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Excessive gingival display treated with two-piece segmental Le Fort I osteotomy: A Case Report

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Recently, the demand for orthodontic treatment and orthognathic surgery has increased worldwide with increasing public awareness of aesthetics and dental care.[1,2] Dentofacial deformities as mandibular deviation and gummy smile negatively affect esthetics, oral function, personality, and social behavior.[3] Women with jaw deformity tend to have a worse QoL than men because of the negative impacts on body-image, low self-esteem, lack of self-confidence and dissatisfaction with life.[4] Therefore, they wish more reliable treatment option for their own ideals.

A gummy smile is characterized by excessive gingival display while smiling and is classified etiologically into dentogingival, muscular, dentoalveolar, and skeletal types.[5,6] The treatment options for excessive gingival display are orthodontic therapy alone, orthognathic surgery, and periodontal surgery. For adult patients with severe skeletal discrepancy, orthognathic surgery is the most suitable treatment option.

Recent case reports of gummy smile treated with temporary anchorage devices (TADs) have showed the feasibility of TADs as absolute anchorage for intrusion of maxillary anterior teeth.[7-9] However, the use of TADs may be complicated by infection, failure, and root resorption.[10,11] Moreover, some studies have reported that the relapse rate after maxillary incisor intrusion ranged from 20% to 60%.[12-14] Therefore, orthognathic surgery is still required for patients with excessive gingival display.

The main orthognathic therapy options include segmental osteotomy, horseshoe palatal osteotomy, and Le Fort I osteotomy. Although these techniques are often used in combination,[15,16] few case report has described the use of two-piece segmental Le Fort I osteotomy.

Here, we report successful results in a maxillary protrusion patient with a severe gummy smile treated by two-piece segmental Le Fort I osteotomy with intraoperative extraction and bilateral sagittal split ramus osteotomy (BSSO).

Case Report

A female patient, 25 years and 9 months of age, presented with a chief complaint of a gummy smile and maxillary protrusion (Fig. 1). Her facial profile was convex with slight protrusion of the upper lip with a frontal view that was almost symmetrical. The molar relationships were Angle Class II on both sides. Overjet was 8 mm and overbite was 5 mm. The maxillary and mandibular dental midlines were matched up to the facial midline.

A panoramic radiograph showed that the maxillary left first molar and mandibular second premolar were non-vital teeth (Fig. 2).

The cephalometric analysis, when compared with the norms for Japanese women, showed a skeletal Class II jaw base relationship (ANB, 7.7°) (Table). The mandibular plane angle was within the normal range (Mp-FH plane, 33.4°). The maxillary incisors were lingually inclined (U1-FH, 104.7°), while the mandibular incisors showed a labial inclination (L1-Mand. pl., 99.8°). As a result, the interincisal angle was close to the average value (122.1°).

The patient was diagnosed with Angle Class II malocclusion, with a skeletal Class II jaw-base relationship caused by mandibular retrusion and excessive gingival display. The treatment objectives were to (1) establish an ideal overbite and overjet, (2) achieve an acceptable occlusion with a good functional Class I canine and Class II molar relationship, (3) improve the facial profile, and (4) correct the gummy smile.

The first alternative was orthodontic treatment with TADs and extraction of the maxillary first premolars to properly reduce the excessive overjet. However, this procedure required the lingual inclination of the maxillary incisors at the end of treatment because the antero-posterior skeletal discrepancy was large and overjet could not be resolved only by the teeth extraction. Thus, to place a burden on the anterior teeth could not be avoided to accomplish the purpose of established ideal overjet.

TADs at the maxillary anterior and posterior sites could help to intrude the maxillary arch and reduce the gum exposure. However, it was almost impossible to correct the gummy smile perfectly. The reason was that the large amount of intrusion was required due to her gum exposure of about 6.5 mm at full smile. Intrusion by TADs may have a risk of apical root resorption and screw failure during and after incisor intrusion. Moreover, many studies described a decrease in overbite during treatment and a tendency to relapse after treatment.[12-14] Therefore, it would be difficult to improve her profile and to obtain a stable occlusion by a camouflage treatment.

The second alternative was orthognathic surgery. Because the cause of maxillary protrusion was suggested to be mandibular retrognathia, BSSO was planned to advance and rotate the mandible counterclockwise. Moreover, two-piece segmental Le Fort I osteotomy with intraoperative extraction of the upper first premolars was expected to reduce the gingival display and deep overbite and to shorten the treatment duration. In this case, two-piece segmental Le Fort I osteotomy meant to divide the maxilla into anterior and posterior segments. Since the maxilla was divided into two piece, the anterior and posterior segment could be respectively repositioned in a horizontal or vertical direction. However, it is also necessary to understand that

orthognathic surgery has risks such as infection, swelling, excessive bleeding, and neurological complication, compared to orthodontic treatment.

After discussion with the patient, she chose orthognathic surgery as a more reliable treatment option.

At the age of 25 years and 11 months, 0.018-in slot preadjusted edgewise appliances were placed on both arches. Leveling and alignment were achieved with nickel-titanium and stainless steel wires. After 10 months of preoperative orthodontic treatment, two-piece segmental Le Fort I osteotomy for the maxilla and BSSO for the mandible were performed at the Department of Oral and Maxillofacial Surgery, Rokko Island Konan Hospital. Under operation, the upper first premolars were extracted and the upper arch was divided into two segments (anterior and posterior). Once, the maxilla was down fractured at the Le Fort I level. The bone cuts were made from the horizontal maxillary osteotomy line to the extraction space of first premolars on each side of the maxilla, whilst maintaining the integrity of palatal mucoperiosteum. The anterior maxillary segment was moved distally to close the space resulting from premolar extractions, and both maxillary segments were fixed with palatal resin plate, and rigid osteosynthesis was crried out by resorbable plates and screws (Lactosorb ®, Zimmer Biomet, Jacksonville, FL, USA) repositioned superiorly to correct the excessive gingival display. The mandible was advanced and rotated counterclockwise by BSSO. Class II training elastics was employed for postoperative one month, and mouth-opening training was initiated thereafter. No intermaxillary fixation was performed.

After 9 months of postoperative orthodontic treatment, the occlusion was much more stable, and acceptable intercuspation of the teeth was achieved with Class I canine and Class II molar

relationship. Immediately after the removal of the edgewise appliances, a wraparound retainer and a lingual bonded retainer were placed on the maxillary and mandibular arches for retention. Genioplasty was recommended to advance the chin and improve the profile, but the patient refused further surgery. The total active treatment period was 19 months.

Posttreatment facial photographs showed an excellent change in the facial profile, as compared with pretreatment ones. The gummy smile and severe overjet had disappeared, and a good smile line was revealed. The convex profile was corrected and a balanced facial profile was achieved. As shown in the posttreatment intraoral photos and casts, acceptable occlusion with Class I canine and Class II molar relationship was achieved (Fig. 3).

A panoramic radiograph showed proper root paralleling (Fig. 4). Cephalometric evaluation showed a change from a Class II jaw-base relationship (ANB, 7.7°) to a Class I jaw-base relationship (ANB, 0.7°). The posterior segment of the maxilla was impacted 7.5 mm at U6. Moreover, the anterior segment of maxilla was impacted and distalized 10.0 mm and 4.0 mm, respectively, at point A to the reference line, which was defined as a perpendicular line to the Sella-Nasion plane through Sella. The mandible was moved 2.0 mm in a forward and upward direction, and the mandibular plane angle was decreased by 2.9° as expected before surgery (Table). The maxillary incisors were labially inclined and the mandibular incisors were lingually inclined (U1-SN, 99.6°; L1-Mand. pl, 93.4°), resulting in an acceptable interincisal relationship. Overjet and overbite decreased to 2.0 mm.

At 1-year postretention, the occlusion was stable and a good facial profile was retained (Fig. 5). Panoramic radiography and cephalometric analysis showed little change (Fig. 6 and 7 and Table).

DISCUSSION

In this study, we reported orthognathic treatment of two-piece segmental Le Fort I osteotomy and BSSO contributed to shortening of the treatment duration and provided sufficient improvement of a severe gummy smile and maxillary protrusion. Previously numerous reports have been published in which vertical maxillary excess with open bite and/or high mandibular plane angle were treated with TADs without orthognathic surgery.[17,18] The molar intrusion by TADs easily causes counter-clockwise rotation of the mandible, leading reduction of anterior facial height and open bite, lip competence, and esthetic smile. However, like the present case, skeletal maxillary protrusion with severe deep bite and gummy smile is extremely difficult to treat with only TADs because molar intrusion is forced to much more intrusion of anterior teeth. In addition, although the premolars extraction enables us to retract the maxillary anterior teeth, resulting in considerable reduction of overjet and deep bite, the antero-posterior relationship between the maxilla and mandible shows no or less changes and the improvement of gummy smile is subject to insufficient.

Smiling is an important facial expression as a nonverbal parameter of communication,[19] and an attractive smile is an important tool to influence people.[20] Tjan and Miller[21] classify the smile line into three types: a high smile line, revealing the complete vertical length of the maxillary incisors and a contiguous band of the gingiva (11% of population); an average smile line,

revealing 75%-100% of the maxillary incisors (69%); and a low smile line, revealing less than 75% of the maxillary incisors (20%). Geron and Atalia[22] evaluated the aesthetic scores of three different smile lines using a total of 300 questionnaires, which included 7500 images, and found that the highest mean score was allotted to an average smile line, in which the upper lip covers about 0.5 mm of the maxillary central incisor crowns and the lower lip covers about 2 mm of the mandibular central incisor crowns. A gingival smile line traditionally provokes more interest and concern among orthodontists and surgeons who are conditioned to view a gingival smile, called a gummy smile, as undesirable.[23,24] Although a gummy smile is considered a normal variation of human anatomy, it is an aesthetic problem that causes patients to be very self-conscious while smiling.[25] In the present case, more than 5 mm of the gingiva was exposed while smiling, which was the major complaint of the patient. Therefore, the incisal edge of the maxillary incisor was intruded by at least 5.5 mm, as mentioned above. Considering that the intrusion of the maxillary incisors by more than 5 mm renders it more difficult to achieve a stable treatment outcome with TADs,[12-14] orthognathic surgery was chosen as a safer and more secure treatment in the present case.

In contrast, the skeletal Class II jaw-base relationship in this patient was due to mandibular retrusion. It is well known that mandibular advancement with BSSO is the preferred therapy for such cases. However, several reports indicate that the degree of skeletal relapse with BSSO and mandibular advancement are greater than that with BSSO and mandibular setback.[26] The amount of advancement, a low or high mandibular plane angle, condylar resorption, control of the proximal segment, soft tissue and muscle tension, and remaining growth and remodeling have been described in several studies as the possible factors of relapse.[27,28] Hence, two-jaw surgery

was planned in order to promote mandibular autorotation accompanied with maxillary impaction and to reduce the amount of mandibular advancement.

Maxillary protrusion is often treated with Le Fort I osteotomy or Wassmund osteotomy.[29,30] However, Le Fort I osteotomy may not be adaptable to cases needing large distalization of the maxilla because the bones that make up the pterygopalatine fossa limit posterior movement.[31] Moreover, Wassmund osteotomy is chosen for the correction of discrepancies in the antero-posterior position and producing minimal change of the anterior part of the maxilla in vertical height. Therefore, in this case, two-piece segmental Le Fort I osteotomy was proposed. This procedure could move the anterior maxillary segment distally to the extraction space without regard to the posterior limit. Furthermore, it would be possible to correct vertical discrepancy of both the anterior part and the posterior part in the maxilla.

To date, several successful cases of intruded incisors with TADs have been reported in the literature.[32,33] The advantages of these devices are lower cost, less invasion, and the ability to provide stationary anchorage without patient compliance.[34,35] Owing to the remarkable development of TADs, some cases that would have previously required surgical orthodontic treatment can achieve good aesthetic outcomes with traditional orthodontic treatment.[17,18] Therefore, patients should receive an adequate explanation of the advantages and risks of treatment in order to choose an optimal approach.

In conclusion, two-piece segmental Le Fort I osteotomy was useful to treat an adult patient with a protrusive profile and excessive gingival display. Maxillomandibular advancement with counterclockwise rotation of the occlusal plane is a stable procedure for patients with skeletal maxillary protrusion. However, the patients must expose themselves to greater danger such as blood loss, infection, nerve injury, and a skeletal relapse related to condylar remodeling and

resorption. Therefore, we should explain several times to the patients for the balance between gains and risks, and patients must decide the treatment options with knowledge of all the conceivable risk. It is hoped that this approach provides patients and doctors with a clue for treatment of severe skeletal discrepancies.

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Figure 1

Pretreatment facial and intraoral photographs.

190x254mm (300 x 300 DPI)

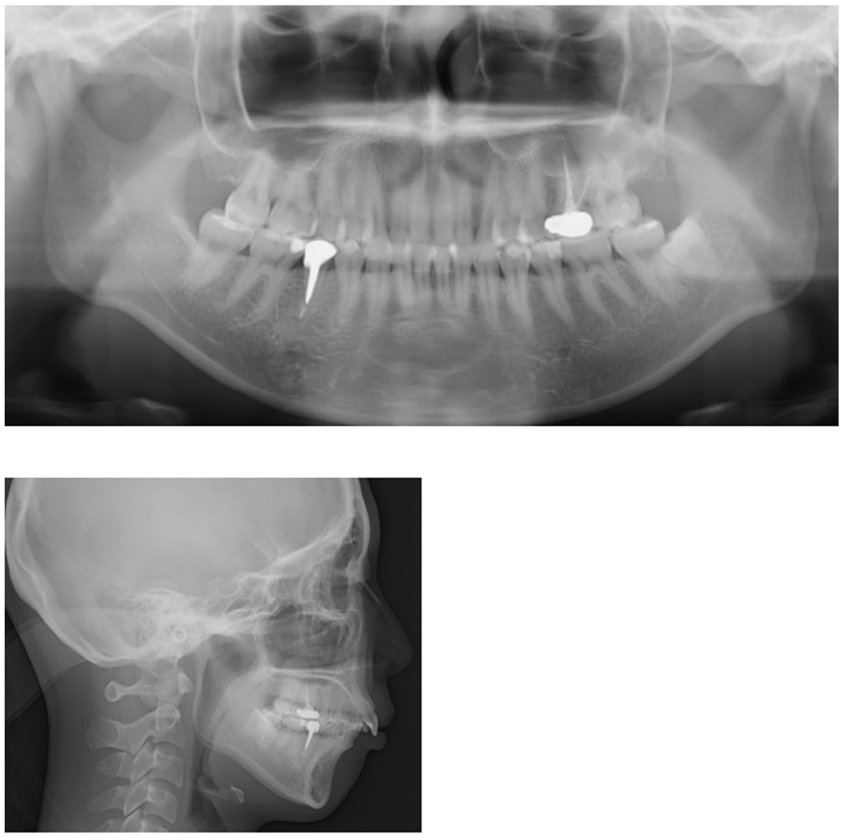

Figure 2

Pretreatment lateral cephalogram and panoramic radiograph.

190x254mm (300 x 300 DPI)

Figure 3

Posttreatment facial and intraoral photographs.

190x254mm (300 x 300 DPI)

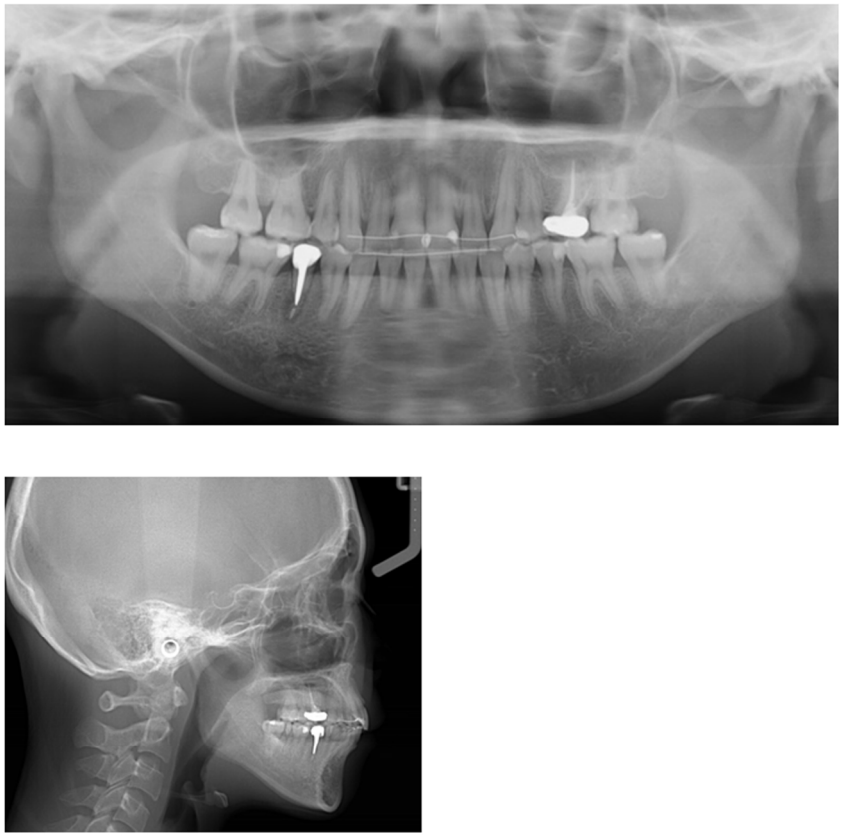

Figure 4

Posttreatment lateral cephalogram and panoramic radiograph.

190x254mm (300 x 300 DPI)

Figure 5

One-year retention facial and intraoral photographs.

190x254mm (300 x 300 DPI)

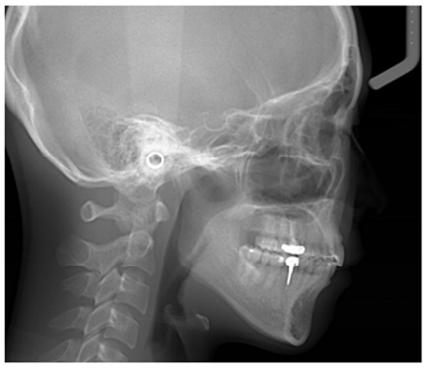

Figure 6

Cephalogram and panoramic radiograph at one-year retention.

190x254mm (300 x 300 DPI)

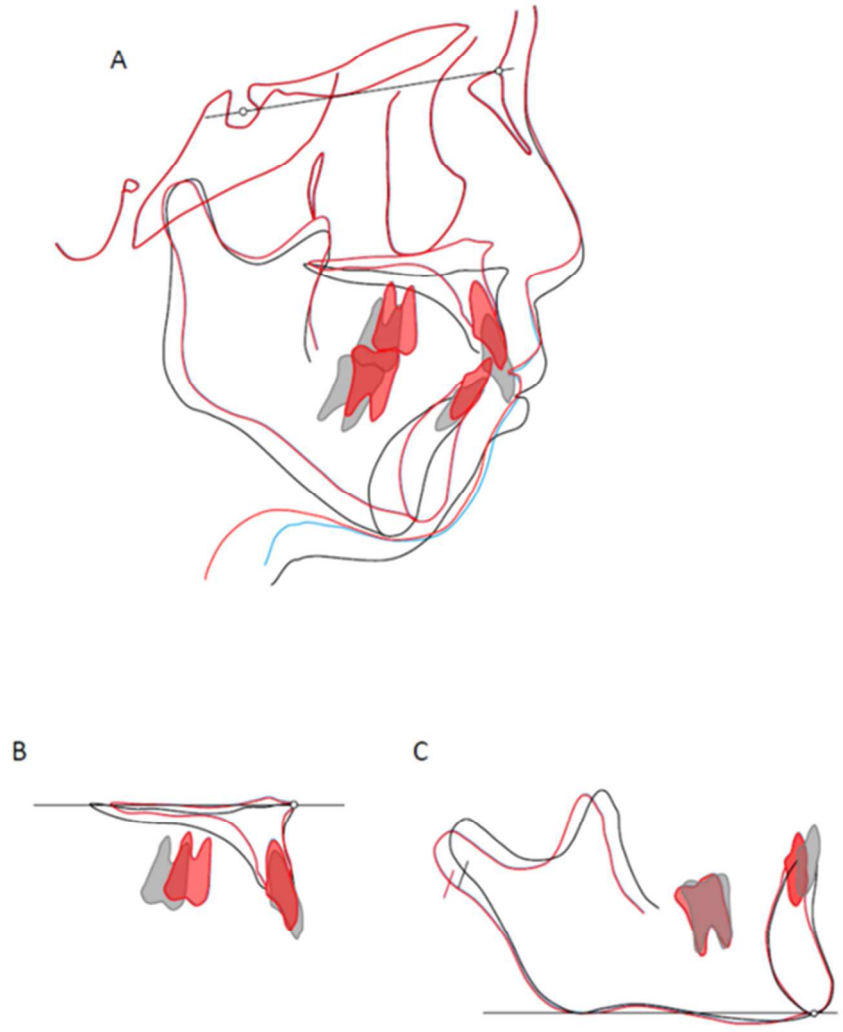

Figure 7

Cephalometric tracings before treatment (black line), posttreatment (red line), and at one-year retention (green line) superimposed on (A) the Sella-Nasion plane at Sella, (B) the anterior palatal contour, and (C) the mandibular plane at Menton.

190x254mm (300 x 300 DPI)

Table: Cephalometric summary

Variables	Japanese norm*	SD	Pretreatment 25 yrs 9 mos	Posttreatment 27 yrs 6 mos	Postretention 28 yrs 6 mos
Angles (°)					
ANB	2.8	2.4	7.7	0.7	0.7
SNA	80.8	3.6	78.9	74.1	74.1
SNB	77.9	4.5	71.1	73.4	73.4
MP–SN plane	37.1	4.6	42.0	39.1	39.1
Gonial angle	122.1	5.3	121.4	127.0	127.0
U1–SN plane	105.9	8.8	104.7	99.6	99.8
L1–MP	93.4	6.8	99.8	93.4	93.6
Interincisal angle	123.6	10.6	122.1	127.9	127.6
Occlusal plane	16.9	4.4	20.5	17.6	17.6
Linear (mm)					
S-N	67.9	3.7	72.4	72.4	72.4
N-Me	125.8	5.0	131.0	125.4	125.4
Me/Palatal plane	68.6	3.7	73.1	74.0	74.0
Ar-Go	47.3	3.3	44.8	44.9	44.9
Ar-Me	106.6	5.7	104.0	107.0	107.0
Go-Me	71.4	4.1	71.6	72.6	72.6
Overjet	3.1	1.1	8.0	2.0	2.0
Overbite	3.3	1.9	5.0	2.0	2.0

* Wada et al. 2006