Case Report

Severe unilateral scissor bite and bimaxillary protrusion treated by horseshoe Le Fort I osteotomy combined with mid-alveolar osteotomy

Kazuo Shimazaki[a]; Kunihiko Otsubo[b]; Ikuo Yonemitsu[a]; Sachiko Kimizuka[c]; Susumu Omura[d]; Takashi Ono[e]

ABSTRACT

This report describes an orthognathic surgical case employing horseshoe Le Fort I osteotomy (HLFO) combined with mid-alveolar osteotomy and bilateral sagittal split ramus osteotomy (BSSRO) for a patient with severe unilateral scissor bite and bimaxillary protrusion. A female patient (aged 26 years, 2 months) presented with a chief complaint of dysmasesis caused by scissor bite on the right side. The clinical examination revealed difficulty in lip closure and a convex profile. Overerupted right maxillary premolars and molars and lingual tipping of the right mandibular premolars and molars were indicated before treatment. After 3 months of presurgical orthodontic treatment, two-jaw surgery involving a combination of HLFO with mid-alveolar osteotomy and BSSRO was performed. A good interdigitation in the right side was established by superior-posterior-medial movement of the dento-alveolar segment of the maxilla. Next, both the maxilla and mandible were moved superiorly and posteriorly to correct the improper lip protrusion, thereby improving the patient's profile. Our results suggest that this new orthognathic surgery technique—achieved by combining HLFO with mid-alveolar osteotomy and BSSRO—is effective for adult patients exhibiting severe unilateral scissor bite and bimaxillary protrusion. (*Angle Orthod.* 2014;84:374–379.)

KEY WORDS: Horseshoe Le Fort I osteotomy; Mid-alveolar osteotomy; Posterior movement of the maxilla; Scissor bite; Bimaxillary protrusion

INTRODUCTION

Patients with scissor bite malocclusion in which only a few teeth are malocclucded and with normal overbite can be successfully treated nonsurgically. However, when multiple teeth are involved in the scissor bite and when the overbite is deep, orthognathic surgery may be indicated if the occlusal contacts interfere with nonsurgical bite opening and prolong the treatment period for scissor bite correction. Although previous reports have shown segmental osteotomy[1] and posterior subapical mandibular surgery[2] to be effective in resolving scissor bite, there are few case reports describing alternative scissor bite treatments because of the rarity of this condition. In particular, no study has reported the efficacy of combining three orthognathic surgical techniques for the treatment of scissor bite.

This case report describes the surgical-orthodontic treatment of a female patient with bimaxillary protrusion and severe unilateral scissor bite. Because the patient's scissor bite was severe and accompanied by a significant amount of overeruption, conventional treatments would not have resulted in correction of her malocclusion. This report describes the combination of horseshoe Le Fort I osteotomy (HLFO) with mid-alveolar osteotomy and bilateral sagittal split ramus osteotomy (BSSRO) as a novel treatment for this type of malocclusion.

[a] Assistant Professor, Orthodontic Science, Graduate School, Tokyo Medical and Dental University, Tokyo, Japan.
[b] Director and Head Orthodontist, Otsubo Orthodontic Clinic, Tokyo, Japan.
[c] Clinical Fellow, Department of Oral and Maxillofacial Surgery, Yokohama City University Medical Center, Kanagawa, Japan.
[d] Associate Professor, Department of Oral and Maxillofacial Surgery, Yokohama City University Medical Center, Kanagawa, Japan.
[e] Professor and Chair, Orthodontic Science, Graduate School, Tokyo Medical and Dental University, Tokyo, Japan.
Corresponding author: Dr Kazuo Shimazaki, Assistant Professor, Department of Orthodontic Science, Graduate School, Tokyo Medical and Dental University, 1-5-45 Yushima, Bunkyo-ku, Tokyo 113-8549, Japan
(e-mail: shimazaki.orts@tmd.ac.jp)

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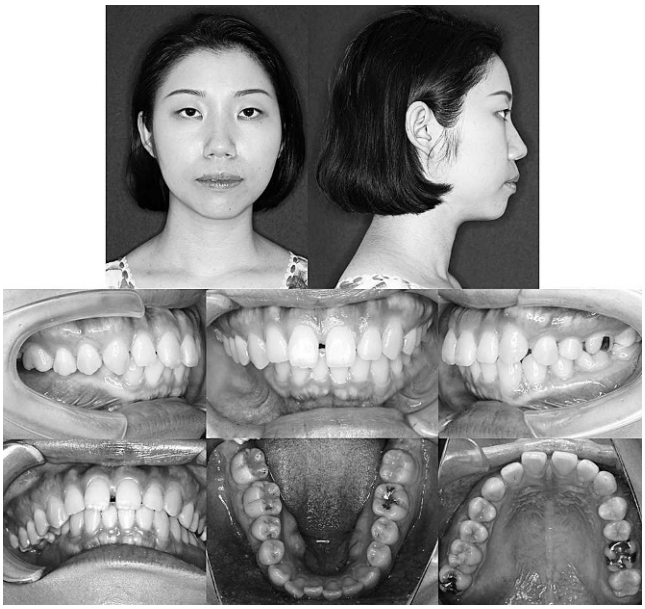

Figure 1. Facial and intraoral photographs of the patient (age: 26 years, 2 months) prior to treatment.

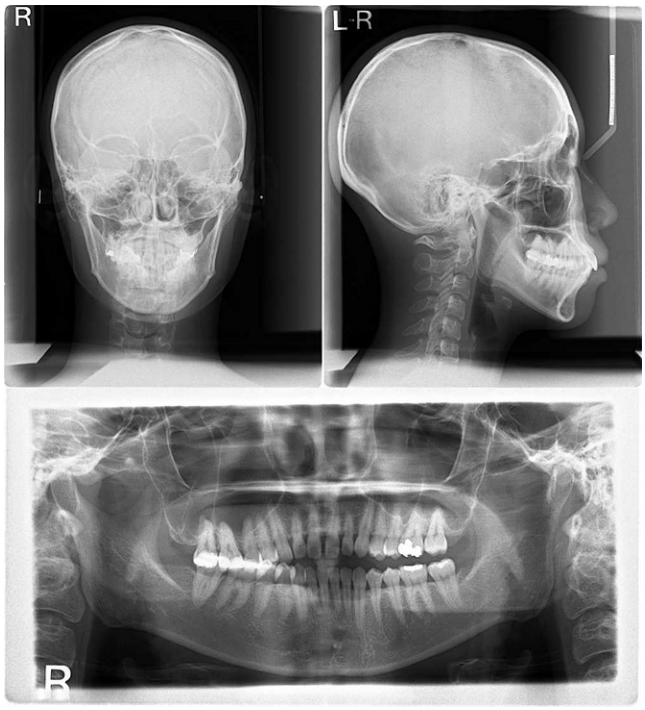

Figure 2. Pretreatment postero-anterior, lateral cephalometric, and panoramic radiographs.

CASE REPORT

The patient, a female aged 26 years, 2 months, came to the Otsubo Orthodontic Clinic complaining chiefly of dysmasesis caused by the right-sided scissor bite, an ''unsettling'' feeling around the area of the right molars and protrusion of the lips. The patient had been aware of her right-sided scissor bite since the age of 18, but she had not sought treatment prior to this point.

Frontal photographs showed a symmetrical mandible and chin, difficulty in lip closure, and a gummy smile. The patient had a convex profile. Intraoral examination revealed that the overjet was +3.0 mm and that the overbite was +4.0 mm, with a leftward midline discrepancy of 2.0 mm (measured as a 2.0-mm deviation of the lower right central incisor to the left). Mandibular right premolars and molars were lingually inclined, and the scissor bite in question was noted (Figures 1 and 2).

A postero-anterior cephalometric radiograph showed an inclination of the maxilla and the mandible in the frontal dimension (Figures 2 and 3). The cephalometric tracing showed that the maxillary occlusal plane inclination was 4.0°, and the menton was deviated 2.0 mm to the right. Cephalometric analysis indicated a slight skeletal Class II tendency with SNA of 85.0°, SNB of 80.0°, and ANB of 5.0°. Labial inclination of the maxillary anterior teeth (U1 to FH) was 117.7°. The upper and lower lips were placed anterior to the E-line by 2.5 mm and 4.5 mm, respectively (Figure 2).

Treatment Objective

The patient refused tooth extraction; therefore, to correct labial inclination of the maxillary anterior teeth, the maxilla required transposition upward and backward and clockwise rotation. Furthermore, to eliminate the occlusal cant due to the overerupted right maxillary premolars and molars and the lingual tipping of the right mandibular premolars and molars the right maxillary dental arch needed to be moved superiorly and medially. For these corrections, two-jaw surgery involving an HLFO combined with mid-alveolar osteotomy and BSSRO was planned.

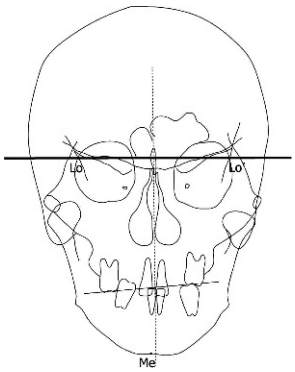

Figure 3. Tracing of the pretreatment postero-anterior cephalometric radiograph. Lo indicates right latero-orbitale; Lo', left latero-orbitale; and Me, lowest point on the midline curve of the symphysis.

Presurgical orthodontic treatment was planned to gain approximately 3.0 mm of space between the maxillary central incisors to protect their roots from damage during the mid-alveolar osteotomy. Also, before orthodontic brackets could be applied to the right mandibular molars involved in the scissor bite, the occlusal surfaces of these molars needed to be built up with composite resin to raise the bite. This treatment plan was designed to deliver a faster resolution of the scissor bite by orthognathic surgery. The procedures, risks, advantages, disadvantages, and costs were explained to the patient, and she was able to give full informed consent prior to the start of treatment.

Treatment Alternatives

The treatment alternative was orthodontic treatment only. The critical procedures for scissor bite correction are intrusion and palatal or buccal tipping of the involved teeth when they are both extruded and tilted. After the scissor bite is corrected, additional premolar extractions are needed to resolve bimaxillary protrusion. However, the orthodontic procedure was deemed to be severe, and the patient was informed that the treatment would be complicated and prolonged if orthodontic procedures alone were used. The patient was given the option (together with the advantages and disadvantages) of having orthognathic surgery combined with orthodontic treatment as an alternative. The patient chose to accept this option and was subsequently referred to the Yokohama City University Medical Center for surgical treatment.

Treatment Progress

Presurgery orthodontic treatments involved occlusal surface buildup with composite resin to raise the bite, followed by attachment of preadjusted edgewise appliances (0.018 × 0.025–inch) with 0.016 × 0.022–inch improved superelastic nickel-titanium alloy (L&H, Tomy, Tokyo, Japan) wires placed in both arches for leveling, alignment, and space creation between the maxillary central incisors. After 3 months both archwires were replaced with 0.016 × 0.022–inch stainless-steel archwires with crimp-on surgical hooks in preparation for orthognathic surgery. In November 2009, two-jaw surgery took place under anesthesia at Yokohama City University Medical Center. Presurgical photographs are shown in Figure 4.

Before surgery, a maxillary splint was constructed on articulated models mounted in centric relation for positioning of the left-side dento-alveolar segment. In addition, we used these models to determine the optimal positioning of a continuous archwire and resin plate to be placed in the right dento-alveolar segment of maxilla, such that it was positioned as parallel to the Frankfurt horizontal plane as possible. These appliances were used to assist in fixing the left and right dento-alveolar segments during the operation. The thickness of the resin plate was 1.2 mm.

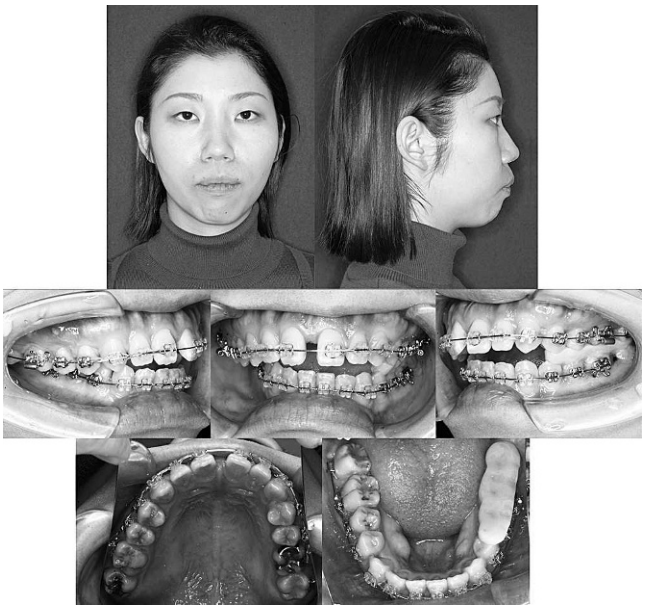

Figure 4. Facial and intraoral photographs of patient taken immediately before orthognathic surgery (age: 26 years, 5 months).

After Le Fort I osteotomy and down-fracture, horseshoe osteotomy was performed from the superior surface of the maxilla. The dento-alveolar segment was then halved between the maxillary central incisors using a surgical saw (Figure 5A).

The left dento-alveolar segment was then moved into its predicted position using the maxillary splint to position it 4.0 mm posterior and 1.5 mm superior at the left first molar and 6.0 mm posterior and 4.0 mm superior at the maxillary incisors, before fixing it with titanium plates (Figure 5B). The right dento-alveolar segment was moved into its predicted position using the resin plate and continuous archwire (Figure 5C) to align it 6.0 mm posterior, 8.0 mm superior, and 4.0 mm medial at the right first molar before fixing it, again with titanium plates (Figure 5D). BSSRO was performed in the mandible and also fixed with titanium plates.

During the postsurgical orthodontic treatment, elastics were used to stabilize the occlusion while correcting the difference in the inclination of the central incisor axis that arose as a result of the nonequivalent clockwise rotation of the left and right dento-alveolar segments. After 18 months of orthodontic treatment, circumferential Hawley retainers were placed.

Treatment Results

Patient cooperation throughout the treatment was excellent. Ideal overjet and overbite with Class I molar

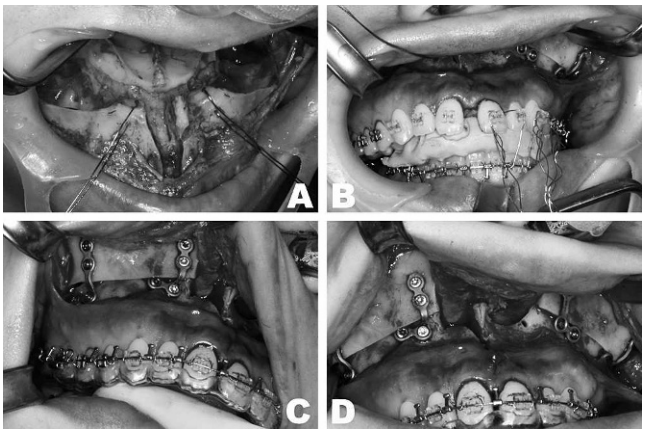

Figure 5. Intraoral photographs during surgery, which included HLFO with mid-alveolar osteotomy: A, Design of the incision line; B, Fixation of the left maxillary dento-alveolar segment; C, Fixation of the right maxillary dento-alveolar segment; D, The maxilla was fixed in the predicted position with titanium screws and plates.

and canine relationships were achieved (Figure 6). Facial symmetry was attained in the frontal view; bimaxillary protrusion and difficulty in lip closure were corrected by the posterior-superior movement of both anterior incisors. The patient was satisfied with her facial appearance and functional occlusion.

Radiographs after treatment are shown in Figure 7, and the cephalometric tracing showed that the maxillary occlusal plane inclination was -2.0°, with the menton located 1.0 mm to the left (Figure 8). Compared to the pretreatment configuration, skeletal asymmetry was corrected. Superimposed tracings of presurgical and posttreatment cephalometry showed that the maxillary incisors were intruded and the mandibular incisors repositioned posteriorly. Bimaxillary protrusion was corrected. Moreover, maxillary and mandibular molars were intruded (Figure 9A,B). After 1 year of retention, at 2.5 years after surgery, the facial profile and occlusion were acceptable (Figure 10).

DISCUSSION

A scissor bite that involves multiple teeth is generally accompanied by a discrepancy in maxillo-mandibular width. Depending on whether the major problem lies in the maxillary or mandibular dental arch, different treatment modalities are needed for correction. In cases relating to a narrow lower dental arch, expansion of this arch is the preferred option.[3,4] However, a scissor bite with a remarkably wide maxillary base, as occurred in this case, is rare. Surgical procedures have been developed to reduce the maxillary width,[5–8] including a midline split after Le Fort I osteotomy. In this case, the dento-alveolar segment was divided after HLFO because of differential movement of each segment. Therefore, the mobility of the right dento-alveolar segment was increased, maxillary width was decreased, and the scissor bite was corrected without removing any of the segmented palatal bone because the bilateral segmented bones were centralized and settled into each other. Without damaging the root of teeth, mid-alveolar osteotomy was easily performed by

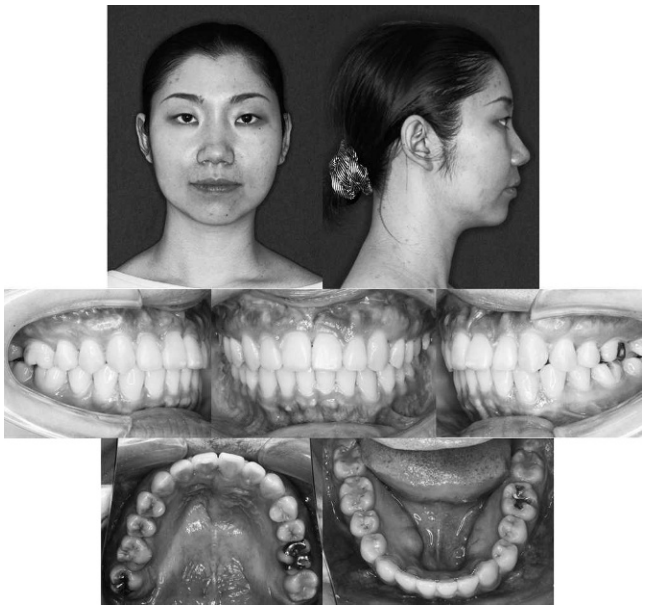

Figure 6. Facial and intraoral photographs of the patient at the end of active treatment (age: 27 years, 8 months).

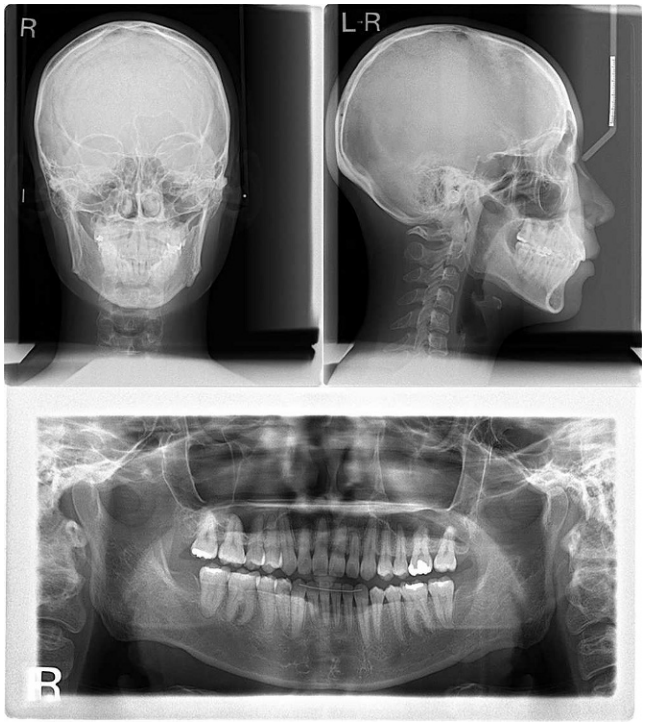

Figure 7. Posttreatment postero-anterior and lateral cephalometric and panoramic radiographs.

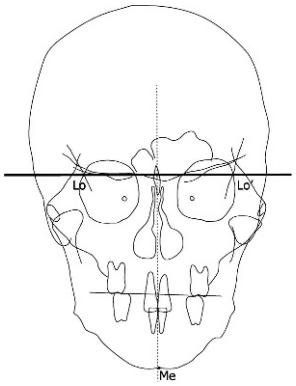

Figure 8. Tracing of the posttreatment postero-anterior cephalometric radiograph. Lo indicates right latero-orbitale; Lo', left latero-orbitale; and Me, lowest point on the midline curve of symphysis.

gaining space between the maxillary central incisors through presurgical orthodontic treatment.

The posterior-superior maxillary repositioning and counterclockwise rotation of the occlusal plane were useful in improving the gummy smile and convex profile that were the consequence of maxillary protrusion. Furthermore, to correct the unilateral scissor bite, a significantly larger amount of posterior-superior and medial movement was required in the right dento-alveolar segment than in the left side. This was technically difficult to achieve by standard Le Fort I osteotomy, so we performed HLFO combined with mid-alveolar osteotomy. Posterior movement of the entire maxilla requires removal of bony interference in the maxillary tuberosity and retromolar bone and horizontal sectioning of the pterygoid plate and the perpendicular portion of the palatine bone without damaging the neurovascular bundle in the limited operative field. If the required amount of movement is still not obtained, inferior resection of the pterygoid process[9] may be considered to facilitate maxillary setback, as it will increase somewhat the range of posterior movement. However, a variety of complications can occur, such as excessive bleeding[10,11] and

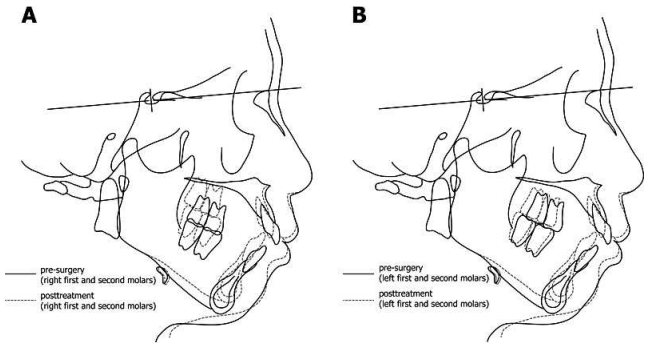

Figure 9. Superimposition of presurgical and posttreatment lateral cephalometric radiographs: A, Superimposition of right molars; B, Superimposition of left molars.

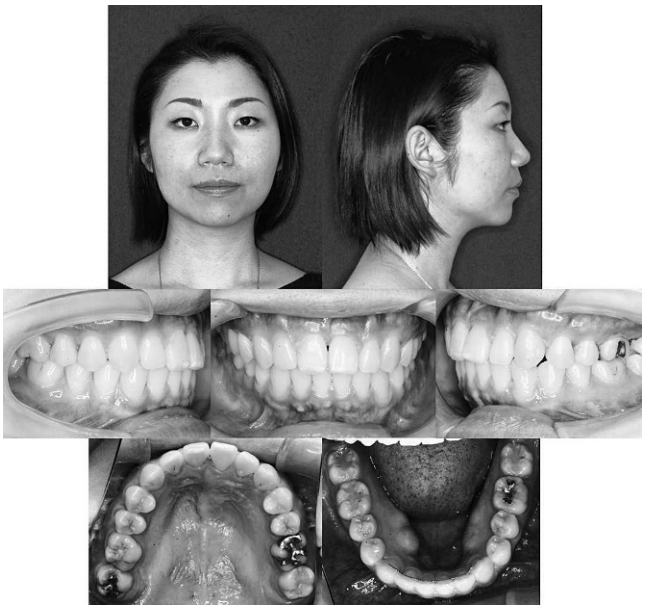

Figure 10. Facial and intraoral photographs of the patient 1 year after active treatment (age: 28 years, 8 months).

injuries to the cranial nerve[12,13] and carotid artery.[14,15] Until now, safe and reliable surgical procedures for moving the maxilla posteriorly have not been available.

The design of the horseshoe osteotomy was first reported in 1975 by Hall and Roddy,[16] who initially called it the "total maxillary alveolar osteotomy." The term "horseshoe osteotomy" was later used by Bell and McBride[17] in a procedure that they referred to as the "horseshoe palatal osteotomy." Therefore, the horseshoe osteotomy is in fact older than the conventional Le Fort I osteotomy. The main advantage of this technique is that it allows high superior repositioning of the maxilla, especially in the posterior region, with no risk of damaging the descending palatine artery because there is no need for bone trimming in this area. This helps to maintain the nasal chamber volume. For the posterior movement of the maxilla in the present case, it was necessary to remove the maxillary tuberosity of the dento-alveolar segment. Bone removal was relatively easy, and the dento-alveolar segment could be set back sufficiently without any fracture or trimming of the pterygoid process. The HLFO technique is regarded as a safe and useful method for both posterior and superior repositioning of the maxilla.

Since the amount of movement and rotation between the right and left dento-alveolar segments differed markedly, the palatal mucosa in the anterior median palate was depressed, causing the patient some temporary discomfort. Moreover, postsurgical orthodontic treatment took time to correct the discrepancies in the inclination of the maxillary incisors caused by the different amounts of rotation between the right and left dento-alveolar segments. It might be

argued that correcting both the maxillary and mandibular dental arch widths by conventional nonsurgical orthodontic treatment would allow the practitioner to avoid these complications. However, in severe scissor bite cases with a large vertical overlap, bonding of orthodontic brackets is impossible, and patients often find the treatment arduous. Additional downsides are that it requires bite jumping and can even result in unfavorable opening of the mandibular plane angle.[18,19]

Although the narrowing of the arch width by multiple segmental Le Fort I osteotomy is moderately invasive, it does avoid mandibular plane angle opening and can shorten the duration of orthodontic treatment. In the present case, orthodontic treatment took only 18 months and achieved good occlusion and elimination of the marked scissor bite without significant discomfort. To remain stable postoperatively, the patient will need to adapt rapidly to the new mandibular position and masticatory movement and comply with long-term measures to maintain the functional occlusion. To that end, tight interdigitation and harmonized arch widths are extremely important. In this case, establishment of these factors in the early treatment stages should be beneficial for occlusal stability. Follow-up examination will pay special attention to any relapse of the arch widths.

This case report demonstrates the efficacy of a novel orthognathic surgical technique featuring the combination of HLFO with mid-alveolar osteotomy and BSSRO to improve a unilateral scissor bite and bimaxillary protrusion.

CONCLUSIONS

- Although surgical orthodontic treatment with two-piece maxillary Le Fort I osteotomy is an established method of correcting severe arch width discrepancies between the maxilla and mandible, it is nevertheless difficult to carry out simultaneous posterior-superior repositioning of the maxilla. In the present case, HLFO combined with mid-alveolar osteotomy and BSSRO was performed in a 26-year-old woman whose chief complaint was dysmasesis caused by unilateral scissor bite and difficulty in lip closure.
- The upward-backward-medial movement of the dento-alveolar segment of the maxilla ultimately established good functional occlusion, and both the maxilla and mandible moved upward and backward to correct the improper lip protrusion. After these treatments, the patient achieved satisfactory occlusion and a good facial appearance.

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