Acta Med. Okayama, 2015
Vol. 69, No. 3, pp. 177–182

Acta Medica Okayama

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Case Report

Maxillary Advancement for Unilateral Crossbite in a Patient with Sleep Apnea Syndrome

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This article reports the case of a 44–year-old male with skeletal Class III, Angle Class III malocclusion and unilateral crossbite with concerns about obstructive sleep apnea syndrome (OSAS), esthetics and functional problems. To correct the skeletal deformities, the maxilla was anteriorly repositioned by employing LeFort I osteotomy following pre-surgical orthodontic treatment, because a mandibular setback might induce disordered breathing and cause OSAS. After active treatment for 13 months, satisfactory occlusion was achieved and an acceptable facial and oral profile was obtained. In addition, the apnea hypopnea index (AHI) decreased from 18.8 preoperatively to 10.6 postoperatively. Furthermore, after a follow-up period of 7 months, the AHI again significantly decreased from 10.6 to 6.2. In conclusion, surgical advancement of the maxilla using LeFort I osteotomy has proven to be useful in patients with this kind of skeletal malocclusion, while preventing a worsening of the OSAS.

Key words: LeFort I osteotomy, maxillary advancement, unilateral crossbite, obstructive sleep apnea syndrome

A skeletal Class III deformity is the result of maxillary deficiency or mandibular protrusion [1]. Generally, the surgical procedure for treating skeletal Class III patients includes mandibular setback surgery. Unilateral crossbite in a patient with skeletal Class III malocclusion has also been treated with mandibular setback surgery [2]. On the other hand, mandibular setback might inhibit physiological adaptation and cause sleep apnea [3]. Along with advances in our understanding of this condition and techniques for its treatment, the orthodontic surgical correction has progressed to include maxillary procedures [4]. Accordingly, we propose that it would be better to consider a maxillary advancement technique, which does not reduce the airway, for patients with skeletal Class III malocclusions who have moderate to severe obstructive sleep apnea syndrome (OSAS). In this report, we present the case of a patient with Class III malocclusion and unilateral crossbite with a history of OSAS who showed a reduction of apnea-hypopnea index (AHI) scores after LeFort I osteotomy.

Received October 27, 2014; accepted December 18, 2014.

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Conflict of Interest Disclosures: No potential conflict of interest relevant to this article was reported.

Case Report

A 44-year-old male presented at the outpatient clinic of Okayama University Hospital with a chief complaint of right-sided unilateral crossbite and difficulty chewing (Figs. 1 and 2A and 2D). Facial photographs showed a symmetrical face, a straight profile, and a harmonious nasolabial angle. His dental history showed the loss of the maxillary central incisors on both sides and the left lateral incisor and second molar because of periodontal diseases with occlusal trauma.

A radiographic examination revealed moderate horizontal alveolar bone loss with generalized chronic periodontitis (Fig. 1C). The molar relationships were class III on both sides, and he had anterior and right posterior crossbites (Fig. 1B). The patient was also diagnosed with moderate OSAS, and polysomnography showed an AHI score of 18.8. When compared with Japanese norms [5], a cephalometric analysis showed a skeletal Class III jaw-base relationship, and a low mandibular plane angle.

The posteroanterior cephalogram showed a maxillary deviation toward the left by 1.5 mm and mandibular deviation toward the right by 2.0 mm. The patient was diagnosed with right-sided unilateral crossbite and Angle Class III malocclusion, with a skeletal Class III jaw-base relationship, and OSAS. The treatment objectives were to achieve acceptable occlusion while correcting the skeletal disharmony, and to reduce the OSAS symptoms.

A comprehensive periodontal treatment around the teeth was accomplished before orthodontic treatment. After 7 months of pre-surgical orthodontic treatment using multi-bracket appliances, the maxilla was advanced 3.0 mm at the ANS with transverse rotation, and was anteriorly repositioned and connected to the mandible in the correct occlusal relationship via LeFort I osteotomy. The maxillary segment was fixed with miniplates and miniscrews in the final position. Intermaxillary fixation with stainless steel wires was maintained for 8 days, and occlusal rehabilitation was performed for 2 months using intermaxillary elastics and an occlusal splint. The total active treatment period was 13 months. After treatment, the anterior and right posterior crossbites were corrected, and an Angle Class I molar relationship was achieved. A post-treatment cephalometric evaluation showed an increase in the ANB angle, and a skeletal Class I jaw relationship was achieved. The maxilla was advanced 3.0 mm at the ANS with transverse rotation and the mandible auto-rotated counterclockwise. Accordingly, the nasopharyngeal depth (NPD) was increased 2.5 mm in linear measurements (Figs. 2B, C and Table 1). After the orthodontic treatment, a removable denture was placed into the maxilla in the anterior edentulous region.

During 12 months retention period after surgery, polysomnography was performed to gauge the changes

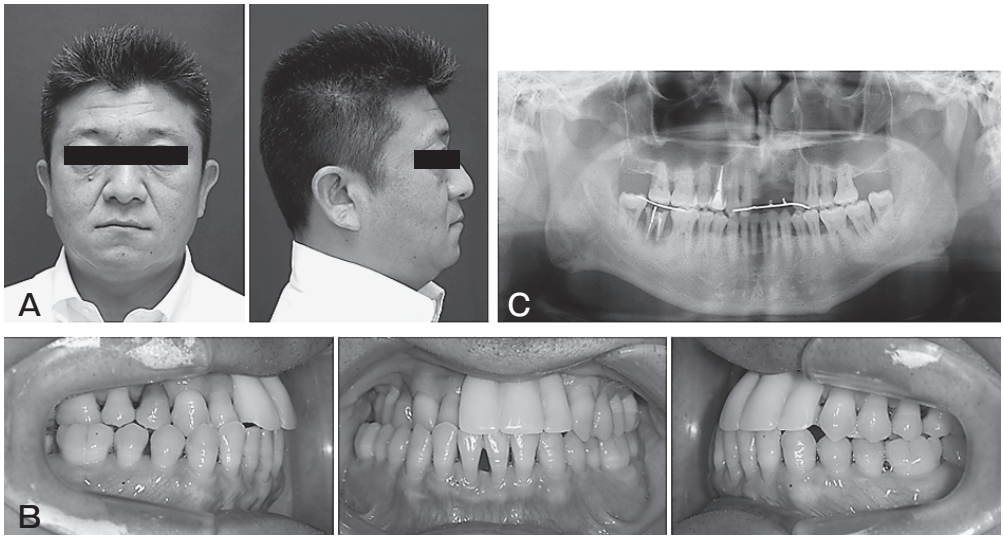

Fig. 1 Pretreatment views. A, Facial photographs; B, Intraoral photographs; C, A panoramic radiograph.

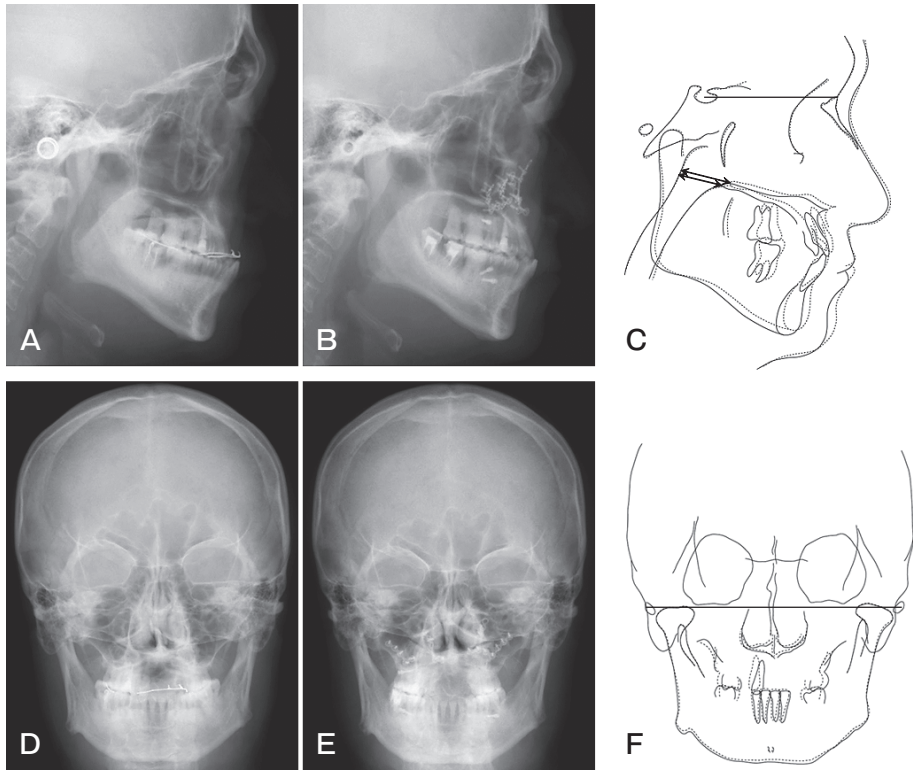

Fig. 2 Cephalometric radiographs. **A**, **D**, Pretreatment; **B**, **E**, Post-treatment; **C**, **F**, Superimposed cephalometric tracings show the changes from the pretreatment (solid line) to post-treatment (dotted line) stages on the sella-nasion plane at the sella (**C**) and on the zygion-zygion plane at the crista galli (**F**). Left/right arrows show the NPD (nasopharyngeal depth): the distance from PP1 to PNS (**C**).

Table 1 The cephalometric measurements

	Pretreatment	Post-active treatment	Normal mean ± SD (Japanese male adult)
Angle (°)			
ANB	0.0	2.5	3.2 ± 2.38
SNA	80.5	84.5	81.5 ± 3.29
SNB	80.5	82.0	78.2 ± 4.02
U1※-FH	129.0	124.5	112.4 ± 7.63
L1-FH	67.0	62.5	56.7 ± 7.79
Mp-FH (FMA)	17.0	15.0	28.0 ± 6.08
NF-FH	2.5	1.5	2.0 ± 2.28
Linear (mm)			
Overjet※	2.5	2.0	
Overbite※	2.0	1.5	
N-Me	133.0	129.5	135.7 ± 3.98
PTM-A/NF	55.5	59.5	51.7 ± 3.79
NPD	24.5	27.0	

※An adhesion pontic bridge or a partial denture was installed for the missing upper incisors.

in sleep-disordered breathing. In an evaluation performed one month after the surgery, his sleep had improved and the AHI decreased from 18.8 to 10.6, which was considered to be a major reduction. Furthermore, the AHI was reduced to 6.2 at the 8 months follow-up, and was 7.6 at the 12 months after the surgery (Fig. 3). There was thus a significant improvement of the AHI values after the surgical-orthodontic treatment of this patient.

The patient has not experienced any further OSAS symptoms and was satisfied with the results of treatment. His occlusion has become stable, and a favorable facial profile has been maintained for 7 months after the surgery (Fig. 4).

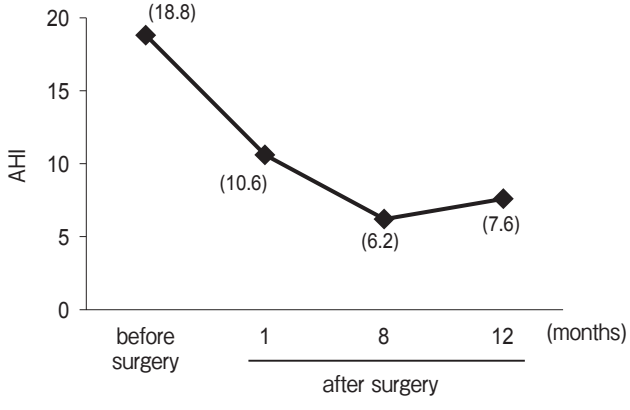

Fig. 3 Results of the AHI evaluations before and after surgery.

Discussion

This patient's whole maxillary right segment was in crossbite, and the maxillary central incisors on both sides and the left lateral incisor were missing. Thus unilateral crossbite in adults becomes the main factor of tooth loss and oral disease. In addition, the patient's unilateral crossbite complicates the anterior prosthesis after he lost the incisors. In addition, the patient was diagnosed with skeletal Class III malocclusion because of a prognathic mandible (Table 1). These discrepancies can generally be solved by mandibular setback and transverse rotation surgery. However, several reports have suggested that mandibular setback surgery can induce disordered breathing [4, 6, 7].

On the other hand, mandibular advancement surgery was used in the early 1980s and improved the symptoms in patients with sleep apnea [8, 9]. By the mid-1980s maxillomandibular advancement was considered to provide better outcomes than mandibular osteotomy alone, because it preserves the maxillomandibular relationship and recognizes the involvement of coexisting mandibular and maxillary deficiencies [10]. However, in a few patients reported in a previous study, the respiratory parameters deteriorated after maxillomandibular advancement surgery [11]. In addition, it was reported that the improvement in the respiratory symptoms by maxillomandibu-

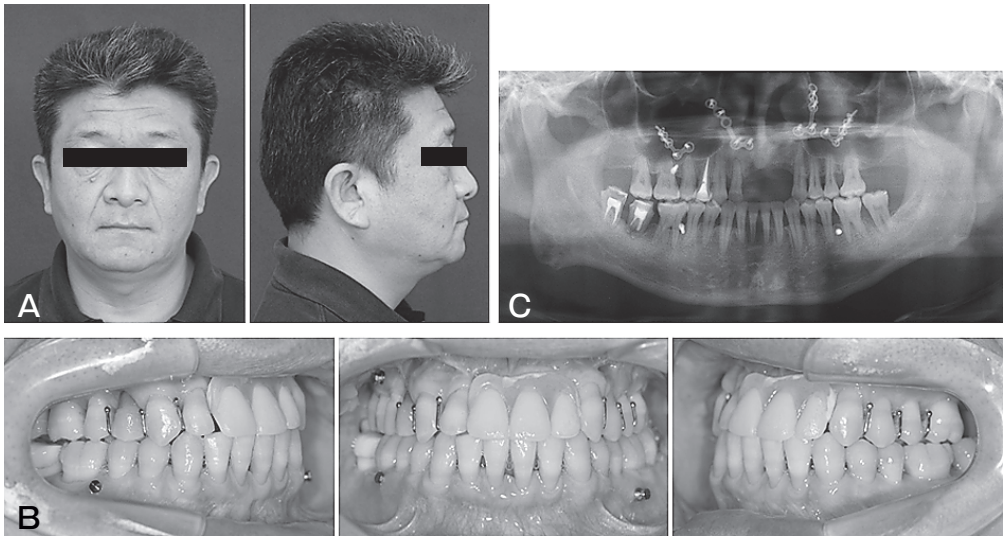

Fig. 4 Post-treatment views. A, Facial photographs; B, Intraoral photographs; C, A panoramic radiograph.

lar advancement surgery was correlated with an increase in the SNA after surgery [12]. To the best of our knowledge, there have been no studies examining the effects on OSAS of treatment consisting of only maxillary advancement surgery. Therefore, in the present case we selected maxillary advancement alone by LeFort I osteotomy in view of the physical status and OSAS symptoms, and followed-up with AHI measurements.

AHI is defined as the frequency of apnea/hypopnea episodes per hour. Sleep apnea syndrome is defined as an AHI of 10 or more in adults. Marked improvement was defined as a 75% reduction in the AHI or a postoperative AHI below 10 in adults [13]. A comparison of the pre- and postoperative polysomnography results in the present patient showed a clear improvement from 18.8 to 10.6, but there was still moderate OSAS remaining at a month postoperatively. However, there was an almost complete resolution of the patient's OSAS, with a postoperative AHI of 6.2, at the 8-months follow-up examination, and the remaining OSAS consisted only of hypopneas and no apneas. A polysomnographic test was performed 12 months after the surgery to confirm the stability of the outcome, and the AHI was maintained at 7.6. These results may be explained by the enlargement of the anterior-posterior dimensions of the upper airway following the maxillomandibular advancement surgery [14]. Furthermore, an increase in NPD was caused by maxilla movement, since LeFort I osteotomy was performed for maxillary advancement. It is generally considered that the shapes of the airway contribute greatly to the severity or mildness of OSAS [4]. In our patient, the initial change in NPD was thought to indicate maxillary advancement, and the subsequent counterclockwise rotation of the mandible resulted in an acceptable anteroposterior maxillomandibular relationship. This is the first report in which a patient with OSAS was treated by orthodontic surgery with maxillary advancement alone. Our results suggest that maxillary advancement alone by LeFort I osteotomy is a useful technique for the treatment of patients with OSAS, especially in patients with skeletal Class III malocclusion. However, because this report describes only a single case, further research will be needed to clarify the effects of maxillary advancement alone on the OSAS symptoms. Nevertheless, this case showed the effectiveness of LeFort I osteotomy and orthodontic treatment in a patient with moderate OSAS. Additionally, the use of prosthesis for the loss of maxillary incisors might have provided flexibility to the position of the upper lip, and also maintained the natural form of the patient's facial profile after the maxillary advancement.

Conclusion

This article reports the successful surgical-orthodontic treatment of a male patient with unilateral crossbite and skeletal Class III malocclusion and moderate OSAS. Surgical advancement of the maxilla using LeFort I osteotomy is a useful technique that can lead to improvements in both the malocclusion and OSAS symptoms.

Acknowledgments. The authors thank Dr. Naoki Kodama in the Department of Occlusal and Oral Functional Rehabilitation at Okayama University of Medical and Dental Hospital for performing the prosthesis treatment for the maxillary anterior edentulous region. The authors also thank Dr. Takamaro Sato of the Department of Periodontal Science at Okayama University of Medical and Dental Hospital for performing the periodontal maintenance and the treatment of periodontal diseases.

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