An orthognathic case of skeletal mandibular prognathism with multiple tooth loss

Nahoko Imai*, Kunihiko Otsubo**, Ladda Winarakwong*, Koji Fujita*, Yutaka Maruoka***

Abstract
The occlusal collapse caused by multiple tooth loss is a frequent problem found in adult patients with skeletal discrepancies who require orthognathic surgery. In this report, surgical orthodontic treatment was performed on a 38-year-old Japanese female patient with her chief complaint being unable to bite and mandibular protrusion. She presented with skeletal mandibular prognathism, a nearly total crossbite, multiple tooth loss in maxilla and mandible, generalized periodontitis, and an unstable occlusion. In order to re-establish a more stable occlusion we took a multidisciplinary approach including orthognathic surgery, periodontal therapy and prosthetic reconstruction with implants. As a result, the patient’s facial profile was improved and a stable occlusion maintained for three years of retention and two and a half years after the prosthodontics treatment with implant restoration.

Key words: mandibular prognathism, orthognathic surgery, multiple tooth loss, multidisciplinary

Introduction
There is an increasing number of adult patients requiring surgical orthodontic treatment. Such cases not only possess skeletal discrepancies of both horizontal and/or vertical relationship between the maxilla and mandible, but may also suffer from multiple tooth loss due to periodontal problem, root fracture, and occlusal trauma. As a result, the total area of occluding tooth surfaces decreases which often leads to bite collapse and unstable occlusion. Occasionally the primary demand of the patients is to replace their teeth, but they will be referred to orthodontists if their skeletal deformities also exist, since it is difficult to restore their occlusal function just by prosthetic reconstruction with implants.11,22 A multidisciplinary approach including orthognathic surgery to correct the jaw relationship is therefore essential to establish a balanced occlusion which leads to a healthy oral condition and improve the patients’ quality of life.35

We report a 38-year-old female case with unstable occlusion due to multiple tooth loss, periodontal defect, and skeletal mandibular prognathism. Her treatment was successful by taking a multidisciplinary approach, which included orthognathic surgery, periodontics and prosthetic reconstruction with implant.

Case history
The patient was a 38-year-old female Japanese coming with a chief complaint of having difficulty in biting on both sides and mandibular protrusion. She had firstly consulted a dentist at our neighboring clinic and was advised to see us because of difficulty in restoring her masticatory function by implant and prosthesis alone.

She had history of several decayed teeth since her teenage, and had lost #16, 26 (right and left upper first molars) due to dental caries at her fifteenth birthday. She later lost #12, 28, 36, 37, 38, and 46 due to recurrent periapical lesions. In her thirties, she was concerned about lack of effective occlusion on the left side. Realizing the need to improve her oral condition, she subsequently sought treatment for replacing her missing teeth and was further recommended for orthodontic consultation.
Clinical examination

Her profile was concave due to mandibular protrusion. She had unbalanced lip thickness with the upper lip narrower and strained on closure, protruded chin, and an excessive lower facial height. From a frontal aspect, her face was symmetrical (Figure 1). The dental examination revealed an overbite of 7.0 mm., negative overjet of 6.0 mm., and a total crossbite except for the right second molar. Canine relationship was bilaterally Class III. She had several missing teeth in the maxilla (#12, 16, 26, 28), and the mandible (#36, 37, 38, 46). The intra-oral photos (Figure 2) show that in the maxillary arch there were a bridge on #11 and #13 replacing missing #12, and connected crowns on #21 and 22. The extraction spaces of #16 and 26 were closed by mesial tipping of #17 and 27. In the mandibular arch, there was a bridge on #45 and 47, replacing missing #46, while the left extraction space remained unrestored. In centric occlusion, right posterior teeth and left canines and first premolars were the only teeth that occluded, making the total occlusal contact area extremely small. Moderate crowding of the mandibular anterior teeth was observed. The maxillary dental midline was coincident with the facial midline, and the mandibular dental midline was 3.0 mm. to the right. Upon lateral excursion, group function was noted on the right, in contrast with a canine-guided configuration on the left, in which the maxillary left canine occluded on the mandibular left first premolar. During anterior protrusive movement, the anterior teeth were free of contact, and a posterior guidance was observed on the right. Evaluation of the periodontal status revealed deep pockets ranging from 5 to 11 mm. on #17, 18, 25, 27, 47 and 48.

Fig. 1 Pretreatment facial photographs.

Fig. 2 Pretreatment intraoral photographs.
Radiographic examination

From the panoramic X-ray, a moderate degree of resorption was seen in the alveolar bones. There was marked horizontal bone resorption affecting #15, 17 and 18, and extensive vertical bone resorption at #25-27, 47 and 48. Teeth #11, 17, 18, 21, 22, 47 and 48 were root canal treated (Figure 3a).

The lateral cephalometric analysis showed a skeletal Class III jaw relationship (Table 1, Figure 3b). The SNA was 89.0˚ and the SNB was 88.0˚, indicating forward positioning of both maxilla and mandible compared to the cranial base, with higher degree of severity in the mandible. The ANB was 1.0˚, and Wits appraisal was -5.0 mm., confirming that the mandible was also in a forward position compared to the maxilla. The inclination of maxillary incisors was within the normal range (U1-SN = 101.5˚), while the mandibular anterior teeth were lingually inclined (L1-MP = 82.5˚, FMIA = 66.0˚). According to Coben analysis, the upper anterior facial height was average, but the lower anterior facial height was excessive (ANS-U1/N-M = 24.0%, L1-M/N-M = 37.0%), showing the poor vertical proportion of the mandible. The soft tissue analysis indicated that the lower lip position related to the Esthetic plane was retruded (E-line-Li = -1.5 mm.). Merrifield’s Z-angle was 82˚, confirming a protruded soft-tissue pogonion with poorly balanced facial profile.

Diagnosis and treatment objectives

This case was diagnosed as skeletal Class III malocclusion with mandibular protrusion and multiple tooth loss. We planned to take a multidisciplinary approach combining oral surgery, periodontic, prosthodontic and implant treatments to restore the patient’s occlusal function. Although the patient demonstrated some degree of maxillary protrusion, considering her age, oral condition, and the amount of invasion during the operation, one jaw surgical procedure by bilateral sagittal split ramus osteotomy (BSSRO) was chosen. Prior to orthodontic treatment, periodontal problems were treated, and any tooth that did not respond to periodontal therapy would be extracted.

Treatment progress

After four months of periodontal treatment, the lower right third molar (#48) failed to show any improvement and was therefore extracted. Moreover, the bridge on lower right quadrant was removed. Following tooth brushing instruction and repeated scaling, the oral hygiene status became controlled after a total period of six months, and presurgical orthodontic treatment was then started. Oral hygiene instruction and prophylaxis were continued throughout the orthodontic treatment in order to prevent worsening of the periodontal status.
The appliances used were 0.018” slot preadjusted edgewise brackets. We expanded the maxillary arch in order to accomplish the objectives for the presurgical phase which included eliminating maxillary right posterior crowding and preparing the maxillary dental arch width to co-ordinate with the postsurgical mandibular arch configuration and position. In the mandibular arch, crowding was eliminated by using the space occupied by the bridge on the right and flaring the anterior teeth. After eight months of presurgical

<table>
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<td></td>
<td>38y. 0m.</td>
<td>39y. 8m.</td>
<td>42y. 8m.</td>
<td>39y. 8m.</td>
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Table 1 Cephalometric measurements. (Means and SDs of normal Japanese female adults.)
orthodontic treatment (Figures 4, 5), mandibular backward repositioning by 9.0 mm. on the left, 11.0 mm. on the right and a 7.0° clockwise rotation of the mandible were carried out by Epker’s modified BSSRO method.\(^{(6)}\)

The small asymmetrical mandibular set-back corrected the mandibular dental midline while having no adverse effect on facial symmetry.

To fix the bone segment, we used resorbable screws (FIXSORB MX, TAKIRON Co, Tokyo, Japan; diameter 2.7 mm., length 18.0 mm.). Vertical elastics were applied instead of rigid intermaxillary fixation. The patient was discharged from the hospital at five days post-operation, and was instructed to continue using the elastics at home. Postsurgical orthodontic treatment was started two weeks after surgery. Short Class III intermaxillary elastics were used to gain a stable occlusion. The mandibular right second molar could not be completely uprighted due to significant mobility. After eight months, the appliances were removed (Figures 6-8), and a full coverage clear retainer for the maxilla was delivered. In the mandible a removable acrylic retainer with a modification in the left edentulous area to serve as a provisional denture was inserted. The patient was instructed to use this denture all-day. In order to maintain vertical dimension,
to improve the occlusal function, maintain space, and for esthetic reasons, the patient was referred to have a crown for #25, a bridge for #45, 46, 47, and dental implants for the mandibular left quadrant after six months of the retention phase. The mandibular retainer was then modified by trimming and cutting away the resin teeth. The maxillary right third molar was extracted at this time since the periodontal condition showed no improvement. After one year of retention, the retainer was worn only at nighttime, and until now, has been continued for another two years.

Fig. 6 Posttreatment facial photographs.

Fig. 7 Posttreatment intraoral photographs.
Treatment results

The patient revealed an acceptable occlusion and her facial esthetics improved significantly. Comparing with the pretreatment condition, the changes after a three-year retention period are summarized as follows:

Her facial balance improved considerably. The lateral view demonstrated a straighter facial profile due to reduction of the protruding chin and slight opening of the mandible (Figure 9). This is supported by the decrease of SNB from 88.0° to 82.5°, and the increase of ANB from 1.0° to 6.5°. Dental change includes lingual tipping of lower incisors as shown by the decreases of L1-MP from 82.5° to 78.5°, and FMIA from 66.0° to 63.0°. According to Coben analysis, L1-M/N-M changed from 37% to 35%, indicating a decrease of lower facial height, which resulted in better proportions of anterior facial height. Remarkable improvement of the soft tissue profile was also observed, with the changes of E-line-Ls from -6.5 mm. to -4.0 mm., E-line-Li from -1.5 mm. to -3.0 mm., and Merrifield’s Z-angle from 82.0° to 76.5° (Table 1). The uneven upper lip became more balanced, and the lips showed less strain on closure.
From a frontal aspect, the face showed symmetry, with the chin situated approximately on the facial midline. Intra-oral evaluation revealed a very stable occlusion, Class I canine relationship with an overbite of +3.5 mm. and an overjet of +3.0 mm. Anterior crossbite was eliminated and the dental midline was corrected (Figure 10).

Mandibular lateral excursive movement was characterized by bilateral group function occlusion due to prosthetic replacement including the implants. Anterior guidance was observed during protrusive movement. A favorable and stable occlusion has been established, showing no sign of relapse after three years of retention (Figure 11, 12).
Fig. 11 Three years retention panoramic and cephalometric radiographs.

Fig. 12 Superimposition of Pretreatment, Posttreatment and Three years retention.

The panoramic X-ray revealed no root resorption, but some degree of bone loss remained on the mesial aspects of #17, 27, and #47 (Figure 11). However, good gingival health was maintained with no abnormal tooth mobility detected. The periodontal probing depth was 2-3 mm. on average.

Discussion

Recently, with growing awareness of malocclusion as a problem, the number of patients with skeletal mandibular prognathism has increased.\(^\text{7}\) To manage adult patients, a multidisciplinary approach is often necessary since they may present with more tooth loss from caries and periodontal disease.\(^\text{8,9}\) As in our case, the total occlusal contact area was very small due to multiple tooth loss. The long term sustainability of the remaining teeth would be difficult just by prosthetic and implant reconstruction, so we decided to offer the patient surgical orthognathic treatment.\(^\text{1,2,8-10}\)

Since anterior and canine crossbites are common in skeletal mandibular prognathism, there is a constant excess load on the molars due to lack of proper anterior and canine guidance during mandibular movement. Therefore, the molar lateral pressure is increased, producing a harmful effect on the molar periodontal tissue. Correction of skeletal discrepancy by orthognathic surgery has proved to be effective in creating a favorable oral environment for a stable occlusion, and thus provides long term sustainability of the remaining teeth for patients with skeletal mandibular prognathism.\(^\text{2,10}\)

Considering the patient’s age, oral condition and surgical invasion, we made an effort to minimize any postoperative complications that may occur. Thus, one-jaw surgery by BSSRO was chosen. Furthermore, as a large distance for mandibular setback (9.0 mm. on the left, 11.0 mm. on the right) and a 7.0° clockwise rotation of the mandible were required, a modification of BSSRO advocated by Epker was used. With this method, the backward displacement of the posterior ramal border can be reduced. It also allows a larger distance of setback since stripping of the internal pterygoid muscle can be performed easily, and thus reduces the resistance of muscle pull on the distal bone segment.\(^\text{6,11}\) In addition, since the resorbable bone screw can provide acceptable stability for bone segment fixation in orthognathic surgery,\(^\text{12,13}\) it can be a preferable choice as it does not require a second surgery for screw removal, and thus reduces the patient discomfort during treatment and overall cost and risks associated with her treatment.

Periodontal disease is another factor that can compromise the orthodontic treatment result, especially in adults.\(^\text{8,9}\) Since the patient presented with severe periodontal problems, she was referred to a periodontist prior to starting orthodontic treatment. She also received thorough scaling and plaque control program during and after the course of treatment. Despite her much-improved oral hygiene, traces of marginal bone loss remained on the mesial surface of #17, 27, and #47. It is therefore essential to closely monitor these areas and attempt to eliminate any interference that may persist. The patient continues under the care of her periodontist and further bone regenerative treatment may be provided as necessary.

In this case, implant treatment was done to the lower left edentulous area after six months of retention. As the surgical procedure changes the occlusal scheme dramatically, we considered that a delay would help stabilizing the new occlusion and allow some time for the patient to get used to it. We therefore used a full coverage retainer in the upper arch and a provisional denture to replace the lower left molars as a removable retainer in the lower arch during the first six months.
of retention period prior to implant placement. This seemed to be useful to the implants in the early adaptation to masticatory function.

**Conclusion**

We found a multidisciplinary approach including orthognathic surgery effective in improving occlusion, mastication and oral environment for a mandibular prognathic patient who also exhibited multiple tooth loss and periodontal problems. A stable occlusion has been established and maintained with great patient’s satisfaction.

**References**