Minimum Presurgical Orthodontic Treatment with Two Jaw Surgery Combined with Anterior Segmental Osteotomy in Skeletal Class II Malocclusion: A Case Report

Jong-Moon Chae, Jun-Young Paeng

Abstract

This case report describes the treatment of a 23-year-old woman who had lip protrusion with gummy smile and mentalis muscle strain. Orthognathic surgery was performed in conjunction with orthodontics. Minimum dental decompensation was performed with presurgical orthodontics followed by an anterior segmental osteotomy for the majority of dental decompensation. Counterclockwise rotation of the maxillomandibular complex was applied by LeFort I osteotomy, and bilateral sagittal split ramus osteotomies with anterior segmental osteotomy to achieve overall facial balance. The active treatment period was 15 months. Stable occlusion and skeletal relationship were observed after a 10-month follow-up period.

Key words: Minimum presurgical treatment, Skeletal Class II, Anterior segmental osteotomy, Counterclockwise rotation

Introduction

Orthognathic surgery is typically recommended to patients if an orthodontic treatment alone is not sufficient to correct any malocclusion and, at the same time, camouflage is not an option[1]. The goal of orthognathic surgery is to maximize or optimize skeletal changes upon reducing the pretreatment dental compensations to improve facial esthetics, function, and posttreatment stability[2]. Skeletal Class II malocclusion problems are usually due to a mandibular deficiency or downward-backward rotation of the mandible caused by excessive vertical growth of the maxilla. The surgical management, therefore, consists of mandibular advancement, superior repositioning of the maxilla, or a combination of the two[3]. In the conventional orthognathic surgery planning, the anteroposterior discrepancies are corrected by advancement or setback of the jaws along the existing occlusal plane. Otherwise, if the maxilla is manipulated in a vertical direction, the mandible will autorotate and alter the angle of occlusal plane[4]. Thus, selective alteration of the occlusal plane allows a maxillofacial surgeon to re-establish the correct and proper jaw function with respect to the cranial base and, consequently, offer an improved esthetic result for patients with dentoskeletal deformities[5].

Recently, surgical-orthodontic management of either sur-
gery-first or minimum presurgical orthodontic treatment has been proposed to address the issue of facial esthetics from the beginning of treatment. Then again, orthognathic treatment with an anterior segmental osteotomy in comparison to conventional orthodontic treatment can markedly reduce the presurgical orthodontic treatment period for the correction of a maxillary protrusion and decompensation of lower dentition[6-8].

The objective of this article was to present the treatment of a skeletal Class II malocclusion in a patient with gummy smile and a high mandibular plane angle. The counterclockwise rotation of maxillomandibular complex with anterior segmental osteotomy and genioplasty provided good maxillary incisor exposure and excellent smile arc, and improved the patient’s facial balance.

**Case Report**

The patient was a 23-year-old woman with chief concerns of lip protrusion, gummy smile, and retrognathic mandible. On exam and in facial photographs, the patient’s face revealed good symmetry but had a convex profile with marked protrusion of the lips, mentalis strain, and excessive lower anterior facial height. Intraoral exam revealed Class II canine and Class I molar relationships with minor crowding and poor oral hygiene. The patient had a deep overbite of 7.5 mm and a large overjet of 5.5 mm. The dental midline was coincident with the facial midline (Fig. 1, 2).

The lateral cephalogram (Fig. 3) and its tracing confirmed a severe underlying skeletal problem. The skeletal pattern was deemed hyperdivergent as evidenced by a
Frankfort-mandibularplane angle (FMA) of 37°. The ANB angle of 6.5° (SNA, 83°; SNB, 76.5°) reflected a class-II skeletal problem. The Z-angle of 50.5° quantified the overall facial imbalance. The angle between Frankfort horizontal and the maxillary incisor axis of 106° indicated linguo-

version of the maxillary incisors (Table 1). The lips were incompetent, and the lower lip was strained to compensate for the vertical discrepancy. Consequently, the labiomental sulcus was eliminated by the upward tension (Fig. 1). A panoramic radiograph showed a full complement of dentition as well as restoration of several teeth (Fig. 3). On exams as well as imaging studies, there were no significant signs or symptoms of temporomandibular disorders.

In pre-surgical counseling interviews, the patient was offered two options. The first was that of an orthodontic intervention with extraction of the four premolars, and direction force technology with micro-implant anchorage[9]. The idea behind this treatment option was that micro-implants would provide absolute anchorage not only in the retraction of the anterior teeth of both maxilla and mandible, but also, in the intrusion of the maxillary anterior and posterior teeth as well as intrusion of the mandibular posterior teeth. This would induce a horizontal mandibular response followed by a more balanced facial profile. A genioplasty would be necessary to reduce the long lower facial height and advance the chin. The downside of this option was that it would take a long period of treatment and compromise the overall facial esthetics.
The second option was an orthognathic surgery. Upon orthodontic decompensation, a single-stage, two-jaw operation would be performed in which the maxilla was differentially impacted and the mandible was advanced. As in the first option, a genioplasty would be necessary to reduce the long lower facial height and to advance the chin along the facial midline.

In the interest of treatment duration and the overall projected esthetic results, the patient wished to undergo the second surgical option. However, she also wanted a minimal presurgical orthodontic treatment, so an anterior segmental osteotomy was chosen instead of orthodontic decompensation to reduce the presurgical orthodontic treatment time. The usual indications for anterior segmental osteotomy are excessive vertical or antero-posterior development of the maxillary alveolar process in patients among whom the upper anterior teeth are uprighted with excessive retrusion of mandible by subsequent clockwise rotation of the maxillomandibular complex. This method provides many biological and psychological advantages over the traditional surgical treatments requiring extensive orthodontics. This method has the additional benefit of showing immediate immediate and significant improvements in facial height and profile early in the course of treatment.

In presurgical orthodontic preparation, 0.022×0.028 inch (in) nontipped, nontorqued edgewise appliances were placed in both arches, and leveling was begun with 0.014-in nickel-titanium and 0.018-in stainless steel archwires. In the leveling and alignment stage, the archwires were coordinated. Preoperative preparation took 2.5 months and was completed with maxillary and mandibular 0.018×0.025-in stainless steel archwires.

The operation included bimaxillary procedures with extraction of 4 first premolars. A 1-piece LeFort I osteotomy with impaction and counterclockwise rotation of the maxilla, anterior maxillary segmental osteotomy with posterior and superior positioning of anterior maxillary segment, bilateral sagittal split osteotomies with advancement and counterclockwise rotation of the mandible, and advancement genioplasty were performed to correct the sagittal maxillomandibular skeletal and dental relations, excessive lower facial height, and gummy smile. In these procedures, rigid fixation was used with titanium plates and screws, while surgical splint was used for fixation of anterior maxillary segment only.

Ten weeks after the operation, 0.018-in stainless steel archwires were used for finishing and detailing. Vertical intermaxillary and Class-II elastics were used to settle the final occlusion. Fixed lingual retainers were bonded to the lingual sides of the six anterior teeth, and circumferential clear retainers were placed on both arches, immediately before and after removing the appliances for retention, respectively. A repeat, 1-year postoperative detailing and finishing were needed before debonding (Fig. 4-6). The final occlusal relationship was retained with maxillary and mandibular Hawley retainers. The total treatment

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Mean±standard deviation (SD) is based on the data from lateral cephalometrics in Korean with normal occlusion by Korean Association of Orthodontists.

FMIA, angle between Frankfort plane and mandibular incisor axis; FMA, angle between Frankfort plane and mandibular plane; IMPA, angle between lower incisor axis and mandibular plane; SNA, angle between SN and NA; SNB, angle between SN and NB; ANB, difference between the SNA and SNB angles; AO-BO, distance between perpendicul ars drawn from point A and point B onto the occlusal plane; OP, occlusal plane; OP angle, angle between Frankfort plane and OP; FH, Frankfort horizontal plane; UI, maxillary incisor axis; FH to UI, angle between Frankfort plane and maxillary incisor axis; Z angle, angle between FH and profile line tangent to the chin and the vermilion border of both lips.

*Measurement between 1 and 2 SD; †measurement between 2 and 3 SD.
The posttreatment facial photographs show a retraction of the upper and lower lips and a reduction in the strain of mentalis muscle (Fig. 4). The posttreatment casts illustrate a Class-I occlusion with a good interdigitation of the teeth and acceptable overjet-overbite relationship (Fig. 5). The panoramic radiograph shows good root parallelism and bone integration (Fig. 6).

The cephalometric superimposition shows a significant increase in mandibular length, not only from the advancement genioplasty, but also from the counterclockwise maxillomandibular rotation— all of which contributed to reduced apical base anteroposterior discrepancy, facial profile convexity, and excessive gingival display when smiling (Fig. 4, 7). The chin advancement obtained by the genioplasty and the maxillomandibular counterclockwise rotation resulted in a decrease of the Frankfort mandibular plane angle by 3°, a reduction of the ANB angle by 2°, and a decrease of the occlusal plane angle by 4.5°. The Z-angle was improved from 50.5° to 70° (Table 1). All these changes contributed to an overall improvement of the facial profile. The results were stable at 10 months after debonding (Fig. 7~10).

**Discussion**

The patient had a convex facial profile with a marked protrusion of upper lips and a retrognathic mandible. For a skeletally-mature patient with skeletal Class II malocclusions, 2 or 4 premolar extraction to retract the anterior teeth is a valid treatment choice of orthodontic camouflage[10]. However, it is a less desirable option than that...
of a combined orthodontic-surgical treatment when considering the overall functional and esthetic outcomes[1].

Surgical-orthodontic treatment of Class II malocclusion in adult patients includes preoperative orthodontic treatment to decompensate the malocclusion, followed by surgical detailing and finishing of the occlusion. The preoperative dental decompensation dictates the magnitude and type of surgical management and is a major factor in the success of treatment[11,12]. The patient in this case report wished for a rapid correction of the esthetically compromised profile, and thus, anterior segmental osteotomies were performed with orthognathic surgery on both the upper and lower jaws to reduce upper lip protrusion and
decompensate lower dentition. Anterior segmental osteotomy is indicated in case where substantial movement of the anterior teeth is required, and where tooth repositioning by orthodontic treatment alone is impossible because of objective factors such as the amount of tooth movement and periodontal circumstances, and subjective factors such as patient age and treatment duration [13].

Recently, the performance of surgery without orthodontic preparation (ie, 'surgery-first'), followed by regular postoperative dental alignment, was proposed by Nagasaka et al. [14]. In this seminal publication, the treatment duration had been shortened to about 12 months far less than the average time needed for traditional preoperative orthodontics alone. Wilcko et al. [15] reported that corticotomy could enhance tooth movement by increasing bone turnover and decreasing bone density. Similarly, bone turnover after orthognathic surgery is known to significantly accelerate orthodontic tooth movement [6,7]. In addition to a significant reduction in treatment time, the surgery-first approach offers a patient immediate gratification in the correction of facial deformities, which promotes improved patient compliance with hardware usage and follow-up appointments. Another reported advantage with this method is the elimination of soft-tissue imbalances that might interfere with orthodontic tooth movements.

Most dento-facial deformities can be corrected by conventional orthognathic treatment, which can also be performed for patients whose treatment requires a differential impaction of the maxilla [16]. The treatment for vertical maxillary excess with greater anterior than posterior vertical max-
illary growth requires a LeFort I down-fracture of the maxilla and differential maxillary impaction, moving the anterior maxilla superiorly more than the posterior maxilla (anterior impaction). In the case presented here, maxillomandibular advancement with counterclockwise rotation and superior repositioning of anterior maxilla was able to improve the patient’s overall facial balance and smile animation.

Rotation of the occlusal plane has been shown to produce significant modifications of the upper airways[17]. In selected cases of obstructive sleep apnea, counterclockwise rotation of the occlusal plane is an effective technique for decreasing upper airway resistance while preventing deformity[18]. Reyneke et al.[19] and Chemello et al.[20] found that counterclockwise rotation of the maxillomandibular complex had good long-term stability. In our patient, the stable occlusion and skeletal relationship were observed after a 10-month follow-up period (Fig. 7~10).

Advancement of the maxillomandibular complex with counterclockwise rotation can improve facial balance, maxillary incisor exposure, and smile animation in patients with Class II malocclusion and anterior vertical maxillary excess. The new orthodontic-surgical protocol (surgery-first or minimum presurgical orthodontic treatment) can improve facial esthetics from the early stages of treatment and reduce total treatment time.
Acknowledgements

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References