2020

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**Recommended Citation**  
DOI: 10.38209/2708-2636.1002  
Available at: [https://www.tjo.org.tw/tjo/vol32/iss3/3](https://www.tjo.org.tw/tjo/vol32/iss3/3)

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CASE REPORT

Surgery First and Atypical Extraction for a Skeletal Class III with Severe Anterior Open Bite and Severe Crowding—Three-year Stability

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ABSTRACT

This case report features a successful combined surgical-orthodontic treatment of a patient with skeletal Class III malocclusion with severe anterior open bite and severe mandibular crowding. Clinical examination revealed concave profile with long-face deformity caused by retrognathic maxilla and excessive vertical growth of mandible, maxillary crowding despite absence of maxillary first premolars, mandibular incisor retroclination, deep curve of Spee, and blocked-out mandibular canines. The treatment involved surgery-first approach with extraction of lower right first premolar and atypical extraction of lower left canine due to its poor periodontal support. Harmonized facial profile, pleasing smile, good occlusal interdigitation as well as skeletal stability were evident 3 years after active orthodontic treatment.

Keywords: Surgery-first; Class III anterior open bite; Atypical extraction

INTRODUCTION

Skeletal open bite remains a challenging problem in dentofacial orthodontics. Exaggerated anterior open bite, manifested by lack of occlusion extending to posterior teeth, is usually rooted from underlying skeletal disproportion.1,2 To date, both temporary skeletal anchorage and surgical intervention could be pursued in terms of solving open bite alone.3,4 However, skeletal repositioning of both maxilla and the mandible is the treatment of choice, given that significant facial improvement is desired along with the open bite correction.

The trending surgery-first approach in combined surgical-orthodontic treatment is well reputed for immediate facial improvements at the beginning of treatment, boosting psychosocial esteem, and overall treatment time reduction.5 General indications for surgery-first approach have been proposed in the literatures, mainly concerning for stable occlusal contact at immediate post-operation6 and feasibility to correct post-operative malocclusion.7 Skeletal open bite has been reported for its strategic advantage in surgery-first approach, in terms of better immediate skeletal stability comparing to the skeletal deep bite deformity,8 as well as long-term stability comparing to conventional orthodontic-first approach.9

To relieve intra-arch severe dental crowding with extraction, selection of first premolars is the conventionally advised approach. However, atypical extraction pattern is usually inevitable in face of individual tooth problem such as compromised periodontal support, ankylosis or severely broken-down tooth structure secondary to caries. Atypical extraction often brings about tooth-size discrepancy problem, visible tooth-shape mismatch, as well as more anchorage demands for space closure.10 These concerns need to be anticipated and tactfully

The authors declare that there is no conflict of interest. No funding was received for this work.

Received 19 June 2020; revised 13 July 2020; accepted 3 August 2020.
Available online 1 December 2020

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https://doi.org/10.38209/2708-2636.1002
2708-2636/0 2020 Taiwan Association of Orthodontist.
handled in order to reach esthetically acceptable outcomes.

This case report presents a case of skeletal Class III deformity with severe anterior open bite treated with surgery-first bimaxillary orthognathic surgery, including maxillary LeFort I osteotomy for impaction, advancement and clockwise rotation, and mandibular BSSO (bilateral sagittal split osteotomies) for setback and upward closing rotation. Post-operative orthodontics with atypical extraction were carried out for crowding relief and finishing of occlusion.

CASE REPORT

An 18-year-old female with chief complaint of her long face and difficulty in chewing, lip incompetence, and phonation, presented to the Craniofacial Orthodontic Department of Chang Gung Memorial Hospital, Taipei branch, Taiwan. She denied any underlying systemic diseases, as well as no known drug allergy. She reported no previous TMJ (temporomandibular joint) symptoms. However, family history revealed positive finding of her grandfather having the similar long-face appearance and dental open bite. Additionally, patient had interceptive treatment of tooth 14, 24 extraction to alleviate maxillary crowding during her mixed dentition.

Pre-treatment data

Extraoral examination

Frontal view showed overall acceptable facial asymmetry with minimal chin deviation to the right (within 1 mm), no lip canting, with lip incompetency and mentalis muscle strain (Figure 1). The lower
anterior facial height was 1.3 times of the middle anterior facial height. Frontal smiling view showed reduced maxillary incisor display of 8 mm with no gingival display, as well as non-consonant smile arc. In relation to the facial midline, the upper dental midline shifted to the right by 0.5 mm, and the lower dental midline also shifted to the right by 1 mm. From lateral view, she exhibited concave facial profile, paranasal depression, obtuse nasolabial angle, retrusive upper lip, steep mandibular plane. The labiomental fold was proper in depth during smiling.

Intraoral examination

The overbite was –10 mm, and overjet was –2 mm. The open bite and cross bite of both anterior and posterior teeth were obvious, with non-contacting tooth involving up to mandibular first molars (Figure 1). The inter-arch relationship was canine Class III and molar Class III bilaterally. The lower dental midline was 0.5 mm to the right, relative to the upper dental midline. The upper arch form was tapered and asymmetric, with moderate crowding (space discrepancy was 4 mm). The lower arch form was square-shaped and asymmetric, with severe crowding associated with labial block-out of tooth 33 and 43 (space discrepancy was 17 mm). The curve of Spee was 4 mm on both sides.

In addition, the tooth 33 had significant gingival recession of 4 mm with lack of keratinized gingival and attachment loss. There was limited width of keratinized gingiva at labial side of mandibular

Figure 2. Initial lateral cephalometric, posteroanterior, and panoramic radiographs.
anterior area (less than 2 mm width). The oral hygiene and general dental health were good, without active periodontal disease or caries.

Radiographic examination
From panoramic radiograph, the morphology of bilateral condyles was generally symmetrical with intact cortical outlines (Figure 2). Three wisdom teeth were missing: 18, 28, 38, in combination of missing maxillary first premolars (14, 24). Posteroanterior radiographic view showed no occlusal canting, with slight chin point deviation to the right by 0.5 mm. Lateral cephalometric examination revealed a skeletal Class III relationship due to retrognathic maxilla, excessive mandibular plane angle, with retroclined mandibular incisors (Table 1). Also, thin mandibular symphysis was noted.

Diagnosis
Skeletally, the patient had a Class III jaw relationship with retrognathic maxilla and hyperdivergent facial type. Dentally, she had Angle Class III malocclusion with severe anterior open bite, anterior and posterior cross bite. Also, bimaxillary space deficiency and retroclined mandibular incisor were diagnosed.

Treatment goal and Treatment plan
The disproportionate lower facial height, concave facial profile, and severe open bite were addressed through combined surgical-orthodontic treatment. The aims of this treatment were to (1) reduce facial concavity, increase the paranasal support, and shorten the lower facial height, (2) correct anterior open bite, anterior and posterior cross bite and achieve Class I molars relationships with proper interdigititation, (3) increase maxillary incisor display, (4) procline the retroclined lower incisors, and (5) correct space deficiency in maxillary arch by expansion and incisor proclination and in mandibular arch by extraction.

These following aims called for surgical correction of both maxilla and mandible (Figure 3). In maxilla, LeFort I osteotomy was planned for posterior impaction, advancement and clockwise rotation, in order to intrude posterior teeth, increase paranasal support and increase incisal display respectively. In mandible, BSSO setback and counterclockwise closing rotation were planned to reduce the long lower facial height, as well as to correct the anterior open bite. Severe crowding and incorrect incisor inclination were addressed via post-op orthodontic treatment with extraction. The chosen extraction in maxilla and mandible was 4 mm at key ridge bilaterally, in combination with

Orthodontic treatment began with banding of all second molars and bonding the entire maxillary and mandibular arch with an 0.022 × 0.028 square inch pre-adjusted self-ligating appliance (Genius, OrthoPartner Mem, Taiwan). The patient had 0.014 nickel-titanium aligning archwires placed and directly underwent orthognathic surgery.

The proposed surgical treatment plan was conducted via three-dimensional surgical simulation software (Dolphin Imaging, Chatsworth, CA), according to the cephalometric prediction and dental cast occlusion setup (Figure 3). The dental cast was set in treatable malocclusion setup, ensuring three-point occlusal contact and coordinated transverse dimension (Figure 4). The overjet was planned slightly more than normal in order to anticipate for subsequent decompensation of lower incisors after surgery. The planned surgery was transferred to the operation via printed intermediate and final splints for optimal accuracy.

In operation, the maxillary LeFort I osteotomy was carried out first, with the guide of intermediate splint to achieve the planned position. The maxilla was advanced by 5 mm, superiorly impacted 4 mm at key ridge bilaterally, in combination with
clockwise pitch rotation. The splint was removed when maxilla was rigidly fixed. Next, the mandibular BSSO was performed, with the guide of final splint toward the planned occlusion. As a result, the mandible had been setback by 5 mm bilaterally, and underwent rigid internal fixation. All third molars and tooth 44, 33 were extracted during surgery. Genioplasty was not performed since patient already had an acceptable chin contour. No intermaxillary fixation (IMF) was placed, as only light intermaxillary elastics in the canines were used to maintain the occlusion and to aid in post-operative oral hygiene maintenance.

Active orthodontic treatment continued at 2-month after surgery. Alignment and leveling were performed using 0.018 inch to 0.016 × 0.022 square inch nickel-titanium archwires. At 5-month post-operation (Figure 5), 0.017 × 0.025 square inch beta-titanium archwire with labial crown torque was used in mandibular arch for the next 3 months, to decompensate the incisors. Anterior triangular and posterior box elastics were used to assist in bite settling throughout the treatment course. The left mandibular first premolar's size was slightly reduced mesiodistally as to replace canine. Ultimately, 0.016 × 0.022 square inch stainless steel

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Figure 3. Pretreatment three-dimensional tomographic image with soft tissue composite: A, pretreatment; and B, surgical simulation.

Figure 4. Surgical occlusion setup.
archwires were used in both arches for residual space closure, coordination of both arches, as well as finishing and detailing of the occlusion. Total treatment time concluded at 13 months, with all brackets debonded and bands removed. As retention, wraparound retainers were delivered for both arches, along with fixed retainers bonded in the incisor regions.

Figure 5. Intraoral photographs at 5-month post-operation.

Figure 6. Posttreatment facial and intraoral photographs.
Treatment results

Post-treatment records confirmed that treatment objectives were met with pleasing esthetic facial changes and good dental interdigitation (Figure 6). The facial appearance became more harmonious, with increase in facial convexity as well as improvement in lip support in relation to E-line. The posttreatment intraoral records showed bilateral Class I molar relationships with good interdigitation, as well as ideal overjet and overbite. Gingival recession of mandibular left central incisor by 2 mm was found as a result of labial crown movement.

Panoramic radiograph revealed optimal dental roots parallelism (Figure 7). Cephalometric measurements and superimpositions demonstrated remarkable skeletal and dental changes after treatment (Table 1, Figure 8A). The most notable changes included reduction of high mandibular plane angle (SN-MP angle from 49° to 43.5°), increase of Wits appraisal from −14.5 to −10 mm, normalization of posterior-to-anterior facial height ratio (PFH/AFH ratio) and upper-to-lower anterior facial height ratio (UAFH/LAFH ratio) to 62.7% and 45% respectively, thereby correcting the long face deformity. The mandibular incisors improved in inclination and position (LI-MP angle from 62° to 70°, LI-NB (mm) from 3.5 to 4.5, respectively). Regional superimpositions demonstrated proclination of both maxillary and mandibular incisors, thus improving interincisal angle, as well as mesial tipping of maxillary molars and uprighting of mandibular molars with minimal extrusion (Figure 8B and C). Three-
dimensional superimposition, with voxel-based method, revealed that from immediate post-operation to debonding, the mandible underwent continued upward and forward skeletal change, thus further shortened the lower facial height (Figure 9). Retention record at 3 years after debonding revealed generally stable outcomes, with minimal mandibular dental midline deviation (Figure 10).

**DISCUSSION**

The present surgery-first approach with atypical extraction in treating this case of severe anterior open bite with periodontally compromised tooth could be considered a success, in terms of excellent facial improvements since immediately at the beginning of treatment, as well as occlusal solid interdigitation, promoting good long-term function.

**Figure 8. Two-dimensional superimposition between initial and debonding (posttreatment): A, overall superimposition; B, regional superimposition at maxilla; C, regional superimposition at mandible.**

**Figure 9. Three-dimensional superimposition between initial (grey), immediate 1-week post-operation (red) and debonding (posttreatment - blue). The superimposition between the initial and 1-week post-operation images revealed the outcome after mandibular setback and shortening of lower anterior face height. The superimposition between the 1-week post-operation and the debonding images showed continued change of mandibular position in counterclockwise direction.**
Conventional orthodontic-first approach surgical orthodontics emphasize on complete incisor decompensation before surgery. In this patient, the lower incisors inclination could have been more normalized if non-extraction plan was undertaken, with space gaining via anterior proclination. However, this was not viable choice for the case due to thin symphysis and limited keratinized gingiva in mandibular anterior region. Extraction plan could minimize the risk of teeth being positioned beyond the alveolar bone support, which jeopardizes periodontal health and long-term stability. In paradigm shift of surgical-first approach, adequate amount of jawbone repositioning is attainable without the need of total incisor decompensation. As rotation of the MMC (Maxillomandibular complex)\textsuperscript{11} and careful surgical occlusion setup in treatable malocclusion\textsuperscript{6,7} play a vital role in achieving successful outcome of surgery-first approach.

Superimposition image of immediate post-op and at debonding illustrated the continued upward and forward movement of mandible (Figure 9). This finding might be viewed as a relapse in skeletal Class III deformity with originally very prognathic mandible and/or deep bite. However, in open bite tendency and mandibular excess in vertical dimension like the present case, this aided in maintaining the proper overbite and further controlling the hyperdivergent tendency. This favorable phenomenon on Class III open bite cases was found in surgery-first approach, but not in the cases with presurgical orthodontics.\textsuperscript{9} Therefore, from post-treatment stability perspective, skeletal Class III open bite cases are advisable for surgery-first approach.

The atypical extraction pattern of mandibular right first premolar and left canine, in combination with sequential tooth reduction of left first premolar to substitute canine, had successfully eliminated tooth-size discrepancy, thus allowing for proper interocclusal cusp-to-fossa relationships. Good arch symmetry and tooth shade harmony were achieved. The limitation of this, was a noticeable difference in tooth contour of mandibular canine from frontal view, compared to its contralateral counterpart. Nonetheless, the patient benefitted from retaining the teeth with good long-term prognosis, eliminating the poor ones.

The gingival recession of left mandibular central incisor at posttreatment was a concern. Since decompensating incisors by labial crown movements could aggravate the recession, in context of pre-existing thin symphysis and mucogingival problems. From the very beginning, there was already a tiny dehiscence of gingiva in the labial side of it (Figure 1). Increasing the amount of attached gingiva before orthodontic treatment could have been implemented to reduce the risk of gingival recession. However, the patient was satisfied with the current outcome and was not interested in any further periodontal enhancements.
CONCLUSION

Patients of skeletal Class III deformity with severe anterior open bite are good candidates for surgery-first approach orthodontics, enabling early improvement of facial esthetic, as well as promoting early occlusal function via closure of anterior open bite right after surgery. Moreover, the direction of surgical relapse was favorable to maintain the long-term posttreatment results.

Atypical extraction plan, with correct management of tooth-size discrepancy should prevail for the best interest of patients in both achieving good intercuspation and maintaining long-term dental health integrity.

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