Surgical orthodontic correction of mandibular laterognathism

Harpreet Singh, Dhirendra Srivastava¹, Pranav Kapoor and Poonam Sharma

ABSTRACT

This case report describes the successful treatment of a patient with mandibular laterognathism and associated facial asymmetry with combined surgical orthodontic approach. After 7 months of presurgical orthodontic treatment, intraoral vertical ramus osteotomy, and straightening genioplasty were performed as two step surgeries to reposition the deviated mandible and chin, respectively. The total active treatment period was 14 months. After surgical orthodontic treatment, significant improvement in occlusion, masticatory function, and facial appearance was discernible. Posttreatment records at 3 years showed stable results with good occlusion.

Key words: Facial asymmetry, genioplasty, intraoral vertical ramus osteotomy, laterognathism, temporomandibular joint

INTRODUCTION

Facial asymmetry is one of the most difficult and challenging dentofacial deformities to correct in orthodontics. Skeletal asymmetry is often caused by age-related adaptive remodeling changes in the temporomandibular joint (TMJ) and thus commonly observed in mandible which forms the skeletal support for soft tissues of the lower face.[1‑3] Conversely, since the maxilla provides minimal soft tissue support, most maxillary asymmetry usually develops secondary to asymmetric mandibular growth.[4] Isolated excessive unilateral anteroposterior mandibular growth or anteroposterior maxillary deficiency, or a combination of the two usually result in the development of asymmetrical Class III dentofacial deformities.[5] Studies have shown that the presence of temporomandibular disorder (TMD) symptoms, such as joint sounds and pain, and articular disk displacement is higher in patients exhibiting mandibular asymmetry.[6‑7] Optimal correction of such asymmetries requires an interdisciplinary approach involving cooperation and skills of both orthodontist and oral surgeon right from the onset of planning through the completion of treatment and retention.

This article describes a case of asymmetrical dentofacial deformity due to mandibular laterognathism with unilateral crossbite treated by a combination of two-stage orthognathic surgery and orthodontic therapy.

CASE REPORT

Diagnosis and Etiology

A 19-year-old adult male reported to the Department of Orthodontics and Dentofacial Orthopedics for correction of his facial asymmetry. The noticeable progressively worsening asymmetry since last 6 years and accompanying masticatory insufficiency was the chief concern of the patient. He did not give any history of injury to his head or jaw. Frontal facial photographs demonstrated severe facial asymmetry with mandibular deviation toward the left side [Figure 1a‑d]. TMJ pop (which was not a reciprocal click) on opening was evidently detectable on the left side without...
any other symptoms typically associated with pathologic temporomandibular disease. On mouth opening, a lateral deviation of the mandible to the left was observed. The maximum interincisal opening was 38 mm.

Intraorally, the patient presented with anterior crossbite involving the maxillary right central incisor to the left lateral incisor with poor occlusion [Figure 1a-g]. The patient had permanent dentition with missing upper left second premolar. The molar relationship was Class III on the right and Class I on the left side. The maxillary dental midline was coincident with the labial frenum during smiling; however, when compared with the facial midline, a deviation of approximately 1 mm toward the left was observed. The mandibular dental midline was shifted toward the left by 4.5 mm when compared with the maxillary dental midline. Cephalometric analysis revealed a skeletal Class III jaw base relationship (ANB - 2°; Wits appraisal - 9 mm). The maxillary incisors were slightly retroclined (U1 to SN, 98°) whereas mandibular incisors had normal inclinations (IMPA, 89°) [Figure 2 and Table 1].

Posteroanterior (PA) cephalometric radiograph revealed mandibular asymmetry with chin deviation to the left side [Figure 3]. PA head film tracing showed approximately 7.5 mm deviation of the mandible toward left and 4.5 mm midline discrepancy [Figure 4].

Panoramic radiographic evaluation revealed increased right ramal height and mandibular right body length. He was missing his maxillary left second premolar and all his third molars [Figure 5].

In accordance with literature studies, a combination of hereditary and environmental factors appeared to be the etiological factors of severe facial asymmetry.[8]

A technetium-99m methylene diphosphonate bone scan revealed mildly increased osteoblastic activity of the right mandibular condyle. However, clinical and radiographic evaluation over a period of 1 year did not reveal any further clinically significant increase in the asymmetry [Figure 6].

Electromyographic monitoring showed that the activities of the masseter and anterior temporals were lower during

| Measurement                              | Pretreatment | Posttreatment |
|------------------------------------------|--------------|---------------|
| SNA (°)                                  | 77           | 78            |
| N-A (II HP) (mm)                         | -7           | -4.5          |
| SNB (°)                                  | 79           | 75            |
| N-B (II HP) (mm)                         | -9           | -13           |
| N-Pg (II HP) (mm)                        | -11          | -15           |
| ANB (°)                                  | -2           | 3             |
| Wits (mm)                                | -9           | -2            |
| SN-MP (°)                                | 35           | 39            |
| FH-MP (°)                                | 30           | 35            |
| LFH (ANS-Me/N-Me) (%)                    | 54.7         | 55            |
| U1 to SN (°)                             | 98           | 100           |
| U1 to NA (°)                             | 21           | 22            |
| IMPA (°)                                 | 89           | 89.5          |
| L1 to NB (°)                             | 20           | 25            |
| Upper lip protrusion (mm)                | 3.5          | 3             |
| Lower lip protrusion (mm)                | 7            | 3.5           |
| Chin prominence in relation to mandibular dental base (mm) | -11 | -15 |
| Maxillary basal length (mm)              | 57           | 55            |
| Mandibular basal length (mm)             | 84           | 76            |

Figure 1: (a) Pretreatment frontal photograph illustrating facial asymmetry. (b) Pretreatment left profile view depicting mandibular prognathism. (c) Pretreatment posed smile photograph depicting smile asymmetry. (d) Submental view photograph illustrating mandibular asymmetry. (e) Pretreatment intraoral-frontal view showing left anterior crossbite with 4.5 mm dental midline discrepancy towards left side. (f) Pretreatment intraoral right lateral view. (g) Pretreatment intraoral left lateral view showing buccal crossbite

Figure 2: Pretreatment lateral cephalogram showing Class III skeletal pattern
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Treatment Plan

In order to address the chief complaints of the patient, i.e., facial asymmetry, orthognathic surgery was unavoidable. Fabrication of mandibular splint was contemplated as the first step which would help in reduction of TMD symptoms and serve as a diagnostic aid. Both the mandibular setback procedures, sagittal split ramus osteotomy (SSRO) and intraoral vertical ramus osteotomy (IVRO) have been employed widely for correction of asymmetric dentofacial deformities; but IVRO provides a greater likelihood of symptom relief in TMDs.[9] Hence, IVRO was selected for correction of severe skeletal asymmetry and improvement of TMD symptoms. Presurgical orthodontic treatment was planned to eliminate compensations of the teeth in maxillary and mandibular arches while taking into account the postsurgical position of upper incisor and observing the anatomic limits of the symphysis. Furthermore, genioplasty was also proposed as an adjunct surgery for correction of deviated chin.

Treatment Progress

Following a 6 weeks period of wear of mandibular disclusion splint, and associated reduction of discomfort as reported by the patient, presurgical orthodontics in both arches was initiated with 0.022” × 0.025” preadjusted edgewise appliances (MBT prescription). Positive control of torque within the buccal segments was achieved using a removable lingual arch. Alignment and leveling were commenced with improved superelastic continuous archwires (0.016” NiTi followed by 0.019 × 0.025” NiTi archwire). Final presurgical records were obtained 3 weeks after the placement of final stabilizing archwires (0.019 × 0.025” SS and 0.021 × 0.025” SS) [Figure 8]. Arbitrary facebow mounting [Figure 9] was employed to locate the jaw anatomically within the anatomic adjustable articulator in a satisfactory manner. Immediate presurgical model surgery was performed on articulator mounted casts in centric
relation which aided in recording and documenting any discrepancy between the jaw relations at the initial contact of the teeth and at the patient’s habitual occlusion [Figure 10]. Model surgery also provided easy visualization of the magnitude of medial/lateral discrepancies existing between condylar and dentoalveolar segments. After 7 months of presurgical orthodontic treatment, asymmetric transverse rotation of the mandible by bilateral IVRO was performed according to the Epker method.\textsuperscript{[10]} In postsurgery, the healing period was uneventful. Maxillomandibular fixation was maintained for 3 weeks [Figure 11] and on release, jaw physiotherapy, which is a combination of isometric and isotonic exercises, was employed for 7–10 days. The patient was given a ruler on which presurgical interincisal opening was marked. He was advised to perform vigorous exercises in front of the mirror for 5 min at least thrice daily which involved forceful opening of the mouth to the maximal distance, followed by holding the jaw open for a few seconds before closing. Afterward, the patient was instructed to maximally protrude the mandible and then place the teeth back into proper occlusion with firm biting. With this regimen, the preoperative extent of mandibular movements was achieved within 12 days.

Post surgical orthodontic treatment was commenced 6 weeks following surgery when the patient had attained full range of movements (with a mouth opening of 48 mm) and had returned to a normal diet. Stabilizing archwires were removed at the first postsurgical orthodontic visit, and fixed appliances and archwires were checked for damage and repaired as necessary. Full-time light vertical 3/8” elastics worn on Kobayashi hooks (modified ligature ties) were used in conjunction with sectional anterior 0.019 × 0.025” TMA wire in upper arch and continuous 0.016” SS wire in the lower arch. Elimination of residual marginal ridge discrepancies was accomplished by placing small vertical bends in the lower arch wire at the second postsurgical appointment. By the third postsurgical appointment, well settled occlusion was obtained, and elastics were worn intermittently only during night for 3 weeks [Figure 12]. After debonding, maxillary and mandibular circumferential retainers were delivered.

Post-IVRO, frontal facial esthetics showed significant improvement [Figure 13]. With the patient’s consent, genioplasty to reposition deviated chin was also performed during a second operation, in order to maximize facial esthetics.

**TREATMENT RESULTS**

The combination of orthodontic-orthognathic treatment approach helped establish a favorable occlusal result with good
interdigitation while restoring facial symmetry to acceptable esthetic and functional levels [Figure 14a-g]. There was clinically significant reduction in TMJ clicking sounds, suggesting an improvement in the TMD symptoms. Anterior crossbite was corrected, and buccolingual inclination of left maxillary and mandibular buccal segments improved after treatment. The patient also reported significant improvement in masticatory efficiency.

The posttreatment lateral cephalometric analysis demonstrated favorable skeletal changes (ANB, 3°; Wits appraisal, -2 mm) and a slight increase in mandibular plane angle (SN-MP, 39°). The maxillary incisor inclinations improved (U1 to SN, 100°) and inclinations of mandibular incisors remained stable (IMPA, 89.5°) [Figure 15 and Table 1].

Posttreatment PA cephalogram [Figure 16] showed significant improvement of facial asymmetry and the PA head film tracing revealed corrected mandibular and chin midline in relation to true facial midline [Figure 17]. The posttreatment panoramic radiograph revealed acceptable root parallelism with no significant apical root resorption or alveolar bone loss [Figure 18].

At the 3-year follow-up, patient exhibited stable occlusion and well maintained acceptable facial profile without obvious relapse, despite maturational changes that would have occurred with time [Figure 19a and b].

**DISCUSSION**

The presence of facial asymmetry may have a significant adverse impact on the patients’ orofacial, nutritional, esthetic, and psychosocial development.\(^{[11]}\) Since only a clinically demonstrable correction in asymmetry would satisfy the patient’s expectations, concerns, and expectations of such patients must be taken into consideration during formulation of a treatment plan.\(^{[12,13]}\) Meticulous clinical and radiographic assessment is necessary to evaluate the stability of the posttreatment results and to monitor for any potential relapse.

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**Figure 11:** Postsurgical orthopantomogram documenting intraoral vertical ramus osteotomy cuts and maxillomandibular fixation

**Figure 12:** Treatment progress photograph showing elastic conduct during postsurgical orthodontic phase

**Figure 13:** Photograph illustrating improved frontal facial esthetics after intraoral vertical ramus osteotomy

**Figure 14:** (a) Post treatment frontal view showing correction of deviated chin after genioplasty. (b) Posttreatment photograph depicting good esthetic profile. (c) Posttreatment posed smile photograph showing smile symmetry. (d) Posttreatment submental view showing mandibular and chin symmetry. (e) Posttreatment intraoral frontal view showing corrected anterior crossbite and coincident midlines. (f) Posttreatment right lateral view showing good occlusion. (g) Posttreatment intraoral left lateral view depicting corrected buccal crossbite
evaluation to identify and quantify facial asymmetry and to understand the dentoalveolar compensations associated with the various types of asymmetries is, therefore, indispensable.

Determination of underlying cause of asymmetry is necessary for the formulation of the appropriate treatment plan. True dental asymmetries are often treated orthodontically by means of asymmetric tooth-extraction sequences and asymmetric mechanics such as diagonal and midline elastics. Partial or complete resolution of discrepancy solely through orthodontic treatment is often dictated by the severity and nature of the skeletal asymmetry. However, skeletal asymmetries treated with orthodontics alone might dictate certain compromises in treatment outcome that need to be explained to the patient before initiating treatment.

Based on Obwegeser and Makek’s classification of skeletal mandibular asymmetries, this case was diagnosed with hemimandibular elongation because of elongation of the mandibular right body in a horizontal plane and both right condyle and ramus in the vertical plane. Consequently, the deviation of the mandible to the left was observed.

Presurgical orthodontic treatment has a profound influence on front face esthetics in patients with facial asymmetry. The primary objective of the presurgical orthodontic treatment is to make the occlusal asymmetry equal in magnitude with that of the skeleton to enable maximize correction of facial esthetics and achieve stable results, thus precluding the need for unnecessary surgery in the maxilla. Determination of the extent of extreme variations in the magnitude of dental compensations is indispensable before initiating presurgical orthodontics. This can be done by guiding the patient’s mandible laterally until the midpoint of the chin is coinciding with the true facial midline and then studying the occlusion in this position. Orthodontic decompensation of the teeth and dental arches was done to enable the required sagittal movement and the asymmetric correction of the mandible and chin in the surgical phase.

In patients with associated TMJ symptoms, use of a disclusion splint (fabricated on articulator mounted casts) for a few days, before making the retruded contact position record is beneficial as muscle spasm does not distort the condylar position.

Anatomic model surgery was performed as it the most invaluable means of identifying the millimetric movements required to correct an asymmetry in the lower third of the face.
Correction of mandibular asymmetry by IVRO facilitates a largely rotational move of one or both mandibular rami. IVRO is indicated for the side that moves in a posterior direction and is usually employed for correction of asymmetries of large magnitude (more than 8 mm) with associated TMD symptoms. Correction of severe asymmetries by SSRO may lead to lateral hump formation, whereby the proximal segments tend to flare, leading to poor bone contact, posterior mandibular asymmetry and a greater predisposition for peripheral condylar sag after placement of internal rigid fixation. The advantages of IVRO include short rehabilitation time (as it is faster and simpler operation) and lower risk of permanent inferior alveolar nerve injury when compared to SSRO. [19]

Since this case demonstrated concurrent asymmetry of mandible and chin, additional correction of the chin midline was necessitated after the correction of the mandibular asymmetry and the dental midline. Anatomic model surgery enabled accurate determination of the three-dimensional change in the position of bony pogonion produced after mandibular osteotomy, and thus helped determine the necessity of its additional repositioning via genioplasty to place bony pogonion symmetrically with the facial midline.

CONCLUSIONS

The optimal stable esthetic result and improved functional outcome in the present case were achieved by transverse rotation of the mandible and straightening genioplasty in conjunction with meticulously planned presurgical and postsurgical orthodontic treatment.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of Interest

There are no conflicts of interest.

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