CASE REPORT

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Unilateral intraoral vertical ramus osteotomy based on preoperative three-dimensional simulation surgery in a patient with facial asymmetry

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Abstract (J Korean Assoc Oral Maxillofac Surg 2014;40:32-36)

Preoperative surgical simulation in orthognathic surgery has progressed in recent years; the movement of the mandible can be anticipated through three-dimensional (3D) simulation surgery before the actual procedure. In this case report, the mandible was moved to the intended postoperative occlusion through preoperative surgical 3D simulation. Right-side condylar movement change was very slight in the surgical simulation, suggesting the possibility of mandibular surgery that included only left-side ramal osteotomy. This case report describes a patient with a mild asymmetric facial profile in which the mandibular menton had been deviated to the right and the lips canted down to the left. Before surgery, three-dimensional surgical simulation was used to evaluate and confirm a position for the condyle as well as the symmetrical postoperative state of the face. Facial asymmetry was resolved with minimal surgical treatment through unilateral intraoral vertical ramus osteotomy on the left side of the mandible. It would be a valuable complement for the reduction of the surgical treatment if one could decide with good predictability when an isolated intraoral vertical ramus osteotomy can be done without a compensatory osteotomy on the contralateral side.

Key words: Surgical simulation, Orthognathic surgery, Three-dimensional simulation surgery, Intraoral vertical ramus osteotomy, Facial asymmetry

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I. Introduction

Clinical evaluation and image evaluation including computed tomography (CT) are necessary to treat facial asymmetry. Dentomaxillofacial evaluation of teeth occlusion, bone structure, and soft tissue is followed by a treatment decision, which usually includes methods such as orthodontics or orthognathic surgery. For postoperative stability and aesthetic reasons, Le Fort I osteotomy in the maxilla and bilateral sagittal split ramus osteotomy (SSRO) or intraoral vertical ramus osteotomy (IVRO) in the mandible are generally useful in orthognathic surgery for patients with facial asymmetry.

Especially in the case of mild facial asymmetry with a minor lateral deviation of the mandible, unilateral sagittal split ramus osteotomy (USSRO) can be considered. Although there are slight rotational changes in the non-operated condyle after USSRO, the interocclusal relationship, teeth occlusion, and mandibular joint function must be maintained in their original state without complications such as temporomandibular joint (TMJ) disorders[1].

Preoperative surgical simulation in orthognathic surgery has progressed in recent years; the movement of the mandible can be anticipated through three-dimensional (3D) simulation surgery before the actual procedure.

Predicting the position of the mandible in a manner that reflects occlusion information is important in establishing plans for orthognathic surgery, because the mandibular position during orthognathic surgery is directly influenced by the planned postoperative teeth occlusion after surgery.

In this case, the mandible was moved to the intended postoperative occlusion through preoperative surgical 3D simulation. Right-side condylar movement change was very slight in the surgical simulation, suggesting the possibility of mandibular surgery that included only left-side ramal osteotomy. Unilateral IVRO (UIVRO) was performed to successfully resolve the facial asymmetry.

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II. Case Report

A 20-year-old female visited the hospital with chief complaints of an asymmetric mandible and teeth that were not occluded. The patient had no specific medical and dental history, including TMJ disorders. Clinical examinations revealed that the mandible was deviated to the right side and that the left lip was down canted. Cross bite of the incisors, crowding of the upper and lower teeth, class III left side molars, and class III left canines were observed. Analysis of the facial skeleton revealed that the upper jaw was in the normal position of the A-point to the nasion (N)-perpendicular line (1.48 mm). The final diagnosis was facial asymmetry.(Fig. 1) The treatment plan was to level and align the teeth via orthodontic treatment before surgery. Orthognathic surgery would then be performed to set back the lower jaw only, as the position of the upper jaw was normal. The occlusion of the teeth would be set and completed through orthodontic treatment after surgery.

Orthognathic surgery was performed after 17 months of orthodontic treatment, when the leveling and alignment of the teeth were complete. CT images (0.7 mm slice cut) of the patient's craniofacial area were used to reconstruct the 3D skeletal images with Mimics version 14.0 (Materialise, Leuven, Belgium). Dental cast models were used to replace inaccurate dentition in the CT images. Current dental cast models of the patient were made and scanned using a 3D optical scanner (Rexcan DS2; Solutionix, Seoul, Korea). The scanned images of the maxilla and mandible casts were overlapped with the 3D reconstructed CT images using the surface-based registration function of the Rapidform XOV2 software (INUS Technology, Seoul, Korea).

In consultation with the orthodontic department, postoperative occlusion was planned using the cast models in order to obtain proper information regarding the post-surgery maxillar and mandibular positions for the simulation. The planned occlusion was formed using the maxilla and mandible cast models. The cast models were fixed in the planned postoperative occlusion state and were scanned with the 3D optical scanner. During the mandibular setback surgery simulation, the CT image of the mandible was set back to overlap with the scanned mandibular planned occlusion cast model image[2,3].(Fig. 2)

The first surgical simulation was checked by referring to the mandibular symmetry. During the simulation, facial asymmetry was corrected only with mandibular surgery. Authors found that right-side condylar movement was slight in the surgical simulation (Fig. 3), suggesting the possibility of mandibular surgery that included only left-side osteotomy. The final surgical plan employed only unilateral mandibular osteotomy in the left side.(Fig. 4) IVRO was considered for facial asymmetry correction, according to the surgeon's preference. After the surgical simulation, the surgical wafer was produced using stereolithography technology (Eden 250; Objet Geometries Ltd., Rehovot, Israel). IVRO setback surgery was performed only on the left side of the mandible using a surgical wafer manufactured via stereolithography.

The final surgical wafer was maintained for 6 weeks including 2 weeks maxillomandibular fixation after surgery to stabilize the occlusion and mandibular segments after surgery. Postoperative orthodontic treatment maintained the facial symmetry obtained after surgery; the down canting of the lip had improved. There was no TMJ disorder. The postoperative orthodontic treatment was completed 6 months after surgery.(Figs. 5, 6)

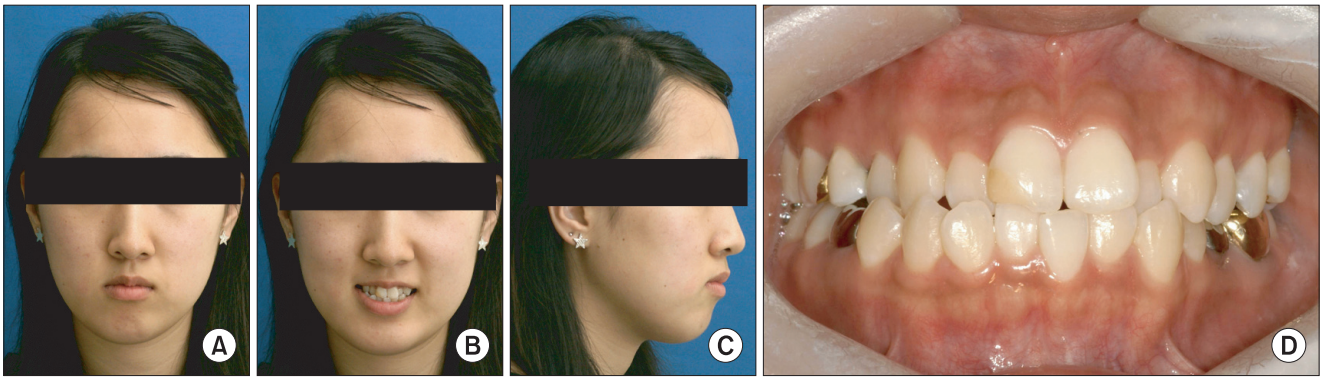

Fig. 1. A-C. Initial pretreatment extraoral photographs. D. Intraoral photograph.
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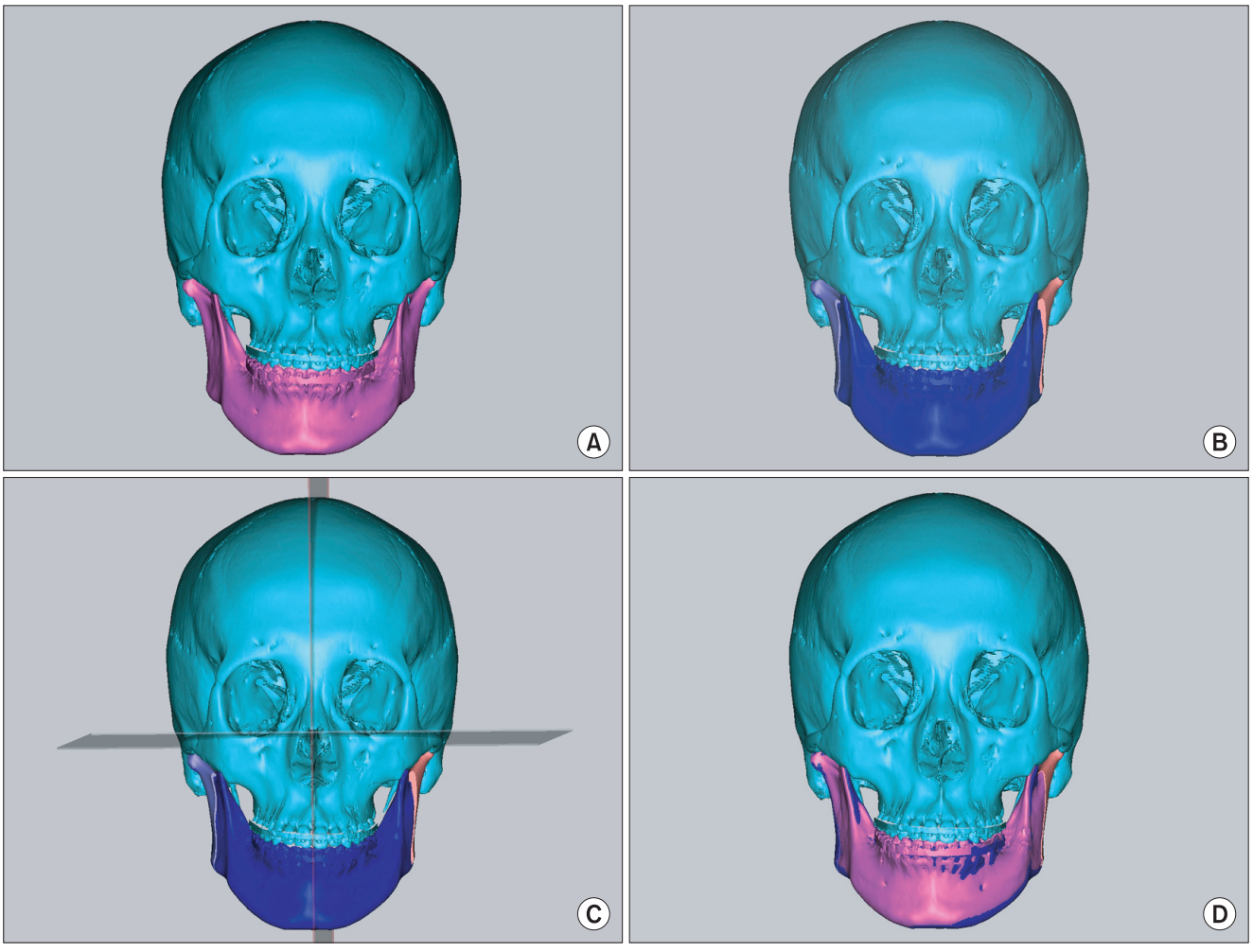

Fig. 2. Mandibular simulation surgery. A. Preoperative three-dimensional (3D) skeletal image overlapped with current occlusion digital cast images. B, C. 3D images of the mandibular setback (blue) repositioning under bilateral ramus osteotomy was simulated and evaluated according to the planned postoperative occlusion images. D. Images were overlaid consisting of the current mandible image (pink) and the repositioned mandible image (blue) in the 3D surgical simulation with the planned postoperative occlusion state.
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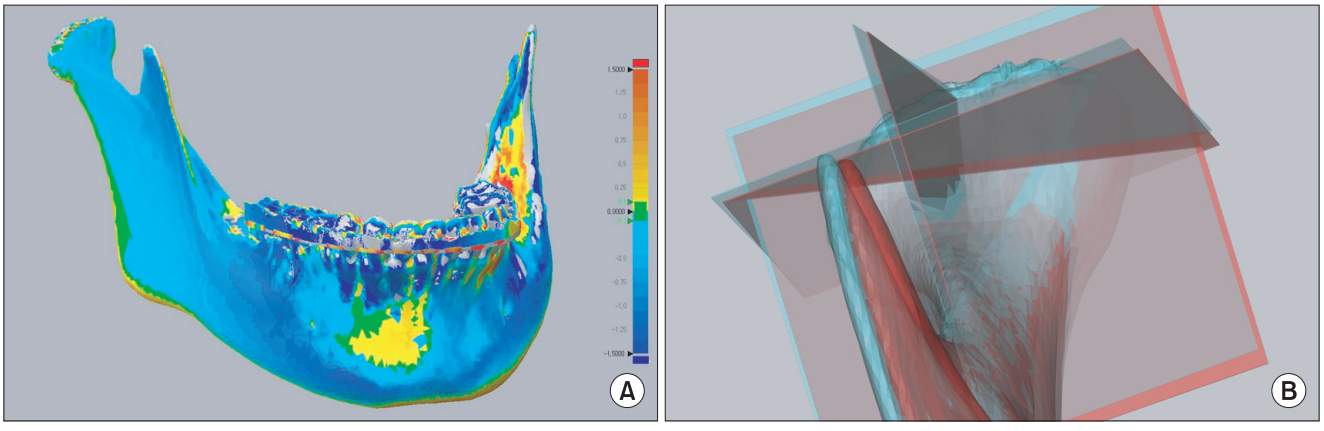

Fig. 3. A. Discrepancies were color-coded and evaluated in the three-dimensional (3D) image based on the range of difference values in the superimposed preoperative mandibular image and the simulated repositioned mandible. B. Discrepancies of the right condyle were evaluated in the 3D image based on the moved range of 3D coordinate planes in the superimposed preoperative mandibular image (sky blue) and the simulated repositioned mandible (red).
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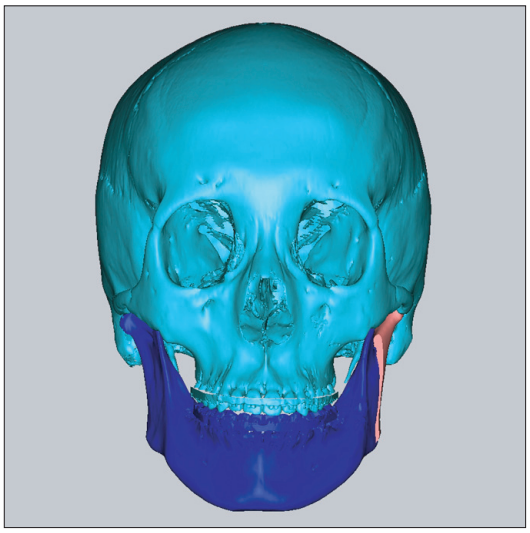

Fig. 4. Final surgical simulation image, with only left mandibular ramus osteotomy. Final surgical simulation with only left mandibular ramus osteotomy (blue) was confirmed, and decided as final surgical plan.
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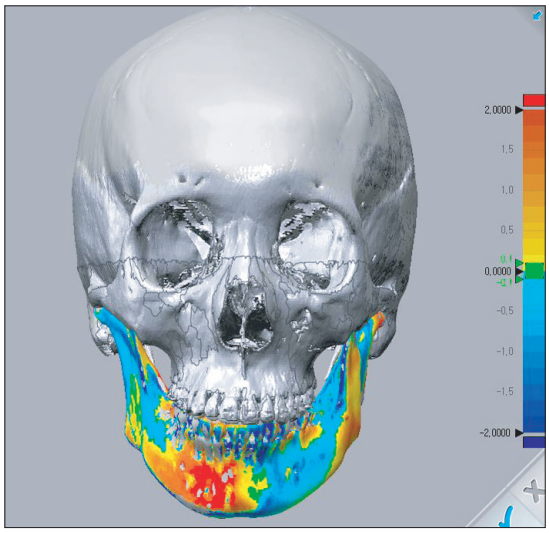

Fig. 6. Discrepancies were color-coded in the three-dimensional image based on the range of difference values in the superimposed preoperative mandibular image and the final result mandible.
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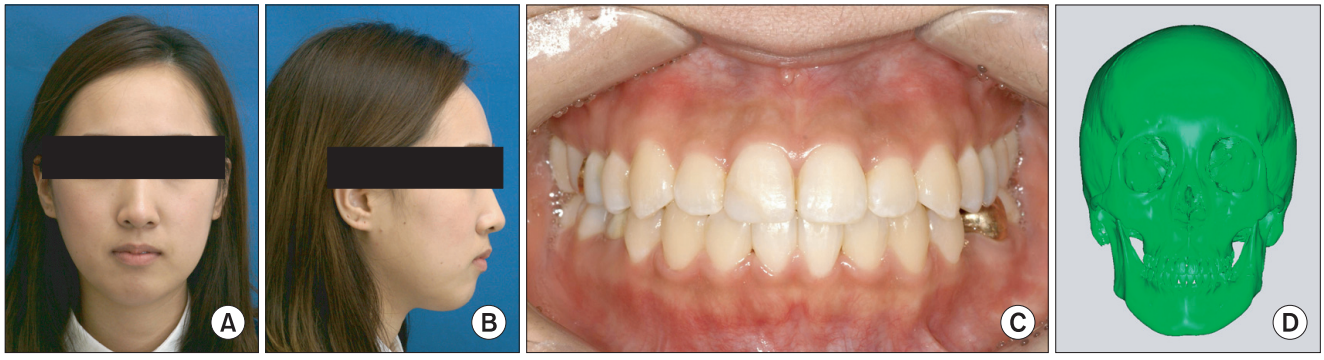

Fig. 5. Extraoral photographs (A, B), intraoral photograph (C), and three-dimensional facial computed tomography (D) of the final result.
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III. Discussion

Unilateral mandibular ramus osteotomy is a surgical method used in unilateral condylar fractures[4]. This method may also be sufficient for facial asymmetry patients whose mandibles are slightly dislocated, because it can align the facial midline and change the posterior occlusion to Angle's Class I[1,5].

Unilateral mandibular ramus osteotomy is a surgical method which may also be sufficient for facial asymmetry patients whose mandibles are slightly dislocated[1]. However, in unilateral ramus osteotomy of the mandible, the rotational or transitional movement of the opposite condyle can automatically change in the glenoid fossa, which can directly affect the functional aspects of the TMJ[1,6-8]. This change may cause TMJ disorders, including the absorption of the condyle, which may result in a reduction in the ramal height after surgery.

Additional complications, including unwanted changes in teeth occlusion from the rotation of the mandible after unilateral ramus osteotomy of the mandible, are also possible. Tolerable range of the condylar positional change after orthognathic surgery have not been verified. Simulated surgery may yield accurate and predictable results for the postoperative position of the unoperated condyle, including the degree of rotation and the amount of setback, increasing the number of clinical cases of unilateral mandibular ramus osteotomy.

In the current case, IVRO was used as the unilateral mandibular ramus osteotomy. SSRO or IVRO can both be used for unilateral mandibular ramus osteotomy. There have also been reports of using IVRO in the shift side of the mandible[9,10]. IVRO was used as the unilateral mandibular ramus osteotomy, considering the use of IVRO in the shift side of the mandible.

The outcome may have occurred by chance alone. There was not established about the protocol to determine if single sided mandibular ramus surgery would be biologically and functionally tolerated. Also, criteria as how many degrees of displacement would be indication, need to be verified, though USSRO is not unique procedure[1]. But, we had expected through the 3D preoperative surgical simulation, the impact of the non-operated condyle would be minimal. It would be a valuable complement for the reduction of the surgical treatment if one could decide with good predictability when an isolated IVRO can be done without a compensatory osteotomy on the contralateral side.

Recent developments in 3D imaging technology[2,3], including 3D simulation surgery, and the manufacture of surgical wafers via stereolithography reduce the possibility of error during orthognathic surgery. Application of 3D imaging technology to unilateral mandibular ramus osteotomy will be helpful for predicting the morphological and functional changes in the temporomandibular region according to changes in the position of the condyle, and thus we expect 3D simulation surgery to be utilized more often in clinical treatment.

In this case report, the patient had a facial profile in which the mandibular menton had been deviated to the right. A stable position for one condyle and a symmetrical postoperative state of the face were confirmed using preoperative 3D surgical simulation. Facial asymmetry was resolved with minimal surgical treatment through UIVRO on the left side of the mandible without TMJ complications.

It would be a valuable complement for the reduction of the surgical treatment if one could decide with good predictability when an isolated IVRO can be done without a compensatory osteotomy on the contralateral side.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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