A Modified Method of Proximal Segment Alignment After Sagittal Split Ramus Osteotomy for Patients With Mandibular Asymmetry

Zhixu Liu, DDS, [*] *Shunyao Shen, DDS, MS,* [†] *James J. Xia, MD, PhD, MS,* [‡] *and Xudong Wang, DDS, MD* [§]

Purpose: The purpose of this study was to evaluate a modified method of aligning the proximal segment after bilateral sagittal split ramus osteotomy (BSSO) in the treatment of patients with facial asymmetry.

Patients and Methods: Eleven patients with mandibular excess and facial asymmetries were enrolled in this prospective study. The surgery was planned according to a computer-aided surgical simulation protocol. In addition, the proximal segment on the hypoplastic side was intentionally flared out after the distal segment was rotationally set back. If the gap between the proximal and distal segments was too wide, then bone grafts were used. The surgery was completed according to the computerized plan. The proximal segment on the hypoplastic side was fixed with bicortical lag screws, and the proximal segment on the hyperplastic side was fixed with a 4-hole titanium miniplate. Postoperative evaluation was performed 6 months after surgery. Statistical analyses were performed.

Results: All surgeries were completed uneventfully. Of the 11 patients, 4 also underwent genioplasty and 3 underwent bone grafting to fill in the gap and smooth the anterior step. The physicians and patients were satisfied with the surgical outcomes. Only 1 patient underwent a secondary revision using an onlay hydroxyapatite implant. Results of statistical analyses showed that the computerized surgical plan could be accurately transferred to the patients at the time of surgery and the surgical outcomes achieved with this modified method were better than with the routine method of aligning the proximal and distal segments in maximal contact.

Conclusion: The present modified method of aligning the proximal segment for BSSO can effectively correct mandibular asymmetry and obviate a secondary revision surgery.

J Oral Maxillofac Surg 73:2399-2407, 2015

[*]Resident, Department of Oral and Craniomaxillofacial Surgery, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine; Researcher Assistant, Shanghai Key Laboratory of Stomatology, Shanghai, China.

†Resident, Department of Oral and Craniomaxillofacial Surgery, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine; Researcher Assistant, Shanghai Key Laboratory of Stomatology, Shanghai, China.

‡Guest Professor, Department of Oral and Craniomaxillofacial Surgery, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China; Director of Surgical Planning Laboratory and Professor of Oral and Maxillofacial Surgery, Institute for Academic Medicine, Houston Methodist Hospital, Houston, TX; Professor of Surgery (Oral and Maxillofacial Surgery), Weill Medicine College, Cornell University, New York, NY.

§Professor and Acting Chair, Department of Oral and Craniomaxillofacial Surgery, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine; Professor, Shanghai Key Laboratory of Stomatology, Shanghai, China.

Zhixu Liu and Shunyao Shen contributed equally to this work.

This project was supported in part by the National Science Foundation of China (grant 81271122), the Top Priority Clinical Medical Center of Shanghai Municipal Commission of Health and Family Planning, the Natural Science Foundation of Shanghai Municipality (grant 10ZR1418000), the Shanghai Municipal Health Bureau (grant 2009077), the Eastern Scholar at Shanghai Institutions of Higher Education, and the Recruitment Program of Global Experts.

Address correspondence and reprint requests to Dr Wang: Department of Oral and Craniomaxillofacial Surgery, Shanghai Ninth People's Hospital, Shanghai Jiao Tong University School of Medicine, 639 Zhi-Zao-Ju Road, Shanghai 200011, People's Republic of China; e-mail: xudongwang70@hotmail.com

Received December 10 2014

Accepted May 2 2015

0278-2391/15/00503-0

http://dx.doi.org/10.1016/j.joms.2015.05.003

It is a challenge to treat patients with mandibular asymmetry, which affects overall facial symmetry. The paradigm shift of computer-aided surgical simulation (CASS) technology has enabled surgeons to better plan an orthognathic surgery for patients with severe facial asymmetry on a computer.[1,2] At the time of the surgery, this computerized plan can be transferred to the patient using computer-generated surgical splints and templates.[1-8] Unfortunately, even with CASS technology, only movements of the maxilla, mandibular distal segment, and chin can be quantitatively planned and transferred. The placement of proximal segments is still based on a surgeon's visual judgment. A surgeon traditionally aligns the proximal segment to the mandibular distal segment and places them in maximal contact. This technique might be acceptable in patients with symmetrical deformity. Conversely, the same might not be true in patients with facial asymmetry.

Mandibular symmetry directly contributes to facial harmony.[4] If there is a residual asymmetry owing to the shape of the mandible after an orthognathic surgery, then a secondary revision (eg, bone graft or prosthetic onlay implant) might be required, likely adding to a patient's discomfort.

It is the authors' belief that placement of the proximal segments plays an important role in the treatment of patients with facial asymmetry. Therefore, the purpose of this study was to evaluate a modified method of aligning the proximal segment for bilateral sagittal split ramus osteotomy (BSSO) in the treatment of patients with facial asymmetry. In this method, the proximal segment was intentionally flared out on the hypoplastic side and fixed with 3 bicortical lag screws in a triangular configuration,[9] and the hyperplastic side was fixed with a surgical miniplate.

Patients and Methods

This prospective study was carried out from January 2013 to August 2014. Eleven patients (8 male and 3 female) with mandibular excess and facial asymmetry were enrolled at the clinic of the Department of Oral and Craniomaxillofacial Surgery at Shanghai Ninth People's Hospital (Shanghai, China). Their average age was 22.1 years (range, 18 to 31 yr).

The criteria for patient inclusion were *1)* patients who were diagnosed with mandibular excess and scheduled to undergo an orthognathic surgery to correct one of the following facial asymmetric deformities: pogonion deviations larger than 5 mm, asymmetric mandibular angles, or laterognathism; *2)* patients who were scheduled to undergo computed tomographic (CT) scanning before and after surgery as a part of their treatment protocol; *3)* 3-dimensional (3D) cephalometric analysis showing the necessity for increasing the bone volume of the mandible to correct mandibular asymmetry; and *4)* patients who agreed to participate in the study. The exclusion criteria were *1)* syndromic patients; *2)* patients who had tumors (eg, ameloblastoma or condylar osteochondroma) or trauma; and *3)* patients with a systemic disease that contraindicated orthognathic surgery. This study was approved by the Shanghai Ninth People's Hospital institutional review board. Before enrollment, signed informed consent forms were obtained from all patients.

PREOPERATIVE DATA ACQUISITION

A preoperative CT scan was acquired with a slice thickness of 1.25 mm using a hospital-based spiral CT scanner. In addition, routine clinical examination was performed. Clinical photographs were taken with a plumb line hanging in the background when the patient's head was oriented to the neutral head posture. These photographs were used in conjunction with CASS during surgical planning.

Although not used for planning, the following examinations for the temporomandibular joint (TMJ) were performed as a part of the routine clinical protocol. Preoperative magnetic resonance (MR) scans of the TMJ were acquired and used to set a baseline of TMJ morphology. These scans were examined by 2 radiologists. Routine TMJ clinical examination findings, including interincisal distance, jaw opening and closing, lateral and protrusion motion pattern, joint noise, and pain, also were recorded.

SURGICAL PLANNING USING CASS TECHNOLOGY

Surgical planning was carried out according to the CASS protocol[6] using a surgical planning software package (ProPlan, Materialise Medical, Leuven, Belgium). The first step of the planning process was to generate a composite skull using the CT data. The resulting composite skull model rendered bony structures and dentition with a high degree of accuracy.

The second step was to quantify the deformity. This entailed 3D cephalometric analysis, the mirror-imaging method, and physical examination to determine the degree of asymmetry.[10-13] The reference frame of the head and the midsagittal plane was determined by clinical examination and photographs.[6]

The third step in the planning process was to simulate the entire surgery on the computer. A maxillary Le-Fort I osteotomy was simulated first, followed by a BSSO and then a genioplasty, if desired. Only the proximal segment on the hyperplastic side was aligned to the distal segment.

The fourth step in the planning process was to align the proximal segment on the hypoplastic side using the mirror-imaging technique (Fig 1). The mirror