# Evaluation of the Mandibular Split Patterns in Sagittal Split Ramus Osteotomy

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**Purpose:** To evaluate the split patterns of the mandibular ramus in sagittal split ramus osteotomy (SSRO) using cone-beam computed tomography (CBCT) and examine the related anatomic features that may be associated with these split patterns.

**Patients and Methods:** The authors designed and implemented a retrospective cohort study and enrolled a sample composed of consecutive patients with different maxillofacial deformities who underwent an SSRO from July 2011 through October 2012 at the Department of Orthognathic Surgery at the Tianjin Stomatological Hospital of Nankai University. The split patterns, which were selected at random at 1 side per patient, were evaluated by CBCT as the outcome variable 1 month after the operation. The predictor variable was composed of a set of heterogeneous anatomic variables that could be associated with the split patterns. Type I split was defined as a split at the lingual side near the mylohyoid sulcus. Type II split was defined as a split at the posterior border of the mandibular ramus. Appropriate bivariate and regression statistics were computed, and the level of statistical significance was set at a $P$ value less than .05.

**Results:** One hundred thirty patients with different maxillofacial deformities (62 male and 68 female; mean age, 23 yr) underwent an SSRO. Two types of split patterns of the mandibular ramus were observed in SSRO: a split at the lingual side near the mylohyoid sulcus, which occurred in 75.38% of patients, and split at the posterior border region of the mandibular ramus, which occurred in 24.62% of patients. No fracture lines were observed through the mandibular canal. The thickness of the lingual cortical bone between the mandibular canal and the posterior border of the ramus was significantly associated with the split patterns ($P < .05$). The thickness of the cortical bone in the posterior border of the ramus, the degree of the mandibular angle, and the shapes of the mandibular ramus in the axial plane also were found to influence these split patterns. There was no meaningful association between the split patterns and a patient's age and gender.

**Conclusion:** The split patterns of the mandibular ramus during SSRO were influenced by some anatomic features of the mandibular ramus. Therefore, examining the anatomy of the mandible with CBCT before surgery may play an important role in predicting the split patterns of the mandibular ramus during SSRO.

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Sagittal split ramus osteotomy (SSRO) was first introduced by Trauner and Obwegeser[1] in 1957. Since then, it has undergone several modifications to become one of the most common operations for the correction of maxillofacial deformities.[2-5] The positions of the horizontal, sagittal, and vertical bone cuts can be accurately controlled in SSRO. However, it is difficult to surgically control the split patterns at

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the posterior border of the mandibular ramus. Although there are some reports on the split patterns of the mandibular ramus,[6-10] the anatomic features that influence these split patterns are less well studied. The purpose of this study was to examine the split patterns of the mandibular ramus during SSRO using cone-beam computed tomography (CBCT). The authors hypothesized that the thickness of the cortical bone of the ramus, the degree of the mandibular angle, and the shapes of the mandibular ramus in the axial plane could be associated with these split patterns. The specific aim of this study was to measure and evaluate the anatomic variables that influence these split patterns. The findings of this study would be useful to surgeons for predicting split patterns.

## Patients and Methods

The authors designed a retrospective cohort study by enrolling patients who visited the Department of Orthognathic Surgery at the Tianjin Stomatological Hospital of Nankai University (Tianjin, China) for treatment of different maxillofacial deformities from July 2011 through October 2012. Patients eligible for inclusion in this study underwent orthodontic treatment with SSRO, removal of their third molars before orthodontic treatment, and consented to enroll in this study. Some patients were simultaneously treated with a genioplasty or Le Fort I osteotomy. Patients were excluded from this study if they had a history of orthognathic surgery or a maxillofacial deformity caused by old fractures or refused consent. This study was approved by the institutional review board.

All surgical procedures were performed under general anesthesia with nasal intubation. An SSRO with the Hunsuck modification was performed in all patients. In all cases, the right and left sides were operated on by the same surgeon. The 3 bone cuts were performed using a drill. The horizontal bone cut (medial bone cut) on the lingual surface was made just above and 3 to 5 mm posterior to the lingula. The vertical bone cut (buccal bone cut) on the buccal surface was made behind the first molar. The bone cuts were connected and the split was completed with a chisel. Then, the mandible was separated into proximal and distal segments. The distal segment was pushed forward, backward, or laterally to correct mandibular deformities. Titanium miniplates with 4 screws were used to fix the fragments. CBCT scans (Implagraphy, Vatech, Korea) were taken 3 days before and 1 month after the SSRO. The patients were scanned in an upright sitting position with their chins on a chinrest to stabilize their heads. The Frankfort horizontal plane was parallel to the horizontal plane. Data from CBCT scans were exported in Digital Imaging and Communications in Medicine format and rendered to hard tissue surface representations. The mandible was digitally isolated from the maxilla and skull and split at the midline to visualize the path of the split on the lingual side. Because the anatomic and morphologic characteristics of the 2 sides of the mandible have strong similarity and consistency, 1 side per patient was randomly selected for evaluation.

The split patterns were defined as the outcome variable. To categorize the split patterns of the mandibular ramus in a bilateral SSRO, the gonion (Go), which is at the extreme inferior and posterior point on the angle of the mandible, was defined as the boundary. Based on the boundary, the split patterns were artificially classified into 2 types. Type I split was located at the lingual side near the mylohyoid sulcus toward the inferior border of the mandible in front of the Go as described by Hunsuck[3] (Fig 1A). In type II,

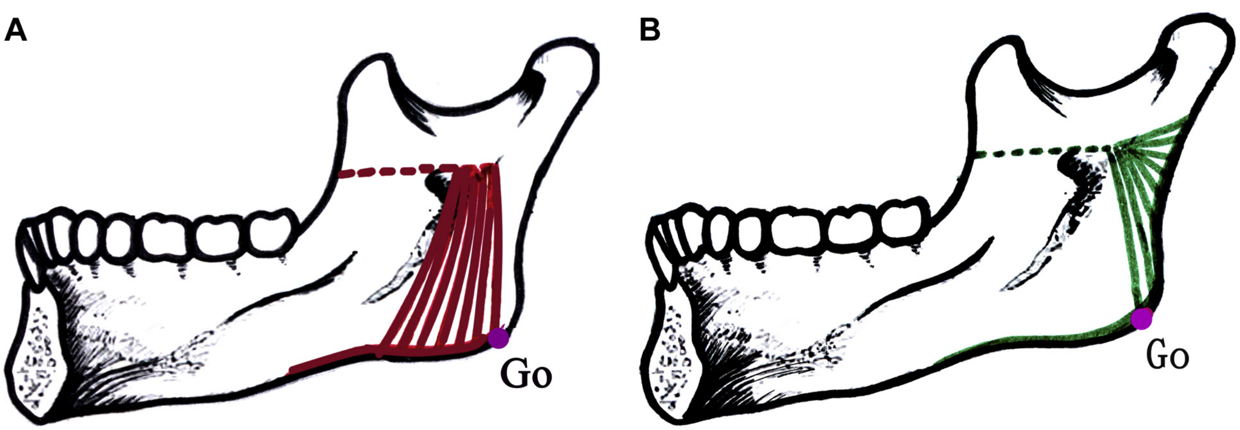


**FIGURE 1.** Split patterns of the mandibular ramus. The Go was defined as the boundary. *A*, Type I pattern split at the region near the mylohyoid sulcus toward the inferior border in front of the Go. *B*, Type II pattern split toward the posterior border of the mandibular ramus behind the Go. Go, gonion.

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