



# Contributing factors to intraoperative clockwise rotation of the proximal segment as a relapse factor after mandibular setback with sagittal split ramus osteotomy



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## ABSTRACT

The aims of this study were to analyze possible contributing factors to intraoperative clockwise rotation (CWR) of the proximal segment (PS), which is known to be a primary factor for relapse after mandibular setback with sagittal split ramus osteotomy (SSRO) and to evaluate the correlation between the CWR of the PS and relapse tendency. The sample was comprised of 47 patients who underwent SSRO for mandibular setback. Lateral cephalograms were analyzed. The vertical difference between the inferior borders of the PS and the distal segment at the vertical osteotomy line for SSRO after setback of the distal segment (vertical bony step, VBS) was the most predictable factor for CWR of the PS ( $p < 0.001$ ), and it correlated significantly with the gonial angle, the surgical change in SNB, and the downward movement of the maxilla ( $p < 0.05$ ). Patients with large CWR of the PS showed a greater tendency in horizontal relapse than patients with small CWR of the PS ( $p < 0.05$ ). Such relapse patterns could be prevented with adequate surgical planning designed to reduce the VBS, such as maxillary posterior impaction or the intentional guidance of the PS to maintain the original position of the PS without CWR.

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## 1. Introduction

Mandibular prognathism is one of the chief complaints of those seeking orthognathic surgery. Surgical correction of mandibular prognathism has been available for the past few decades; however, mandibular setback has been reported as being one of the three most problematic procedures in terms of postoperative stability, with surgical movements of downward movement of the maxilla and widening of the maxilla (Proffit et al., 2007). Postoperative relapse is distressing to both patients and surgeons, and the results of mandibular setback are potentially unstable even with rigid fixation, which shows horizontal relapse of 20–55% (Abeltins et al., 2011; Ayoub et al., 2000; Chou et al., 2005; Franco et al., 1989; Jakobsone et al., 2011; Lee et al., 2013; Politi et al., 2004; Proffit et al., 2007).

Several contributing factors for skeletal relapse after mandibular setback have been reported, including presurgical orthodontic alignment of dental arches to obtain a stable occlusion, the amount

of mandibular setback, perimandibular soft tissue tension and postoperative scarring, the method of fixation, the duration of intermaxillary fixation, condylar displacement, and positional change of the tongue with a reduced space (Chou et al., 2005; Kim et al., 2007; Moure et al., 2012; Mucedero et al., 2008; Paeng et al., 2012; Proffit et al., 2007; Rodriguez and Gonzalez, 1996). Additionally, it has been reported that the lengthening of the musculature caused by the clockwise rotation (CWR) of the mandibular proximal segment (PS) tends to return the PS to its original position after bilateral sagittal split ramus osteotomy (BSSRO), leading to relapse, especially during the first eight weeks after surgery (Cho, 2007; Franco et al., 1989; Kim et al., 2007; Komori et al., 1989; Politi et al., 2004; Proffit et al., 2007). Politi et al. found a significant correlation between the amount of mandibular setback and intraoperative CWR of the PS (Politi et al., 2004). It has been suggested that intraoperative CWR of the PS results from the increased backward force of soft tissue in response to mandibular setback movement (Franco et al., 1989; Komori et al., 1989; Mobarak et al., 2000; Moldez et al., 2000). However, we think that CWR of the PS can be reduced through the application of the surgeon's manual skill during the adaption of the PS to the mandibular distal segment (DS) for condylar guidance. Depending on the vertical position of the inferior border of the DS at the vertical osteotomy line between the first and second molar after setback movement of the DS, a

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different length of vertical bony step (VBS) can be made depending on the positional difference of the inferior border between the PS and the DS at that position (Fig. 1A and B). During condylar guidance for rigid fixation between the PS and DS, it is natural that surgeons will try to adapt the PS to the DS so that there is no vertical difference in the inferior border. This is to ensure the formation of an optimal bone contact surface and to prevent the development of a bony step at the inferior border (Fig. 1C). We postulated that manual guidance could cause CWR of the PS intraoperatively because the inferior border of the DS is usually located lower than that of the PS after setback movement due to the inclination of the mandibular inferior border. This CWR of the PS during surgery results in counterclockwise rotation (CCWR) of the PS after surgery (Fig. 1D). The greater the amount of mandibular setback, the more the amount of VBS can be increased, and thus the more the amount of CWR of the PS may also increase.

The purpose of this study was to identify possible contributing factors to intraoperative CWR of the PS, which is one of the main factors responsible for postoperative relapse after mandibular setback, and to evaluate the correlation between the CWR of the PS and relapse tendency.

**2. Material and methods**

**2.1. Patients**

This retrospective study analyzed 47 consecutively admitted patients (28 males, 19 females) who underwent orthognathic surgery for mandibular setback with or without genioplasty from 2009 to 2011. Six patients had a one-jaw procedure using BSSRO, and 41 patients underwent Le Fort I osteotomy and BSSRO. Patient ages ranged from 18 to 35 years, with a mean age of 23.1 years. All patients had pre- and postoperative orthodontic treatment. The exclusion criteria were patients with mandibular setback of less than 5 mm or patients with severe facial asymmetry who showed menton deviated more than 4 mm from the facial midline.

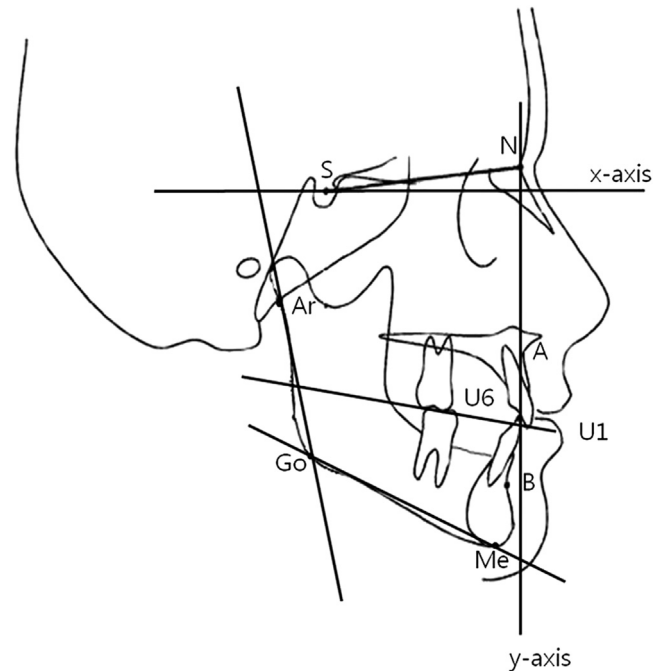
**2.2. Surgical phase**

All patients underwent modified BSSRO according to the short-lingual technique (Wolford et al., 1987) for mandibular setback. Surgeries were performed by one oral and maxillofacial surgeon. The masseter muscle was partly stripped for transbuccal fixation, which was achieved with a positioning screw, and the medial pterygoid muscle was fully detached from the PS. After removal of the intersegmental bone interference, the PS was positioned at the most appropriate location in the anterior–superior direction with regard to the glenoid fossa. One miniplate and one positioning screw were used for the fixation of bone segments on each side.

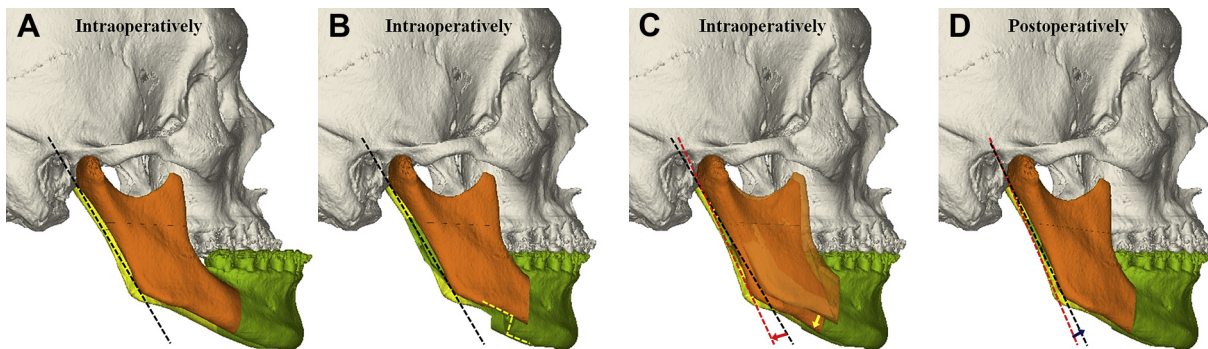
No intermaxillary fixation was used immediately following the operation, and light triangular guiding elastics were applied for 4–5 weeks postsurgery.

**2.3. Cephalometric analysis**

To measure surgical changes and to evaluate postoperative stability, lateral cephalograms were taken in the maximum intercuspal position with a magnification ratio of 1.1:1 prior to surgery (T0), immediately postoperative (T1), at 6 weeks (T2), and at 6 months or 1 year (TL) after surgery. Cephalometric analysis was carried out according to the superimposition technique. Each cephalogram was traced on acetate paper. Nine cephalometric reference points (sella (S), nasion (N), A point (A), B point (B), the tip of upper central incisor (U1), the mesiobuccal cusp of upper first molar (U6), articulare (Ar), menton (Me), and gonion (Go)) were located on the lateral cephalogram at T0 and were transferred to the lateral cephalograms taken at T1, T2, and TL (Fig. 2). An X–Y coordinate system was established (Fig. 2) in which the x-axis (SN7) was constructed by rotating S–N



**Fig. 2.** Determination of landmarks used in cephalometric analysis and in angular and linear measurements. S, sella; N, nasion; A, point A; B, point B; Go, Gonion; Me, Menton; Ar, Articulare; U1, tip of the upper central incisor; U6, mesiobuccal cusp of the upper first molar; x-axis (SN7), a line drawn 7° to the sella–nasion line; y-axis (SN7V), a line at the nasion perpendicular to the x-axis.



**Fig. 1.** Schematic drawing of the VBS after mandibular setback and rotation of PS. (A) After osteotomy for SSRO of prognathic mandible. (B) The VBS after repositioning of the DS according to the final occlusion. (C) Intraoperative CWR of the PS due to adjustment of the inferior borders of the PS and the DS. (D) Postoperative CCWR of PS due to muscle action.

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