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Prediction of neurosensory alterations after sagittal split ramus osteotomy

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Abstract. Prediction of neurosensory deficit in the lower lip and chin after sagittal split ramus osteotomy (SSRO) is challenging. This study aimed to elucidate factors related to the development and improvement of neurosensory disturbance (NSD) after SSRO with respect to surgical procedure and the anatomical and structural characteristics of the craniomaxillofacial skeleton. Subjects comprised 50 patients treated by a single experienced surgeon. Anatomical data and landmarks were obtained by computed tomography (CT) imaging. There was a significant difference between patients with or without NSD for the surgical space on the medial side of mandibular ramus 1 week after SSRO ($P = 0.006$). Less than 15.0 mm between the lingula and mandibular notch (relative risk, 6.7; 95% CI, 1.7–33.8) and 195.0 mm^2 or more space on the medial side of the mandibular ramus (relative risk, 17.2; 95% CI, 3.9–100.4) indicated a significant risk of NSD development at 6 months postoperatively. These results suggested that the development of NSD is related to the surgical space on the medial side of the mandibular ramus and subsequent manipulation of the inferior alveolar nerve (IAN) in that region. Limited periosteal degloving prevents excessive stretching of the IAN during SSRO, thus lowering NSD incidence.

Key words: orthognathic surgery; sagittal split ramus osteotomy; neurosensory disturbance; surgical complication.

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Sagittal split ramus osteotomy (SSRO) has gained widespread popularity in the field of orthognathic surgery, but previous studies[1–6] have reported complications associated with this procedure. SSRO may damage the inferior alveolar nerve (IAN) and cause neurosensory disturbance (NSD) in the lower lip, which is one of the most common and unpleasant postoperative complications. The NSD caused by damage to the IAN is reportedly 9–84.6%.[7,8] Even with careful surgery, injury to the IAN appears unpredictable. Multiple factors are considered responsible for the development of NSD after SSRO, including fixation methods,[9,10] patient age,[8,9] surgical procedures,[7,11] improper splinting,[12] magnitude of mandibular movement,[9,13] experience of surgeons,[7,14] and timing of the postoperative neurosensory evaluation.[7,14] Although many investigators have reported NSD after SSRO, the precise factors remain to be elucidated. A few studies have examined the position and course of the mandibular canal in SSRO patients to elucidate any association with direct or indirect intraoperative damage to the IAN.[15,16] Yamamoto et al.[17] described the interface between the mandibular canal and the buccal cortical bone using computed tomography (CT) images, and the distance between the mandibular canal and the split surface was evaluated as a surgical risk factor for NSD after SSRO. The lower distance between

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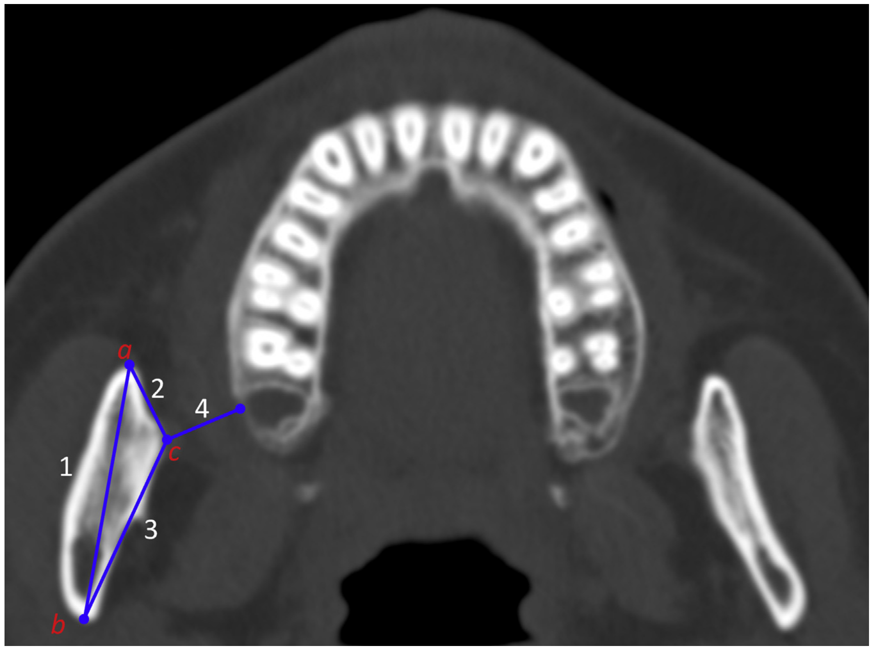

Fig. 1. Reference points and regions on CT images.

mandibular canal and buccal cortical bone are also described as risk factors for NSD in other studies.[17–21]

In addition to the above factors related to mandibular splitting, other factors known to cause postoperative NSD include the procedure of medial periosteal dissection and compression of the nerve on the medial side of the mandibular ramus by the protecting retractors. The space located in the medial aspect of the mandibular ramus is important for working space in SSRO; it is prepared for subperiosteal tunneling in order to insert a channel retractor just superior to the lingual to protect IAN and cut the mandible at the horizontal line. In this procedure the IAN is likely to be stretch excessively by the channel retractor to allow better visualization in this narrow surgical field. The relationship between the surgical space located medial to the mandibular ramus and the development of NSD remains to be evaluated. The present study aims to investigate the factors associated with the development and subsequent improvement of NSD on the basis of mandibular morphology on CT images and the surgical space located medial to the mandibular ramus.

Materials and methods

The study group comprised 50 patients (32 women and 18 men; aged 17–44 years) who underwent consecutive series SSRO (100 SSROs in total) for the correction of mandibular prognathism ($n = 48$) and retrognathism ($n = 2$) between November 2006 and January 2010. All patients were candidates for mandibular osteotomy alone, and cases requiring surgery in both jaws were excluded from the study. All impacted third molars were surgically extracted at least 1 year before surgery. Demographic data, such as age, sex, height, weight, and body mass index (BMI) were collected for all patients.

The standardized surgical procedures of the Obwegeser method, wherein a separator is used for splitting the ramus, were followed.[22] All patients were operated on by a single experienced surgeon. Efforts were made to protect the IAN from damage in every phase. The medial aspect of the mandibular ramus was prepared for subperiosteal tunneling, followed by insertion of a channel retractor just superior to the lingula. The mandible was cut at the horizontal and vertical osteotomy line and at the anterior border of the ascending ramus using a long Lindemann bur and a no 702 tapered fissure bur, respectively. A thin sharp osteotome was malleted to section the body of the mandible at the junction of the lateral cortical plate and the intramedullary bone in the vertical and horizontal bone cut. No IAN injuries, such

Table 1. Initial reference points and regions.

Setup of specified points	
Point a	Anterior border of the ramus
Point b	Posterior border of the ramus
Point c	Edge of the medial oblique line
Measurement region	
(1) Points a–b	The distance from points a–b – antero-posterior length of the lateral ramus
(2) Points a–c	The distance from points a–c – thickness of anterior ramus
(3) Points b–c	The distance from points b–c – antero-posterior length of the medial ramus
(4) Maxillary tuberosity to the mandible	The distance from the edge of the medial oblique surface to the maxillary tuberosity
(5) Lingula to the mandibular notch	The distance from the mandibular notch to the lingula
(6) Thickness of the mandible	Horizontal thickness of the mandible at the lowest point of the lingula
(7) Width of the bone marrow space at the buccal side	The bone marrow space between the outer mandibular canal and the inner surface of the buccal cortical bone
(8) Space on the medial side of the ramus	The area enclosed by the mandible, the maxilla and the zygomatic bone