

Comparison of osseous healing after sagittal split ramus osteotomy and intraoral vertical ramus osteotomy

S. Rokutanda^{1,2}, S. Yamada³,
S. Yanamoto¹, K. Omori¹,
Y. Fujimura⁴, Y. Morita⁴,
H. Rokutanda⁴, H. Kohara⁴,
A. Fujishita⁴, T. Nakamura⁴,
T. Yoshimi⁴, N. Yoshida⁴,
M. Umeda¹

¹Department of Clinical Oral Oncology, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki City, Nagasaki, Japan; ²Department of Oral and Maxillofacial Surgery, Juko Memorial Nagasaki Hospital, Nagasaki City, Nagasaki, Japan; ³Department of Dentistry and Oral Surgery, Shinshu University School of Medicine, Matsumoto City, Nagano, Japan; ⁴Department of Orthodontics and Dentofacial Orthopaedics, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki City, Nagasaki, Japan

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Abstract. The sagittal split ramus osteotomy (SSRO) is generally associated with greater postoperative stability than the intraoral vertical ramus osteotomy (IVRO); however, it entails a risk of inferior alveolar nerve damage. In contrast, IVRO has the disadvantages of slow postoperative osseous healing and projection of the antegonial notch, but inferior alveolar nerve damage is believed to be less likely. The purposes of this study were to compare the osseous healing processes associated with SSRO and IVRO and to investigate changes in mandibular width after IVRO in 29 patients undergoing mandibular setback. On computed tomography images, osseous healing was similar in patients undergoing SSRO and IVRO at 1 year after surgery. Projection of the antegonial notch occurred after IVRO, but returned to the preoperative state within 1 year. The results of the study indicate that IVRO is equivalent to SSRO with regard to both bone healing and morphological recovery of the mandible.

Key words: facial changes; intraoral vertical ramus osteotomy; osseous healing; sagittal split ramus osteotomy.

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The sagittal split ramus osteotomy (SSRO) is a common orthognathic surgical procedure for patients with skeletal mandibular prognathism. This mandibular setback procedure can secure an extensive contact area between the split segments^{1,2}. However, SSRO is also associated with a high rate of mandibular nerve paresthesia³⁻⁵.

In contrast, the intraoral vertical ramus osteotomy (IVRO) is believed to have several advantages, as it is a comparatively easy surgical procedure and is associated with a low rate of mandibular nerve paresthesia⁶. However, because the split segments are not fixed, the contact area between them is small, which makes IVRO inferior to SSRO in terms of post-

operative stability and the postoperative healing process and duration. Moreover, problems involving protrusion of the proximal segment can cause the mandibular angle to protrude towards the buccal side.

Many studies have examined temporal changes in the morphology of mandibular ramus osteotomy sites during healing after SSRO and IVRO^{1-3,7,8}. However, there

have been no reports on how the healing process differs depending on the surgical procedure, although it is widely believed that postoperative healing is better after SSRO due to the large contact area between the segments. Previously, Al-Moraisi and Ellis performed a meta-analysis comparing mandibular setback after SSRO and IVRO for skeletal mandibular prognathism⁹. They reported no statistically significant difference between the two procedures in terms of the horizontal stability of the mandibular setback. For vertical stability, they observed a tendency towards retrogression with IVRO, although the difference was not significant. However, they did not explore differences in the duration of osseous healing.

It is extremely important to investigate differences in the duration of osseous healing after different surgical procedures and to determine whether the smaller contact area between the segments in IVRO—which is considered to be problematic—delays osseous healing, and if so to what extent. This knowledge will help the surgeon to select surgical procedures that reduce the incidence of adverse events such as inferior alveolar nerve hypoesthesia.

Hence, the present study was performed to compare the osseous healing processes after SSRO and IVRO and to investigate the changes in the distance between the left and right mandibular angles due to protrusion of the proximal segment after IVRO.

Materials and methods

This retrospective study was approved by the Ethics Committee for Hospital and Clinical Research of Nagasaki University Graduate School of Biomedical Sciences.

Participants

The participants were patients diagnosed with skeletal mandibular prognathism from July 2012 to August 2016 at the Department of Clinical Oral Oncology, Unit of Translational Medicine, Nagasaki University Graduate School of Biomedical Sciences. Twenty-nine patients who had undergone only mandibular setback with SSRO or IVRO were selected (19 female, 10 male; 58 sides). All participants provided informed consent, and all procedures were performed by the same surgeon. Patients who had also undergone maxillary surgery were excluded. SSRO was performed from July 2012 to September 2012; thereafter, until August 2016, all patients underwent IVRO. Factors such as the presence or absence of temporomandibular symptoms were not considered when selecting the surgical procedure. Computed tomography (CT) was performed before surgery, immediately after surgery to check for complications, and at 1, 3, 6, and 12 months postoperative (Aquilion 64; Canon Medical Systems Corporation, Tochigi, Japan). CT was performed with the mouth closed and with a slice thickness of 3 mm.

Assessment methods

The first assessment was the comparison of callus formation at the ramus osteotomy sites between patients who underwent SSRO and those who underwent IVRO. Two parallel slices were used as references: a slice passing through the mandibular foramen parallel to the occlusal plane (upper slice) and a slice passing through the mandibular first and second molar furcations (lower slice). All of the slices between these two planes were analyzed. With regard to healing of the ramus osteotomy site, phase 1 was when a gap between the sections was observed in all CT slices; phase 2 was when the sections exhibited connectivity as callus-like CT images in some slices; and phase 3 was when callus-like or normal bone-like CT images were observed in all regions of the osteotomy site in all slices (Fig. 1).

The second assessment was the change in distance between the left and right mandibular angles after IVRO. During IVRO, the proximal section is placed lateral to the distal section when the mandible is moved posteriorly. This gives rise to a concern that the width of the frontal aspect (front of the face) will increase after the operation. Therefore, changes in the distances between the left and right mandibular angles before and after IVRO were evaluated. A line was drawn passing through the centre of the foramen magnum from the mental spine on three-dimensional (3D) reconstructed CT images. Lines were also drawn perpendicular to this from the bottoms of the proximal segments on their buccal sides, and changes in these distances were measured (Fig. 2). To reduce protrusion of the mandibular angle after IVRO, bone milling is sometimes performed on the surgical margins of the proximal and distal segments near the mandibular notch and on the bottom of the proximal segment. However, this treatment was not performed in any of the patients in this study.

The third assessment was the positional relationship between the proximal and distal segments after IVRO. When IVRO was performed, the proximal segment was guided to a position lateral to the distal segment in all patients. However, depending on the case, the positional relationship is not always maintained after IVRO. This may have been relevant to the results of the current study. Therefore, positional relationships between the proximal and distal segments after IVRO were examined.

The fourth assessment was postoperative mandibular nerve hypoesthesia after

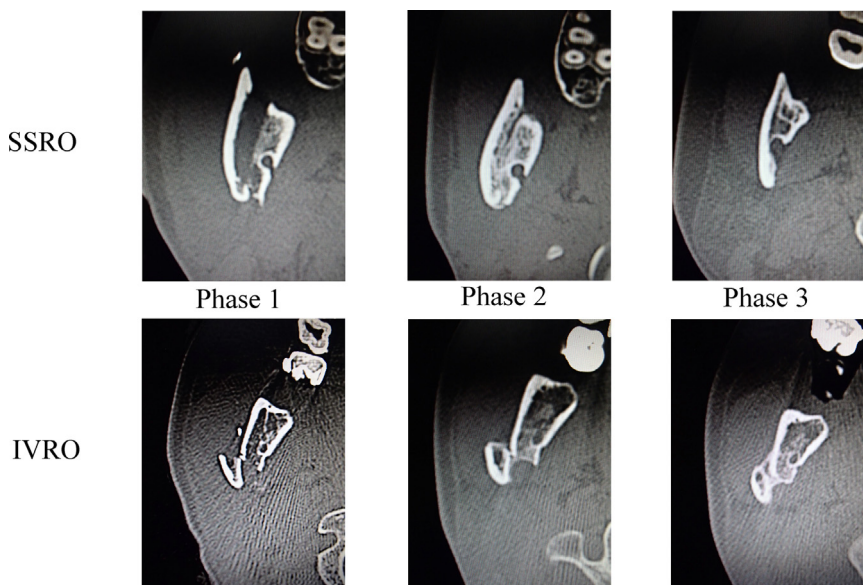


Fig. 1. Categorization of callus formation. Phase 1: no callus-like tissue in any slices. Phase 2: connectivity between segments due to callus-like tissue in some slices. Phase 3: connectivity between segments due to callus-like tissue in all slices.

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