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Long-term changes in mandibular and facial widths after mandibular setback surgery using intraoral vertical ramus osteotomy

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Abstract. This study was performed to evaluate the long-term changes in mandibular width, lower facial width, and ramus angulation after intraoral vertical ramus osteotomy (IVRO) and to identify the factors influencing these changes. This retrospective study included 53 consecutive patients with mandibular prognathism who underwent IVRO with ($n = 33$) or without ($n = 20$) Le Fort I osteotomy. Postero-anterior cephalograms and frontal facial photographs obtained before, 1 month after, and at least 24 months after IVRO were used for measurements. A linear mixed model and paired *t*-tests were used to analyze temporal changes and the associated influencing factors. The mandibular width increased immediately after surgery ($P < 0.05$), but decreased continuously thereafter. The ramus angulation showed negligible change within the first month ($P > 0.05$) and decreased thereafter up to approximately 36 months. The amounts of mandibular setback and posterior impaction and the length of time postoperative influenced these changes. The lower facial width changed, although inconsistently, within 3 mm over time ($P > 0.05$). In conclusion, the mandibular width increased after IVRO but seemed to normalize within approximately 3 years. The lower facial width did not reflect underlying skeletal changes. Therefore, long-term transverse changes after IVRO can be considered clinically irrelevant.

Key words: mandibular prognathism; IVRO; mandibular width; lower facial width; PA cephalometry.

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The intraoral vertical ramus osteotomy (IVRO) and sagittal split ramus osteotomy (SSRO) are major techniques for correcting mandibular prognathism.[1] The SSRO allows for a large area of bony contact, rigid internal fixation of the segments, and early mobilization.[2] On the other hand, IVRO is technically simpler, shows a lower incidence of nerve damage, and carries a lower risk of temporomandibular joint dysfunction,[3,4] because the segments can move freely and heal accordingly.[5]

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The mandibular width can increase after mandibular setback surgery because of proximal and distal segment overlap. The increase after SSRO has little clinical relevance.[6–8] Notably, the bigonial width has been reported to increase immediately after IVRO and decrease thereafter, although remaining larger than the initial width after 1 year.[7–9] Bone remodelling between segments through functional activities of the mandible contributes to a decreased width in the gonial region[9]; however, the same extent of narrowing is not likely to occur in the superior portion of the ramus. Furthermore, because the proximal segments flare after a large amount of mandibular setback,[7,9] transverse changes may occur in both the inferior and the superior portions of the ramus. These changes raise aesthetic concerns because they can affect the gonial prominence and lower facial width.

Recent studies have shown changes in the bigonial width up to 6–12 months after surgery.[7–11] Importantly, most of the data have indicated an initial increase followed by a continuous decrease. However, long-term evaluation is essential to determine when the width stabilizes. Therefore, this study was conducted to evaluate the long-term changes in mandibular width, lower facial width, and ramus angulation after IVRO and to identify the factors influencing these changes.

Materials and methods

Subjects

A total of 148 patients underwent bilateral IVRO to correct mandibular prognathism between 2009 and 2011 at the study hospital. Of these, 53 consecutive patients (29 men and 24 women; mean age 23.9 years, range 18.1–37.7 years) underwent IVRO with ($n = 33$) or without ($n = 20$) Le Fort I osteotomy (Table 1) and were included in this retrospective study. The inclusion criteria were as follows: mild facial asymmetry with a menton deviation of <2 mm before surgery; availability of serial postero-anterior (PA) and lateral cephalograms and frontal facial photographs obtained before, 1 month after, and at least 24 months after IVRO; availability of data for the intercanthal distance measured directly on the face; and absence of systemic diseases, cleft lip/palate, or craniofacial syndromes.

PA and lateral cephalograms and frontal facial photographs were obtained before (baseline) and 1 month after the surgery. Additional PA cephalograms and frontal facial photographs were obtained at approximately 6, 12, 24, 36, 48, and 60 months after surgery. Only the data taken before and after a month of each follow-up schedule were included in this study. PA cephalograms were acquired after stabilizing the patient's head using ear rods, with the Frankfort horizontal (FH) plane parallel to the floor. Frontal facial photographs were obtained with each patient seated in an upright position and the FH plane maintained parallel to the floor. To obtain reliable natural head position, the photographs were taken after the patients had looked into the reflected image of their own eyes in a mirror placed in front of them.

Surgical technique

One surgeon performed all the surgeries, and all patients underwent pre- and postoperative orthodontic treatment. The medial cortical volume of the proximal segment and the lateral cortical volume of the distal segment in the overlapping region were routinely reduced to obtain an even contact between the two segments by removing point contacts. The vertical overhang of the proximal segment after mandibular setback was also resected. The distal end of the proximal segment was trimmed laterally to eliminate the lateral overhang of the proximal segment. Rigid stabilization was not employed and intermaxillary fixation was retained for approximately 2 weeks. Thereafter, all patients underwent intensive mandibular movement exercise regimens and sequential elastic traction to maintain an ideal occlusion.

Measurements

On each PA cephalogram, a horizontal reference plane (HRP) and two bilateral landmarks, Ma and Go, were established. HRP connected the lowermost points of the mastoid processes, Ma represented the intersection of HRP and the lateral border of the proximal segment, and Go represented the most inferolateral point of the proximal segment. The mandibular width was measured between the right and left landmarks as Ma_R–Ma_L and Go_R–Go_L (Fig. 1). In addition, the ramus angulation was measured between HRP and the line connecting Ma and Go unilaterally; the mean of the right and left side values was analyzed.

Two bilateral landmarks were also identified on each frontal facial photograph. Ear′ represented the intersection of the facial contour and the line connecting the lowermost points of the earlobes, while Lip′ represented the intersection of the facial contour and the line connecting the cheilions. The lower facial width was measured between the right and left landmarks as Ear'_R–Ear'_L and Lip'_R–Lip'_L (Fig. 2).

The intercanthal distance was measured as the distance between the endocanthions on the patient's face (true value). The photographs (estimated values) were used to adjust Ear'_R–Ear'_L and Lip'_R–Lip'_L data to correct for magnification errors that occurred despite the use of standardized photography from a distance of 160 cm.

The amount of maxillary posterior impaction was calculated from the lateral

Table 1. Demographic features of the study subjects; mean ± standard deviation values.

	Male		Female	
	1-jaw surgery ($n = 12$)	2-jaw surgery ($n = 17$)	1-jaw surgery ($n = 8$)	2-jaw surgery ($n = 16$)
Age (years)	23.5 ± 4.0	22.6 ± 3.5	26.0 ± 4.5	24.4 ± 5.4
SNA (°)	81.9 ± 2.1	82.3 ± 3.5	81.2 ± 2.8	79.9 ± 3.2
SNB (°)	83.9 ± 2.7	86.1 ± 3.5	82.5 ± 3.5	81.8 ± 4.2
ANB (°)	−1.9 ± 2.6	−3.8 ± 2.7	−1.3 ± 1.3	−2.0 ± 2.5
SN–MP (°)	34.7 ± 5.7	34.2 ± 4.7	38.1 ± 4.5	37.4 ± 6.1
Gonial angle (°)	126.0 ± 6.2	127.7 ± 7.2	127.0 ± 6.2	125.3 ± 7.6
Mandibular body length (mm)	95.1 ± 5.6	94.9 ± 5.9	88.6 ± 5.3	88.8 ± 6.3
Mandibular setback (mm)	7.6 ± 3.2	6.4 ± 4.7	4.6 ± 2.6	4.9 ± 2.8
Maxillary posterior impaction (mm)	0.0 ± 0.0	2.9 ± 1.0	0.0 ± 0.0	1.9 ± 1.2

SNA, sella–nasion–A point angle; SNB, sella–nasion–B point angle; ANB, A point–nasion–B point angle; SN–MP, sella–nasion to mandibular plane angle.

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