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Changes in border movement of the mandible in skeletal Class III before and after orthognathic surgery

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Abstract. The purpose of this study was to examine the changes in border movement of the mandible before and after mandibular ramus osteotomy in patients with prognathism. The subjects were 73 patients with mandibular prognathism who underwent sagittal split ramus osteotomy (SSRO) with and without Le Fort I osteotomy. Border movement of the mandible was recorded with a mandibular movement measure system (K7) preoperatively and at 6 months postoperatively. Of the 73 patients, 21 had measurements taken at 1.5 years postoperative. Data were compared between the pre- and postoperative states, and the differences analyzed statistically. There was no significant difference between SSRO alone and SSRO with Le Fort I osteotomy in the time-course change. The values at 6 months postoperative were significantly lower than the preoperative values for maximum vertical opening ($P = 0.0066$), maximum antero-posterior movement from the centric occlusion ($P = 0.0425$), and centric occlusion to maximum opening ($P = 0.0300$). However, there were no significant differences between the preoperative and 1.5 years postoperative measurements. This study suggests that a postoperative temporary reduction in the border movement of the mandible could recover by 1.5 years postoperative, and the additional procedure of a Le Fort I osteotomy does not affect the recovery of mandibular motion after SSRO.

Key words: border movement of the mandible; orthognathic surgery; sagittal split ramus osteotomy; Le Fort I osteotomy.

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Orthognathic surgery can induce not only morphological but also functional improvements. However, surgical invasion can affect the recovery of mandibular functions. Several investigators have assessed the immediate to medium term functional results, as all groups of skeletal malocclusion tend to have some degree of hypomobility of the temporomandibular joint (TMJ) postoperatively.[1–9]

Surgical orthodontic correction of skeletal Class III physiology has been reported to have favourable effects on the function of the mandible, such as increased ranges of maximum motion in the anterior, posterior, and lateral excursions.[10] It was shown in previous questionnaire studies that, with the recovery of normal occlusion, there was an improvement in chewing efficiency in more than 75% of patients who had undergone

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surgical–orthodontic correction of a skeletal Class III malocclusion.[11,12]

Yazdani et al.[13] concluded that sagittal split ramus osteotomy (SSRO) resulted in the greatest effect, and extraoral vertical ramus osteotomy (EVRO) in the least effect, on limitation of movement after mandibular setback surgery, although electric devices such as the kinesiograph were not used in that study. Studies using the kinesiograph for mandibular motion after mandibular setback surgery with Le Fort I osteotomy are few, although there are some studies on mandibular advancement surgery and mandibular setback surgery alone.

The purpose of this study was to examine the time-course changes in mandibular motion before and after SSRO with and without Le Fort I osteotomy for patients with prognathism, using a kinesiograph.

Patients and methods

Patients

The subjects consisted of 16 men and 57 women (average age 30.6 ± 11.7 years) with mandibular prognathism without severe TMJ dysfunction. The subjects had no history of temporomandibular disorder such as locking. The patients with slight muscular dysfunction or sound in the TMJ were included, however subjects with maximum vertical mouth opening of under 30 mm were excluded. Forty-one patients underwent SSRO alone and 32 underwent SSRO with Le Fort I osteotomy. Two unsintered hydroxyapatite and poly-L-lactic acid (uHA/PLLA) miniplates (28 mm × 4.5 mm × 1.5 mm with four screws (2 mm × 8 mm); Super-Fixorb-MX, Takiron Co., Osaka, Japan) were used for bilateral internal fixation of the mandible (the u-HA/PLLA group). Two uHA/PLLA L-type miniplates (10 mm × 22 mm × 1.4 mm with four screws (2 mm × 8 mm); Super-Fixorb-MX, Takiron Co.) and two straight uHA/PLLA plates (28 mm × 4.5 mm × 1.4 mm with four screws (2 mm × 8 mm); Super-Fixorb-MX, Takiron Co.) were used to fix the maxilla.

None of the patients underwent maxillomandibular fixation (MMF) after surgery. However, maxilla–mandibular traction with an elastic was performed until the occlusion was stable. No patient performed postoperative mandibular exercises or training to promote recovery of mandibular motion.

Border movement of the mandible was recorded with a mandibular movement measurement system (K7; Myotronics Inc., Kent, WA, USA) preoperatively and at 6 months postoperatively. Multiple sensors in a lightweight array tracked the motion of a magnet attached to the midpoint of the lower incisors (Fig. 1).

Of the 73 patients, 21 had measurements taken until 1.5 years postoperative. Preoperative and postoperative measurements of maximum vertical opening, maximum antero-posterior movement from centric occlusion, maximum lateral deviation on the left and right, and centric occlusion to maximum opening were compared and the differences analyzed statistically.

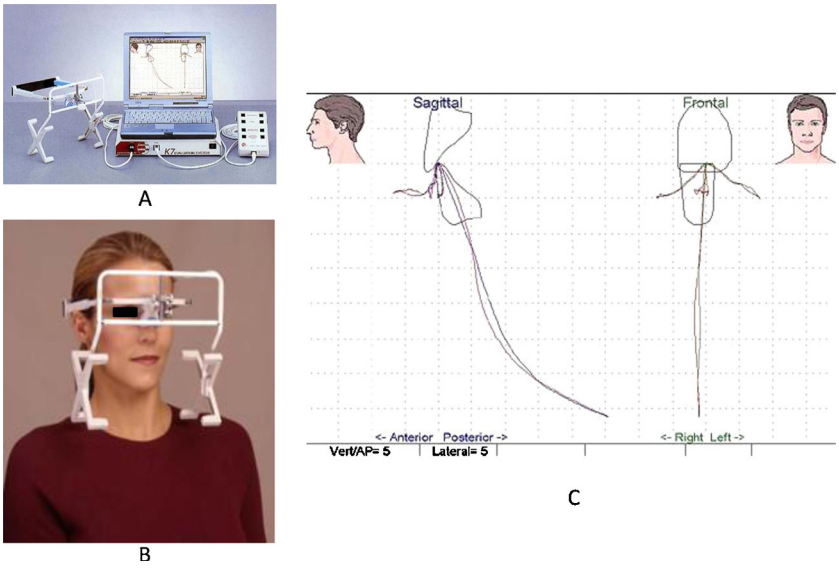

Fig. 1. (A) The K7 system. (B) Multiple sensors, in an extremely lightweight (four ounces) spectacle-like array, track the motion of a tiny magnet attached to the lower incisal gingiva with adhesive material. (C) Tracking of the border movement of the mandible.

Statistical analysis

Data were analyzed using Dr. SPSS II (SPSS Japan Inc., Tokyo, Japan).

The total time-course changes from preoperative to 6 months and 1.5 years postoperative were examined by repeated measures analysis of variance (ANOVA). Comparisons between each time period were performed by paired *t*-test. Differences were considered significant at $P < 0.05$.

Results

There was no significant difference between SSRO alone and SSRO with Le Fort I osteotomy in the time-course change by repeated measures ANOVA. With regard to the results of the 73 subjects observed preoperatively and at 6 months postoperatively, the values at 6 months postoperative were significantly lower than the preoperative values for maximum vertical opening ($P < 0.0001$), maximum antero-posterior movement from centric occlusion ($P < 0.0001$), and centric occlusion to maximum opening ($P < 0.0001$).

When the paired comparisons were performed statistically in the 21 patients who had measurements taken at 1.5 years, similar results were obtained (Fig. 2 and Table 1). The values at 6 months postoperative were significantly lower than the preoperative values for maximum vertical opening ($P = 0.0066$), maximum antero-posterior movement from centric occlusion ($P = 0.0425$), and centric occlusion to maximum opening ($P = 0.0300$). However, there were no significant differences between the preoperative and 1.5 years postoperative measurements.

Discussion

SSRO surgical methods have been used for many years to correct mandibular prognathism. SSRO with rigid fixation has several advantages associated with it, such as a larger bony interface between the segments, easier fixation, and earlier healing. Therefore, SSRO can provide immediate postoperative jaw mobilization without MMF. Furthermore, Le Fort I osteotomy is also used very frequently with SSRO for orthognathic surgery.[14]

As functional changes following orthognathic surgery are important, many studies have documented masticatory functions such as masticatory efficiency,[14,15] muscle activity,[16] bite force, and occlusal contacts.[17–20] Several studies have reported that mandibular advancement surgery limits mandibular mobility