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The amount of mandibular setback influence on occlusal force following sagittal split ramus osteotomy

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ABSTRACT

Purpose: The purpose of this study was to examine the influence between the magnitude of setback in sagittal split ramus osteotomy (SSRO) and occlusal contact area and bite force without relapse after surgery.
Patients and methods: Sixty female patients with a diagnosis of mandibular prognathism were divided into 3 groups according to the magnitude of setback: group 1 ($\leq$5 mm), group 2 (>5 mm but <10 mm), and group 3 ($\geq$10 mm). All patients underwent skeletal analysis by lateral and frontal cephalogrammetry and measured the occlusal contact area and bite force by the pressure-sensitive system (Dental Prescale, Dental Occlusion Pressuregraph FDP-705; Fuji Photo Film Co., Tokyo, Japan) preoperatively and postoperatively at 1 month, 3 months, 6 months, and 1 year.
Results: There were no significant differences in occlusal contact area and bite force between the 3 groups. Only group 3 showed a significant difference in occlusal contact area and bite force between the preoperative and 1-year measurements.
Conclusion: The results indicate that the magnitude of setback did not influence the bite force or occlusal contact area in SSRO.

1. Introduction

Mandibular prognathism is corrected by orthognathic surgery, including sagittal split ramus osteotomy (SSRO). Many reports have been published on the relationship between orthognathic surgery and masticatory function, before and after surgery (Nagai et al., 2001; Iwase et al., 2006). Although Throckmorton et al. (2000) reported that the relative difference between anterior and posterior facial height strongly correlated with maximum bite force, Ueki et al. (2006) reported that bite force significantly positively correlated with the masseter muscle area and that both the masseter and medial pterygoid muscles were related to ramus morphology. These reports indicate that changes in ramus morphology affect the tissue surrounding the skeletal muscles in addition to affecting masticatory function. The occlusal contact area and bite force of patients with mandibular prognathism were shown to be lower 1–7 weeks after surgery than prior to surgery (Kim and Oh, 1997; Shiratsuchi et al., 1991). Occlusal contact area and bite force increased after surgery with improvements in patient adaptability to new oral environments (Nagai et al., 2001).

Some reports have indicated that changes in jaw morphological characteristics influence masticatory function, among other factors. It was reported that there is a significant difference in occlusal force after operation between one-jaw surgery and two-jaw surgery (Harada et al., 2003). Moreover, facial asymmetry patients had greater improvement in bite force than other patients after orthognathic surgery (Moroi et al., 2015). However, no reports concluded that differences in skeletal movement influenced bite force and occlusal contact area. The purpose of our study was to examine how the magnitude of setback in SSRO affects occlusal contact area and bite force.

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2. Material and methods

2.1. Patients

This was a retrospective study of 60 female patients (mean age, 27.6 years; range, 15–58 years) diagnosed with mandibular prognathism, who had undergone orthodontic surgery and SSRO between April 2007 and September 2013. Inclusion criteria were as follows: only slight possible differences in magnitude of setback (difference between opposite side of setback: <3 mm); and no history of surgery that involved the middle or lower face. Informed consent was obtained from all patients in accordance with the Declaration of Helsinki, and the ethics committees of Yamanashi University Hospital approved our study.

2.2. Surgical procedure

In all patients, SSRO was performed by the same surgeon and assistants using the conventional Obwegeser method, a 1.6-mm round bur at the anterior side of the ramus, a Lindemann bur above the lingula of the mandible, and a reciprocating saw at the lateral cortex. Mandibular crack was split using an osteotome and a bone spreader. After the split, the proximal segments were tested for adequate mobility. At the time of fixation, the dental arch was secured to the maxillary arch with an interpositional splint and wire. An osseous step was formed at the site of fixation; this was dependent on the amount of setback. The overlapping area consisted of the anterior part of the proximal segment and the distal segment, which was fixed without removing the overlap of the lateral cortex. Plates were bent to fit to the step at the overlap and to maintain the condyle in its original position in both groups (Fig. 1) (Ueki et al., 2001, Ueki et al., 2014a, 2014b).

Patients were divided into 3 groups according to the magnitude of setback: group 1 (≤5 mm), group 2 (>5 mm but <10 mm), and group 3 (≥10 mm). Group 1 consisted of 20 patients ranging in age from 15 to 52 years (mean ± SD: 26.7 ± 10.0 years). The average magnitude of setback for group 1 was 4.1 ± 0.9 mm. Group 2 consisted of 20 patients ranging in age from 17 to 58 years (mean ± SD: 30.3 ± 12.6 years). The average magnitude of setback for group 2 was 7.3 ± 1.2 mm. Group 3 consisted of 20 patients ranging in age from 16 to 48 years (mean ± SD: 25.8 ± 8.2 years). The average magnitude of setback for group 3 was 11.1 ± 1.4 mm.

A miniplate and 4 screws were placed monocortically in the mandibular angle region on each side. In group 1, 10 patients received unsintered hydroxyapatite (uHA)/poly-L-lactide (uHA/PLLA) miniplate (28 × 4.5 × 1.5 mm), and 4 uHA/PLLA screws (2 × 6 mm or 8 mm) (Super Fixsorb-MX; Takiron, Osaka, Japan); 3 patients received uHA/PLLA miniplate, 4 uHA/PLLA screws, and 1 uHA/PLLA bicortical screw (2.7 × 16 mm) (Super Fixsorb-MX) affixed to each side of the plate in the posterior superior region; and the remaining 7 patients received 1 long, titanium miniplate (4 holes/bur, 8 mm deep, 1 mm thick) and 4 titanium screws (2 × 7 mm) (Würzburg titanium miniplate system; Stryker Leibinger, Freiburg, Germany) via the conventional technique.

In group 2, 6 patients received 1 uHA/PLLA miniplate and 4 screws; 9 patients received 1 uHA/PLLA miniplate, 4 screws, and 1 bicortical screw affixed to each side of the plate in the posterior superior region; and the remaining 5 patients received 1 long titanium miniplate with 4 titanium screws.

In group 3, 4 patients received 1 uHA/PLLA miniplate and 4 screws; 4 patients received 1 uHA/PLLA miniplate, 4 screws, and 1 bicortical screw (2.7 × 16 mm) affixed to each side of the plate in the posterior superior region; and the remaining 12 patients received 1 long titanium miniplate with 4 titanium screws.

Immediately after surgery, intermaxillary fixation (IMF) was not performed, and elastic was placed for 1–4 months to maintain ideal occlusion for patients in all groups; there was no difference in duration of elastic wear between groups.

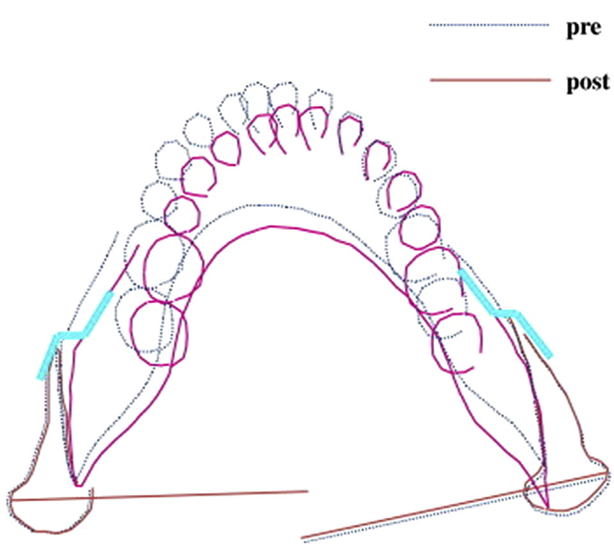

Fig. 1. Simulation of plate bending. The plates were bent to prevent the proximal segments from rotating internally. Note the gap between the osteotomy surfaces on both sides.

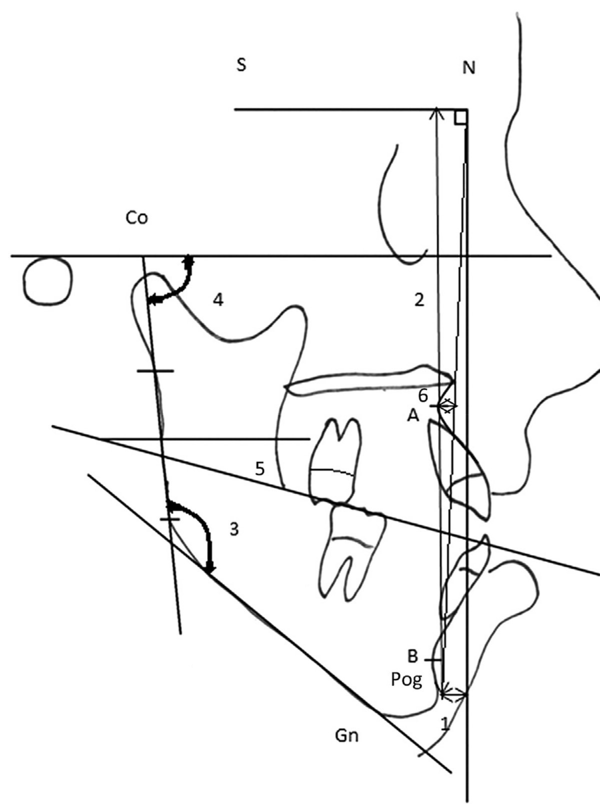

Fig. 2. Measurements in lateral cephalogram. 1: Pog-N parallel to SN; 2: Pog-N perpendicular to SN; 3: gonial angle; 4: ramus inclination; 5: occlusal plane; 6: convexity.