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Evaluation of postoperative stability after BSSRO to correct facial asymmetry depending on the amount of bone contact between the proximal and distal segment

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ABSTRACT

Sagittal split ramus osteotomy (SSRO) benefits patients through the wide bone contact between the proximal and distal segment, which contributes to postoperative stability. Recently, a posterior bending osteotomy (PBO), an additional vertical osteotomy performed posterior to the second molar after SSRO, has been introduced to avoid positional changes of the condyle from bony interference in patients with facial asymmetry, which leads to decreases in bone contact. The aim of this study was to investigate postoperative stability after SSRO with PBO. Forty patients with facial asymmetry were enrolled and divided into two groups according to the surgical method used on the deviated side: PBO ($n = 18$) and grinding method ($n = 22$). Cephalometric analysis was performed. In addition, adaptation and bone healing of the PBO segments were assessed with 3-month postoperative three-dimensional computed tomography depending on the fixation of the PBO segment. The two groups showed no significant difference in postoperative relapse. Most PBO segments were well-adapted to the proximal segment. Twelve segments with fixation exhibited good bone healing. Two of three segments without fixation, however, had poor bone healing. In summary, PBO did not cause postoperative instability, and the PBO segments were well-healed with rigid fixation.

1. Introduction

Since sagittal split ramus osteotomy (SSRO) was introduced by Trauner and Obwegeser (Trauner and Obwegeser, 1957); it has been modified, and used widely for the correction of various dentofacial deformities, including facial asymmetry. There is still debate, as to how to optimize postoperative stability following SSRO, where factors considered include: surgical techniques of osteotomy, amount and direction of surgical movement, type of fixation, soft tissue tension caused by surgical changes, occlusal stability and force, condylar displacement, condylar displacement and resorption, amount of bone contact between proximal segment (PS) and distal segment (DS) (Franco et al., 1989; Komori et al., 1989; Michiwaki et al., 1990; Wolford et al., 1993; Rodriguez and Gonzalez, 1996; Shetty et al., 1996a, 1996b; Ayoub et al., 2000; Politi et al., 2004; Cho, 2007; Kim et al., 2007; Reyneke et al., 2007; Mucedero et al., 2008; Jakobsone et al., 2011; Moure et al., 2012; Paeng et al., 2012).

Mandibular stability in SSRO can be considered as the intersegmental stability between the PS and DS, and whole mandibular stability. The former is determined primarily by the amount of bone contact and type of fixation, such as wire, miniplate or position screws, partly by postoperative soft tissue tension and occlusal force (Shetty et al., 1996a, 1996b; Politi et al., 2004; Kim et al., 2007; Moure et al., 2012; Paeng et al., 2012). While the effects of different types of fixation on postoperative stability have been well-studied (Shetty et al., 1996a, 1996b; Politi et al., 2004; Moure et al., 2012; Paeng et al., 2012), there have been no reports about the relationship between the amount of bone contact after SSRO and postoperative stability, even though the wide bone contact between PS and DS is frequently regarded as the main advantage of SSRO and an important stabilizing factor.

Facial asymmetry is one of the primary indications for orthognathic surgery. Asymmetry in the mandible is more apparent than in the maxilla (Cheong and Lo, 2011). Conventional SSRO is the most commonly used method to correct mandibular asymmetry. Bony interference between the PS and DS, however, inevitably occurs in cases of mandibular asymmetry, due to yawing and/or shifting movements of the DSs. The PS and DS should be passively

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positioned to prevent condylar displacement resulting from this bony interference when internal fixation devices are applied (Ellis, 2007; Kang et al., 2010), because condylar displacement has a significant influence on early postoperative relapse and temporomandibular joint dysfunctions, such as temporomandibular joint pain, clicking sounds, disc displacement, and condylar resorption (Hackney et al., 1989; Ellis and Hinton, 1991; Ellis, 1994; Harris et al., 1999; Yoshida et al., 2001; Baek et al., 2006; Angle et al., 2007; Ueki et al., 2008; Kang et al., 2010).

Recently, additional vertical osteotomy of the DS, just behind the terminal molar, was proposed in order to passively align the PS and DS to eliminate all bony interferences, even in cases of severe asymmetry (Fig. 1) (Epker et al., 1998; Ellis, 2007). Full vertical osteotomy is performed, after lateralization of the inferior alveolar nerve, using a fissure bur or saw. Otherwise, partial osteotomy is performed, which is comprised of an osteotomy from the superior border of the mandibular ramus to the level of the mandibular canal, and from the inferior border to just below the mandibular canal. Force is applied in a lingual direction, causing a greenstick fracture with or without an osteotome (Epker et al., 1998; Ellis, 2007). In the present study, we used a piezoelectric bone-cutting device instead of a fissure bur or saw in order to avoid damage to inferior alveolar nerve or lingual nerve. We call this osteotomy technique a “posterior bending osteotomy” (PBO).

It has been suggested that the increased backward force of soft tissue in response to mandibular setback movement results in an intraoperative clockwise rotation of the PS (Franco et al., 1989; Komori et al., 1989; Mobarak et al., 2000; Moldez et al., 2000). The clockwise rotation of the PS leads to the lengthening of the pterygo-masseteric sling, which tends to return the PS to its original position after SSRO. It has been reported that this postoperative rotation of the PS has significant correlation with postoperative relapse, especially during the first eight weeks after surgery (Franco et al., 1989; Komori et al., 1989; Politi et al., 2004; Cho, 2007; Kim et al., 2007; Proffit et al., 2007).

In order to resist the forward pull of the pterygo-masseteric sling and guarantee a stable prognosis, sufficient bony contact between the PS and DS is required. The effect of bony contact on postoperative stability, however, has not been studied previously. The PS and DS can be passively aligned using PBO to correct facial asymmetry. As a result, the anterior gap decreases, and direct bone contact between the PS and DS is possible on the deviated side. One issue with PBO, however, is that the posterior area of the DS is cut separately. This decreases the bony contact surface between the PS and DS, which ensures postoperative stability (Fig. 2). The posterior PBO segment may contribute to maintaining mandibular bone volume after bone healing, but its adaptation and bone healing results have yet to be reported. In this study, we evaluated the postoperative stability after SSRO with PBO, and the adaptation and bone healing of the PBO segment. Additionally, we examined the effect of intraoperative clockwise rotation of PS on the postoperative stability in relation to PBO.

2. Material and methods

2.1. Patients

Patients who underwent orthognathic surgery for correcting facial asymmetry with class I or III malocclusions were evaluated in this study. In selecting patients with facial asymmetry, the facial

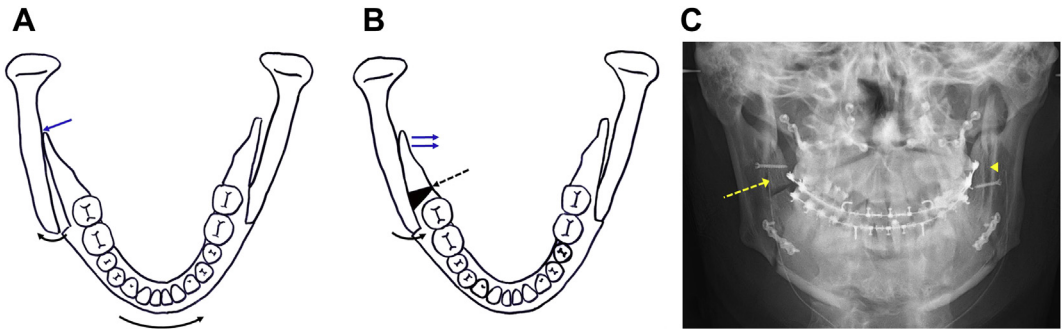

Fig. 1. Illustration of PBO from the axial view and postoperative PA cephalogram. A, Bony interference (blue arrow) occurs after rotation of the distal segment with SSRO in cases of asymmetry of the mandible; B, additional osteotomy of the distal segment posterior to the last molar. The PBO segment is turned inward to passively align the proximal and distal segments, which makes a dead space (dotted arrow); C, PBO segment (dotted arrow) was fixed with a position screw. Arrow head indicates inter-segmental gap on the non-deviated side.

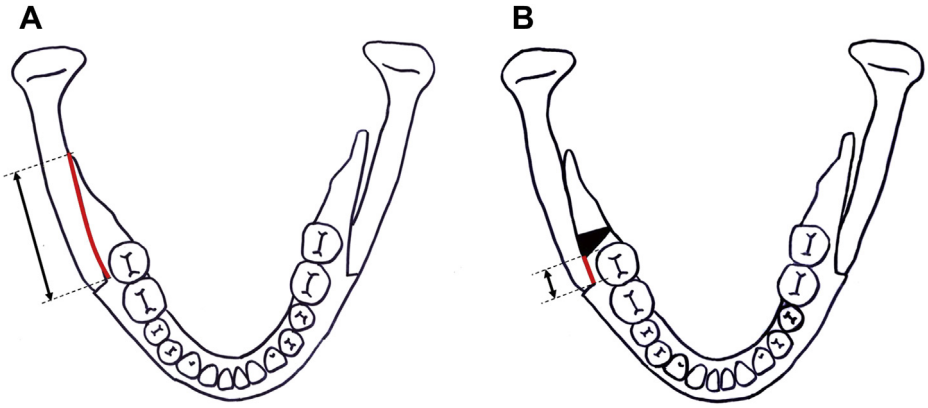

Fig. 2. The reduced contact area after PBO. A, Contact area (red line) after SSRO; B, contact area (red line) after PBO.