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# Skeletal stability after mandibular setback surgery: Comparison between the hybrid technique for fixation and the conventional plate fixation using an absorbable plate and screws

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ABSTRACT

*Purpose:* The purpose of this study was to compare the temporal changes in condylar long axis and skeletal stability after sagittal split ramus osteotomy (SSRO) with the hybrid fixation technique and the conventional plate fixation.
*Patients and methods:* Of 44 Japanese patients diagnosed with mandibular prognathism, 22 underwent SSRO with the conventional plate fixation (1 u-HA/PLLA plate and 4 monocortical screws in each side) and 22 underwent SSRO with a hybrid fixation technique (1 u-HA/PLLA plate and 4 monocortical screws and bicortical screw in each side). The temporal changes in condylar long axis and skeletal stability were assessed by axial, frontal, and lateral cephalograms. After surgery, breakage of the plate and screws was checked by 3-dimensional computed tomography (3DCT).
*Results:* Although there was a significant difference between the groups regarding Me–Ag in T1 ($P = 0.0138$), there were no significant differences between the groups for the other measurements in lateral, frontal and axial cephalometric analysis in each time interval. In two cases, 4 sides in the conventional plate fixation group, failure of the absorbable plate was found by 3DCT. However, there was no breakage in the hybrid fixation group.
*Conclusion:* This study suggested that there were no significant differences in the postoperative temporal changes between the two groups in mandibular setback surgery.


## 1. Introduction

Recently, many surgeons have been using the so-called hybrid technique, which was initially proposed by Schwartz and Relle (1996), aiming to combine the advantages of fixation with bicortical screws and miniplates with monocortical screws. Before being considered for use in sagittal split ramus osteotomy (SSRO) fixation, the use of screws associated with miniplates was primarily used for the management of unfavorable splits, lingual or buccal plate fracture, or bone gaps related to the third molar sockets (Tucker and Ochs, 1988; Van Sickels et al., 1985).

On the other hand, the use of resorbable materials to stabilize the maxillofacial skeleton has been reported recently (Bessho et al., 1997; Bos et al., 1987; Edwards et al., 2001). There is no need for a second operation to remove the implant, less risk of weakening of the bone because of stress shielding and no risk of metallic corrosion. However, several problems remain, including mechanical weakness (Böstman, 1991; Takizawa et al., 1998), late foreign body reactions, osteolytic change, and micro-movement of bone caused by a low initial stability (Ahl et al., 1994; Böstman et al., 1993; Donigian et al., 1993). Poly-L-lactic acid (PLLA) is one of the several absorbable materials that have been used for fixation after SSRO. PLLA miniplates promote osteosynthesis of the oral and maxillofacial skeleton, and PLLA screws have been used in patients undergoing orthognathic surgery (Harada and Enomoto, 1997; Ueki et al., 2005; Ueki et al., 2006). In our previous study, it was found that PLLA plates and screws (Fixorb®-MX, Takiron Co., Osaka, Japan) were useful in SSRO, as well as the conventional titanium plate system. Furthermore, the fixation plate system (Super-FIXSORB®-MX. Takiron Co. Ltd, Osaka) has been newly developed for use in orthopedic or cranio-facial, oral and maxillofacial or plastic and

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reconstructive surgeries (Shikinami and Okuno, 1999; Shikinami and Okuno, 2001; Shikinami et al., 2005). These devices are made from composites of unsintered hydroxyapatite (u-HA) particles and poly-L-lacted (PLLA). They are produced by a forging process, which is a unique compression moulding, and machining treatment. They have a modulus of elasticity close to that of natural cortical bone, and they can retain a high strength during the period required for bone healing. They can also show optimal degradation and resorption behavior, osteoconductivity, and bone bonding capability. The previous studies proved that the u-HA/PLLA plate system was also very useful for the fixation in SSRO and Le Fort I osteotomy (Ueki et al., 2011a,b; Ueki et al., 2012a,b,c). However, a method to compensate the strength of the plate was necessary, because concerns about failure of the absorbable plate still remained.

The purpose of this study was to compare the temporal changes in condylar long axis and skeletal stability after sagittal split ramus osteotomy (SSRO) with the hybrid fixation technique and the conventional plate fixation using u-HA/PLLA plates and screws.

## 2. Patients and methods

### 2.1. Patients

Forty four Japanese adults (16 men and 28 women) with mandibular prognathism were randomly selected in this study presenting with jaw deformities. At the time of orthognathic surgery, the patients ranged in age from 16 to 48 years, with a mean age and standard deviation of 29.1 ± 10.1 years. This study is a prospective study. Informed consent was obtained from the patients and the study was approved by Kanazawa University Hospital.

### 2.2. Surgery

In the hybrid fixation group, 22 patients (men: 10, women: 12) underwent bilateral SSRO for correction of their mandibular deformities. A miniplate (28 × 4.5 × 1.4 mm) and 4 screws (2 × 6 or 8 mm) (Super Fixorb®-MX, Takiron Co., Osaka, Japan) were placed monocortically in the mandibular angle region in each side. In addition, a bicortical screw (2.7 × 16 mm) (Super Fixorb®-MX, Takiron Co., Osaka, Japan) was placed at the posterior-superior region to the plate in each side (Fig. 1). The patients in the u-HA/PLLA group ranged in age from 17 to 46 years, with a mean age and standard deviation of 29.0 ± 9.4 years.

In the conventional fixation group, 22 patients (men: 6, women: 16) underwent bilateral SSRO. A miniplate (28 × 4.5 × 1.5 mm) and 4 screws (2 × 6 or 8 mm) (Fixorb®-MX, Takiron Co., Osaka, Japan) were placed monocortically in the same region and manner (Fig. 2). The patients in the PLLA group ranged in age from 16 to 48 years, with a mean age and standard deviation of 29.1 ± 10.1 years.

At the site of fixation, an osseous step was formed, depending on the amount of setback. The overlapped area consisted of an anterior part of the proximal segment and the distal segment was fixed without removal of the overlap close by the lateral cortex. The plates were bent to fit to the step at the overlap and to maintain the condyle in its original position in both groups (Ueki et al., 2001)(Fig. 3).

Although cortical bony contact between segments was made at the anterior part of the proximal segment, a bony gap remained at

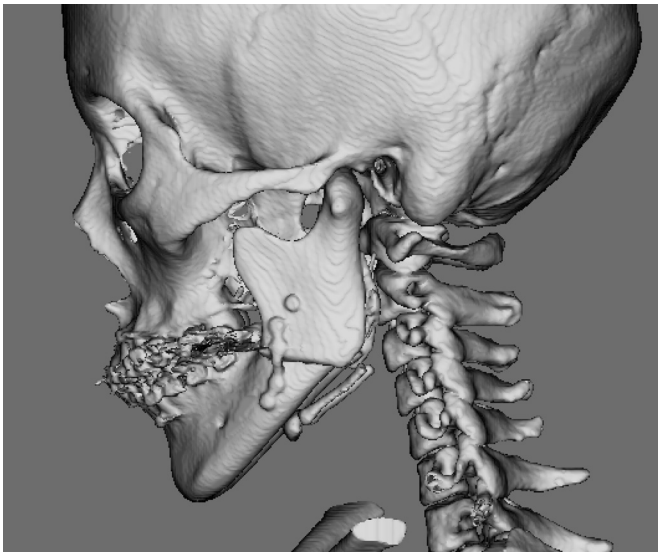

**Fig. 1.** 3DCT image of the hybrid technique fixation using an u-HA/PLLA plate and bicortical screws.

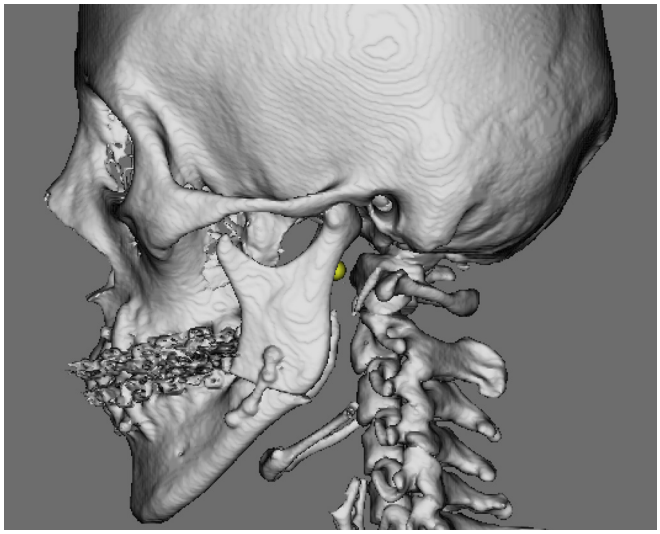

**Fig. 2.** 3DCT image of the conventional plate fixation using an u-HA/PLLA plate.

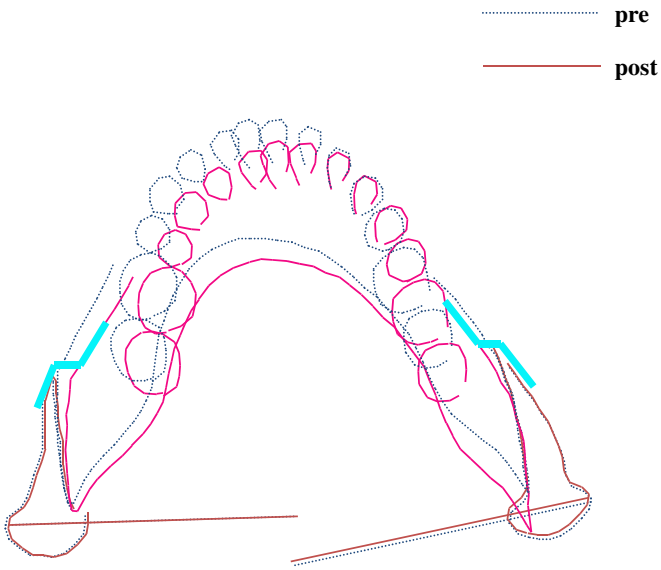


**Fig. 3.** Simulation of the plate bending. The plates were bent to prevent the proximal segments from rotating internally. Note the gap between the osteotomy surfaces on both sides.