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Original Research

Postoperative mandibular stability after bilateral sagittal split ramus osteotomy based on skeletal correction in patients with facial asymmetry

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A B S T R A C T

Objective: The objective of this study was to examine postoperative stability of the mandible after bilateral sagittal split ramus osteotomy (BSSRO) based on skeletal correction rather than occlusal correction in patients with facial asymmetry.
Methods: Eighteen patients with facial asymmetry were enrolled in this study. BSSRO was performed, and an intermaxillary mandibular repositioning splint was prepared using a newly developed surgical simulation system (Mandibular Motion Tracking System [ManMoS]). Chin deviation was evaluated by frontal cephalography immediately after surgery (T1) and after active orthodontic treatment (T2). Three-dimensional analysis was carried out by calculating the three-dimensional coordinates of the cranial and mandibular planes.
Results: The mean crista galli-anterior nasal spine-menton angle was 1.11° at T1 and 0.88° at T2. The rotational change (T2–T1) was calculated as an actual number (Roll: $-0.29 \pm 1.78°$, Elevation: $-1.31 \pm 2.44°$, Azimuth: $+0.41 \pm 1.64°$).
Conclusions: Our results suggest that the spatial orientation of the mandibular body was stable after BSSRO in the horizontal and frontal planes, while forward and upward rotation of the mandible was recognized in the sagittal plane. Thus, mandibular positioning with priority given to skeletal correction using the ManMoS is an effective therapeutic method, especially in cases of facial asymmetry.

1. Introduction

Sagittal split ramus osteotomy (SSRO) [1] is the most frequently used osteotomy for correction of mandibular deformities. However, skeletal instability after SSRO may have several contributing factors, including inadequate condylar position during surgery [2], tension in the soft tissue and muscles [3,4], disturbances of the pterygomasseteric sling [5], interference between the proximal and distal segments [6], and positional changes of the tongue with reduced space after mandibular setback [7]. Although several modifications of SSRO have been proposed to alleviate these problems [5,8–10], improving postoperative stability is still a matter of controversy, especially in the case of facial asymmetry [11].

It has been reported in cases of facial asymmetry that the cant of the frontal occlusal plane ascends toward the side of the chin deviation [12]. The cant of this plane appears to be difficult to improve during preoperative orthodontic treatment. Le Fort I osteotomy can be performed to improve occlusal discrepancies, including cants [13,14]. When surgical preparation is carried out based on occlusal correction, interference between the distal tooth-bearing segment and the condylar proximal segment is a matter of concern, especially for patients with facial asymmetry [15]. As a consequence, accidental displacement of the condylar segment can occur. However, when surgical preparation is carried out based on skeletal

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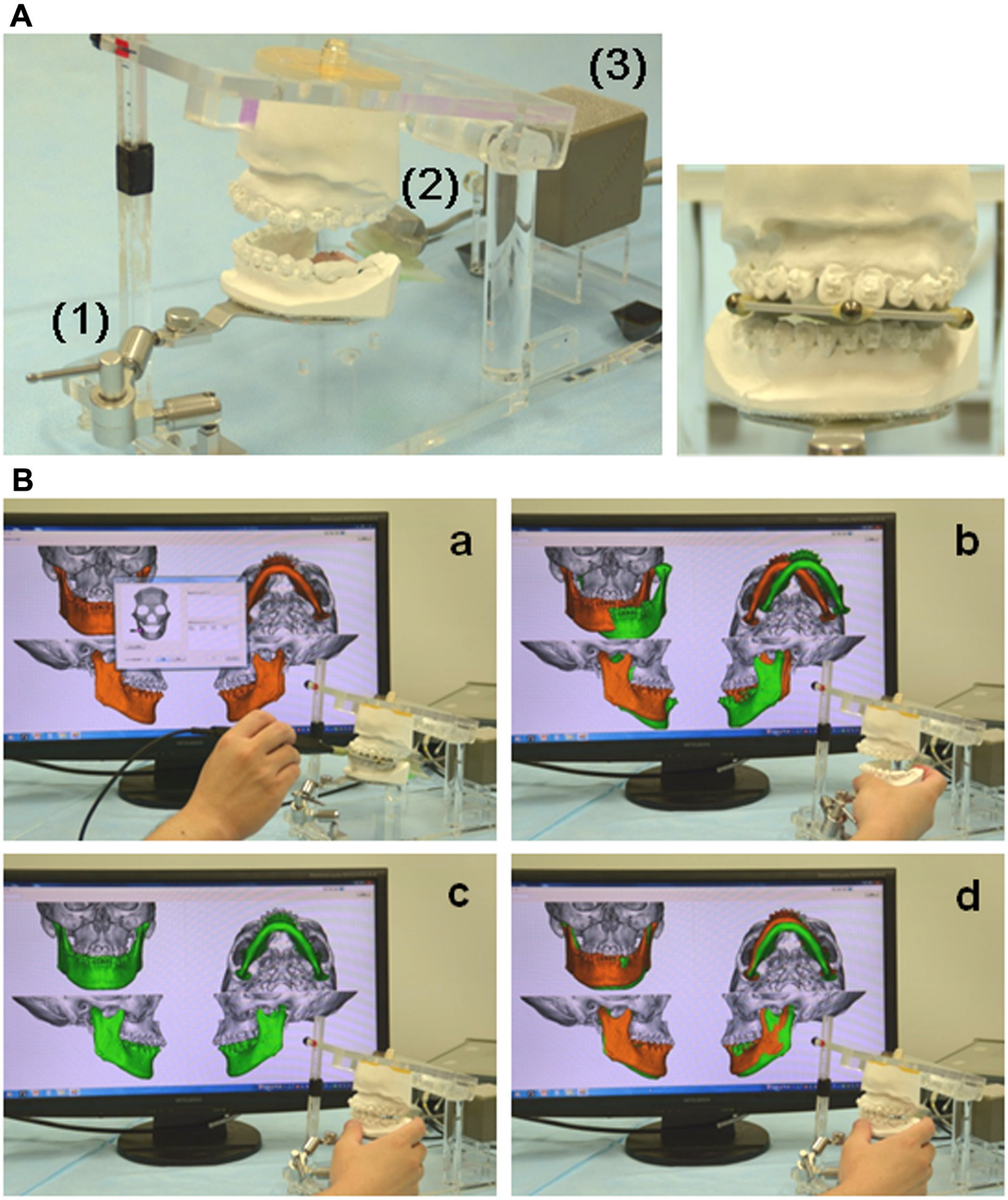

Fig. 1. (A) Articulator and reference splint. The articulator of the ManMoS simulator was made of acrylic, and the lower dental cast is fixed on the inferior part through the universal joint (1). The motion of the lower dental cast can be detected as the motion of the receiver (2) against the transmitter (3) placed at the rear. The reference acrylic splint was affixed with three titanium spheres. (B) Linkage of three-dimensional craniofacial model in virtual space and the actual dental cast model. (a) Calculation of three-dimensional coordinates of the three titanium spheres; (b) virtual linkage of the mandible on the PC monitor and mandibular dental cast; (c) positioning of the image based on skeletal correction; (d) superimposition of the preoperative (orange) and postoperative (green) mandibular position. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

correction to symmetrically position the distal segment, interference between the bony segments can be controlled.

We have developed a new orthognathic surgical simulation system, the Mandibular Motion Tracking System (ManMoS, MacroSystem Co., Tokyo, Japan), which uniquely integrates the change of a three-dimensional computed tomography (CT) mandibular model in virtual space with the occlusal change of an actual dental cast model [16]. The operation of the ManMoS is outlined as follows: (1) A reference acrylic splint affixed with three titanium spheres is made (Fig. 1A). (2) CT is performed while the patient occludes the reference splint. (3) The reference splint and receiver are attached to a mandibular dental cast and a maxillary dental cast. The assembly is then placed in an acrylic articulator, which detects the movement of the dental cast by measuring changes in the magnetic field. (4) A three-dimensional craniofacial model is reconstructed from the DICOM data of the CT recording. (5) The three-dimensional coordinates of the three titanium spheres are calculated. (6) A receiver is attached to the mandibular dental cast to link the mandible to the personal computer (PC). (7) After removing the reference splint, the mandibular position based on skeletal correction is simulated on the PC monitor while moving the mandibular dental cast (Fig. 1B). (8) After recording the occlusal position between the maxilla and mandible, an interocclusal splint is manufactured. Visual simulation by the ManMoS allows an operator to obtain significant information relating to surgical preparation. The ManMoS renders the skeletal correction of the mandibular setup in three dimensions. Therefore, we adopted the treatment policy of improving skeletal asymmetry by SSRO

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