Simple Estimation of Movement of the Distal Segment Separately at the Right and Left Vertical Osteotomy Lines in Sagittal Split Ramus Osteotomy

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ABSTRACT

To estimate the linear and rotational movement of the distal segment in sagittal split ramus osteotomy on the right and left sides, we developed a simple method using the common dental materials. This technique was based on the double-split cast method. Two removable intermediate components were used, one for the original mandibular positioning and the other for the postoperative one. In the original position, a wire was fixed at the buccal side of the first molar of the cast model, corresponding to the vertical osteotomy line of the sagittal split ramus osteotomy on the right and left sides. Another wire was fixed at the base of the articulator on each side, so that the upper portion of the wire is adjacently parallel to the one attached to the cast model. The original intermediate component was replaced with the postoperative component, creating a gap between the wires. The gaps reflect the required movement of the distal segment on each side, which often differs between the right and left.

Keywords: Articulator, Elderly patients, Occlusion, Orthognathic surgery, Rotation, Simulation.

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BACKGROUND

In sagittal split ramus osteotomy, the preoperative precise evaluation of the movement of the distal segment, particularly the counterclockwise rotation, is very important, and the amount should be within a reasonable range to achieve postoperative stability. Recently, the number of elderly patients with a high number of missing teeth, a pathological periodontal condition, and/or dentures is increasing. Elderly patients require a more comfortable prosthesis, including implant placement, which facilitates functional mastication. In their treatment course, particularly postoperatively, authors sometimes face problems that we seldom have in the young patients. Due to a poor or undesirable periodontal condition, and a low number of remaining teeth, postoperative elastic traction cannot be applied in elderly patients the same way it is done in young patients. To reduce the traction process as much as possible, considerable attention should be paid to the counterclockwise rotation of the distal segment of the mandible in the sagittal plane. Preoperative measurements have been obtained from cephalograms so far, but it is difficult to measure the movement of the distal segment separately on the right and left sides. In recent years, it has become possible to measure the movement and simulate the postoperative condition using software.¹

Various surgical splints can easily be fabricated by computed tomography (CT) data as well.²⁻⁴ However, it is not always the best method for prediction and fabrication of the splint because CT images do not always reflect real structures due to scan conditions and potential metal artifacts.⁵ When making a fused skeletal and cast model on the software, registration of the reference points on the cast model with those on the CT is not always accurate in our experience. For both the distance and direction of the movement of the distal segment, we performed measurements using simple wires fixed at the buccal side of the first molar on the cast model equivalent to the vertical osteotomy line of the sagittal split ramus

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osteotomy, instead of the conventional index lines on the model. Our method supplies direct visualization of the movement of the distal segment in a three-dimensional fashion, relative to the condylar position, for the right and left sides at a glance.

CASE TECHNIQUE

This technique was based on the double-split cast method.⁶ A method for single-jaw surgery is described in this article. The maxillary cast was mounted with a facebow and directly attached to the upper base in the conventional manner. This base can be detached from the upper frame by loosening the tightening screw. The mandible cast was mounted with an occlusal record in centric relation and attached to the lower frame through the removable

intermediate component. The intermediate component consisted of two flat plates with outward facing index projections and the cast sandwiched within, which fit between the basement of the mandibular master cast and the lower mounting plate known as the double-split system. The index projections engaged with the opposing grooves.

In the original position, two simple, parallel wires with a diameter of 1 mm were placed on the right and left sides (Fig. 1). One was fixed at the buccal side of the first molar on the mandibular master cast, vertical to the occlusal plane on the mandible, a position equivalent to the vertical osteotomy line; the other was fixed to the base of the articulator. Mesiodistally, a pair of parallel wires is usually located at the position of mesiobuccal cusp, buccal groove of the first molar, or contact points because they are obvious landmarks and reliable reference points for an easy registration. No extra appliance for transfer is required during surgery. The parallel portion was 25 mm long, and 25 mm from the top the mandibular nerve is located.

For the cast simulation, the maxilla and mandible models were handheld and a desirable occlusion was decided upon by manual articulation. After fixing them with PerfectIM® Systems (J. Morita USA, CA), an impression material effective for fixation instead of the conventionally used sticky wax, the maxilla was fixed at the original position by tightening the corresponding screw. As for the mandible, another intermediate component was made, so that the mandible cast could remain at the desirable occlusion. The two intermediate components could be removed and easily rearranged. Replacing the starting position component with the postsurgical component created a gap between the wires (Figs 2 and 3). This indicates very clear movement of the distal segment and also shows the exact difference between the right and left sides. The distance between the wires can be easily measured to one decimal place by a vernier caliper between two reference points (top of the wire and 25 mm from the top). This is the exact distance and direction in which the points at the vertical osteotomy line moves, and the

equivalent amount of bone should be removed to allow for the setback movement. Rotational movement in the sagittal plane can also be easily observed and can be measured by a calculation using the traveling distance of the upper and lower reference points or by protractor on the picture taken away from the articulator vertical to the sagittal plane.

DISCUSSION

Although our method is certainly old-fashioned, it provides more valuable and precise information that might not be acquired using the routine computer simulations. In cases requiring more than 8° counterclockwise rotations of the distal segment, some modifications of the surgical planes and ingenious attempts have to be made. For example, relaxing the suprahyoid muscles by botulinum toxin or detaching it from the mental spine should be considered. From this perspective, the present method gives

Fig. 2: Movement on the right side. The first intermediate component is replaced with another component. There is a gap between the wires, which directly indicates the changes in the reference points at the vertical osteotomy line. We can determine the direction and distance of movement of the distal segment separately on the right side at a glance

Fig. 1: Wire setup on the original occlusion. Mounting the casts using the facebow transfer method. The maxilla is fixed directly to the mounting plate, and the mandible is attached to the mounting plate through the intermediate component. One wire is fixed to the lateral side of the first molar perpendicular to the occlusal plane on the mandible main cast (arrow), and the other is fixed on the base of the articulator (arrowhead). Two wires are located parallel to each other at the main cast level. The length of the parallel portion is 25 mm

Fig. 3: Movement on the left side. The gap on the left side is shown. Differences in the movement of both sides are easily recognized on both sides at a glance

Fig. 4: A representative case requiring 14° counterclockwise rotation of the distal segment. The mandibular segment should move forward to the position where the posterior wire coincides with the anterior one. Maxillary osteotomy was finally performed to reduce the counterclockwise rotation of the distal segment of the mandible. Note: in cases requiring forward movement, pairs of parallel wires cannot be placed in the original position of the mandible as mentioned in the technique paragraph. A wire placed on the base of the articulator will block the placement of intermediate component for the postoperative position. In this case, a pair of parallel wires is placed to coincide with each other in the postoperative position, as opposed to coinciding in the preoperative position, as for the backward movement

us valuable information (Fig. 4). Analogue simulations have their own advantages and we believe they are not always inferior to digital simulations. First, no highly technical apparatus or expensive software is required, and second, routinely available dental materials are enough to measure the distance and angular changes. This setup articulator is also a powerful tool to provide explanations of treatment plans to patients. We believe this analog method is even more valuable now in the era of digital technology.

CONCLUSION

The double-split cast method in combination with two pairs of wires enables easy visualization of the movement of the distal segment in sagittal split ramus osteotomy.

COMPLIANCE WITH ETHICAL STANDARDS

This article does not contain any studies with human participants performed by any of the authors.

INFORMED CONSENT

This article does not contain any studies with human participants or animals performed by any of the authors.

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