Case Report
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Maxillary Positioning Device for Intermediate Waferless Orthognathic Surgery

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Le fort 1 osteotomy surgery is one of the most popular surgical methods for the treatment of patients with facial bone deformities. An intermediate wafer splint is used to fix the bone segment to the planned position, but there are many steps that can cause errors. To reduce these errors, we propose a method of using a surgical guide made with virtual surgical simulation.

Key Words Computer-assisted surgery · Virtual simulation · Waterless · Orthognathic surgery.

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Introduction

Orthognathic surgery including Lefort 1 osteotomy and bilateral sagittal split osteotomy is the most common surgical procedure for correction of skeletal deformity. The conventional method for maxillary Lefort 1 surgery is the planning using 2D cephalometry analysis. Then, the intermediate wafer splint is fabricated to accurately position the segmented maxilla during surgery through facebow transfer, dental impression, dental cast fabrication, mounting and model surgery. The process of fabricating intermediate wafer splints is relatively simple, but there is a disadvantage in that errors may occur at each step. In the case of a semiadjustable articulator used by most clinicians, facebow transfer is difficult to accurately reproduce the patient's mandibular movements. In addition, the osteotomy line of Le fort 1 segment can not be accurately reproduced during model surgery. Even if these errors are precisely planned before surgery, it is difficult to accurately reproduce them in actual surgery. In order to overcome these shortcomings, we have planned using 3 dimensional virtual surgery instead of model surgery and and designed surgical guides for waferless maxilla positioning.

Case Presentation

The first step is to begin by taking the patient's Computed Tomography (CT). The CT dataset is imported into commercial medical software in dicom format to reconstruct a three-dimensional model(Fig. 1). The patient is diagnosed on a 3-dimensional model and a surgical plan is established. Virtual surgical simulation is performed according to this plan. At this stage, osteotomy line, design and the final position of segment is verified. Then a customized template is created to guide transfer the virtual plan to the operation room itself. They are designed for bone cutting and segment fixation, and the screw holes in the Le fort 1 segment and maxilla are shared between the bone cutting guide and the fixed template using the "cylindrical positioning point concept" (1). Finally, the designed surgical guide are exported as a STL and manufactured by 3 dimensional printer.

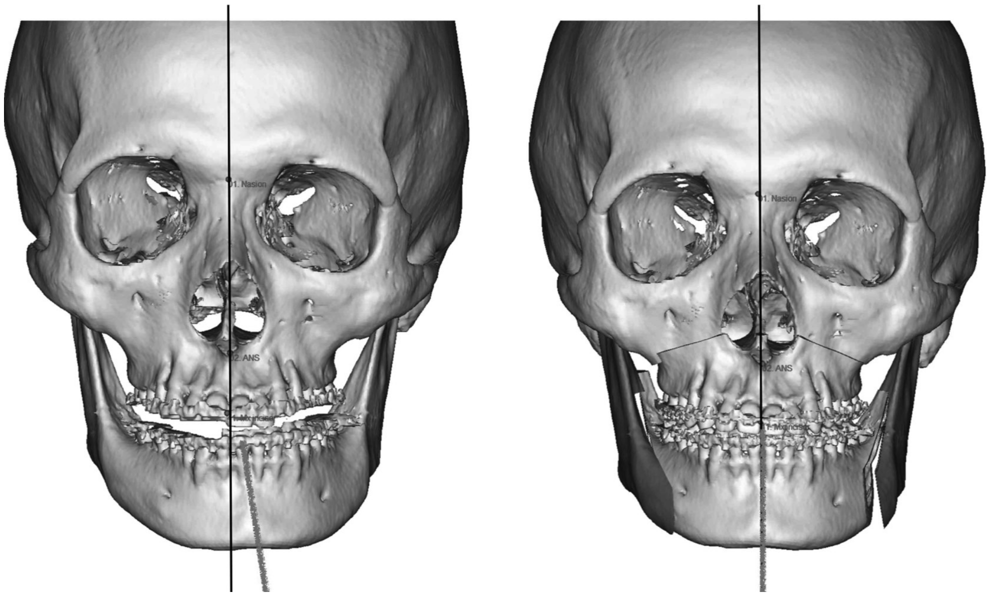

Fig. 1. Accurate diagnosis (Left) and virtual surgical simulation (right) are perform on the 3D model created using computed tomography.

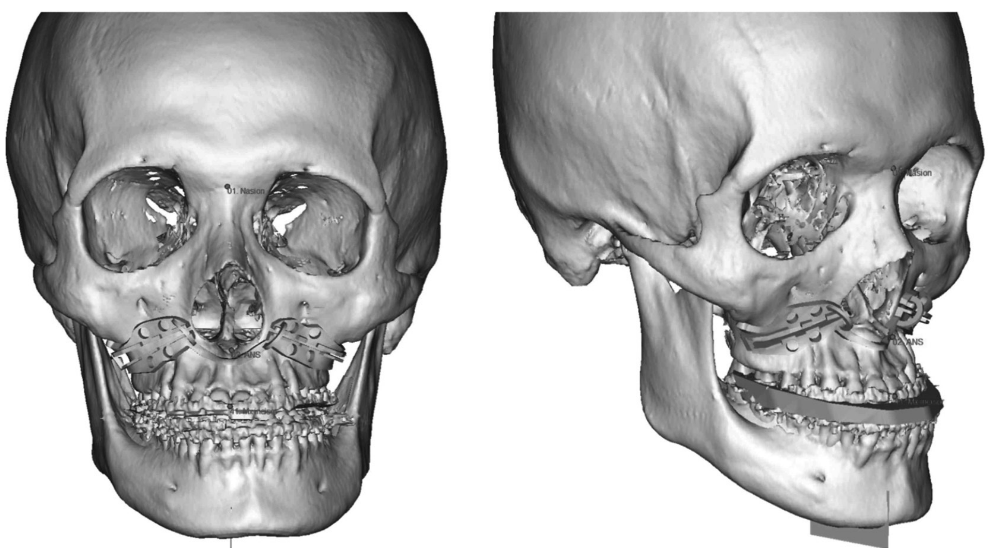

Fig. 2. Designed osteotomy guide. Using this guide, bone cutting was performed in actual surgery and the segments were fixed using holes (cylindrical positioning point concept).

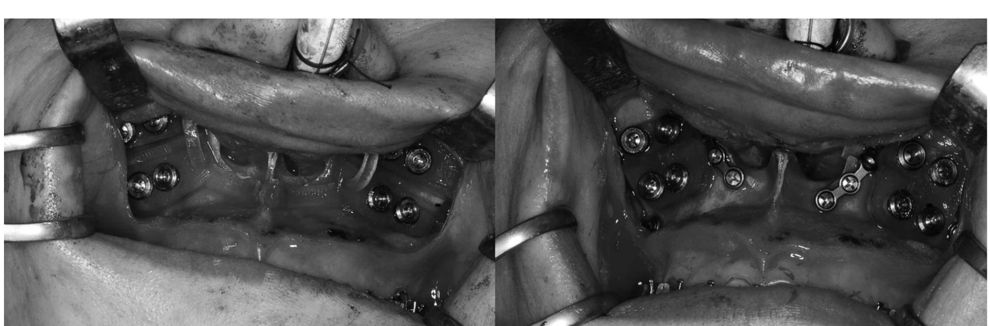

Fig. 3. A surgical guide for osteotomy (left) was applied to the actual operation and fixed with miniplate and screws using a guide for fixation (right).

Discussion and Conclusion

We performed Le fort 1 ostetomy and fixation using a computer-assisted surgical guide without an intermediate wafer. In case of using intermediate wafer, the bone should be gradually trimmed after osteotomy. However, using a surgical guide made with virtual simulation, unnecessary bone removal can be avoided through accurate bone cutting and operative time can be reduced. In addition, errors that may occur when manufacturing intermediate wafers were eliminated. These errors occur at all stages of 1) facebow transfer, 2) dental cast mounting, 3) model surgery, and 4) wafer splint fabrication. The method presented in this paper does not require the facebow transfer and the dental cast mounting process because it directly uses the 3D model from the computed tomography. As a result, surgical errors such as CO-CR discrepancy may be avoided (2). Because the osteotomy in the actual operation cannot be accurately reproduced in the model surgery, the model surgery line of maxilla may be lower or higher than the actual osteotomy line. Our method can eliminate these errors. Finally, errors in wafer splint fabrication can be implemented with little error with 3d printing using the additive manufacturing as the technology advances.

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