Does the Implementation of Virtual Planning has a Significant Impact on Reducing the Revision Rate in Orthognathic Surgery?

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Purpose: Conventional orthognathic surgical planning has limitations in accurately transferring the relationship between soft tissue and bone. Virtual planning offers enhanced accuracy and visualization through computer simulation. This study aimed to compare the need for reoperation between patients who underwent conventional and virtual surgical planning for orthognathic surgery.

Material and Methods: The study included 352 patients who underwent orthognathic surgery. Reoperation rates and reasons for reoperation were evaluated in patients with conventional model surgery planning (143 patients) and virtual planning (209 patients).

Results: The reoperation rate was 7.69% for conventional surgery patients and 3.82% for virtual planning patients. Malocclusion was the most common reason for reoperation in both groups. Bilateral sagittal split ramus osteotomies (BSSO) and genioplasty were the most frequently performed revision procedures.

Conclusion: Virtual planning in orthognathic surgery may lead to a reduced reoperation rate compared with conventional planning methods. The accuracy, visualization, and interdisciplinary collaboration offered by virtual planning can improve surgical outcomes.

Key Words: Conventional surgical planning, orthognathic surgery, reoperation, virtual surgical planning

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Despite the fact that conventional model surgery has produced successful and consistent outcomes for more than 50 years, there are a number of limitations in the treatment planning of complex dentofacial abnormalities and asymmetries.[1] Conventional orthognathic surgical planning of orthognathic surgery is performed in 2 dimensions utilizing cephalometric films and plaster models.[2] Although the spatial position of the jaws and their relationship with each other are transferred to the articulator using the face bow, the complete transfer of the relationship between soft tissue and bone to the planning can only be achieved to a limited extent through clinical examination. Although virtual planning eliminates significant errors that may affect surgical outcomes in any of the delicate stages such as obtaining a dental model, connecting the model to an articulator, or creating a splint, the most significant potential error that can occur is the incomplete transfer of the planning to the surgery.[3,4] Virtual planning has replaced conventional techniques in many clinics due to its simplicity of use in the transfer and splint fabrication and its capacity to simulate multiple movements repeatedly on a computer.[5,6]

Positive treatment outcomes in orthognathic surgery can be obtained through a comprehensive clinical and radiological examination, precise treatment planning, and adherence to the appropriate surgical technique. However, as with any surgical procedure, sometimes a second redo surgery may be required due to complications and dissatisfaction. The revision rate for orthognathic surgery has been reported to be 6% to 12.2%.[7–9] There are several factors that contribute to the perception of surgical procedures as failure among both patients and surgeons. These factors include malocclusion, asymmetry, nasal septum deviation, alterations in condylar position and structure, loosening of fixation, and nonunion of the segments.[10–12] Managing complications with revision surgery is generally more difficult and burdensome than the primary surgery. The paramount prerequisite for achieving a favorable surgical outcome invariably lies in the attainment of success at the initial planning and implementation of the surgical procedure. Proper surgical planning and accurate transfer to the surgery are important to minimize unplanned returns to the operating room after orthognathic surgery.[13,14]

Although there are studies focusing on redo surgeries in orthognathic surgery in the literature, there is currently a lack of studies that directly compare conventional surgical planning with virtual surgical planning. The aim of this study is to compare the need for reoperation redo surgery among orthognathic surgery patients who have undergone conventional or virtual surgical planning.

PATIENTS AND METHODS

This study included patients who underwent orthognathic surgery performed by the same surgical team in the Department of Oral and Maxillofacial Surgery at Medipol Mega University Hospital between April 2015 and August 2022. Patients who were treated with Le Fort I, bilateral sagittal split ramus osteotomies, and genioplasty surgeries alone or in combination after orthodontic treatment and had a minimum follow-up of 6 months after surgery were included in the study. Cleft lip and

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palate patients, osteotomies performed in conjunction with posttraumatic revision or benign tumors (fibrous dysplasia, osteochondroma in the joint, etc.), and patients whose initial surgery was surgical-assisted maxillary expansion were excluded from the study. Perioperative and radiological data were obtained using clinical follow-up notes. The follow-up period after surgery was at least 6 months for all patients. During the follow-up, the need for redo surgery due to complications or unsatisfactory results was evaluated.

The data were recorded and documented in a standardized data collection form created using Microsoft Excel.

RESULTS

A total of 352 patients who underwent orthognathic surgery due to dentofacial deformity were included in the study (198 women and 154 men). The mean age at the initial surgical intervention was 22 (17–52). The number of patients who underwent orthognathic surgery planning with conventional model surgery was 143, and the number of patients who underwent virtual orthognathic surgery planning was 209. The procedures that were conducted on the patients are shown in Table 1 (Supplemental Digital Content 1, http://links.lww.com/SCS/G353).

Table 2 (Supplemental Digital Content 1, http://links.lww.com/SCS/G353) presents the initial dentofacial deformity, surgical procedure at the first operation, time of reoperation, reason for reoperation, procedure performed during reoperation, and other demographic data.

The rate of redo surgery was 7.69% in patients who underwent conventional model surgery and 3.82% in patients who underwent virtual orthognathic surgery planning (a total of 19 patients underwent reoperation).

Redo surgeries were carried out on patients who underwent conventional model surgery on average after 9 months and on patients who underwent virtual surgical planning on average after 4.1 months. Malocclusion was the most common reason for redo surgery in both planning groups. The occurrence of asymmetry was shown to be the second most prevalent factor, accounting for 27.2% in conventional model surgery and 0.0% in virtual planning.

The most performed osteotomy was BSSO, which was performed in 10 cases of 19 redo surgeries. There were 5 patients in the conventional group and 5 patients in the virtual planning group. The second most common revision procedure was genioplasty (performed in 7 of 19 patients). In the conventional planning group, 3 of 4 patients who underwent revişion genioplasty were orthognathic surgery patients who were not initially planned for genioplasty but underwent isolated genioplasty due to postoperative genial asymmetry. In the virtual planning group, revision genioplasty was performed in 3 patients, and genioplasties were repeated. The Le Fort I surgery was performed on the remaining 2 patients.

DISCUSSION

The biggest expectation of patients with maxillofacial deformities is aesthetics, followed by function. It is a complex process that includes long-term treatment involving orthodontics and preoperative orthodontic preparation, surgical stress, loss of jaw sensation, and cost.[15,16] Patients often have the expectation that surgical intervention will resolve all their issues. Informing patients about the necessity of a second corrective operation (revision surgery) poses a challenging predicament for the surgeon. Therefore, the surgeon should make thorough analysis and planning during the preoperative period. A mistake or overlooked detail during surgical planning, whether in the operating room (condyles) or in the postoperative period (relapse), may require additional surgery.[17,18] From the patients' perspective, the need for reoperation in the postoperative period is one of the most distressing complications. Therefore, meticulous preoperative planning, thorough surgical evaluation, and comprehensive postoperative monitoring are required.

In recent years, the increasing use of digital technologies has yielded numerous benefits in the field of planning orthognathic surgery. Nevertheless, there is a lack of research examining the impact of digital technology on rates of revision. This study aimed to evaluate 2 planning methods and assess their impact on revision rates. The findings revealed a significant reduction in revision rates, with a halving effect found when compared with the usual method. However, studies evaluating the effects of digital systems on revision.

Asymmetry is considered the most complex aspect of planning because it also needs to be assessed in the transverse plane. Three-dimensional planning with elliptical planning starting from the lower jaw provides an opportunity for ideal treatment in asymmetric cases.[19]

Orthognathic surgery is a complex procedure that requires precise planning and execution to achieve optimal outcomes. Traditional planning methods using cephalometric films and plaster models have been used for many years but have limitations in accurately transferring the treatment plan to the surgical field.[20] Virtual planning, on the other hand, allows for more accurate and detailed visualization of the surgical movements and their impact on the facial structures.[20,21]

In this study, we compared the redo surgery rates between patients who underwent orthognathic surgery with conventional planning and virtual planning. The results demonstrated a lower redo surgery rate in the virtual planning group compared with the conventional planning group. This suggests that the utilization of virtual planning has the potential to enhance surgical outcomes and decrease the necessity for further surgical interventions.

One possible explanation for the lower redo surgery rate in the virtual planning group is the enhanced accuracy and precision of the treatment planning process. Virtual planning allows for the simulation and evaluation of various surgical movements and their effects on the facial structures before the actual surgery. This enables the surgeon to make more informed decisions and optimize the treatment plan, reducing the likelihood of errors or inadequate corrections.[5,22]

In addition, virtual planning offers the advantage of better communication and collaboration between the surgical team members, including the orthodontist, oral surgeon, maxillofacial surgeon, and prosthodontist. The virtual models and simulations can be easily shared and discussed, allowing for a more comprehensive and interdisciplinary approach to treatment planning.

It is important to note that virtual planning is not without its limitations. The accuracy of the virtual models and simulations relies on the quality of the imaging data and the expertise of the surgeon in interpreting and manipulating the virtual models.[3,23] Technical issues or errors in the virtual planning process can potentially impact the surgical outcomes.

CONCLUSION

In conclusion, our study suggests that virtual planning in orthognathic surgery may contribute to a reduced reoperation rate compared with conventional planning methods. The enhanced accuracy, visualization, and interdisciplinary collaboration offered by virtual planning may help optimize the treatment plan and improve surgical outcomes. However, further research and larger studies are needed to validate these findings and explore the long-term effects of virtual planning on orthognathic surgery outcomes.

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