PSM Journals

PSM
Biological Research

Case Report 2023 | Volume 8 | Issue 2 | 69-74

Article Information

Received: December 23, 2022

Accepted: March 30, 2023

Published: May 31, 2023

Keywords
3d surgical guide,
dental models,
reparative surgery images,
3d printing technology.

Authors' Contribution
EP designed; EP, RHR and COB wrote and MNI revised the paper.

How to cite
Pizoni, E., Barbeiro, R.H., Barbeiro, C.O., Iqbal, M.N., 2023. Surgical Guide for Restorative Orthognathic Procedure. PSM Biol. Res., 8(2): 69-74.
Email:
betp33@hotmail.com

Surgical Guide for Restorative Orthognathic Procedure

Elisabeth Pizoni[1], Roberto Henrique Barbeiro[2]*, Camila de Oliveira Barbeiro[2], Muhammad Naeem Iqbal[3]

[1]Biomaterial Laboratory, Institute of Chemistry, Physical Chemistry Department, Unesp, Araraquara, Brazil.
[2]Sugery laboratory, Dentistry University, Department of Surgery, Unesp, Araraquara, Brazil.
[3]Pacific Science Media, England, United Kingdom.

Abstract:
Dental models have been helping surgeons to preview accurately what they must accomplish during surgery. Although a patient-specific model gives the surgeon the ability to plan and feel what they will be dealing with during the surgery, it would give a lot of worries and work very hard work to make a perfect model that could give a true image of the problems that could be faced during the procedure. This is where 3D printing technology comes in, 3d printing can decrease the number of surprises that could occur during the procedure. The benefits of 3D printing are to give the surgeon the skill to see patient-specific anatomical models, rather than viewing X-rays, ultrasound images, computed tomography (CT) images, or magnetic resonance imaging (MRI) images that might not be as clear as the surgeon would like. This skill can lead the surgeon greater insight as to what he/she will be facing during the procedure and give a more satisfactory outcome for the patient. When things don't go well in surgery, the operation's time and costs increase, and the patient's recovery time might be extended with many other expenses. The best the surgeon knows the patient's anatomy the best he/she can overcome some unexpected situations during the surgery. The aim of this article is to report a prognathic reparative surgery using a 3d surgical guide to plan the steps of it as well as the best way to follow them.

INTRODUCTION

Digital technology and 3D modeling, have become the targeted technology applied to achieve very accurate results and challenges in many fields, especially in dentistry and the medical area, resulting in a fast and good outcome at low cost (Schubert *et al.*, 2014). One of the best specialties of this technology is customized surgical planning which gives to the surgeon the perfect scenario of the problem and helps him/her, to plan the best way to accurately solve it. In this article, we present a current technological use of a pre-operatory surgical procedure for an orthognathic restorative procedure in an asymmetric prognathous patient (Aimar *et al.*, 2019; Calderone, 2016; Jones *et al.*, 2007; Klein *et al.*, 2013). Orthognathic surgery is a unique way in facial surgery that a patient's appearance and occlusal function can be improved significantly, impacting the patient's sense of self and well-being. Successful outcomes in modern orthognathic surgery rely on close collaboration between the surgeon and the orthodontist across all stages of treatment, from preoperative planning to the finalization of occlusion. Virtual computer planning promotes a more accurate analysis of dentofacial deformity and preoperative planning. It is also an invaluable aid in providing comprehensive patient satisfaction (Calderone, 2016).

A young man (27 year old) was diagnosed with a dent facial deformity, which was compromising his chewing and aesthetics causing severe facial pain because of the mandible mal formation. Due to these problems it was suggested a surgical correction by a surgeon and orthodontist.

After all the exams were concluded, the maxillofacial surgeon examined the patient´s reviews and all available records and discusses with patient and family the available treatment options. It was chosen an orthodontic treatment and orthognathic surgery because it was going to give the patient more comfort in chewing and would improve a lot her aesthetic (Picture 1, 2 and 3) (Schendel and Jacobson, 2009; Schendel and Montgomery, 2009). So the surgeon applied for using a 3d surgical guide to plan the surgery because this method would help him to see and study a very complex surgery entirely. But it should be noted here that it is also possible today to do all orthodontic treatments using printed aligners also by CAD / CAN technology (Maal *et al.*, 2010). This present case was treated by means of conventional orthodontics.

METHODS (CASE REPORT)

The patient J.A.P., 27 years old, male, was referred by the orthodontist after orthodontic preparation with angle class III skeletal deformity, with important facial asymmetry (Figure 1), difficulty in phonation and chewing, in addition to the objective aesthetic complaint. After evaluating the study models that allowed adequate function in Angle Class I, the patient was submitted to facial analysis to obtain preoperative measurements and decision of surgical movements necessary for correction of skeletal deformity, intraoral clinical examination (Figure 2), analysis of panoramic radiography and cephalometric radiography in lateral and frontal norm (Figure 3) (Atram *et al.*, 2021; Bagheri, 2014).

Fig. 1. Frontal and lateral extraoral photographs after orthodontic treatment with asymmetric prognathism

patient with his mouth closed, resting and smiling. Patient at 27 years of age.

Fig. 2. Intraoral photographs after orthodontic treatment.

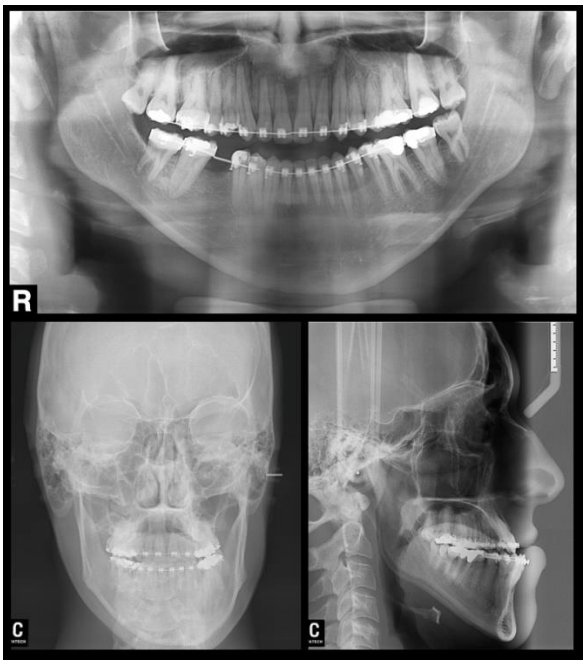

Fig. 3. Pre-surgical of conventional radiographs Panoramic, Lateral and Frontal cephalometric radiographs for basic evaluation.

The proposed treatment was bimaxillary orthognathic surgery with Mentos plastic through planning and construction of surgical guides in virtual planning. The clinical protocol consists of 3D data acquisition of the craniofacial complex by cone-beam computed tomography (CBCT) and surface scanning of the plaster dental casts (Rangel *et al.*, 2018). The skull situation for virtual simulation was prepared, the virtual patient in software DDS-Pro*(www.dds-pro.com.pl) and are drawn the Le Fort I osteotomy, bilateral sagittal split osteotomy and chin horizontal osteotomy osteotomies and the soft tissues can also be seen (Figure 4). In this case, we opted for the conventional order of surgery initiated by the maxilla by means of The Le Fort I Osteotomy with an advance of 6 mm, intrusion of 1.5 mm in the region of the central incisors, intrusion of 2 mm in the region of the first molar and correction of the cant (Figure 5), followed by bilateral sagittal osteotomy of the mandible to correct the mandibular asymmetry and obtaining a stable occlusion. Finished with a vertical reduction meatoplasty of 4 mm (Figure 6). The guides generated in the software (Figure 7) are printed for trans operative use and thus allow the achievement of the desired and previously established results in virtual planning (Figure 8) (Meyer-Szary *et al.*, 2022).

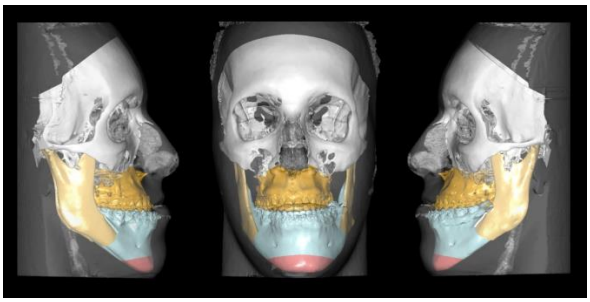

Fig. 4. 3D Image of the preoperative skull situation for virtual simulation with Frontal and Lateral view of a Le Fort I osteotomy, bilateral sagittal split osteotomy and chin horizontal osteotomy showing soft tissue.

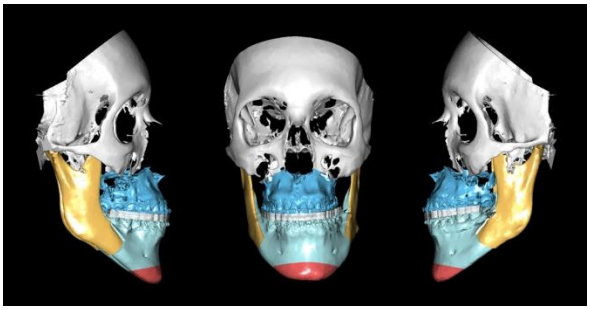

Fig. 5. 3D Image of the simulation the intermediate movement of the Maxilla by a Le Fort I osteotomy in Frontal and Lateral view showing virtual splint set between the dental arches.

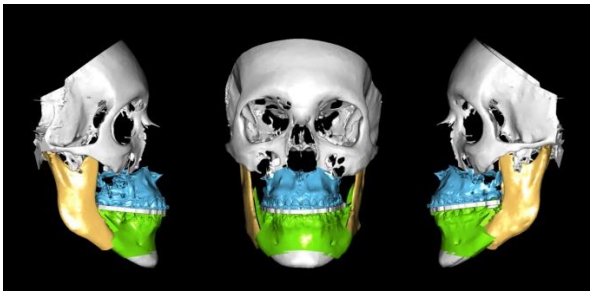

Fig. 6. 3D Image of the simulation the final movement of the Mandible by a bilateral sagittal split osteotomy and chin horizontal osteotomy in Frontal and Lateral view showing virtual splint set between the dental arches.

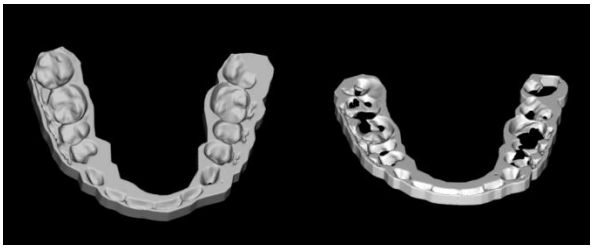

Fig. 7. 3D Image of intermediate and final virtual split the virtual ready to be printed.

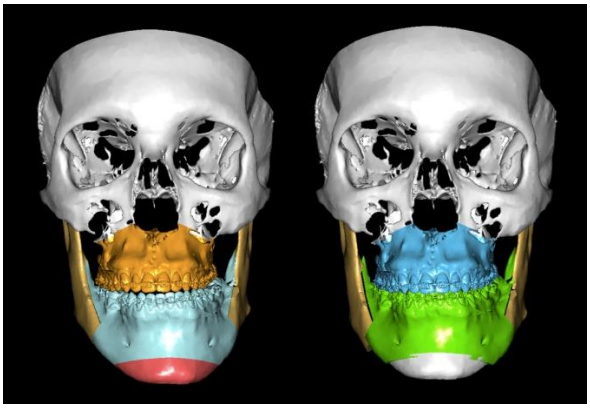

Fig. 8. 3D Image of the preoperative skull and postoperative virtual simulation of the predicted results on hard tissues after reposition the mobilized bone estructures.

RESULTS AND DISCUSSION

In the immediate postoperative period, panoramic radiography and cephalometric radiographs are obtained in lateral and frontal norm (Figure 9) to confirm the quality of skeletal fixations and evaluate the results. The processes of panoramic and cephalometric radiography are mostly done in succession to save the patients time and energy (Feragalli *et al.*, 2017; Wrzesień and Olszewski, 2017). The patient remains on average 3 to 6 months in orthodontic follow-up with the objective of an adequate completion allowing an excellent occlusal and functional result (Figure 10). A previous study documented that orthodontic treatment using implant-anchored mechanics provided a proper facial profile with significantly improved occlusal function (Ishihara *et al.*, 2020). Also no less important we observed the aesthetic result of prognathism correction and correction of asymmetry (Figure 11) optimized by correct virtual planning. An accurate surgical plan, implemented with precision during the real surgery, is very important for the success of orthognathic surgery (Ying *et al.*, 2015). Virtual planning seems to be an accurate and reproducible method for orthognathic treatment planning, especially in terms of frontal symmetry (Alkhayer *et al.*, 2020; Brito and Mordente, 2018).

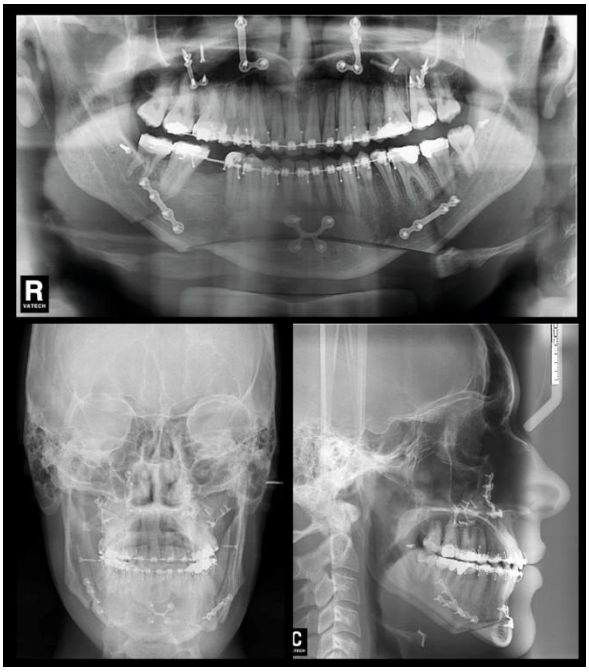

Fig. 9. Postoperative conventional radiographs Panoramic, Lateral and Frontal cephalometric radiographs.

Fig. 10. Postoperative intraoral photographs after surgery and finishing orthodontic to an excellent occlusal and functional result orthodontic and surgical treatment.

Fig. 11. Postoperative frontal and lateral extraoral photographs after orthodontic treatment with asymmetric prognathism patient with his mouth closed, resting and smiling. Six months after surgery.

CONCLUSION

Virtual planning in orthognathic surgery contributes to the care and improvement of treatment quality in dental facial deformities and it represents an important evolution of this process in recent years.

However further studies for a deeper knowledge in the software and hardware is required for the virtual planning.

In our field we also should consider improving costs and a software upgrade to ease and popularize its use, thus creating well defined protocols and increasingly predictable planning.

This evolution will allow more accurate results, besides increasing the confidence between the surgeons and the patient satisfaction.

The exposed clinical case confirms the importance of the 3d technology evolution in the medical field and the results confirm the evolution of virtual planning and the success of the interdisciplinarity of many areas of knowledge to obtain more predictable results in medicine, increasing the surgeon and patient confidence.

ACKNOWLEDGMENT

I would like to thank the University of São Paulo State, Unesp, where I develop my Ph.D thesis in the 3d Bioprinting area.

Funding

There was no sponsor (private clinic).

CONFLICT OF INTEREST

I declare that this research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

REFERENCES

Aimar, A., Palermo, A., Innocenti, B., 2019. The role of 3D printing in medical applications: a state of the art. Journal of healthcare engineering, 2019.

Alkhayer, A., Piffkó, J., Lippold, C., Segatto, E., 2020. Accuracy of virtual planning in orthognathic surgery: a systematic review. Head Face Med., 16(1): 34.

Atram, H. et al., 2021. Assessment and comparision of Gonial angle in

panoramic radiograph and lateral cephalogram in adult patient with Class I and Class II malocclusion. Archives of Dental Research, 11: 17-23.

Bagheri, S.C., 2014. Chapter 9 - Orthognathic Surgery. In: Bagheri, S.C. (Ed.), Clinical Review of Oral and Maxillofacial Surgery (Second Edition). Mosby, St. Louis (MO), pp. 293-332.

Brito, H.H.A., Mordente, C.M., 2018. Facial asymmetry: virtual planning to optimize treatment predictability and aesthetic results. Dental Press J. Orthod., 23(6): 80-89.

Calderone, L., 2016. Robots in manufacturing applications. Manufacturing Tomorrow.

Feragalli, B. et al., 2017. Cone beam computed tomography for dental and maxillofacial imaging: technique improvement and low-dose protocols. Radiol Med, 122(8): 581-588.

Ishihara, Y., Arakawa, H., Nishiyama, A., Kamioka, H., 2020. Occlusal reconstruction of a patient with ameloblastoma ablation using alveolar distraction osteogenesis: a case report. Head Face Med., 16(1): 12.

Jones, R., Khambay, B., McHugh, S., Ayoub, A., 2007. The validity of a computer-assisted simulation system for orthognathic surgery (CASSOS) for planning the surgical correction of class III skeletal deformities: single-jaw versus bimaxillary surgery. Int. J. Oral Maxillofac. Surg., 36(10): 900-908.

Klein, G.T., Lu, Y., Wang, M.Y., 2013. 3D printing and neurosurgery--ready for prime time? World Neurosurg., 80(3-4): 233-5.

Maal, T.J. et al., 2010. Registration of 3-dimensional facial photographs for clinical use. J Oral Maxillofac Surg, 68(10): 2391-401.

Meyer-Szary, J. et al., 2022. The Role of 3D Printing in Planning Complex Medical Procedures and Training of Medical Professionals-Cross-Sectional Multispecialty Review. Int. J. Environ. Res. Public Health, 19(6).

Rangel, F. et al., 2018. Integration of digital dental casts in cone beam computed tomography scans—a clinical validation study. Clin. Oral Investig., 22.

Schendel, S.A., Jacobson, R., 2009. Three-dimensional imaging and computer simulation for office-based surgery. Journal of oral and maxillofacial surgery, 67(10): 2107-2114.

Schendel, S.A., Montgomery, K., 2009. A web-based, integrated simulation system for craniofacial surgical planning. Plast. Reconstr. Surg., 123(3): 1099-1106.

Schubert, C., van Langeveld, M.C., Donoso, L.A., 2014. Innovations in 3D printing: a 3D overview from optics to organs. Br. J. Ophthalmol., 98(2): 159-61.

Wrzesień, M., Olszewski, J., 2017. Absorbed doses for patients undergoing panoramic radiography, cephalometric radiography and CBCT. Int J Occup Med Environ Health, 30(5): 705-713.

Ying, B. et al., 2015. Correction of facial asymmetry associated with vertical maxillary excess and mandibular prognathism by combined orthognathic surgery and guiding templates and splints fabricated by rapid prototyping technique. Int. J. Oral Maxillofac. Surg., 44(11): 1330-1336.