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Case Report

Mandibular Reconstruction Assisted by Virtual Planning with Freeware and FDM 3D Printing: Case Report

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Abstract

The use of virtual tools in the planning of maxillofacial surgeries has undergone a progressive advance in recent years, becoming more accessible due to the decrease in equipment costs and access to freeware.

In the present work, we present our experience of management with a patient previously operated on for a cementoblastoma resection, who after the initial reconstruction, the ascending ramus of the mandible displaces occupying an aberrant position. We perform free software-assisted planning and reconstruction with the help of rapid prototyping biomodel and iliac crest graft.

Keywords: *Freeware; 3D Print; Cementoblastoma; Mandible Reconstruction; Iliac Bone Graft; Rapid Prototyping*

Abbreviations

FDM: Fused Deposition Modeling; DLP: Digital Light Processing; CT: Computerized Tomography

Introduction

The use of rapid prototyping has been introduced to many branches, medicine being one of those that has taken advantage of its development, either for the development of instruments or for the manufacture of biomodels and implants that allow us to plan complex surgeries, allowing us to lower costs and operating room time [1].

Stereolithography was widely used in dentistry and medicine, making it possible to obtain models of great precision but with the problem of high cost of both equipment and biomodels, as well as the long time to elaborate the model [2].

Other types of 3D printing, such as FDM or DLP, emerged as work options [3], with an obvious cost reduction versus stereolithography and with minimal disadvantages such as material porosity [7].

Some studies carried out on jaws, vertebrae and other bones [4-7], measured the variation of 3d impressions with fused thread deposition in contrast to the bone, obtaining safe values that support clinical use.

Analyzing the applications in oral and maxillofacial surgery [3], 3D printing is used mainly in dentistry for three cases: realization of 3D surgical models, surgical guides and prostheses and specific implants for patients. But we cannot ignore its use in both surgical and patient teaching [7].

The planning and elaboration of the biomodel using freeware such as Blender® or Meshmixer® has been described by some authors with satisfactory results [8,9].

Case Report

This case is about a 34-year-old female, without underlying pathology, patient of the ICO (Chuquisaca's Institute of Oncology). Initially operated on for a mandible cementoblastoma resection and reconstructed with a non-vascularized iliac crest graft, fixed by two 2.0 mini-plates. Apparent insufficient length of the graft causes tension displacing the mandibular ramus anteriorly and medially. The patient has difficulty opening and pain in the contralateral temporomandibular joint. The initial graft becomes necrotic and loses.

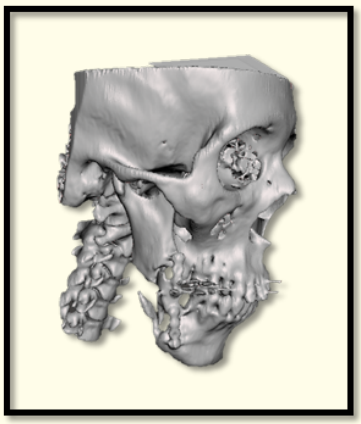

Figure 1: Previous CT Lateral view.

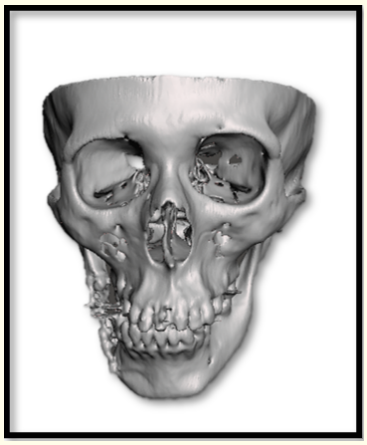

Figure 2: Previous CT frontal view.

Initially, the first graft and osteosynthesis material are removed, to proceed to perform a new CT scan showing the displacement of the ramus.

Figure 3: CT Lateral view without first graft.

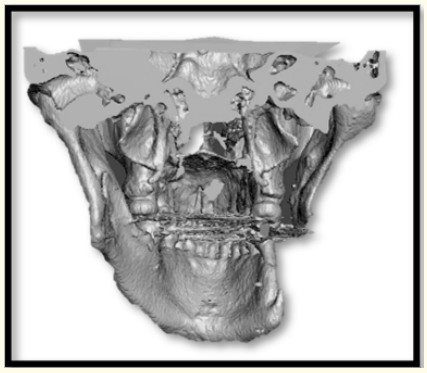

Figure 4: CT Posterior view showing positions of spine of Spix and gonion.

A repositioning of the ramus is performed in Meshmixer (Figure 4-6), taking into account the position of the contralateral side, taking as references the spine of Spix, the gonion and a mirror superposition.

After obtaining the new position, the model is printed on an FDM printer, XYZ DaVinci Pro, with PLA filament. A resin guide is made to obtain the donor bone (Figure 8).

Figure 5: CT Lateral view without planning.

Figure 6: CT Lateral view repositioned.

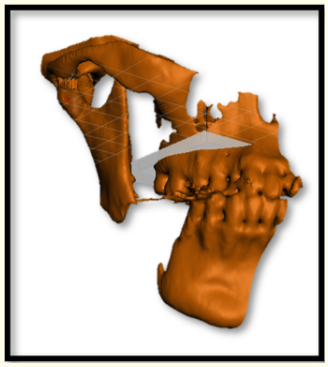

Figure 7: STL model.

Figure 8: Printed model with resin guide.

In the model (Figure 10), the reconstruction plate (Synthes 2.4 system) is contoured. Then the non-vascularized iliac crest graft is taken using as reference the acrilic guide block (Figure 9). In the next step the graft is fixed to the plate and then is easily positioned in the receptor bone (Figure 11).

Figure 9: Bone graft.

Figure 10: Printed model with plate screws and bone graft.

The position achieved is the one that was sought, obtaining stability. The patient is followed for 6 months without complications.

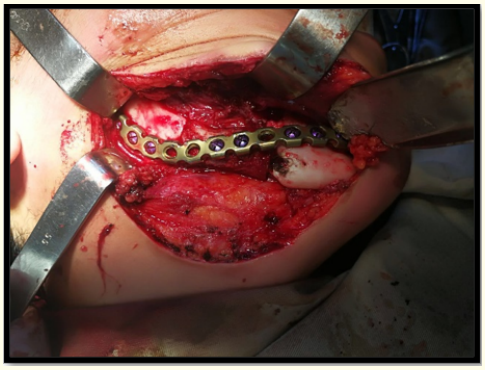

Figure 11: Plate, screws and bone graft placed in receptor bone.

Figure 12: CT 6 months follow up.

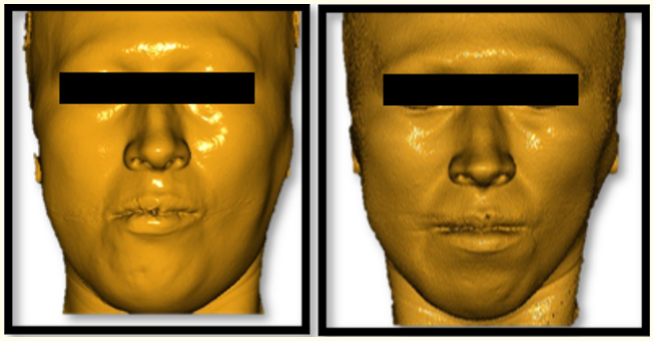

Figure 13 and 14: Pre and post-operative soft tissue reconstruction (Frontal view).

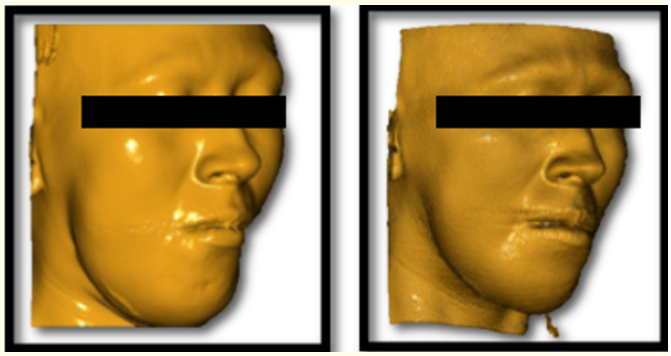

Figure 15 and 16: Pre and post-operative soft tissue reconstruction (Sideway view).

Discussion

Virtual planning and work with biomodels allows us to approach the surgical treatment with greater safety, being able to obtain better results. There is even more to be done by creating cutting guides and drilling guides to position the osteosynthesis material as planned.

Conclusion

The use of FDM printers and freeware are allies when planning maxillofacial reconstructions since they allow reducing surgical times and improving results.

Acknowledgements

To our patient for the trust.

Conflict of Interest

There is no conflict of interest.

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