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## Prototyping for the treatment of late zygomatic-orbital fracture: A case report



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### ABSTRACT

**INTRODUCTION:** Zygomatic-orbital complex fractures are the most common facial traumas that can result in severe esthetic and functional sequelae. Surgical correction of these fractures is a delicate approach and prototyping is an excellent tool to facilitate this procedure.

**PRESENTATION OF CASE:** A 27-year-old man, a motorcycle accident victim, was hospitalized in the intensive care unit for 30 days. After this period, facial fractures were treated surgically, leaving sequelae such as enophthalmos, dystopia and loss of projection of the zygomatic arch. A second intervention was planned after one year for reconstruction of the orbit with the help of prototyping. Better outcomes were achieved than in the first intervention.

**DISCUSSION:** This report permits to compare the result of conventional surgery and the use of a prototype in the same patient. Noticeably better outcomes were achieved with the second approach. Prototyping made the surgical procedure more predictable and reduced operative time because of the possibility of using preshaped titanium plates.

**CONCLUSIONS:** Prototyping was found to be an excellent option to overcome the deficiencies of the conventional technique, recovering the functional and esthetic characteristics of the patient's face and ensuring a markedly satisfactory outcome.

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## 1. Introduction

Surgical reduction of zygomatic-orbital complex fractures is generally challenging for the surgeon because of the lack of an occlusal guide and the involvement of various structures of the middle third of the face [1]. Severe esthetic and functional sequelae can occur in cases of trauma to this region, including enophthalmos and diplopia, as a result of swelling of the orbit due to orbital floor fracture and herniation of the ocular content into the maxillary sinus [2,3].

Excellent results in the treatment of these sequelae are observed for reconstruction of the orbital floor with titanium meshes and stable internal fixation with mini-plates using rapid prototyping for surgical planning [4]. The use of prototypes in oral and maxillofacial surgery has benefits such as greater predictability, more detailed

planning and a shorter operative time because of the possibility of using preshaped plates [5–7].

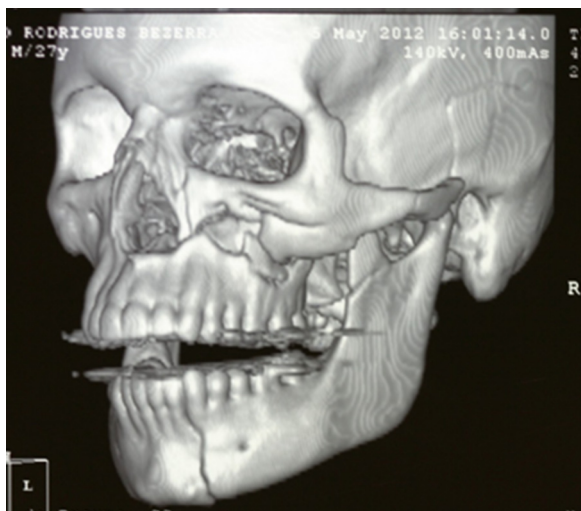
For better planning of reconstructions of the contour and volume of the orbit, the so-called mirror image technique, in which the software is able to mirror the healthy hemiface and print the intended bone framework, has become a useful tool. Thus, the surgeon can plan the procedure from a prototype exactly corresponding to the way he intends the patient to look after surgery [1,8].

The objective of this study was to report a case of orbit reconstruction for correction of an esthetic defect caused by severe injury to the zygomatic-orbital region using prototyping for surgical planning and optimization. This work has been reported in line with the SCARE criteria [9].

## 2. Presentation of case

A 27-year-old white male patient, a motorcycle accident victim, was brought by an ambulance to the emergency department of a public trauma hospital in Campina Grande, Paraíba, Brazil. The

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**Fig. 1.** Computed tomography scan showing fractures in the zygomatic bone, maxilla and mandible after trauma.



**Fig. 2.** Frontal view of the patient one year after the first surgical intervention. Note the presence of enophthalmos, dystopia and deficient projection of the zygomatic bone.

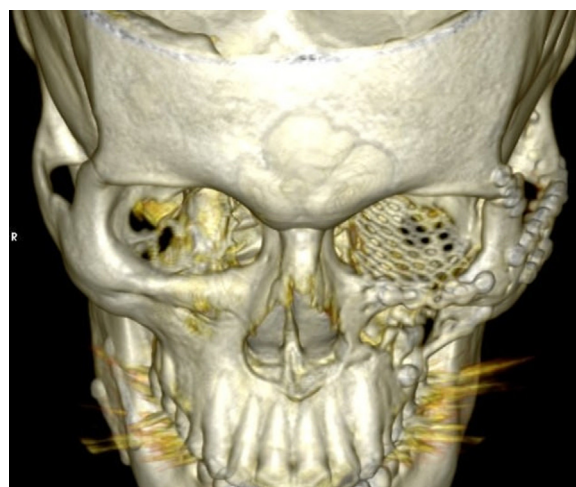
patient presented with fractures in the mandible, maxilla and left zygomatic-orbital complex, in addition to traumatic temporal lobe damage. In view of other morbidities, the patient remained hospitalized in the intensive care unit receiving neurosurgical care for 30 days. After this period, healing of the facial fractures had already progressed substantially (Fig. 1) and the patient was referred to the oral and maxillofacial sector of the hospital. A first intervention of the face was performed after analysis of the images and preoperative exams. In this procedure, the oral and maxillofacial surgeon aimed at reduction and fixation of the fractures.

After one year, the patient sought the team because of esthetic complaints in the left eye. Physical examination revealed the presence of enophthalmos, dystopia, deficient projection of the zygomatic bone, facial nerve damage and amaurosis, which resulted in a perceptible esthetic defect and discomfort to the patient (Fig. 2). The mandibular fractures had healed satisfactorily and no occlusal alterations were observed.

The computed tomography images were updated, digitized, and sent to the Renato Ascher Information Technology Center. A mirror image was produced with the Invesalius 3 Beta 4 software, dividing the image in the midline of the face and reproducing the healthy side to obtain a perfect and symmetric model of the face. After image editing, a prototype was printed in resin that reliably reflected the bone structure of the patient (Fig. 3). Next, surgical planning aimed at sectioning and correct repositioning of the zygomatic bone was performed, including pre-shaping of the plates and fixation in the model (Fig. 3).



**Fig. 3.** Surgical planning using titanium plates and meshes.



**Fig. 4.** Computed tomography scan obtained after the second surgical intervention.

Surgery consisted of a coronal incision for complete exposure of the zygomatic bone and sectioning along the frontozygomatic suture, lateral wall of the orbit, zygomatic arch and zygomaticomaxillary region. A subciliary incision was made to gain access to the orbital floor and an intraoral approach was used for visualization and fixation in the zygomaticomaxillary region. A system of 2.0-mm titanium plates with monocortical screws was applied (Fig. 4).

Postoperative recovery occurred without intercurrents. During the return visit 40 days after the surgical procedure, the patient showed considerable improvement, with alignment of the orbits, absence of enophthalmos and dystopia and satisfactory projection of the zygomatic arch. The postoperative outcomes were satisfactory, permitting functional and esthetic rehabilitation of the patient (Fig. 5).

### 3. Discussion

The patient of this case report presented with sequelae of a previous zygomatic complex fracture and destruction of the orbital floor, which led to healing of the zygomatic bone in an undesired position, including the loss of projection and a defect in the lateral wall of the orbit [10]. Fractures of the orbital bones and zygomatic bone can cause undesirable esthetic sequelae in the patient. In this respect, techniques such as prototyping have provided successful results and its use has become increasingly important [11].

In this study, it was possible to compare the surgical outcome in the same patient since he was treated in two ways, with and without prototyping, and a noticeably better outcome was achieved

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