



Management of Bilateral Condylar Fractures in an Edentulous Patient with Atrophic Mandible Using CAD/CAM Technology

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Abstract

Purpose The objective of this article is to report the case of an edentulous patient with a diagnosis of bilateral condylar fracture, who was treated using virtual planning.

Methods CAD/CAM technology was used for the design and manufacture of a Gunning splint, which was employed for open reduction of the right fracture and closed management of the left side.

Results The reduction of the right condylar fracture projected in the planning was achieved, as well as the return of the vertical dimension and the restoration of function, after 28 months of observation.

Conclusion In the case of total edentulism, the lack of occlusal guidance and bone atrophy are important variables to consider; however, tools such as CAD/CAM technology can be used to take more predictable treatment decisions and facilitate the execution of the procedures.

Keywords Condylar fracture · Edentulous · Atrophic mandible · Virtual surgical planning

Introduction

The management of condylar fractures is possibly one of the most controversial issues in maxillofacial trauma, since it must be assessed whether the risk of performing an open reduction is greater than the benefit that could be achieved with the closed method. In the case of partially or totally edentulous patients, the impossibility of using occlusion to achieve adequate alignment of the segments adds a variable to consider [1]. Completely edentulous patients with advanced mandibular atrophy may additionally present a deterioration in their general state of health, due to their poor diet. In these cases, it is valid to use resources that help to surgically guide the repositioning of the bone segments, such as Gunning splints [2]. Between 1866 and 1867, Thomas Brian Gunning documented the closed treatment of condylar fractures using 4 different types of splints, based on the principle of positioning and immobilization of bone segments. His work included devices for toothed patients, the retention of which was achieved by leaning on the occlusal surfaces of the teeth or by means of wires or screws with bone or dental anchorage. For edentulous patients, he used devices that had extraoral and elastic fixation wings to maintain their stability [3]. Also, Wolfe et al. [4] reported the placement of a mini-osteosynthesis plate fixed with screws in the anterior region, to achieve intermaxillary fixation and regain vertical dimension in an edentulous patient.

Different surgical modalities have benefited from the advent of CAD/CAM technology, because it provides greater diagnostic accuracy, can generate prosthetic implants, and optimize procedures by printing cutting guides and splints [5]. The objective of this article is to present a case in which this technology is used for the elaboration of a Gunning splint for the combined

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open/closed management of bilateral condylar fractures in an edentulous patient.

Case Report

A 75-year-old male patient, with no relevant medical history, partially edentulous, suffers facial trauma from a fall from a height of 2 m from the ground. The clinical examination shows oral hypometry with slight right mandibular deflection, in addition to bilateral condylar absence during palpation and tooth mobility. Computed tomography (CT) confirmed the diagnosis of bilateral subcondylar fracture and dentoalveolar fractures (Fig. 1). The CT was sent to the company Surgical Planning SAS (Medellín, Colombia) to carry out the virtual planning for the open reduction of the right subcondylar fracture, using the Materialize-3-Matic 12.0 software (Materialize, Leuven, Belgium). The vertical dimension was restored considering an adequate reduction of the fracture, the distance to the edentulous edges of both maxillae, and the correct seating of the condyles in the most posterior and superior position of the glenoid fossa (Fig. 1). Subsequently, the extraction of the remaining teeth was planned to continue with the design of the splints, which had wings with holes for intraoral fixation using IMF screws, avoiding damage to

neighboring neurovascular structures (Fig. 1). Once the splint was printed, surgery was executed under general anesthesia with nasotracheal intubation, first performing the multiple extractions and regularization of the alveolar ridges, followed by flapless intraoral fixation of the splints in the maxilla and mandible, with which the dynamic stabilization was achieved using elastics (Fig. 2). Using a minimally invasive preauricular approach, the right subcondylar fracture was reduced and fixed using a 2.0 system miniplate and 4 screws (Fig. 3). The surgical access was closed by planes and the Gunning splint was left in place for 4 weeks for the consolidation of the left subcondylar fracture. Subsequently, the splint was removed in the fourth postoperative week, instructing the patient to undergo jaw movement physiotherapy. In the postoperative tomography, an adequate reduction of the fracture was observed (Fig. 4), and during the postoperative controls it was possible to verify preserved oral opening and symmetrical mandibular movements (Fig. 5). The patient was rehabilitated with total upper and lower prosthesis at 3 months (Fig. 6) and has a 28-month follow-up.

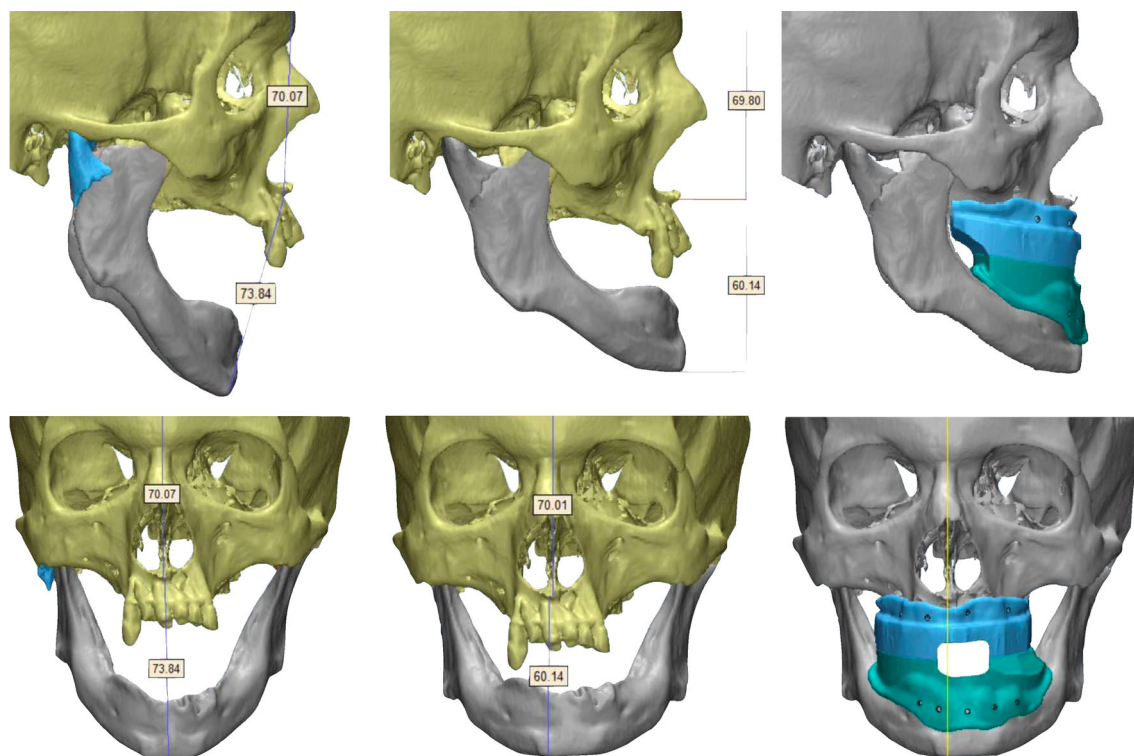


Fig. 1 Tomographic image in three-dimensional reconstruction showing the condylar fractures, the virtual planning for the reduction of the right condylar fracture and the return of the vertical dimension,

and the Gunning splint digital design. Note the wings with holes projected in areas of secure bone anchorage

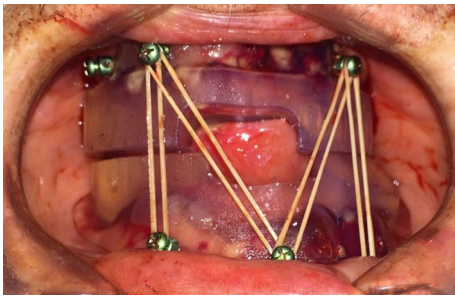


Fig. 2 Intraoral fixation of the splints with IMF screws, which in turn serve for the placement of dynamic stabilization elastics

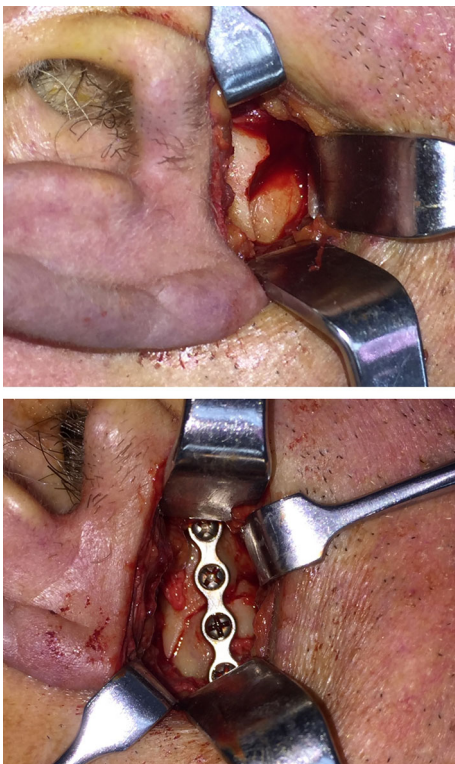


Fig. 3 Image showing the conservative preauricular approach, the location, reduction and fixation of the fracture

Discussion

Traditionally, the most appropriate treatment for condylar fractures has been a matter of debate. Closed management has been used for cases of mild or moderately displaced unilateral fractures, seeking to avoid the adverse effects associated with the surgical procedure; however, joint mobilization and strict occlusion control are required as soon as possible to avoid permanent complications [6]. On the other hand, the open method allows a greater visualization of the operative field, which is why it is very useful in cases of bilateral condylar fractures without contact of the bone segments, in partially edentulous patients with unstable occlusion and in edentulous patients with unilateral or bilateral fractures, always taking into account the recovery of the height of the ramus to avoid open bites [1]. The disadvantages of the latter are the risk of causing nerve damage and unsightly scars. Taking into account the above, the management of condylar fractures in edentulous patients with atrophic jaw is a challenge that adds 2 additional variables to the already complex decision-making of whether the management should be open or closed: the decrease in quality and quantity of bone, and the absence of a guide for the repositioning and fixation of the segments. It is because of all the above that in this case it was decided to perform an open approach only to reduce the right fracture, which presented absence of contact between the bone segments, in order to ensure the vertical dimension without having to intervene on the left side.

Gunning splints have been of great help in the management of fractures in total or partial edentulous patients, because they provide stability at low cost. However, this stability has been questioned in certain cases, coupled with the fact that taking impressions in the fractured patient can generate discomfort and pain for the patient and become a challenge for the operator. These splints seek to recover the vertical dimension in edentulous patients and provide stability in the reduction of fractures, and if they allow a closed management, they in turn avoid invasive procedures

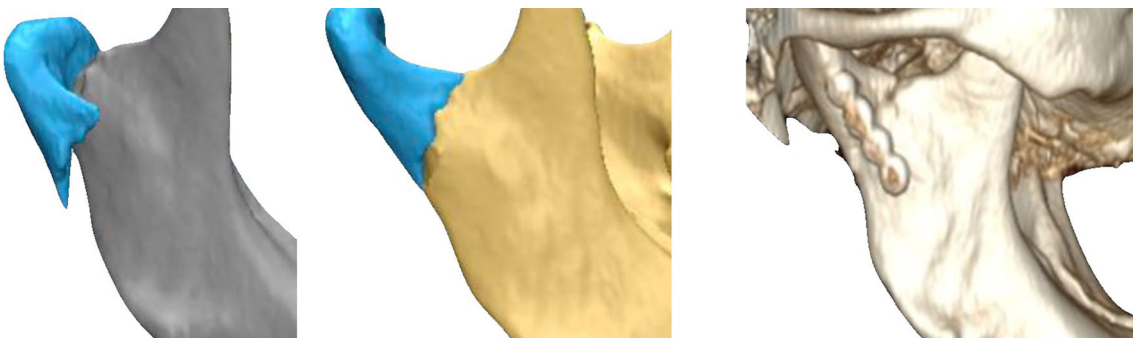


Fig. 4 A series of images showing the initial position of the bone segments (left), the virtual projection of the reduction (center) and the final position achieved surgically (right)



Fig. 5 Images of the patient obtained at the 28-month postoperative control, showing adequate vertical dimension and preserved oral opening



Fig. 6 Intraoral photograph showing the oral rehabilitation of the patient with upper and lower total prostheses, three months after the surgical procedure

in patients who in many cases have advanced age, possibly a compromised state of health and a decreased vascularization, factors that in turn can compromise healing [7]. Traditionally, they consist of two attachments, one maxillary and the other mandibular, which, after placement, must be held together by means of wires or elastics to achieve intermaxillary fixation. Over time, some modifications have been proposed, such as that of Chaudhary et al. in 2014, who suggested the manufacture of Gunning splints fixed with IMF screws, which allows these same screws to be used for intermaxillary fixation. They also incorporate Erich arches to the splint in case the use of elastics is required. A limitation of this technique is that at least 10 mm of bone height is required to anchor the screws [8]. In 2018, Wang et al. reported the case of a total upper and partial lower edentulous patient, diagnosed with mandibular fractures of the right body, left angle and left condyle, in whom adequate reduction and fixation of body and angle fractures was achieved using CAD/CAM technology to perform virtual surgical planning, and later the design and manufacture of a maxillomandibular splint and a milled patient-specific reconstruction plate. The authors reported benefits from the use of CAD/CAM technology such as better planning, reduced surgical times due to precontouring of plates and smaller approaches [9]. Another modification to the design was proposed more recently by

Hwang et al. in 2021, documenting a case of bilateral condylar fracture in an edentulous patient in whom the vertical dimension was restored using an acrylic monoblock Gunning splint for intermaxillary fixation using circum-mandibular and circum-zygomatic wire [10]. In the present case, the benefits of the Gunning splint for the reduction and stabilization of fractures are highlighted, as well as those achieved by means of CAD/CAM technology to virtually restore the vertical dimension without having to resort to traditional manipulation for the fabrication of the acrylic guides, which can be painful for the patient and difficult for the operator. At the same time, it was possible to optimize the precision in the adjustment and stabilization by obtaining a personalized splint that could be fixed with screws inserted in areas of good anchorage and security, avoiding important anatomical structures. In turn, the open management of the right side was combined with the closed management of the left, for which the splints also served as a guide for consolidation, at the same time that they provided the controlled dynamism with the intermaxillary fixation elastics necessary to avoid trismus and ankylosis.

Regarding the disadvantages of using CAD/CAM technology, the authors of this article agree with Wang et al. [9] in the fact that the process of virtual planning and obtaining splints is slower (2 days in this case) than the manual preparation, and undoubtedly more expensive; however, the safety given by the accuracy of this method, the comfort of the patient and the reduction in surgical time are important mitigating factors, since the availability of tomography and planning software are increasingly within the reach of public and private systems of health, which in turn will decrease its cost over time.

In conclusion, open or close reduction of condylar fractures in edentulous patients can benefit from the use of virtually planned Gunning splints. CAD/CAM technology can contribute to obtaining a better diagnosis and treatment plan, minimizing risk and surgical times, and improving

aesthetics. Its use is highly recommended by the authors both for the indication presented in this article and in other innovative treatments, because it will be increasingly available to health systems and trauma centers worldwide.

Declarations

Conflict of interest The authors declare that they have no conflict of interest. No financial support was received by any of the authors of this article.

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Informed Consent Obtained.

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