

The Advantages of Three-Dimensional Planning in Mentoplasty

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Abstract

Computer-assisted Mentoplasty or genioplasty is gaining popularity in maxillofacial surgery due to the ease of planning the future position of bone segments and because it allows a real estimate of the position of the soft tissues of the chin after treatment is complete. The purpose of this article is to make some assessments regarding the benefits of performing this type of computer-planned surgeries so that surgeons become familiar with some concepts and understand the benefits of this type of planning for themselves and patients.

Keywords: Computer-Assisted Mentoplasty; Three-Dimensional Planning; Genioplasty

Introduction

Mentoplasty or genioplasty is surgery aimed at decreasing or increasing the projection of the chin to achieve facial harmony, obtaining aesthetics and solving dentofacial anomalies [1]. For its planning, knowledge and anatomical study of the region of the mandibular symphysis is necessary in order to estimate the precise conditions in which osteotomies are performed to separate this segment of the mandible [2].

The conventional planning method consists of conducting two-dimensional imaging studies performing a cephalometric estimation to be able to position a bone segment resulting from the osteotomy [3]. Later, with the advancement of technology, the stereolithographic biomodels appeared that allow the operation and the testing of surgery in hard tissues without dimensioning the changes that occur in soft tissues [4]. In the computer age,

computer programs in maxillofacial surgery appeared and made it possible to obtain an estimate of the final result and the creation of surgical guides that allow us to guide the positioning of the segment [5,6]. To carry out the planning process by 3D images, the use of digital software is extremely important, which is the essential element to be able to plan the repositioning of the bone segment and to precisely design the surgical guides that will be used in the surgical field.

With regard to computer programs, they can be differentiated into: 1) software that are used for segmentation (extraction of the area of interest from the DICOM images created by the Cone Beam Computed Tomography) and surgical simulation (Dolphin®, Simplant OMS®, Proplan®, Mimics®); 2) software used for the design of the surgical guides (Rhinoceros 3D software®, 3-matic®, Geomagic®, SensAble FreeForm Modeling®) and 3) software used for precision

analysis: Geomagic®, 3DS Max®, Matlab®, 3-matic®) [7]. These softwares allow clinicians to determine lengths, dimensions, anatomical structures and plan the final position of the bone segment and the soft tissues that we want to displace, obtaining the final result of the face in the 3d image of the computer [8] which can be present the patient as an accurately estimated result and obtain their opinion about their final result. This type of procedure can be performed using customized computer-made guides and plates, making it minimally invasive, safe, highly precise, and predictable [9].

Regarding the precision, good results have been demonstrated in the comparison of the data obtained in the digital planning, with respect to the postoperative values, with a linear deviation of its planned position of 0.7 mm, which indicates a high degree of precision. However, an angular difference of 4.58° greater than expected in Pitch orientation can also be observed, which is within the limits of clinical acceptance and which may be mainly produced by the non-use of a lingual guide and by force of the soft tissues and muscles that generate a slight rotation of the chin [10]. In contrast to a control group without guides, the differences between planned and actual results were greater and statistically significant, these occurred mainly in vertical direction and Pitch and Yaw orientations [11]. In addition, the use of guides does not present a statistically significant difference in the incidence of complications and does not cause further surgical infection [12]

In relation to innovations, new minimally invasive guided genioplasty techniques (MIGG technique) have been designed, the advantages of which lie in the combination of piezosurgery and digital planning of 3D-printed cut guides. This type of technique uses open source programs and a more affordable 3D printing technology, which is presented as an opportunity for future research and implementation in the maxillofacial surgery department, which do not have the money to obtain the paid software [12]. In this sense, in a retrospective clinical study that involved a control group of 56 patients using the conventional technique and a group of 24 patients, in which the MIGG technique was implemented, it was concluded that there are no significant differences in the incidence of complications between one technique and another; it is also evidenced that the use of the cutting guide protects anatomical structures and improves the predictability and precision of surgery [13].

Other options are to use the 3D printing model to perform the planning of the surgery and through an instrument called “the precise repositioning instrument for genioplasty” to transfer the positioning of the bone segment to the patient. The combination of the 3D printing model and the use of the instrument provide greater precision in orthognathic surgeries with complex facial asymmetries and present a predictable alternative for these interventions [14].

Undoubtedly the most important thing for surgeons and patients is to accurately predict how many millimeters the soft tissue will move when positioning a bone segment in the chin. It is very important to determine in what position they will be in order to plan the mobilization of the bone segment and allow the patient to know what their final result will be through 3d models. Prior to software, lateral cephalometric radiographs were a feasible method to predict soft tissue movements in the sagittal plane and have an idea of changes in the chin and lower lip in relation to points in hard tissue but did not allow the creation of surgical guides and not present patients with an estimate of their final result.

To determine how much the soft tissue will move there are several studies that allow to obtain an idea of the response. In this sense, in a retrospective study, soft tissue changes were observed in the sagittal plane and concluded that the Pogonion (Pg) with the soft-tissue Pogonion (Pg') and the B-point (B) with The soft-tissue B-point (B') were correlated, allowing clinicians to accurately estimate how much the soft tissues will move in relation to the positioning of the bone segment, obtaining precise values on the translation of the chin skin. On the other hand, the lower incisor (li) and the lower lip, represented by the landmark Labrale inferius (Li) do not have correlation, therefore there is less predictability of the expected position of the lower lip [15]. Also, the soft chin point with its counterpart in hard tissue chin presents a relationship of 85% and 96% for the ascending and descending movements, respectively, being able to determine the position of the soft tissue of the chin in a vertical direction [16].

In the two-dimensional methods we can establish a correlation of the movements and make an estimate, but we are only allowed that operation, on the other hand, in the 3d models we can see the future relationships of the new positioning of the segment and

show it to the patient so that they can give us their opinion making him more involved in his surgery, as well as serving as information to make the corresponding informed consents.



Figure 1: Pre-surgical image of patient with sedation.



Figure 3: Immediate postoperative period after computer-assisted mentoplasty with 8 mm advance.

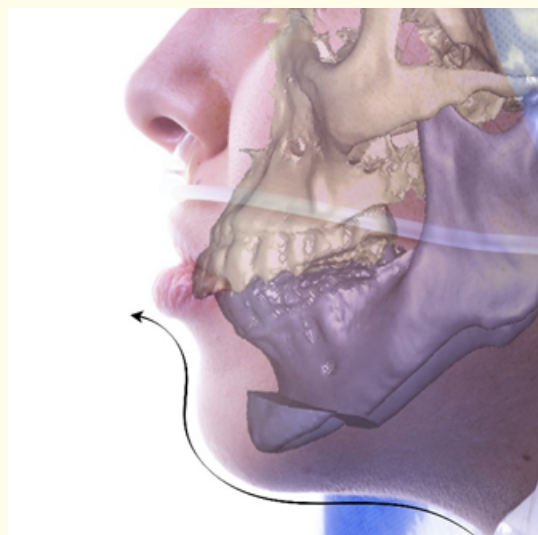


Figure 2: Final result with surgical planning.

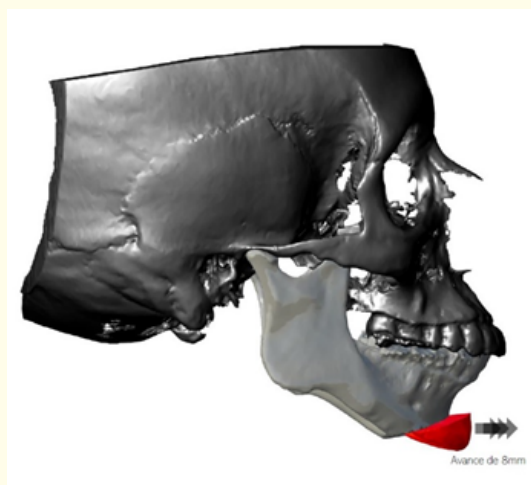


Figure 4: Mentoplasty planning with 3d images.



Figure 5: Osteotomy brands.

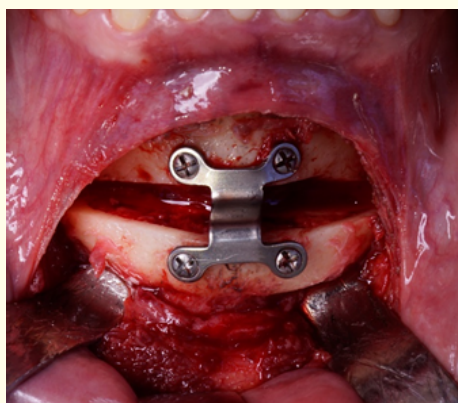


Figure 6: Fixation with an 8 mm titanium osteosynthesis plate.

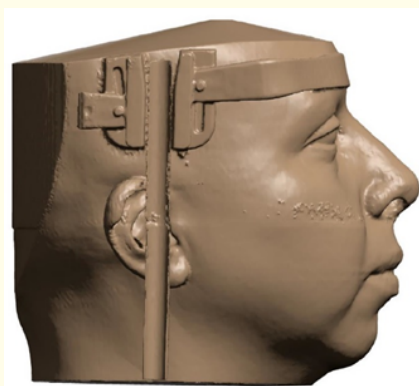


Figure 7: Face morphing with ProPlan CMF software.

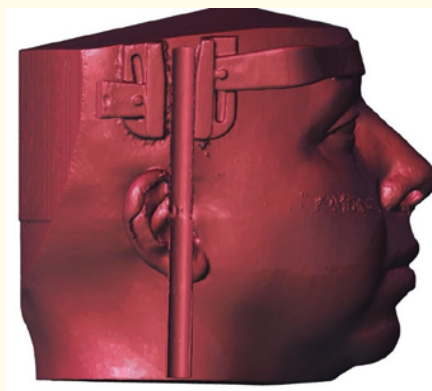


Figure 8: Post-surgical face morphing.

Conclusion

In conclusion, 3D images have advantages over two-dimensional visualization since we have no loss of information, there is no overlap of anatomical elements, we can see anatomical details and they are ideal images to study asymmetry in the frontal and sagittal plane. The planning and management of software comprises an approximate week of training of surgeons, time compensated with ease of planning, comfort of the surgeon and decreased surgical times. Creating surgical guides can be important, however, the design of these guides is sometimes bulky, difficult to use intraoperatively and can usually be applied to monoblock genioplasty. Without a doubt the most important thing is that on 3d images we can work, mentoplasty can be planned in relation to all parts of the face and we can establish harmonization relationships with the nose, cheekbones and other maxillofacial structures that in two-dimensional methods cannot. For all these advantages, maxillofacial surgeons should routinely use 3d planning in Mentoplasty.

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