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Virtual and minimally traumatic surgery in bucomaxillofacial procedures: a concise systematic review

Liliane Fernanda Luz Ortega[1,2]*, Alvaro José Cicareli[1,2], Elias Naim Kassis[1,2], Régis Manzini[1,2]

[1] UNORTE - University Center of Northern São Paulo, Dentistry department, Sao Jose do Rio Preto, Sao Paulo, Brazil.
[2] UNIPOS - Post graduate and continuing education, Dentistry department, Sao Jose do Rio Preto, Sao Paulo, Brazil.

*Corresponding author: Dr. Liliane Fernanda Luz Ortega. UNORTE/UNIPOS - Graduate and Postgraduate in Dentistry, Sao Jose do Rio Preto, Sao Paulo, Brazil.
E-mail: lilianeortega226@gmail.com
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Abstract

Introduction: In recent years, maxillary atrophy is an increasingly frequent clinical condition and the causes that lead to focal or generalized atrophy are multiple factors. Based on the histological concept in which living tissues are formed by cells joined by thin elastic tissue and with nerve fibrils, capillaries, lymphatic and blood vessels. The disruption of these cells by surgical trauma provides the release of enzymes that delay healing. For this reason, surgical trauma should be minimized. **Objective:** Aimed to perform a brief review of the main considerations of virtual and minimally traumatic surgery in the context of maxillofacial surgery. **Methods:** The model used for the review was PRISMA. We used databases such as Scielo, Lilacs, Google Scholar, PubMed. The Cochrane Instrument was used to assess the risk of bias of the included studies. **Results and Conclusion:** A total of 118 articles were found involving virtual and minimally invasive surgery in maxillofacial procedures. A total of 56 articles were fully evaluated and 28 were included in this study. the main considerations regarding minimally traumatic surgery are the attempt to minimize the professional's effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain, and ecchymosis that can affect patients. Thus, the maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the ridge of the alveolar bone to achieve a minimization of surgical trauma must be sought.

Keywords: Virtual surgery. Guided surgery. Minimally invasive surgery. Minimally traumatic surgery. Maxillofacial surgery.

Introduction

In recent years, maxillary atrophy is an increasingly frequent clinical condition and the causes that lead to focal or generalized atrophy are in multiple factors [1-3]. Thus, bone density influences the operative protocol [4]. In this aspect, based on the histological concept in which living tissues are formed by cells joined by thin elastic tissue and with nerve fibrils, capillaries, lymphatic and blood vessels. The disruption of these cells by surgical trauma provides the release of enzymes that delay healing. For this reason, surgical trauma should be minimized [5].

In this context, trauma prevention is done through good surgical planning, joint work, good lighting, force control, knowledge of topographical anatomy, control of movements and gestures, search for a support point to reduce the tremor, and decreased surgery time [6,7]. In this sense, the basic rules that guide the doctrine of minimally traumatic surgical technique are a surgeon without tension, minimal and precise movements, dissecting only what is essential, reducing tissue exposure to a minimum, gentle manipulation, use of correct instruments and techniques, use of compresses soaked in warm saline solution [8].

In this context, the optimization of faster and more accurate techniques by dentists and postoperative surgeons with better results and quality of life stimulated the development of numerous software and hardware (equipment and instruments) for performing computer-guided surgeries, the so-called Guided Surgeries (GS) [5]. In this sense, it is essential to perform Computed Tomography (CT) in the patient, with reference points, such as the prosthesis itself, for capturing images on a computer, with the images

processed in programs such as NobelGuide®, Simplant® or DentalSlice ® [9-12].

In this sense, as information gaps, we can mention the image acquisition process, the registration process, software navigation, the production of the surgical guide, and human error [13-16]. However, compared to the traditional technique, placing the implant with the aid of a computer requires substantially greater investment and effort, but it seems to provide a good result, in the sense of eliminating errors and systematizing the successful reproduction of treatments [16]. In addition, GS allows the protection of critical anatomical structures, as well as the aesthetic and functional advantages that come from placing the implant in the location determined by the prosthesis. GS is not indicated in easy cases, with sufficient anatomical orientation and bone volume [17]. However, it can be indicated in cases where CT is recommended as a diagnostic tool, when the placement of the implant is mandatory, and when implants with longer lengths are desired for the optimal use of the available bone [18].

In this way, reconstruction technologies have expanded to include the use of guided surgical planning (GSP) and computer-aided design and manufacturing (CAD-CAM), and three-dimensional printing. The advantages of GSP over traditional techniques can be in relation to late reconstruction, maxillary reconstruction, placement of dental implants, and precision-guided oncology [19]. Furthermore, the use of CT and the development of programs for guided planning are directing oral surgery precisely towards a specific target [20].

Thus, the present study aimed to carry out a brief review of the main considerations of virtual and minimally traumatic surgery in the context of maxillofacial surgery.

Methods

Study Design

The present study followed a systematic review model, following the rules of systematic review - PRISMA (Transparent reporting of systematic review and meta-analysis, access available in: http://www.prisma-statement.org/).

Data Sources

The search strategy was performed in the PubMed, Scielo, Cochrane Library, Web of Science and Scopus, and Google Scholar databases, using scientific articles from 1977 to 2022.

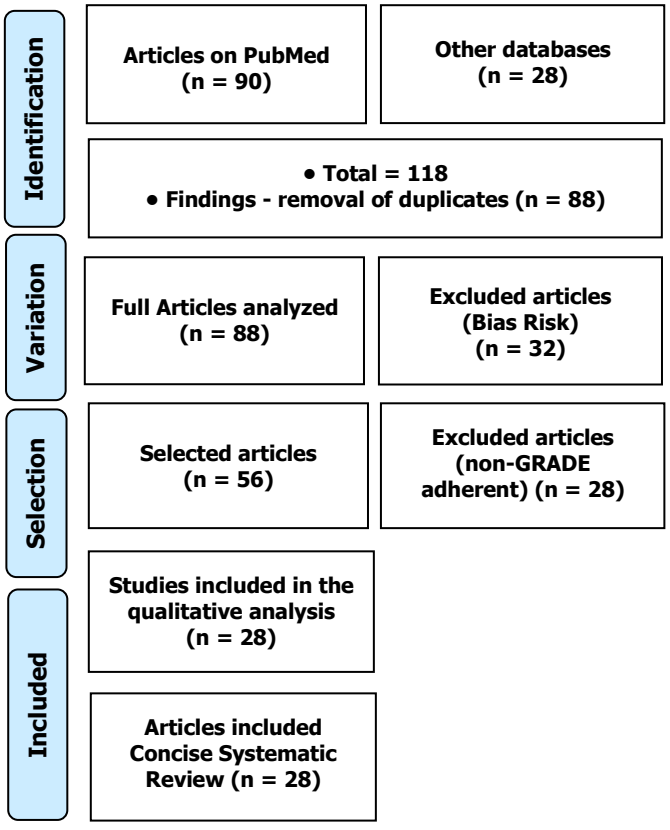
Descriptors (MeSH Terms) And Risk Of Bias

The main MeSH Terms used were "*Virtual surgery. Guided surgery. Minimally invasive surgery. Minimally traumatic surgery. Maxillofacial surgery*". For greater specification, the description "Guided Surgery" for refinement was added during the searches, following the rules of the word PICOS (Patient; Intervention; Control; Outcomes; Study Design). The **Cochrane Instrument** was used to assess the risk of bias of the included studies.

Results

A total of 118 articles were found involving virtual and minimally invasive surgery in maxillofacial procedures. Initially, the duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, based on the elimination of articles with biases that could compromise the reliability of the results, according to the rules of the Cochrane instrument, as well as articles that presented low quality in their methodologies, according to the GRADE classification. A total of 56 articles were fully evaluated and 28 were included in this study (**Figure 1**).

Figure 1. Flowchart showing the article selection process.



In the scenario of minimally traumatic surgery techniques, there are several advantages over

conventional techniques, especially about maintaining the integrity of the alveolar bone and attached gingiva, consisting of controlled techniques with a high level of predictability [21]. As an example, the technique of controlled avulsion extraction can be considered the most predictable, assuring maximum integrity of the alveolar bone wall, drastically reducing bleeding and especially the procedure time [21].

Added to this, there is the atraumatic restorative treatment (ART) which offers a glimpse of several minimally traumatic treatment options, depending on factors such as esthetics, tooth function, patient expectations, restoration cost and optimization of surgical techniques. Thus, some authors have listed the advantages of ART, such as greater preservation of the tooth structure, curative and preventive technique in a single procedure, preservation of the innermost dentin, reduced trauma, less risk of pain, no need to use anesthesia, reduced anxiety of patients, greater acceptance by adults and children, lower cost, speed of execution, possibility of correcting the inadequate technique, good clinical performance in restorations on one face, possibility of execution in social spaces such as schools, day care centers or at home [22,23].

In this sense, the main considerations regarding minimally traumatic surgery is the attempt to minimize the professional's effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain and ecchymosis that can affect patients. Thus, the maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the ridge of the alveolar bone to achieve the minimization of surgical trauma should be sought [1,22].

Still, as an example, the minimally invasive elevation of the balloon of the antral membrane was introduced as a less traumatic technique in nasal sinus floor elevation surgery.

A systematic review study evaluated bone gain, breast augmentation success rate, implant survival rate, and complications with the minimally invasive antral membrane balloon elevation technique compared to the sinus floor elevation technique. Traditional transalveolar (Summers' technique). The extracted articles that involved the use of the balloon technique in maxillary sinus elevation surgery were 27 articles. The mean perforation of the schneiderian membrane with the minimally invasive antral membrane balloon elevation technique (MIAMBE) was 6.76%. The success rate of sinus augmentation ranged from 100 to 71.4%, with an average of 91.6%. Bone gain with this technique can reach more than 10 mm with an average of 6.96 mm [24].

In the scenario of GS in dentistry, advances in technology have contributed to the improvement of models, as there was only the direct impression technique for obtaining patient models, with implant placement not very favorable in aesthetic terms [1]. The information that is acquired in 3D reconstructions allows us to determine the quantity and quality of the available bone and also allows the simulation of the implant installation in a virtual environment [1]. This provides the predictability of techniques and difficulties that can be encountered during the surgical intervention, reducing the time and the possibility of errors, allowing the overall reduction in the costs of oral rehabilitation [10].

In this context, a study used two programs, one for the reconstruction of the 3D bio model (MIMICS®) and another for the CAD project, for the preparation of surgical guides (3-Matic®). MIMICS® is a modeling program and is very fast and intuitive, presenting the ability to separate parts in which there are no interconnections and subtractions, without resorting to the generation of models. The 3-Matic®, on the other hand, has specific design tools, with which it becomes relatively simple to model a prosthesis, as it uses triangular mesh and not curved surfaces that are quite difficult and time-consuming to model. However, 3-Matic® has a disadvantage, it does not show mistakes made during the design phase, impairing the 3D printing phase [20].

Regarding GS, it is considered accurate, accurate, and reliable in comparison to free implant surgery [25,26]. However, the deviation between guided implant planning and the actual implant position can occur due to the surgical learning curve and the accumulated errors that can occur over various stages of the digital workflow [27,28].

Conclusion

The main considerations regarding minimally traumatic surgery is the attempt to minimize the professional's effort, reduce surgical time and alleviate bleeding and inflammatory processes, edema, pain and ecchymosis that can affect patients. Thus, the maximum preservation of the integrity of the soft tissues adjacent to the prosthetic spaces and the preservation of the level of the ridge of the alveolar bone to achieve a minimization of surgical trauma must be sought.

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Conflict of interest
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