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Key clinical considerations and updates on the techniques for successful zygomatic implant: a systematic review

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Abstract

Introduction: In the context of implant dentistry, what represents a great burden in the aesthetic recovery of patients who have suffered dentoalveolar trauma is the lack of bone in the alveolar crest, compromising the quality of life due to tooth loss. **Objective:** Performed a systematic review to present key clinical considerations and updates on the best techniques for successful zygomatic implantation. **Methods:** The systematic review rules of the PRISMA Platform were followed. The research was carried out from February to May 2023 in Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument. **Results and Conclusion:** A total of 128 articles were found, 54 articles were evaluated in full and 34 were included and developed in this systematic review study. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 22 studies with a high risk of bias and 32 studies that did not meet GRADE. Zygomatic implants can be placed with good precision. The application of these newly designed 3D-printed surgical guides results in the predictable placement of zygomatic implants and offers the possibility of immediate prosthetic rehabilitation. Preliminary data from one year after loading suggest that immediately loaded zygomatic implants were associated with statistically significantly fewer prosthetic failures. Also, zygomatic implants proved to be a better rehabilitation modality for severely atrophic jaws.

Keywords: Zygomatic Implant. Lack of bone. Tooth loss. 3D-printed surgical guides.

Introduction

In the context of implant dentistry, what represents a great burden in the aesthetic recovery of patients who have suffered dentoalveolar trauma is the lack of bone in the alveolar crest, compromising the quality of life due to tooth loss [1,2]. In this sense, the zygomatic implant (ZI) is an alternative when there is bone loss [3-7]. The ZI is long, threaded, oxidized, and moderately rough, with lengths ranging from 30 to 52.5 mm. They have an inclined head, designed to allow the placement of the prosthesis 45 along the axis of the implant, providing an excellent ability to retain, support, and stabilize the prosthesis [8-16].

In this sense, contact and bone-to-implant are correlated with implant survival. An important variable that alters the zygomatic contact and bone-toimplant is the angle at which the implant is placed [17-20]. Thus, Branemark et al. [21] introduced a technique called zygomatic fixation, to reach these new implants with fixation in the dense zygomatic bone and, thus, rehabilitating these areas, combined or not with other types of implants. Thus, the ZI provides anchorage, when crossing the maxillary tuberosity, passes through the pyramidal process of the palatine bone, and is part of the pterygoid process of the sphenoid bone, making implants successful [22].

Also, ZI is used in patients with maxillary defects to improve the retention and stability of obturator prostheses. Maxillectomy can be performed with a 3D printed cut, as well as drilling guides for the subsequent placement of the ZI with immediate placement of an implant-retained obturator prosthesis. Thus, the ZI can be placed with good precision. The application of these newly designed 3D-printed surgical guides results in predictable ZI placement and offers the possibility of immediate prosthetic rehabilitation in head and neck cancer patients after maxillectomy [23,24].

Therefore, the present study carried out a systematic review to present the main clinical considerations and updates of the best techniques for the success of the zygomatic implant.

Methods

Study Design

The systematic review rules of the PRISMA Platform were followed. Available at: www.prisma-statement.org/). Accessed: 04/04/2023.

Research Strategy, Quality of Studies and Risk of Bias

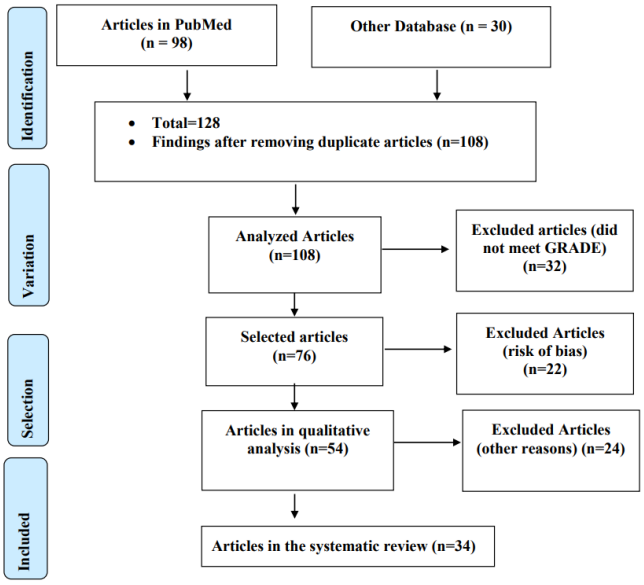
The search strategies for this systematic review were based on the keywords (MeSH Terms): *Zygomatic Implant. Lack of bone. Tooth loss. 3D-printed surgical guides.* The research was carried out from February to May 2023 in Scopus, PubMed, Science Direct, Scielo, and Google Scholar databases. In addition, a combination of keywords with the Booleans "OR", "AND" and the operator "NOT" were used to target scientific articles of interest. The quality of the studies was based on the GRADE instrument and the risk of bias was analyzed according to the Cochrane instrument.

Results and Discussion

Summary of Findings

A total of 128 articles were found. Initially, duplication of articles was excluded. After this process, the abstracts were evaluated and a new exclusion was performed, removing the articles that did not include the theme of this article, resulting in 108 articles. A total of 54 articles were evaluated in full and 34 were included and developed in this systematic review study (Figure 1). Considering the Cochrane tool for risk of bias, the overall assessment resulted in 22 studies with a high risk of bias and 32 studies that did not meet GRADE.

Figure 1. Flowchart - Article Selection Process.



Source: Own authorship

Main Outcomes - ZI

Based on literary findings, studies show that guided rehabilitation with a zygomatic implant can represent a reliable, efficient, fast, ergonomic, and safe surgical protocol, but more investigations are needed [25,26].

Besides, some studies have broadened clinical understanding based on comparative studies to show the success rate of ZI [27-29]. Thus, a randomized study compared the clinical outcome of immediately loaded cross-arch maxillary prostheses supported by ZI versus conventional implants placed in the enlarged bone. In total, 71 toothless patients with severely atrophic jaws without sufficient bone volume to place dental implants or when it was possible to place only two implants in the anterior area (minimum diameter of 3.5 mm and length of 8 mm) and less than 4 mm diameter bone height subantrally, were randomized according to a parallel group design to receive ZI (35 patients) to be loaded immediately versus grafted with a xenograft, followed after 6 months of graft consolidation by placing six to eight dental implants conventional submerged for 4 months (36 patients). For immediate loading, the ZI had to be inserted with an insertion torque greater than 40 Ncm. Temporary prostheses in metal-reinforced acrylic, screwed on, were provided to be replaced by permanent prostheses Procera Implant Bridge Titanium (Nobel Biocare, Gothenburg, Sweden), with ceramic or acrylic veneer 4 months after the initial loading. Patients were followed up for 1 year after loading. Therefore, preliminary data from one year after loading suggest that immediately loaded ZI were associated with statistically significantly fewer prosthetic failures (one versus six patients),

implant failures (two versus eight patients), and time required for functional loading (1.3 days versus 444.3 days) when compared to augmentation procedures and conventionally loaded dental implants. Even though more complications were reported for ZI, they proved to be a better form of rehabilitation for severely atrophic jaws. Long-term data are necessary to confirm or contest these preliminary results [30].

Also, a segment of the same study compared the clinical outcome of immediately loaded cross-arch maxillary prostheses supported by ZI versus conventional implants placed in the enlarged bone. A total of 71 toothless patients with severely atrophic jaws, who did not have the sufficient bone volume to place dental implants or when it was possible to place only two implants in the frontal area (minimum diameter of 3.5 mm and length of 8 mm) and less than 4.0 mm bone height subantrally, were randomized according to a parallel-group design. They (35 patients) received zygomatic implants to be loaded immediately versus grafted with a xenograft, followed, after 6 months of graft consolidation, by placing six to eight conventional dental implants, submerged for 4 months (36 patients). To be loaded immediately, zygomatic implants needed to be inserted with an insertion torque greater than 40 Ncm. Patients were followed up for 4 months after loading. No augmentation procedure has failed. Three patients dropped out of the augmentation group. Therefore, preliminary data from four months after loading suggest that zygomatic implants were statistically significantly associated with fewer prostheses (one versus six patients) and implant failures (one patient lost three implants versus 35 implants in eight patients), as well as the time required for functional loading (1.3 versus 444.3 days) when compared to augmentation procedures and conventionally loaded dental implants. Even if more complications were reported for ZI, which spontaneously resolved or could be manipulated, ZI proved to be a better rehabilitation modality for severely atrophic jaws [31].

Furthermore, another study compared the result of preparing the cancer site for ZI using conventional preparation with rotary drills or piezoelectric surgery with dedicated inserts for the placement of two ZI per zygoma. Twenty toothless patients with severely atrophic jaws without sufficient bone volume to place dental implants and less than 4 mm bone height subantrally had their Hemi-jaws randomized according to an open-mouth design in preparing the implant site with conventional rotational preparation or piezoelectric surgery. In two patients, drills were also used on the side of the piezoelectric surgery to allow the preparation of the implant sites. An implant for the group of conventional drills did not reach an insertion torque greater than 40 Ncm, as it fractured the zygoma. No patient gave up and two distal cancer implants failed in the same patient (one per group), who was not prosthetically rehabilitated. Six complications occurred in perforated sites and three in piezoelectric surgery sites (two patients had bilateral complications), the difference is not statistically significant (P (McNemar's test) = 0.375; odds ratio = 4.00; 95% CI of odds ratio: 0.45 to 35.79) The implant placement with conventional drills took an average of 14.35 ± 1.76 min and with piezoelectric surgery 23.50 ± 2.26 min, with the implant placement time being significantly shorter with the conventional perforation (difference = 9.15 ± 1.69 min; 95% CI: 8.36 to 9.94 min; p <0.001) Postoperative hematomas were more frequent in the perforated sites (p = 0.001), and 16 patients considered the two techniques equally acceptable, while four preferred piezoelectric surgery (p = 0.125). Both drilling techniques achieved similar clinical results, but conventional drilling required 9 minutes less and could be used in all cases, although it was more aggressive. These results can be systemdependent, so they cannot be generalized to other zygomatic systems with confidence [32].

Based on recent studies, new challenges have been presented. The management of patients with a severely atrophic or ZI-resected maxilla can be a surgical challenge. This retrospective cohort study assessed the percentage of survival of ZI placed over 18 years. In total, 88 ZI were placed in 45 patients aged 42-88 years. Of the 88 implants, 54 were immediately loaded. The implant survival rate was 94.32%, with five implants failing during the study period. Failures were not significantly associated with gender, surface finish, implant length, or classification of the zygomatic approach guided by the anatomy or position of the implant (p> 0.05). All failed implants were fitted with fixed prostheses. Failures occurred between 6 months and 15 years after placement. This study of ZI placed in patients with severely atrophic and resected maxilla confirms that this approach is a predictable method to support fixed or removable prostheses for up to 18 years, demonstrating high survival rates [33].

Moreover, a meta-analysis study included sixty-eight studies, comprising 4556 ZI in 2161 patients with 103 faults. The accumulated survival rate at 12 years was 95.21%. Most of the failures were detected within the post-surgical period of 6 months. Studies (n = 26) that exclusively assessed load showed a statistically lower ZI failure rate than studies (n = 34) assessing loading protocols (p = 0.003). Other studies (n = 5)

evaluating ZI for the rehabilitation of patients after maxillary resections presented lower survival rates. Postoperative complications were as follows: sinusitis, 2.4%; soft tissue infection, 2.0%; paraesthesia, 1.0%; and oroantral fistulas, 0.4%. However, these numbers may be underestimated because many studies have not mentioned the prevalence of these complications. Therefore, ZI presents a high survival rate accumulated in 12 years, with most failures occurring in the initial stages postoperatively. The main complication observed related to ZI was sinusitis, which may appear several years after implant surgery [34].

Conclusion

Zygomatic implants can be placed with good precision. The application of these newly designed 3D-printed surgical guides results in the predictable placement of zygomatic implants and offers the possibility of immediate prosthetic rehabilitation. Preliminary data from one year after loading suggest that immediately loaded zygomatic implants were associated with statistically significantly fewer prosthetic failures. Also, zygomatic implants proved to be a better rehabilitation modality for severely atrophic jaws.

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Ethical Approval

Not applicable.

Informed consent

Not applicable.

Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

Similarity check

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