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Zygomatic Implant Rehabilitation: A Prosthodontic Driven Approach: A Review

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ABSTRACT

Zygoma implants, sometimes called zygomatic implants, are different from conventional dental implants in that they are affixed in the zygomatic bone, not the maxilla. They can be used in situations when there is not enough maxillary bone, either in terms of quantity or consistency, to support a dental implant. Insufficient maxillary bone volume may result from a combination of maxillary sinus pneumatization and bone resorption. To guarantee proper implant survival, the normal implant placement in the posterior maxilla requires a bone height of about 10 mm. Increased bone volume can be achieved by sinus elevation and bone grafting techniques in cases when there is insufficient bone available. The drawbacks of bone grafting procedures in the jaws include the need for prolonged care, restrictions on denture wear, morbidity at the donor surgical site, and graft rejection.

Keywords: Zygomatic implants, Prosthodontic Rehabilitation, Prosthetically driven approach

INTRODUCTION

Zygomatic implants are regarded as an alternate option for the prosthetic rehabilitation of atrophic maxilla. Their primary benefit is that they can avoid the problems associated with grafting procedures and shorten the duration of treatment.[1] Branemark introduced zygomatic implants in 1988. Branemark invented a unique implant known as a zygomatic fixture, which offered a fixed solution even in cases where the implant insertion was unfavorable in the posterior region of maxilla.[2] This is an alternative to procedures like bone grafting or the invasive sinus lift. He thought of employing the zygomatic bone as an anchoring for other abnormalities and for rehabilitation in individuals who had hemi-maxillectomy. The treatment period is accelerated by the combination of the zygomatic implants and the immediate loading technique.[2]

Indications[3]

1. Zygomatic implants are recommended for patients with maxillary bone atrophy or deficiency, unsatisfactory prior graft and/or implant therapies, avoidance of staged bone grafting, and factors such as benign cysts and injuries that might complicate conventional bone grafting techniques.
2. When the maxillary bone is entirely or partially missing due to resection, trauma, or congenital defects.

Contraindications[4]

1. Any general contraindication to the surgical operation and anesthesia, such as patients with impaired immune systems, pregnant women, people with uncontrolled diabetes, people with acute sinusitis, and people who are addicted to drugs or alcohol.
2. Medical therapy including bisphosphonates and radiation therapy to the head and neck region above 70 Gy are also included in the list of general contraindications.
3. Limited mouth opening (less than 30 mm),
4. Acute or chronic maxillary sinusitis accompanied by blockage of the osteo-meatal complex, and any anomaly involving the zygomatic bone are listed as local contraindications.
5. Relative contraindications for the treatment are smokers and illnesses that could be managed before zygomatic implants are placed.

Surgical techniques[5]

Original Surgical Technique:

The traditional Brånemark method involved two stages of surgery: two ZIs inserted into the premolar or molar, along with two to four regular implants (RIs) positioned in the anterior region for delayed restoration. Bedrossian and Chow et al. (2006) demonstrated the effectiveness of immediate loading and the functionality of ZIs, the protocol regarding immediate implants has been extensively studied and has significantly improved patient outcomes when compared to conventional grafting techniques.

Quad approach[6]

Eventually, the traditional method was further altered to create the so-called "quad approach," which identified the severely atrophic maxilla as having insufficient bone in the anterior or posterior zones to support the implantation of traditional dental implants. Instead, two ZI were placed on each side of the zygoma. When traditional implants cannot be placed in the posterior and anterior maxillary regions and grafting options were not practical, predictable, or patient-preferred, the quad zygomatic implant technique (two bilaterally implanted zygomatic implants) may be considered as an alternative. All the implants in this case needed to be splinted.[3]

Under the original surgical technique (OST) developed by Brånemark, a sizable lateral osteotomy to the sinus is produced. The best entrance, from a prosthetic perspective, was as far posterior and near the crestal midline as possible. The fixture was usually considered to have come from the second premolar area when these factors were taken into account.

Modification of the technique:

Several clinicians have improved the initial procedure in the past years that followed, focusing on the sinus position and crestal emergence to enable greater individual anatomical and prosthetic adaption.

In patients with significant buccal concavities in the maxillary sinus area, Stella and Warner adapted it to a sinus slot approach, which avoids sinus window formation and raises the sinus membrane for zygomatic implant implantation. The smaller antrostomy created by this slot will position the twist drills for implant insertion.

Boyes-Varley et al. (2003) modified the OST to achieve better access to the surgical site and lower the rate of complications following surgery. Additionally, they defined ZI as a rescue implant in cases of anterior or posterior tilted implant failure and adjusted the angulation of the implant head to a 55° correction. To prevent sinusitis, Malo and his colleagues (2008) suggested an extra-maxillary technique in which ZI trajectory was prepared just in the zygomatic bone and assigned to the maxilla's lateral wall groove.[5]

The zygomatic implant being inserted intra-sinus may have additional drawbacks, such as a higher risk of sinus problems and a bulkier prosthesis due to the palatal emergence. To avoid these restrictions, the

extra-maxillary surgical technique places the zygomatic implant extra-maxillary (external to the maxillary sinus before anchoring in the zygomatic bone, covered only by soft tissue along its lateral maxillary surface), preserving the Schneiderian membrane and reducing the vestibular-palatine width of the prosthesis.

The addition of 45- and 60-degree abutments may be beneficial to rehabilitate by offering the required compensation for angulation degrees.[5]

Zygomatic Anatomy-Guided Approach (ZAGA):

This is a concept for minimally invasive osteotomy. This classification relies only on the bony anatomy of the maxilla and does not incorporate the restorative plan into the decision-making process. Based on a cross-sectional investigation of 200 human radiography locations, Aparicio proposed the classification of the zygomatic anatomy-guided approach (ZAGA) in 2010. This method was naturally developed to improve "Anatomy-Guided" approaches for various anatomical solutions, ranging from the concave or atrophied maxillae to the flat maxillary wall.[7]

There are five distinct sorts of relationships between the zygomatic buttress and alveolar crest area according to Anatomy Guided, which is an extension of the extra-sinus method. This method allows the ZI body's course to vary from total intra-sinus (ZAGA 0) to the maxilla wall (ZAGA 1 & 2) to total extra-maxillary sinus (ZAGA 3 & 4). The eventual relationship between the implant and the anterior maxillary wall was determined by the curvature of the maxillary buttress's external wall. A slightly beveled palatal incision was made from the posterior buccal aspect of the maxillary tuberosity to the midline to gain surgical access.[7]

The outcome of surgical techniques:

ZI for the Anatomy-Guided and OST techniques, which are both linked to a low rate of surgical problems and a good implant survival rate, for the rehabilitation of severely atrophic edentulous maxillae. The most common conditions mentioned here are sinusitis and soft tissue infections near the implant. High implant survival rates are reported for both immediate and delayed regimens. The Anatomy-Guided approach makes greater use of the immediate loading protocol than does OST.[7]

Surgical risks and failures[8]

The frequently reported biological side effect associated with ZI treatment is sinusitis. According to reports, sinusitis is a very frequent complication that might result in ZI implant loss. The correlation between sinusitis and ZI survival is unclear. The combined incidence rates for sinusitis in Anatomy Guided were 4.4% (0–11.8%) and in the Original Surgical Technique (OST) were 9.5% (0–37.5%). The majority of sinusitis cases were described in the literature without any distinction between patients that had symptoms and those that did not. It is possible to effectively cure sinusitis. Following a diagnosis of sinusitis, effective therapy with antibiotics and/or a surgical meatotomy was documented, with no long-term effects.[3]

Technical complications

The chipping or loss of the veneering material (acrylic or ceramic), fracture of the metal substructure, and fracture and/or loosening of the abutments or screws are examples of technical issues for ZI-supported reconstructions. At a mean follow-up of 76.0 months, the prosthesis survival supported by ZIs was 94%. The prostheses were designed to be either fixed or removable, and they were made of ceramic and resin superstructures fixed on metal substructures.[3]

A PROSTHETICALLY DRIVEN APPROACH WITH ZYGOMATIC IMPLANTS

Planning prosthesis-guided surgery can lead to more predictable results and less guesswork than anatomically directed surgery.

There will be a greater chance of predictable results if surgical decisions are made at the

treatment planning stage rather than the intraoperative surgery phase. Concerning zygomatic implant rehabilitation, the surgeon makes decisions about implant length, type, trajectory, need for simultaneous soft tissue augmentation, and placement of other implants during the preoperative treatment planning stage based on the combined anatomic and prosthetic plan.[9]

According to Aparicio's zygoma anatomy guided technique, the surgeon should arrange the course of zygomatic implant based on the concavity of the maxillary sinus wall and the degree of maxillary resorption. However, the implant platform may not be positioned optimally with regard to the occlusal forces under function if the patient's anatomy is used to determine zygomatic implant position.[10]

Traditionally placed zygomatic implants within the existing resorbed alveolar bone can result in an undesired prosthetic buccopalatal cantilever due to the medial and superior direction of maxillary bone resorption. when implanted using an anatomy-guided approach, zygomatic implants positioned in this manner will likewise result in a comparable "prosthetic offset".[9]

Two common errors made when starting an osteotomy to insert zygoma implants are starting the procedure "too anteriorly" or "too palatally." This is because the relatively difficult access can cause disorientation for untrained surgeons. An improper osteotomy could lead to an unfavorable palatal emergence of the zygoma implant, which could cause biological and prosthetic difficulties. This could happen if the osteotomy is started on the palatal process of the maxilla rather than the palatal/lingual wall of the maxillary alveolus.[11]

The Restoratively Aimed Zygomatic Implant Routine (RAZIR)[9]

The RAZIR approach begins with the preoperative evaluation and ends with a customized procedure. Establishing the intended locations for the maxillary teeth is the first stage. This can be done digitally using a virtual diagnostic tooth configuration. Using record bases and occlusal rims, analog planning can also be used to finish it. To properly support phonetics, lip position, esthetics, and oral hygiene requirements, the anterior and posterior teeth must be positioned buccopalatally.

Assessing the association between the planned tooth locations and the current alveolar bone position, gives important insights into the extent of the composite defect. After this is finished, the exact type of final prosthesis can be identified. The suitable final prosthesis can be chosen using a variety of analog evaluation techniques. New and developing technologies have emerged to help with the digital workflow integration for these processes.

The digital integration of the suggested tooth locations with the intraoral scan and the diagnostic CBCT scan is eventually necessary for the RAZIR, regardless of whether these preparatory stages are carried out digitally, analogically, or through a combination of both.

The surgeon can digitally combine all of these layers so that the zygomatic implant can be placed virtually. The implant platform ought to be aimed toward the central fossa of the second premolar or cingulum of the lateral incisor if anterior zygomatic implant is necessary.

3D printed surgical guides

When 3D-printed surgical guides are used, head and neck cancer patients can undergo immediate prosthetic rehabilitation following a maxillectomy and have predicted zygomatic implant placement. Moreover, it is thought that using this reliable procedure will reduce the possibility of surgical and prosthetic difficulties.[12]

Immediate loading

The initial study was published in 1990 and suggested that implants might be loaded either immediately or early in the jaws. A dental implant can be loaded immediately or within hours of implantation, which is known as immediate loading. As of this

now, the Esposito et al protocol has been accepted; immediate loading happens before one-week, early loading happens between one week and two months, and conventional loading happens after more than two months following implant placement. The primary stability, implant length, implant design, implant amount, bone quality and quantity, parafunction, and prosthesis design are the elements determining the outcome of mid-implant loading of a fixed prosthesis.

The complications of immediately loaded zygomatic implants are rare, and most of them could be resolved easily in the clinic. The alveolar bone guide can be used to avoid possible biological complications such as sinusitis. [13]

ITI (International Team for Implantology) consensus:

During a mean follow-up of 73.6 months, the ZI survival rate for immediate loading protocols was 98.1%.

Over an average of 69.3 months of follow-up, the mean survival prevalence for delayed load regimens was 95%.

Maintenance[14]

Compared to standard intraoral implants, zygomatic implants have a different peri-implant anatomy because, in most cases, the palatal bone is absent and the vestibular portion of the implant is surrounded by soft tissues. This means that the stability of the implant is primarily provided by the zygoma-inserted implant apex. This demands the use of a sensitive probing method to prevent modifying desmosomal adhesion and precludes the use of standard periodontal parameters often applied for dental implants. Probing should only be used to confirm the healthy soft tissue attachment, according to the prospective study by Agliardi et al in 2017. While investigating, zygomatic implants can be difficult, probing is still one of the most effective clinical strategies to prevent inflammation of the peri-implant tissue.

A routine assessment of the temporomandibular joint (TMJ) is recommended to monitor any changes in the occlusal plane or pain described by the patient. Aparicio updated the ORIS criteria of success in 2020 by revising the zygoma success code.[15]

The evaluation of zygomatic implants can be divided into five categories based on Aparicios criteria:

Success Condition 1: At this point, the zygomatic implant performs exceptionally well and satisfies all the requirements for success. It is the ideal stage.

Success Condition 2: This state denotes a slight deviation from the norm, with no discernible clinical influence on the functionality of the implant or the patient's quality of life.

Success Condition 3: In this case, the zygomatic implant exhibits borderline traits along with clinically noticeable changes. These changes can still be effectively treated, nevertheless, to guarantee the long-term health of the implant.

Success Condition 4: This condition relates to a surviving implant that supports the prosthesis. Additional evaluation could be required to ascertain its overall success.

Success Condition 5: This indicates implant failure, in which the zygomatic implant has not achieved the anticipated success requirements and necessitates revision or suitable intervention.

Proposed protocol for the follow-up and maintenance of patients who have undergone zygomatic implant rehabilitation; it is recommended that this protocol be implemented in the maintenance phase following the delivery of the final prosthesis (that is, approximately 4 months after surgery).

Step 1: Intra/Extra oral and TMJ Examination

The examination of the temporomandibular joint and the soft tissues within and outside of the mouth is the initial stage. When there are TMJ issues, a thorough assessment of the dental occlusion balance is advised, along with electromyography to assess the severity of the bruxism episodes.

Step 2: Soft Tissue and Transmucosal Path Observation

Examining the soft tissues next to the prosthesis and implants is the second stage. During this stage, it is necessary to identify and report transmucosal decubitus, fenestrations, hypertrophy, fistulas, and dehiscence. In these situations, the prosthesis is unscrewed to evaluate the morphology of the prosthodontic framework and the peri-implant tissues.

Step 3: Peri-Implant Indices and Digital Stimulation of Tissues

The most recent guidelines for conventional dental implants define peri-implant probing as an essential clinical procedure to evaluate crestal bone loss and ascertain the health or disease status surrounding the implant. The same standard, however, cannot be used for extra-sinus zygomatic implants since the crestal bone that is absent from the vestibular side.

Alternatively, a probe designed to work around this kind of implant might be used to measure bleeding and determine the health status of the mucosa.

Step 4: Prosthesis Examination

It is crucial to identify mechanical problems in the first year of use of a prosthodontic device supported by a tissue implant to prevent biomechanical complications that could jeopardize osseointegration and cause inflammation in the mucosal tissue surrounding the implant.

Step 5: Take Photographic Records

The most recent recommendation is to gather intraoral and extraoral images at least once a year to track the development of potential dehiscence, occlusal wear, and other issues.

CONCLUSION

Zygomatic implants have frequently demonstrated enhanced clinical outcomes when compared to bone grafting and could be the next "gold-standard" treatment for damaged maxillary bone. When developing a zygomatic implant-retained prosthesis, a fully digitalized process for guided resection, zygomatic implant insertion, and prompt prosthetic rehabilitation is achievable. Restoratively driven zygomatic implant rehabilitation tends to have a better long-term prognosis. Proper maintenance and oral hygiene play a vital role.

Declaration by Authors

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