

Review Article

Zygomatic Implants: A Narrative Review

Dr. Arpit Sikri^{1*}, Dr. Jyotsana Sikri²¹Associate Professor & Post Graduate Teacher, Department of Prosthodontics, Crown & Bridge and Oral Implantology, Bhojia Dental College & Hospital, Budh (Baddi), Teh. Baddi, Distt. Solan, Himachal Pradesh, India²Associate Professor & Post Graduate Teacher, Department of Conservative Dentistry & Endodontics, Bhojia Dental College & Hospital, Budh (Baddi), Teh. Baddi, Distt. Solan, Himachal Pradesh, India***Corresponding Author:** Dr. Arpit Sikri

Associate Professor & Post Graduate Teacher, Department of Prosthodontics, Crown & Bridge and Oral Implantology, Bhojia Dental College & Hospital, Budh (Baddi), Teh. Baddi, Distt. Solan, Himachal Pradesh, India

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Abstract: Zygoma implants, also known as zygomatic implants, differ from traditional dental implants in that they are placed in the zygomatic bone (cheekbone) instead of the maxilla (upper jaw). These implants are used when there is insufficient bone quantity or quality in the maxilla to support regular dental implants. Insufficient maxillary bone volume can result from bone resorption, maxillary sinus pneumatization, or a combination of both factors. In the posterior area of the upper jaw, a minimum bone height of approximately 10 mm is typically required for successful implant placement. When there is not enough bone available, bone grafting and sinus lifting procedures are performed to increase the volume of bone. However, these procedures have drawbacks such as prolonged care, limitations on denture use, potential complications at the donor surgical site, and the risk of graft rejection.

Keywords: Atrophic edentulous maxilla, cheek bone, immediate loading, maxillary bone, zygoma, zygomatic implants.

INTRODUCTION

People who complain about missing teeth often experience difficulties in chewing, speech problems, aesthetic concerns, and a lack of self-confidence in social settings. However, this is not a new issue in the field of dentistry. Dentistry has made significant advancements since the introduction of osseointegration by Per-Ingvar Branemark in 1965, which involved placing implants inside the oral cavity. Implants have become a widely accepted treatment option for patients who have lost their teeth and serve as a substitute. Modern dentistry aims to restore patients' oral health in a predictable manner. Partial and complete dentures may not fully restore normal form, function, esthetics, comfort, or speech [1].

Assessing the Quality of Implants: The mobility and pain of implants are the main criteria for evaluating their quality. Probing depths can help identify any local disease or pre-existing tissue thickness before the implant placement. An increase in probing depth indicates bone loss, gingival hyperplasia, or hypertrophy. Probing depths are a better indicator of bone loss than intraoral periapical radiographs (IOPAR). Implant quality factors, established by James and modified by Misch, form an implant quality scale that assesses implant health and disease, influencing treatment and prognosis. Atrophic resorption of the edentulous maxilla occurs due to the lack of stimulation in the internal bone (cortical and cancellous) and non-physiological loading of the crestal bone. This leads to the inability to use a conventional full denture prosthesis. Various treatment protocols, such as composite or complex grafting with bone and Le Fort osteotomy, as well as sinus bone augmentation, have different success rates. These protocols often involve separate surgical treatments and require one to two months or more of healing before implant placement. To overcome the need for a staged procedure, zygomatic implants invented by Branemark are used [2].

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Zygomatic Implants: Zygomatic implants are longer (30-52.5 mm) machined titanium screws that are inserted through the crestal bone (palatal part) of the posterior maxilla (which has experienced resorption) trans-antrally into the compact bone of the zygoma. Additionally, 2 or 4 conventional screws are inserted in the anterior part of the maxilla. The support provided by these screws is ensured by their contact with four bony cortices: the crestal ridge, the floor of the maxillary sinus, the sinus roof, and the superior border of the zygoma. Zygomatic implants are used to provide posterior maxillary support when the surrounding bony structures do not allow for regular implant placement. The use of bone graft augmentation (sinus lifts and on-lay grafts) is often required alongside zygomatic implants, adding to the associated discomfort, prolonged treatment time, and increased risk of complications. Zygomatic implants are recommended in situations where the entire maxillary arch experiences advanced posterior resorption that would otherwise require grafting. In cases of partial or incomplete maxillectomy, additional implants may be inserted in other areas such as the pyriform sinus, rims of the orbit, palatal shelves, or pterygoid plates to provide anchorage for cross-arch stabilization [3].

INDICATIONS [4]

The use of zygomatic implants is commonly preferred for patients with moderate to severe bone atrophy. However, it can also be considered a beneficial choice for patients with or without significant atrophy who require posterior maxillary implant support. The following are specific scenarios where zygomatic implants may be suitable:

1. **Moderate Atrophy:** When the patient has moderate bone loss in the posterior maxilla.
2. **Severe Atrophy:** In cases of severe bone resorption in the posterior maxilla.
3. **Syndromic Patients:** For individuals with syndromes like ectodermal dysplasia, which often presents with partial anodontia (missing teeth).
4. **Acquired & Congenital Defects:** Patients with conditions such as cleft palate or those who require reconstruction after the removal of malignant tumors in the nose (rhinectomy).
5. **Partial Edentulism:** When the patient has some missing teeth in the posterior maxilla.
6. **Immediate Loading:** In situations where immediate implant loading is desired.

In all of these cases, zygomatic implants can provide the necessary support and stability for dental restorations.

Contraindications [5]

There are several contraindications for zygomatic implants, which include:

1. **Sinus Pathology:** Any existing pathology or disease affecting the sinuses can be a contraindication for zygomatic implants.
2. **Systemic Diseases:** Certain systemic diseases or conditions may make a patient unsuitable for zygomatic implants. These can include uncontrolled diabetes, autoimmune disorders, bleeding disorders, or conditions that compromise the immune system.
3. **Adequate Maxillary Bone:** Zygomatic implants are not necessary when there is sufficient bone in the maxilla to support the placement of regular implants in positions and numbers that can adequately retain a prosthetic appliance.
4. **Insufficient Pre-Maxillary Anchorage:** If there is not enough bony anchorage in the pre-maxillary area to support two stable implants with good long-term prospects, zygomatic implants may not be recommended. The volume and condition of the anterior bone in the maxilla are important factors that influence the decision, rather than solely considering the state of the posterior maxilla, to determine the suitability of this procedure for edentulous patients.

It is important for a qualified dental professional to thoroughly evaluate the patient's medical and dental conditions to determine if zygomatic implants are a suitable treatment option.

Medical Evaluation

The medical history of a patient includes relevant medical conditions that can influence decisions regarding implant treatment. The physical examination involves a hands-on evaluation and the recording of vital signs. The laboratory evaluation section focuses on specific tests relevant to implant dentistry, such as a complete blood count (CBC), sequential multiple analysis (SMA), and tests for bleeding disorders. The third section discusses the medical and dental implications of common systemic diseases found in implant patients, as these conditions have a significant impact on implant dentistry [6].

Pre-surgical assessment considers both the physical and mental stability of the patient, as they will undergo a surgical procedure lasting approximately two hours under deep intravenous sedation or general anesthesia. Adequate mandibular range of motion is necessary to ensure proper access during the placement of 30-52.5 mm long fixtures in the region of the zygomatic buttress. The presence of opposing mandibular teeth can hinder the placement of the zygoma fixture. In cases of deep sedation, it is advisable to administer local anesthesia in the mandibular arch and the surgical site itself.

Radiographically, an image-guided oral implantology system (IGOIS) is used, which includes preoperative planning, 3D reconstruction, registration, and a motion tracking algorithm to precisely transfer the preoperative plan. Stereolithography technology is utilized to create a jaw model and a surgical drill guide with skeletal support based on the finalized treatment plan. The objective is to design an individualized drill guide that matches the patient's bone profile. CAD/CAM programs use the bone contour and 3D information of the planned drill course to create the drill guide through stereolithography. Before the surgery, a simulated operation is performed on the stereolithographic maxillary model using the surgical drill guides [7].

Current trends in clinical dental implant therapy involve the use of endosseous dental implant surfaces with nanoscale topographies. Research supports the role of nanotopography in modulating crucial steps in osseointegration by modifying the implant surface at the nanoscale level. These nanoscale modifications can influence cellular and tissue responses, potentially benefiting the osseointegration process and dental implant procedures.

Surgical Protocol [8]:

During zygoma implant placement surgery, general anesthesia or deep intravenous sedation is typically used. Local anesthesia is also administered, including maxillary nerve blocks, vestibular infiltration, and infiltration or percutaneous blocks laterally and superiorly to the zygomatic notch (just lateral to the orbital rim). In cases where sedation is used, a bilateral inferior alveolar nerve block can be beneficial for adequate access.

The surgical procedure starts with a crestal incision slightly palatal to the ridge in the region of the first molar-second premolar. Bilateral releasing incisions are made at the ends of the incision. A full-thickness mucoperiosteal flap is reflected to expose the lateral maxilla, allowing visualization of the zygomatic buttress from the crestal ridge to the superior surface of the zygoma at the zygomatic notch. To avoid tearing of the flap during retraction, the anterior maxilla is exposed to the piriform rims, facilitating the placement of conventional premaxillary implants. A vertical "slot" window is created on the lateral wall of the maxillary sinus, parallel to the planned course of zygoma implant placement, which provides direct visualization and access for implant placement.

Incremental site preparation is carried out using a series of long drills. The length of the zygoma implant can vary from 30 to 52.5 mm, with a diameter of 5 mm in the alveolar one-third and 4 mm in the apical two-thirds. A customized zygoma retractor with a toe-out tip is used for visualization and proper positioning. The site preparation involves the use of sequentially drilled preparations, including 2.9 mm diameter long twist drills, 2.9 mm to 3.5 mm pilot drill, and 3.5 mm twist drill. The implant is inserted along with irrigation and should be in the same plane as the drills. The apical portion of the implant is engaged 2-3 mm into the dense zygomatic bone, and a manual driver is used to complete the implant installation. The proper abutment platform angulation is determined, and a cover screw is placed after the implant carrier is removed.

In addition to zygoma implants, 2-4 regular platform implants (such as Mark III or Mark IV Nobel Biocare) are inserted in the pre-maxillary region. The flap is repositioned, and sutures are placed. The maxillary denture is relieved at the site of implant emergence and relined with a tissue conditioner. An impression of the implant level is taken before closure for the fabrication of a rigid bar, which will be placed in the second stage of the surgery around six months later.

Prosthetic Procedure: Healing Phase

In zygoma implant placement surgery, the existing or provisional maxillary denture can be remodeled for immediate use to preserve the patient's esthetics. This allows the patient to have teeth throughout the treatment process, which is generally more pleasing than periods of no prosthesis that may occur during other procedures such as grafting. However, it's important to note that there may be limitations in terms of functional use, including potential alterations in retention or masticatory ability. Despite these limitations, having teeth during the treatment process is often preferred by patients [9].

Protective splinting

Combining splinting and cross-arch stabilization with zygoma implants provides a unique strength that enhances their functionality. It is important to prevent the independent transfer of stress from the denture base to individual implants after the stage II surgery or uncovering of all implants with abutment connections. To achieve this, precautionary measures can be taken.

One approach is to use a gold bar, approximately 2 mm in diameter, that is contoured to be in contact with a set of gold cylinders attached to the abutment analogs on the cast. These components can be soldered together using a micro-welding device, creating a passive protective splint. This splint is fabricated within a short period of time.

The bar splint is delivered to the patient usually on the next day. The maxillary denture is hollowed out to ensure complete seating without interference from the bar. An absolute softliner can be applied to the maxillary prosthesis at this time to improve retention and comfort. If the patient is not wearing a maxillary prosthesis, the bar splint may not be necessary. However, if constant denture wear is recommended, the bar splint protocol should be followed.

By using a protective splint, the stress and load on the zygoma implants are distributed more evenly, promoting better osseointegration and long-term success [10].

Final prosthesis construction

After a sufficient healing period, typically around 3 to 4 weeks, final impressions are taken to capture the oral tissues. Approved wax-up silicone putty indexes are created using these impressions, which serve as a matrix for fabricating a metal bar structure.

In the second try-in appointment, the passive fit and esthetics of the prosthesis are evaluated. If everything is satisfactory, the prosthesis is processed using heat polymerizing resin. During the delivery appointment, appropriate screws and screw torques are used to ensure even and complete seating of the prosthesis [11].

This process ensures that the final prosthesis fits well, provides adequate support, and meets the desired esthetic goals for the patient.

DISCUSSION

The complete restoration of a severely atrophied maxilla poses challenges for both surgeons and prosthodontists. Traditional implant placement in such cases often requires extensive bone grafting, sinus lift procedures, and the use of larger amounts of donor bone. This approach is associated with inconvenience for the patient, longer treatment duration, potential complications, lower implant success rates, donor site morbidity, and higher costs. Additionally, patients may have difficulty wearing a prosthesis for an extended period, which can discourage them from pursuing treatment [12].

Zygoma implant rehabilitation offers several benefits and considerations that make it an attractive alternative in these cases. The advantages of zygoma implants include reduced or eliminated donor site morbidity, shorter treatment duration, avoidance of bone grafts, fewer required implants to support the prosthesis, relatively lower cost, and less invasiveness compared to other alternatives [13].

However, there are also some disadvantages to consider. Zygoma implant surgery is demanding and requires well-trained technical skills. Surgeons should be capable of managing any potential surgical complications that may arise. There is a risk of injuring adjacent structures such as orbital contents, the facial nerve, the infraorbital nerve, or the lacrimal apparatus. While the risk of postoperative sinusitis is relatively lower compared to sinus lift procedures, it is still present. In rare cases of fixture failure, retreatment can be more difficult. General anesthesia or deep sedation is typically required for the surgery [14].

The success of zygoma implant treatment relies on extensive coordination between the surgeon and the prosthodontist. The presence of the prosthodontist at the time of surgery is ideal, and the surgeon should be familiar with the prosthetic requirements and techniques of fixture positioning and final restoration. Patient education, preparation, assessment, and informed consent are crucial steps in the procedure's success. Patients need to understand the importance of meticulous oral hygiene and maintenance [15].

In summary, zygoma implant treatment provides an alternative for patients with severely atrophied edentulous maxillae. It offers advantages such as reduced morbidity, shorter treatment duration, and a stable, well-tolerated, and esthetically acceptable prosthesis. However, it requires skilled surgical expertise, carries some risks, and necessitates proper patient education and cooperation for long-term success.

CONCLUSION

Zygoma implants are recommended for the restoration of the atrophied edentulous maxilla due to the following reasons:

1. High success rate: Zygoma implants have a success rate of greater than 96% in terms of osseointegration, providing a reliable treatment option [16].
2. Reduced surgical interventions: Zygoma implants eliminate the need for extensive bone harvesting or grafting procedures, reducing the invasiveness of the treatment.
3. Time-saving: The use of zygoma implants decreases the overall operating and working time for the surgeon, making the treatment more efficient.

4. Office-based surgery: The zygoma implant surgery can be performed within the office setting, providing convenience for both the patient and the surgeon.
5. Precise placement: The placement of the zygoma implant platform on the crest of the maxillary ridge allows for the access screw hole of the implant to surface in the central groove of the first molar, ensuring accurate positioning.
6. No need for angled or custom-made abutments: Unlike traditional implant techniques, zygoma implants do not require the use of angled or custom-made abutments in the final restoration, simplifying the treatment process.
7. Time and cost efficiency: Zygoma implants do not require additional restorative dental or laboratory time compared to traditional implant techniques, saving both time and cost for the patient.
8. Cost-effective: The overall laboratory and prosthetic charges for zygoma implant rehabilitation are comparable to or even less than those for conventional implants, making the therapy relatively economical for the patient.

In summary, zygoma implants offer a reliable and efficient treatment option for atrophied edentulous maxilla, providing high success rates, reduced surgical interventions, time-saving benefits, and cost-effectiveness.

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