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Indications for Zygomatic Implants: A Narrative Review

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ABSTRACT

Zygomatic implants represent a reliable graftless solution for the rehabilitation of patients with severe maxillary bone deficiency. Originally developed for maxillary defects following tumor resection, their clinical indications have expanded considerably with advances in surgical techniques and prosthetic protocols. This narrative review aims to summarize and critically discuss the contemporary indications for zygomatic implants based on evidence synthesized from recent systematic reviews and key clinical studies. Severe maxillary atrophy remains the most common indication, followed by avoidance of bone grafting procedures, management of failed grafts or implants, oncologic and traumatic defects, congenital anomalies, and medically compromised patients. Despite high reported survival rates, zygomatic implant therapy is technique sensitive and requires careful patient selection and surgical expertise. Standardization of indication criteria and high-quality prospective studies are needed to further refine clinical guidelines.

Introduction

Rehabilitation of the edentulous maxilla using conventional dental implants often necessitates adequate bone volume and quality to achieve long-term success.[1,2] Severe maxillary resorption, sinus pneumatization, trauma, congenital deformities, and post-oncologic defects frequently compromise implant placement, making conventional approaches challenging. Bone augmentation techniques such as sinus floor elevation, block grafts, and distraction osteogenesis are commonly employed but are associated with increased morbidity, prolonged treatment duration, higher costs, and variable outcomes.[3,4]

Zygomatic implants were introduced as an alternative anchorage solution by utilizing the dense zygomatic bone, thereby bypassing the deficient maxillary alveolar bone. Over the years, refinements in implant design, surgical approaches (intrasinus and extrasinus), and immediate loading protocols have expanded their clinical applicability.[5,6] Recent systematic reviews, by Polido et al. (2023), have attempted to consolidate and clarify the clinical indications for zygomatic implants. This narrative review builds upon that evidence to provide a clinically oriented overview of current indications, advantages, limitations, and future directions.[7]

Evolution of Zygomatic Implant Therapy

Initially, zygomatic implants were indicated primarily for

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patients with maxillary defects following oncologic resection. Subsequently, their use expanded to patients with severely atrophic maxillae where conventional implants were not feasible. The introduction of immediate loading concepts, quad-zygoma protocols, and digital planning has further enhanced predictability and reduced treatment time. Today, zygomatic implants are considered a viable alternative to extensive grafting procedures in selected patients.[7,8]

Indications for Zygomatic Implants[10-11]

Severe Maxillary Atrophy

Severe posterior maxillary atrophy remains the most widely accepted and frequently reported indication for zygomatic implants. Patients with advanced resorption (Cawood and Howell Class V or VI) often lack sufficient bone height and quality for conventional implants, even with sinus augmentation. Zygomatic implants provide posterior anchorage, enabling stable support for fixed prosthetic rehabilitation, often with immediate loading.

Avoidance of Bone Grafting Procedures

Zygomatic implants offer a graftless alternative for patients unwilling or unsuitable for bone grafting. Avoidance of donor site morbidity, reduced surgical interventions, and shorter treatment duration are key advantages. This indication is particularly relevant in elderly patients or those seeking rapid oral rehabilitation.

Failed Bone Grafts or Conventional Implants

Patients with a history of failed sinus grafts, block grafts, or conventional implants represent a challenging clinical group. Re-grafting procedures in such cases are unpredictable due to compromised vascularity and scarring. Zygomatic implants have demonstrated high survival rates in these scenarios and are widely accepted as a salvage or rescue treatment option.

Oncologic and Traumatic Maxillary Defects

Maxillary defects resulting from tumor resection or trauma often preclude conventional implant placement. Zygomatic implants utilize residual zygomatic bone to support prosthetic rehabilitation without the need for extensive reconstructive surgery. Although prosthetic complexity may be increased, functional and esthetic outcomes are generally favorable.

Congenital and Developmental Anomalies

Congenital conditions such as cleft lip and palate are associated with maxillary hypoplasia and deficient bone volume. Zygomatic implants may be indicated when conventional implant placement is not feasible. Multidisciplinary planning is essential in such cases to ensure optimal outcomes.

Medically Compromised Patients

In medically compromised patients where extensive bone grafting poses increased risk, zygomatic implants provide a less invasive alternative. Reduced surgical stages and faster rehabilitation are advantageous; however, careful patient selection and thorough medical evaluation are mandatory.

Table 1: Major Indications for Zygomatic Implants

Indication	Clinical Description	Rationale
Severe maxillary atrophy	Advanced posterior maxillary resorption	Insufficient bone for conventional implants
Avoidance of grafting	Patients unwilling or unsuitable for graft procedures	Reduced morbidity and treatment time
Failed grafts/implants	Previous unsuccessful augmentation or implants	Predictable anchorage in zygomatic bone
Oncologic defects	Maxillectomy or tumor resection	Rehabilitation without major reconstruction
Traumatic defects	Loss of maxillary bone due to trauma	Bypasses compromised anatomy
Congenital anomalies	Cleft palate, maxillary hypoplasia	Limited conventional implant options
Medically compromised	Systemic conditions limiting surgery	Reduced surgical burden

Table 2: Indications Reported in Representative Studies

Author(s)	Year	Reported Indication	Clinical Context
Brånemark et al.[12]	2004	Severe maxillary atrophy	Original use in severely resorbed maxilla
Aparicio et al.[13]	2000	Graftless rehabilitation	Avoidance of sinus grafting
Bedrossian et al.[14]	2006	Posterior maxillary atrophy	Zygomatic + anterior implants

Davó et al.[15]	2013	Failed grafts/implants	Salvage therapy
Malevez et al.[16]	2004	Severe maxillary resorption	Long-term clinical outcomes
Chrcanovic et al.[17]	2016	Atrophy and implant failure	Complication analysis
Aparicio et al.[18]	2014	Extrasinus technique	Reduced sinus complications
Polido et al.[7]	2023	Multiple indications	Systematic review synthesis

Table 3: Advantages of Zygomatic Implants Compared to Graft-Based Rehabilitation

Parameter	Zygomatic Implants	Graft-Based Implants
Surgical stages	Fewer	Multiple
Treatment duration	Shorter	Longer
Donor site morbidity	Absent	Present
Predictability in severe atrophy	High	Variable
Patient acceptance	Higher	Lower

Table 4: Limitations and Clinical Considerations

Aspect	Consideration
Surgical complexity	Technique sensitive
Anatomical risks	Sinus and orbital proximity
Complications	Sinusitis, soft tissue infection
Prosthetic issues	Hygiene and emergence profile
Evidence quality	Mostly retrospective studies

Clinical Considerations and Limitations

Despite high survival rates, zygomatic implant therapy is surgically demanding and associated with potential complications. Lack of standardized criteria for defining severe maxillary atrophy and heterogeneity in study designs limit direct comparison of outcomes. Most available evidence is based on retrospective studies and case series, underscoring the need for well-designed prospective trials.

Factors Affecting Planning and Outcomes of Zygomatic Implants

Successful rehabilitation with zygomatic implants depends on meticulous preoperative planning, precise surgical execution, and appropriate prosthetic rehabilitation. Multiple patient-related, anatomical, surgical, and prosthetic factors influence both short- and long-term outcomes.

Patient-Related Factors

Patient selection plays a crucial role in treatment success. Systemic health conditions such as uncontrolled diabetes, osteoporosis, immunosuppression, and history of head and neck radiotherapy may affect healing and implant survival. Smoking has been associated with increased risk of postoperative complications, particularly sinus-related issues. Patient expectations, oral hygiene capability, and compliance with follow-up visits also significantly influence outcomes.

Anatomical Factors

Adequate understanding of maxillofacial anatomy is essential during planning. The quality and volume of the zygomatic bone directly affect primary stability. Maxillary sinus anatomy, degree of sinus pneumatization, and sinus health are critical considerations, as improper planning may result in sinusitis or implant malposition. Proximity to vital structures such as the orbit and infraorbital nerve increases the risk of serious complications if anatomical variations are not carefully evaluated using three-dimensional imaging.

Radiographic and Digital Planning Factors

Cone-beam computed tomography (CBCT) is indispensable for assessing bone availability, sinus anatomy, and implant trajectory. Digital planning software allows virtual implant placement, angulation control, and selection of appropriate implant length. In complex cases, guided surgery may improve accuracy and safety, particularly for less experienced surgeons.

Surgical Technique and Operator Experience

Zygomatic implant placement is technically demanding and highly operator dependent. Surgical approach (intrasinus vs extrasinus), implant trajectory, and insertion torque influence primary stability and postoperative complications. Experienced surgeons demonstrate lower complication rates and better prosthetic outcomes. Immediate loading protocols require excellent primary stability and precise surgical execution.

Prosthetic Factors

Prosthetic design significantly affects functional and esthetic outcomes. Proper emergence profile, passivity of the framework, and occlusal scheme are essential to minimize biomechanical stress. Poor prosthetic design may lead to soft-tissue inflammation, hygiene difficulties, and mechanical complications. Screw-retained prostheses are generally preferred for ease of maintenance.

Postoperative Care and Maintenance

Postoperative instructions, antibiotic coverage, sinus care, and long-term maintenance play a vital role in outcome success. Regular follow-up is necessary to monitor soft tissue health, prosthetic integrity, and sinus status. Poor maintenance is a common cause of late complications rather than implant failure itself.

Table 5: Factors Influencing Planning and Outcomes of Zygomatic Implants

Category	Factors	Impact on Outcome
Patient-related	Systemic health, smoking, oral hygiene	Healing, complication risk
Anatomical	Zygomatic bone quality, sinus anatomy	Primary stability, safety
Radiographic planning	CBCT, digital planning	Accuracy, reduced complications
Surgical	Technique, implant angulation, surgeon experience	Implant survival, morbidity
Prosthetic	Design, occlusion, hygiene access	Long-term success
Postoperative care	Follow-up, maintenance	Prevention of late complications

Future Directions

Future research should focus on standardized indication criteria, long-term comparative studies with graft-based approaches, patient-reported outcome measures, and the role of digital planning and guided surgery in improving safety and predictability.

Conclusion

Zygomatic implants are primarily indicated for rehabilitation of severely atrophic maxillae and for avoidance of extensive bone grafting procedures. Additional indications include failed grafts or implants, oncologic and traumatic defects, congenital anomalies, and selected medically compromised patients. When performed by experienced clinicians and with appropriate case selection, zygomatic implants provide a reliable and efficient alternative to conventional graft-based rehabilitation.

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