



Commentary - Step-by-Step: Zygomatic Implants

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Severe maxillary atrophy poses a difficult challenge when considering implant-supported dental rehabilitation. The vertical bone can be limited by the maxillary sinuses and nasal floor, and the horizontal bone can be limited by the palatal and posterior resorption pattern of the edentulous maxilla. When determining which type of implants to place (ie, axial, angled, zygomatic), the 3 zones of the maxilla should be evaluated (Fig 1). If adequate bone is present in zones I, II, and III, axially loaded implants are a viable option. If zones I and II are suitable, one should consider axial anterior and angled posterior implants. If only zone I is adequate, 2 zygomatic implants with 2 axial implants can be considered. Finally, 4 zygomatic implants should be considered when atrophy is present in all 3 zones.

For cases of severe maxillary atrophy, zygomatic implants will allow for effective and predictable implant-supported dental rehabilitation without the need for bone augmentation, such as sinus augmentation or guided bone regeneration. The 12-year survival rate of these implants has been ~95%.¹ Zygomatic implants can be placed in an edentulous arch or at the time of extraction. Zygomatic implants are also useful in complex reconstructions after pathology and trauma. Immediate provisionalization of the implants is preferred, because it provides cross-arch stabilization of the zygomatic implants. If immediate loading is not an option, zygomatic implants can be “buried” for 4 to 6 months to allow for osseointegration before fabrication of the final prosthesis.

Patient Evaluation

The patient evaluation should include the following:

- As always, every patient should be evaluated with a full history and physical examination to ensure they are an appropriate candidate for the procedure
- Appropriate patient selection is crucial when planning zygomatic implants and includes
 - Patients with severe maxillary atrophy
 - Patients unwilling or unable to tolerate multiple procedures
 - Patients seeking an immediately loaded fixed prosthesis
- Interdisciplinary consultation and planning between an oral and maxillofacial surgeon and prosthodontist or general dentist is crucial
- Cone-beam computed tomography (CBCT) is recommended for preoperative evaluation
 - To evaluate the distance from the alveolar ridge to zygoma body to obtain an estimate for implant sizes
 - To evaluate the quality and quantity of the zygomatic bone available
- A minimum of 7 mm of anchorage into the zygoma is required for stability of zygomatic implants, with a greater amount required if 2 implants are to be placed

Contraindications

The absolute contraindications include the following: a restricted mouth opening not allowing for instrumentation; an inability of the patient to tolerate anesthesia; and the presence of maxillary and/or zygomatic pathologic features.

The relative contraindications include the following: active maxillary sinus pathologic features

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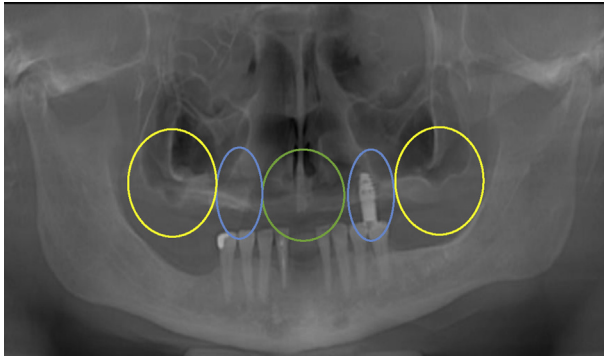


FIGURE 1. A 56-year-old woman with maxillary hypoplasia and severely atrophic maxilla in all 3 zones and a failing implant after bilateral sinus augmentations 2 years previously. The patient was a candidate for removal of the failing implant and 4 zygomatic implants. Green indicates zone 1; blue, zone 2; and yellow, zone 3.

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(chronic sinusitis acceptable); and the use of bisphosphonates and radiation (no definitive studies).

Specialized Armamentarium

The specialized armamentarium² (Nobel Zygoma System; Nobel Biocare, Kloten, Switzerland; Fig 2) includes the following:

- Zygomatic implants: available in 8 lengths and 2 angulations (0° and 45°)
A 0° implant allows for the choice of multiple abutment angles and can achieve a more buccal position



FIGURE 2. Zygomatic specialized armamentarium.

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Length in 2.5-mm increments available from 30 to 52.5 mm

- Multiple abutment options available with angulations from 0 to 60°
- Zygoma retractors
- Zygoma implant-specific drills
- Zygoma depth gauge
- Angled surgical or contra-angle dental implant handpiece
- Surgical guide, if planned
- It is recommended to have at least 2 implants in each length available

The Steps

INCISION/EXPOSURE

- General anesthesia or intravenous sedation if an adequate maximum interincisal opening is present and the patient is a candidate for office-based anesthesia
- The crestal incision should be positioned slightly toward the palatal aspect, with posterior vertical releasing incisions bilaterally
- The infraorbital nerve should be identified and the inferior-lateral aspect of the orbital rims exposed
- Intrasinus technique (see also next section)
Create a 5 × 10-mm sinus window or slot for access and direct view of the implant trajectory
To protect the sinus mucosa, reflect it medially
- Extrasinus technique (see also next section)
Osteotomy should be initiated at the zygoma body with small relief at the palatal aspect of maxilla at planned location of implant emergence

OSTEOTOMY (EXTRASINUS TECHNIQUE)—PREFERRED

- Begin with posterior zygomatic implant site
- Begin preparation at the palatal aspect of the second premolar/first molar region with a round burr (2000 rpm maximum)
- A trough can then be created along the sinus wall to aid in drill guidance
- A round burr is then used to begin preparation into the zygoma body
- Care must be taken to direct all drills toward the incisura of the zygoma to avoid inadvertent perforation into the orbit
- Drill guards can be used to protect the soft tissues while creating the osteotomy
- With the zygoma retractor in place, begin with the 2.9-mm drill and proceed bicortically through the zygoma and then use the 3.5-mm diameter drill

- Use the zygoma depth gauge to determine the length of implant needed
- The anterior implant site can then be prepared, generally at the region of the maxillary canines. Divergent angulation to the posterior implant with apex more cephalad in position (generally a longer implant)

IMPLANT PLACEMENT

- Loosen and retighten the transfer abutment
- Place the implant using a manual driver until the apex is inserted into the zygoma, with a minimum torque of 35 Ncm (Fig 3). Never exceed 45 Ncm to prevent damage to implant or bone. Ensure the implant crestal emergence is ideal for restoration access before removing the transfer abutment
- Place the cover screw or multiunit abutment

POSTOPERATIVE CARE

- Perform a postoperative Panorex radiograph or CBCT (Fig 4)
- Immediate provisional restoration can be placed or delayed final prosthesis can be placed once uncovered after 4 to 6 months. For immediate provisionalization: the patient should be sent to the restorative dentist for immediate fixed prosthesis the day of or the day after surgery
- After 6 months of osseointegration, the final prosthesis can be fabricated
- It is imperative that the restorations are retained by screws to provide cross-arch stabilization of the implants

Discussion

COMPUTER-AIDED SURGERY

Just as with conventional implants, the optimal implant placement is critical for an ideal prosthetic outcome. In the past, stereolithographic models were used to plan the ideal implant position and angulation. At present, custom surgical guides can be created for the initial pilot drills. Navigation can also be used to precisely position the zygomatic implants. Although these adjuvant techniques are not necessary, they can be beneficial, especially during training.

INTRASINUS VERSUS EXTRASINUS PLACEMENT

The traditional placement of zygomatic implants has been intrasinus, with a palatal emergence of the implant head. However, the palatal emergence is less



FIGURE 3. Intraoperative placement of implants into the zygoma. Weyb, Nocella, and Salman. *Step-by-Step: Zygomatic Implants.* *J Oral Maxillofac Surg* 2020.

desirable prosthetically because it can increase the palatal prosthesis bulk, negatively affecting the patient's speech and comfort. However, this placement is necessary to keep the implant body within the sinus. Placing extrasinus implants can improve the intraoral emergence toward a more crestal location and also reduces the risk of the development of chronic sinusitis.³

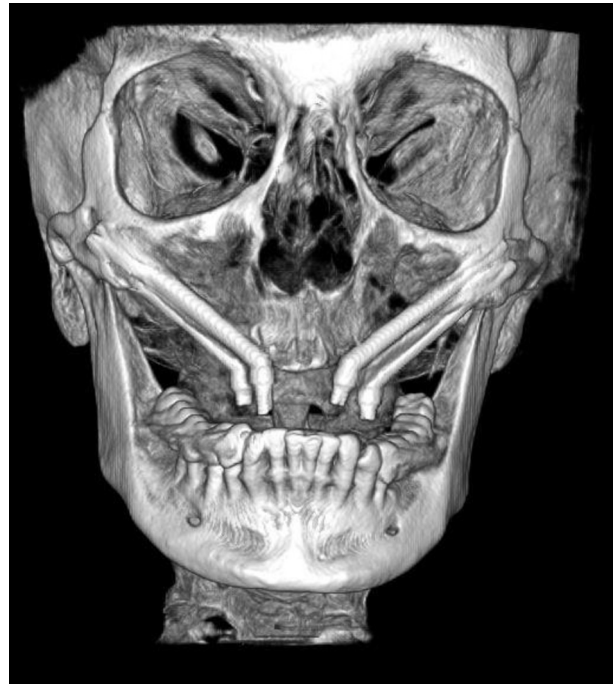


FIGURE 4. Postoperative cone-beam computed tomography scan. Weyb, Nocella, and Salman. *Step-by-Step: Zygomatic Implants.* *J Oral Maxillofac Surg* 2020.



FIGURE 5. Panorex radiograph of a 40-year-old woman who had been referred by her prosthodontist. She was unhappy with the missing teeth and esthetics of the maxillary anterior teeth. She had multiple missing, carious, and periodontally involved teeth. Placement of zygomatic implants was chosen to avoid multiple procedures, and because she desired an immediate fixed prosthesis.

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ALTERNATIVE TECHNIQUES FOR RESTORING THE ATROPHIC EDENTULOUS MAXILLA

When severe atrophy is present, extensive grafting via onlay bone grafting, Le Fort I interpositional grafting, maxillary sinus augmentation, nasal floor elevation, and grafting or a combination of techniques will be required to allow for restoration without the use of zygomatic implants. Different configurations of zygomatic implants with axial implants can be placed, depending on the availability of the maxillary bone (4 zygomatic implants vs 2 zygomatic plus 2 axially loaded implants vs 1 zygomatic implant splinted to additional implants). Pterygoid implants can also be considered.



FIGURE 6. Postoperative Panorex radiograph showing final placement of 4 zygomatic implants. Immediate fixed prosthesis was placed the same day.

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ZYGOMATIC IMPLANT PITFALLS AND PEARLS

The pitfalls of zygomatic implants are as follows:

- The most common complication is chronic sinusitis. Asymptomatic mucosal thickening on imaging studies will be present in 20% of patients.
- Major complications include placement of the implant into the orbit or pterygomaxillary space. Care should be taken to not perforate through the posterior wall of the maxilla or deep to the zygomatic body.
- Poor visibility intraoperatively and complex anatomy will result in a clinically demanding procedure.

The pearls of zygomatic implants are as follows:

- The extrasinus placement of implants can help avoid the development of chronic sinusitis and position implant emergence to a more ideal prosthetic location.
- Cross arch stabilization is mandatory for zygomatic implants.
- To improve the anteroposterior spread and minimize an anterior cantilever when placing 4 zygomatic implants, the implants should emerge at the area of the first molars and canines, if possible.
- Exposure of the lateral-inferior orbital rim will minimize the risk of injury to the globe and orbital contents.
- Gently loosen the implant transfer abutment before placing it in the mouth—these generally have a tight seal; thus, breaking the seal before intraoral placement will allow for easier removal once the implant has been placed.

In conclusion, oral and maxillofacial surgeons are uniquely qualified to place these highly technique-sensitive implants. Zygomatic implants are an integral part of dental rehabilitation of patients with severe maxillary atrophy and those with postablative and post-traumatic defects. They offer a predictable graftless technique to restore the edentulous maxilla in a single procedure (Figs 5, 6).

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