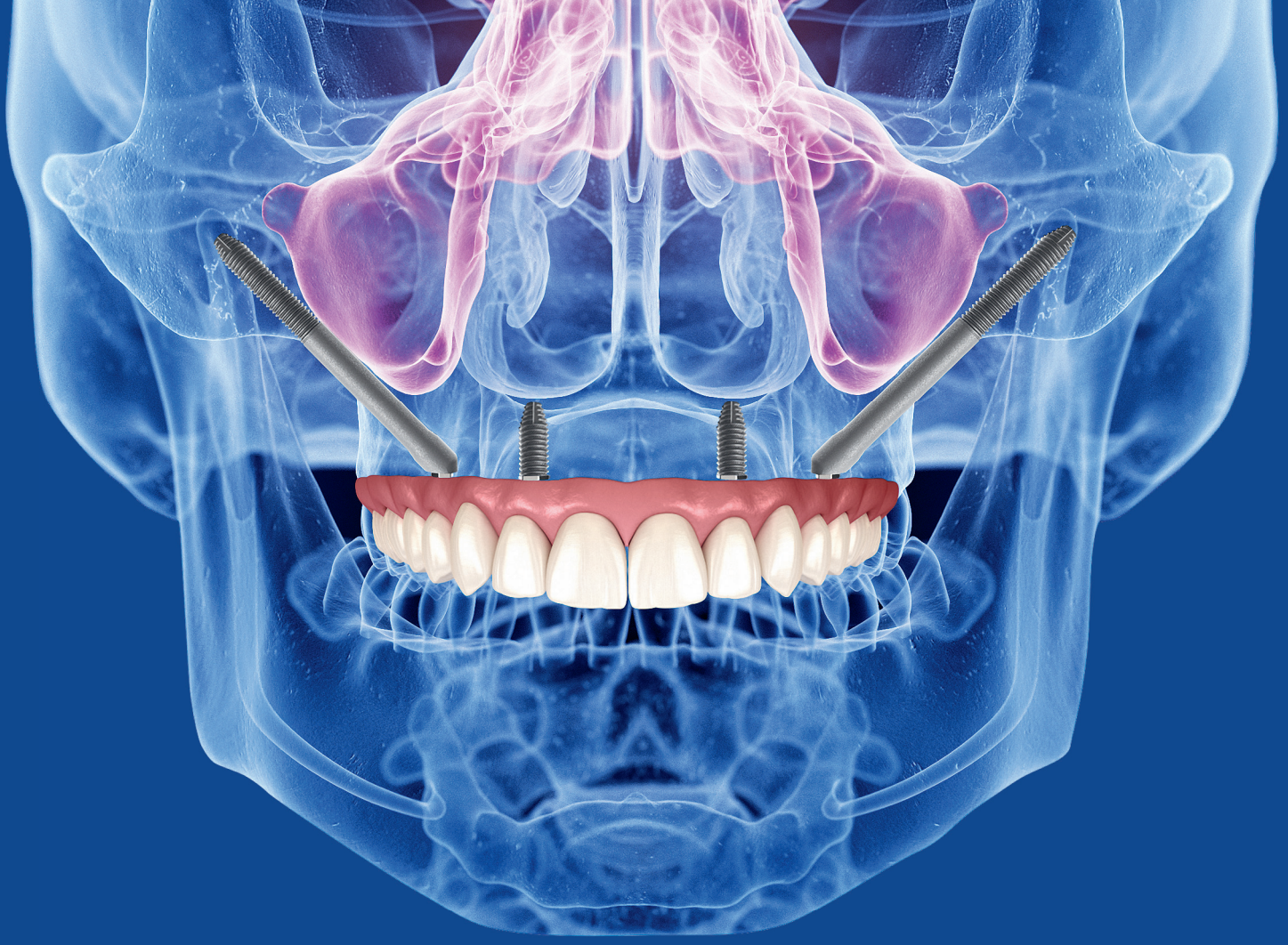

# ZYGOMA IMPLANTS

## STEP BY STEP

EDITED BY **ARUN K. GARG, DMD**

QUINTESSENCE PUBLISHING

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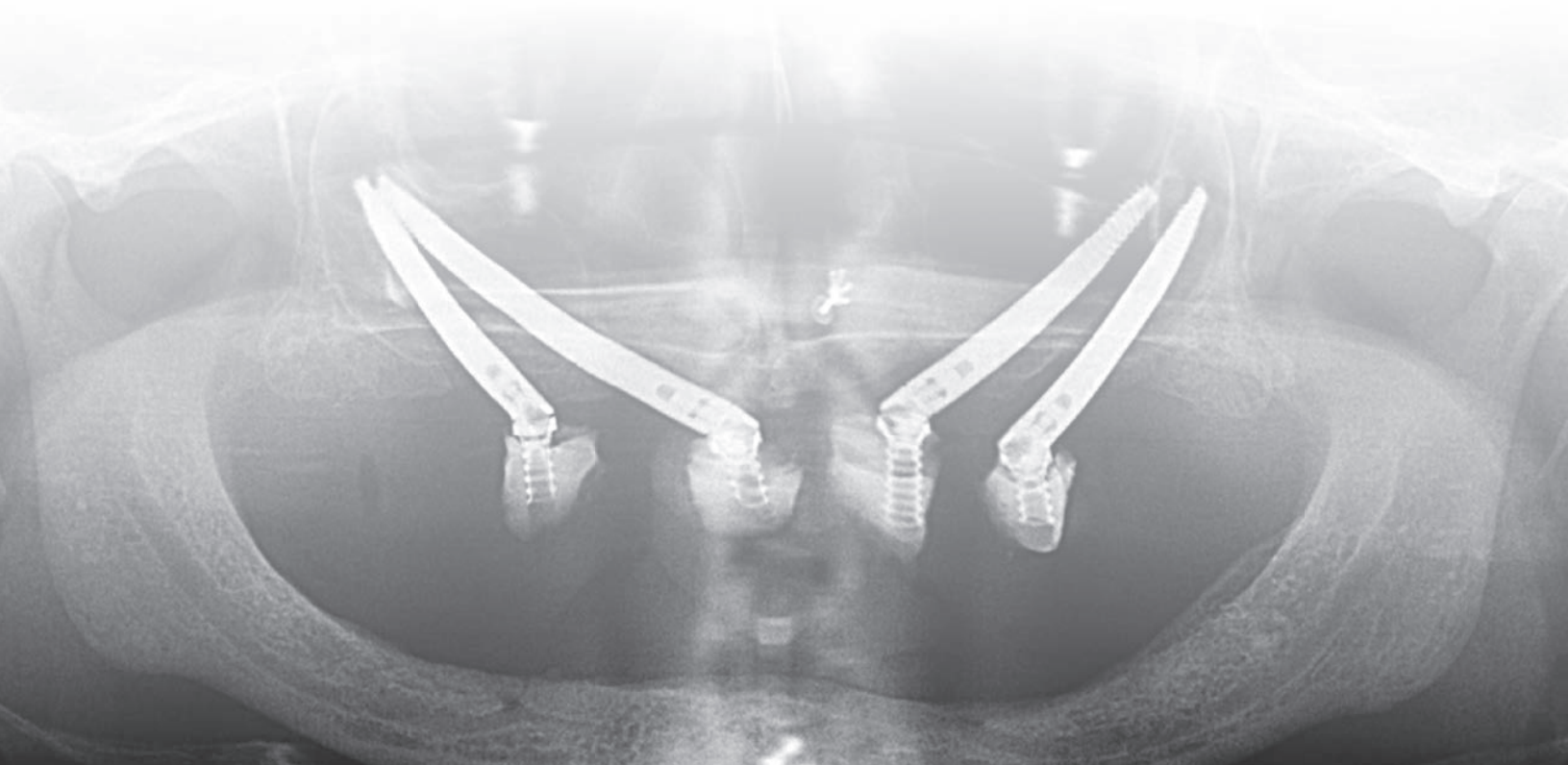
# Contents



# Preface

Over two decades have passed since P-I Brånemark published the first study demonstrating the efficacy of using extramaxillary implants to support a prosthesis in patients with an extremely atrophic maxilla. In the intervening period, numerous additional studies have confirmed the long-term stability and predictability of zygoma implants, with reported survival rates ranging from 95% to more that 98% over 3 to 12 years of follow-up. Today, zygoma implants are the standard of care in the treatment of patients with severe maxillary bone atrophy who cannot be rehabilitated with surgical bone augmentation and/or the placement of conventional or tilted implants.

This book is designed for experienced implant surgeons who wish to acquire both a broad understanding of the various surgical and prosthetic protocols being practiced around the world today as well as the knowledge to perform these procedures in step-by-step fashion in their own practices. Unlike many edited volumes, the chapters in this book are not a random collection of articles mashed together but a carefully selected and organized series of chapters that build the reader's knowledge from start to finish.

The distinguished contributors were selected based on their decades of actual clinical knowledge and experience with zygoma implants and exceptional clinical skill. Each has contributed extensively to the rapid progress that has been achieved over the past two decades in our ability to restore function and esthetics in a long-neglected patient population. Additionally, because these authors come from many different parts of the world, this book represents the most innovative and advanced knowledge and techniques available anywhere on this topic.

Patients who qualify as candidates for zygoma implant therapy usually get only one chance to regain their masticatory function, so the stakes for this treatment are very high. For that reason, extra care has been taken to equip the reader with comprehensive knowledge of every facet of the surgical and prosthetic treatment protocols, ranging from patient evaluation and selection to step-by-step procedures and the management of complications. To help guide and enhance the reader's comprehension, ample professional drawings and case illustrations have been beautifully reproduced for maximum educational benefit by Quintessence Publishing, the world's preeminent publisher of professional dental literature.

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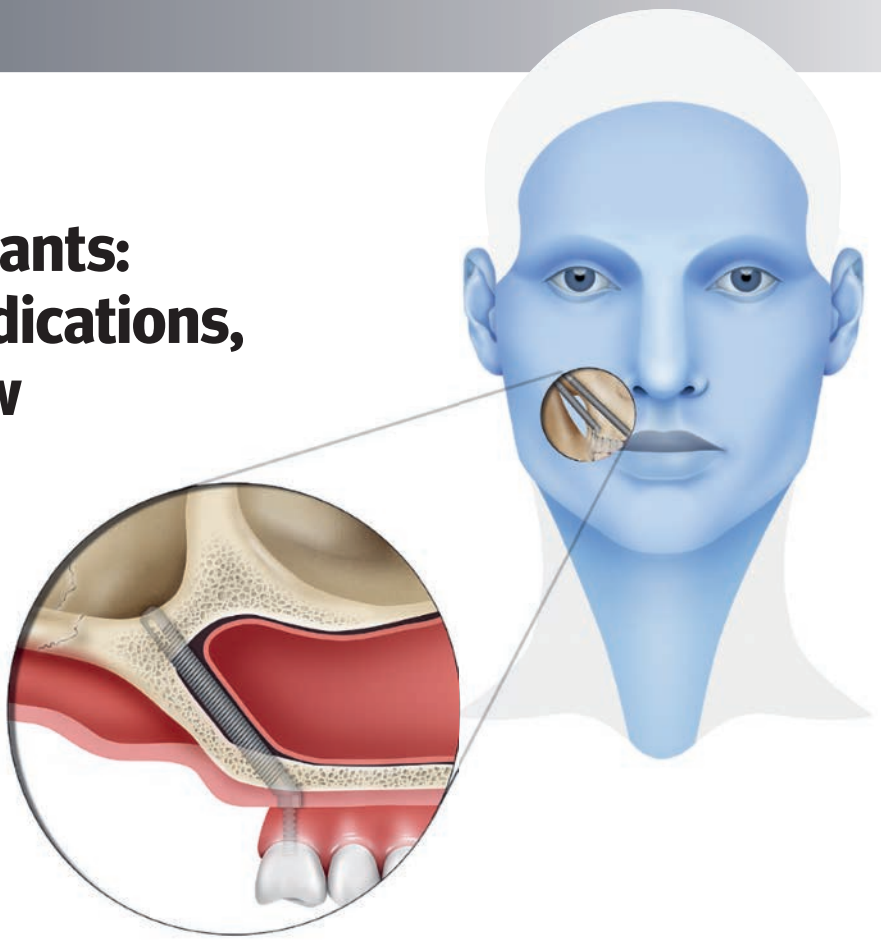
Chapter 1

# Zygoma Implants: Rationale, Indications, and Overview

Arun K. Garg
Angelo Cardarelli



Zygoma implants are often the anchoring mechanism selected by the interdisciplinary surgical/restorative team in the prosthetic reconstruction of the extremely atrophic maxilla, whether the maxillary defect is congenital in origin (eg, cleft lip and palate) or acquired via injury or following tumor resection in cancer treatment. In the surgical/restorative team, the surgical associates are guided by the restorative dentist's decisions regarding type and placement of provisional and final prostheses. Both zygoma implants and traditional or tilted implants are often chosen to provide optimal prosthesis support and distribution of occlusal forces.

The literature confirms the safety, predictability, and cost-efficiency of zygoma implant procedures.[1–9] When the maxillary bone cannot sufficiently anchor a prosthesis to restore the region's function and esthetics via traditional implant placement, zygoma implants can often be a good solution. In these cases, zygoma implants not only reduce the overall treatment time because fewer implants are placed, but they also restore function immediately without the need for bone grafting, thereby avoiding the added morbidity of extra procedures. However, the patient will be subject to a more complex procedure, including sedation (general or deep) and more complicated and potentially problematic treatment conditions if the implants fail. Therefore, patient selection is crucial for zygoma implants. The scientific basis for zygoma implants stems from the anatomy of the zygomatic bone itself along with the surrounding cranial structures. These two factors must be considered to determine which patients are most suitable for the procedure as well as to develop appropriate perioperative treatment plans.

**FIG 1-1** *(facing page)* The apical portion of the zygoma implant is osseointegrated into the zygomatic bone. The coronal portion of the implant can be osseointegrated into the alveolar crest, although on occasion it simply rests on the crest and is not osseointegrated into it. The body of the zygoma implant may be through the maxillary sinus, adjacent to the maxillary sinus by elevating the sinus membrane prior to implant placement, or outside of the bony housing of the maxillary sinus.

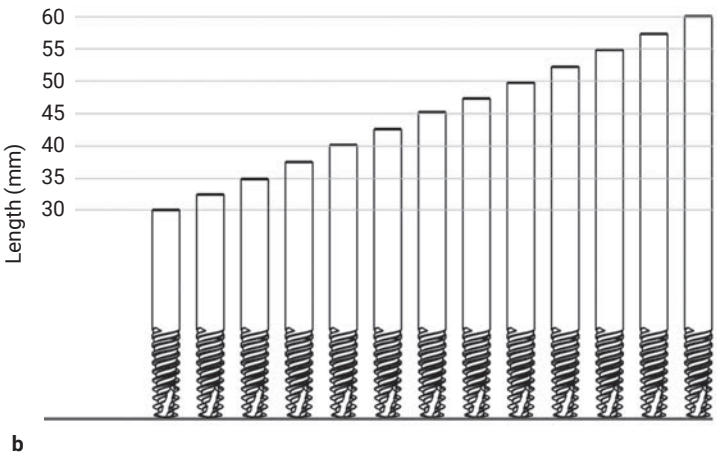



**FIG 1-2** *(a)* Zygoma implants come in a variety of designs. The apical portion is always intended to osseointegrate within the zygomatic bone. *(b)* Zygoma implants are commercially available in a variety of lengths to accommodate differences in distance between the zygomatic bone and residual alveolar crest in each patient.

## Rationale for Zygoma Implants

Insufficient maxillary bone often precludes the use of conventional or tilted implants to support prostheses aimed at restoring function and esthetics in the maxilla. Zygoma implants offer a solution to this problem, but the tradeoff is a more complicated procedure with more risks for the patient down the line. The anatomy of the zygoma and the specifications of the implants designed to exploit that anatomy provide clinicians with concrete evidence to support zygoma implant procedures.

### Zygoma anatomy

The anteroposterior length of the zygomatic bone averages 14 to 25.5 mm and ranges in thickness from 7.5 to 9.5 mm. Upon placement of a zygoma implant, slightly more than one-third of the implant (14–16.5 mm) comes into direct contact with the zygoma's solid, sturdy outer cortex, where the implant obtains primary stability[10–14] (Fig 1-1).

To ensure a palatal emergence profile of the zygoma implant, the original procedure called for implant placement within the sinus.[15,16] The clear advantage to palatal emergence is that as the maxilla resorbs, the basal bone remaining in the maxilla will orient posteriorly to the alveoli while the zygomatic bone position remains constant. However, this emergence profile requires increased buccal cantilevers because of the relative bulkiness of the prosthesis required for such a platform.

### Zygoma implant specifications

Zygoma implants sold in the United States generally are available in lengths ranging from 30 to 52 mm. Because clinicians must have some leeway in determining the proper path for drilling into the zygomatic bone, the implant emergence point in the palate may have to be widened. Therefore, zygoma implants are tapered in diameter, from 5 mm at the coronal end (about one-third the length of the implant) to 4 mm in diameter for the remaining apical end of the implant (Fig 1-2). The coronal portion usually has a 45-degree platform for connection to the prosthesis.[12,17–19]

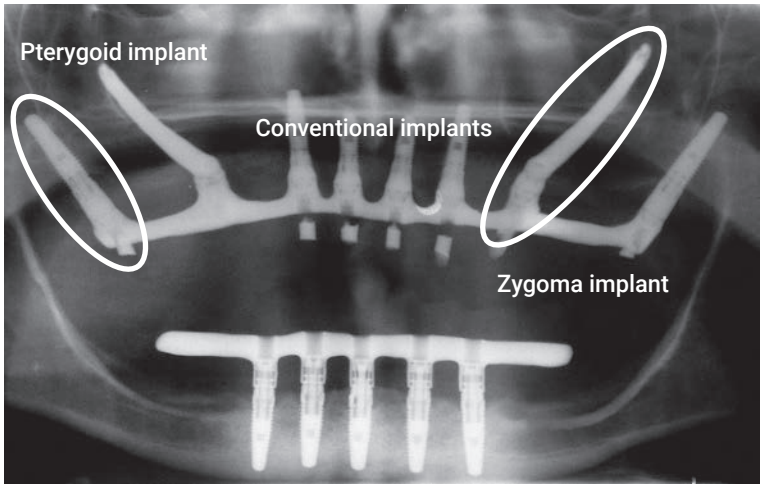



**FIG 1-3** Radiographic view of zygoma implants, pterygoid implants, and conventional or tilted implants in the maxilla.

## Patient Selection for Zygoma Implants

Patient selection for zygoma implants depends on patient expectations, maxillary bone indications regarding implant suitability, and a number of medical and dental contraindications that direct nontreatment or alternative treatment.[17,20–22]

### Indications

Designed by Per-Ingvar Brånemark and ranging in length from 30 to 62 mm or slightly longer, zygoma implants anchor in the zygoma when there is insufficient or no available anchorage in the alveolar bone of the maxilla to support a full-arch prosthesis. Zygoma implants can be used alone or in conjunction with conventional implants. Often when the posterior maxilla suffers from near complete atrophy, there is still enough bone in the anterior maxilla to anchor traditional or tilted implants to assist in the positioning and support of a prosthesis secured primarily by zygoma implants[4,7,23–26] (Fig 1-3). When the anterior maxilla is too resorbed due to defects[7] (cleft lip or palate, tumor resection, or unsuccessful implant/bone restorations), zygoma implants are used alone to support and retain the prosthesis.[1–3,5,6,27–31]

### Contraindications

As a major dental procedure, zygoma implants are contraindicated for many patients, including medically compromised patients with systemic conditions such as diabetes mellitus, patients suffering from acute sinusitis, and patients whose maxillary alveolar bone can support traditional implants. Depending on the severity of conditions, damage to the masticatory muscles (trismus) may also be a contraindication for zygoma implants, as may radiation treatments affecting bone quality in the head and neck regions.[32,33]

## Perioperative Overview for Zygoma Implants

The original surgical procedure for zygoma implants has evolved over the years to accommodate the diverse restorative circumstances associated with individual patients and to prevent surgical and postoperative complications.

### Original (intrasinus) surgical procedure

The clinician chooses general anesthesia or intravenous deep sedation for the procedure. For hemorrhage control and nerve blocks (superior alveolar, infraorbital, and greater palatine), local anesthesia

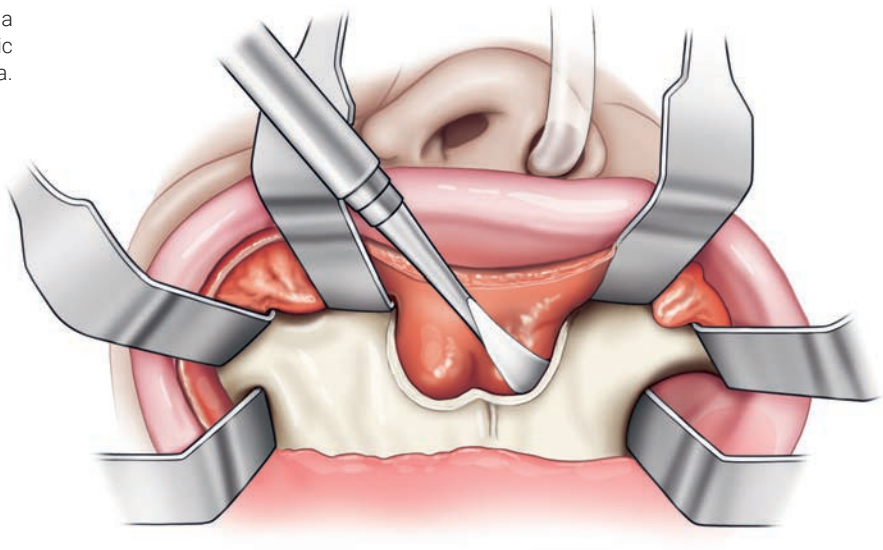


**FIG 1-4** Drawing depicting the area of nasal elevation and the zygomatic bone after reflection and the incisura.

is administered intraorally (the maxillary vestibule and the posterior hard palate). When deep sedation is used, the zygoma prominence is also treated with extraoral anesthesia/infiltration.[12,18,34]

When preparing the osteotomy and placing implants, clinicians generally use a contra-angle handpiece if the patient's mouth opening is restricted. The keratinized gingiva is bisected between the tuberosities via a crestal incision. The clinician then makes vertical incisions posteriorly along the maxillary buttress and anteriorly within the midline region. An elevated mucoperiosteal flap reveals the alveolar crest, lateral maxilla and antral wall, infraorbital nerve, zygomaticomaxillary complex, and the lateral surface of the zygomatic bone cranially, to the area between the lateral/medial surfaces of the frontal process and arch of the zygomatic bone, namely the incisura (Fig 1-4).

Although exposing the infraorbital rim is not necessary, exposing the infraorbital nerve is important because this nerve marks the boundary for the interior placement of two ipsilateral zygoma implants, when such an approach is required. To reduce cantilevering by increasing the posteroanterior separation of two ipsilateral implants, the clinician places the two implants so that their apices converge rather than lie parallel. Posterior implant placement is performed as close as possible to the posterior lateral wall of the maxillary sinus, and anterior implant placement is achieved as close anteriorly to the infraorbital nerves as safety will permit.

Retraction of soft tissues at the incisura (via careful placement of a zygoma retractor near the infraorbital rim) facilitates proper angulation of implants during placement. The zygoma implant platforms usually emerge in the region of the first molar or second premolar, unless an ipsilateral implant is required, in which case this will shift to the canine region.

The path of the implant is determined visually. The zygoma retractor provides a view of the targeted base of the zygomatic bone, and a straight measurement tool or drill bit can be laid across the lateral wall of the maxilla as a directional guidepost for drilling. Using a 105-degree handpiece with a round bur, the clinician penetrates the zygomatic bone regions for implant placement. To establish the final width of the implant site, the clinician first uses a 1-mm twist drill to pierce the cortices of the zygoma, followed by a 2-mm drill. An osteotomy depth gauge, which uses a hook to reach the superior cortex, measures osteotomy depth in 5-mm increments.

The implants are placed manually or with a handpiece. The clinician must prevent soft tissue from engaging the implant body and becoming embedded in the osteotomy, which may adversely affect osseointegration. The clinician should place the implant tip

2 mm past the superior cortex of the zygomatic bone, with the implant platform flush to the occlusal plane and as near the maxillary bone as possible. Next, the clinician retrieves the implant mount and places the cover screws. If two ipsilateral zygoma implants are placed, traditional implants may or may not be placed in the anterior maxilla for additional support. Finally, the clinician checks to ensure that bleeding has been controlled and applies copious irrigation before suturing with 3-0 polyglactin 910 (Vicryl, Ethicon).[12,18,34]

## Surgical complications

Common complications involve unintended incursions into regions adjacent to the zygoma, namely the orbit and the temporal fossa (Fig 1-5). Incursions into the former are best avoided by the clinician's correct use of the zygoma retractor in the incisura, ensuring a clear view of the region. Incursions into the temporal fossa result from an excessive posterior placement of the zygoma implant relative to the base of the bone; occasionally, the lack of adequate zygomatic bone can cause an incursion as well, particularly when ipsilateral implants are placed. Repositioning the implant bed anteriorly can remedy this complication.[35–37]

## Postoperative procedures

Clinicians familiar with postoperative procedures for implant placement into the maxilla accompanied by a sinus elevation will already be familiar with the procedures needed following the zygoma implant placement, namely safety measures related to the sinus, a soft food diet, and analgesic and antibiotic regimens.[1,38,39]

## Postoperative complications

In addition to the kinds of postoperative complications associated with any dental implant procedure, the zygoma implant procedure has the additional concerns of a resulting oroantral communication and sinusitis. Sinusitis is a complication often associated with the intrasinus zygoma implant approach because it requires incursive surgery—a foreign body (the implant) placed in the sinus—possibly resulting in oroantral communication. Antibiotics and nasal decongestants are often the medical treatment of choice for sinusitis. However, a surgical remedy may be needed if medical treatment fails (eg, functional endoscopic sinus surgery, or FESS).[9,40–42]

## Modified surgical procedures

A number of modified surgical approaches and procedures have been developed since Brånemark and colleagues pioneered the intrasinus approach in 1998.[15,16] For example, using an extrasinus zygoma implant can reduce complications in the sinus while simultaneously optimizing buccal cantilevering, because the clinician avoids penetrating the maxillary sinus and what remains of the maxilla's alveolar ridge[24,34,43–45] (Fig 1-6).

Several specific modifications to the zygoma implant procedure have resulted in designated nomenclature. For example, the sinus slot technique does not require the creation of a sinus window, and it also optimizes the position of the zygoma implant.[26,46] The sinus slot procedure provides for an increase in the vertical position of the zygoma implant as well as a superior buccal location of the implant platform. The crestal incision is shorter in this procedure, and the mucoperiosteal flap is raised to provide the clinician enhanced visibility. Additionally, the alveolar ridge is exposed via reflection of the palatal mucosa. The clinician creates a bur hole superiorly on the contour of the zygomatic buttresses as well as a bur hole on the alveolar ridge so that the apertures can be connected by a slot orienting the drilling for implant placement in the zygomatic bone. The result is good visibility of the implant during the procedure as well as superior bone-to-implant contact, because the implant intrusion into the sinus is correspondingly lessened, reducing complications.[10]

The zygoma anatomy-guided approach (ZAGA) to implant placement focuses on the creation of an optimal osteotomy site by emphasizing the two elemental structures of the procedure: the zygomatic bone anchor and the fixed prostheses themselves.[47] The specific conditions of each patient's edentulous maxilla guide the site preparation of the zygoma implant, obviating slot/window preparation of the lateral wall of the maxillary sinus. Optimal implant

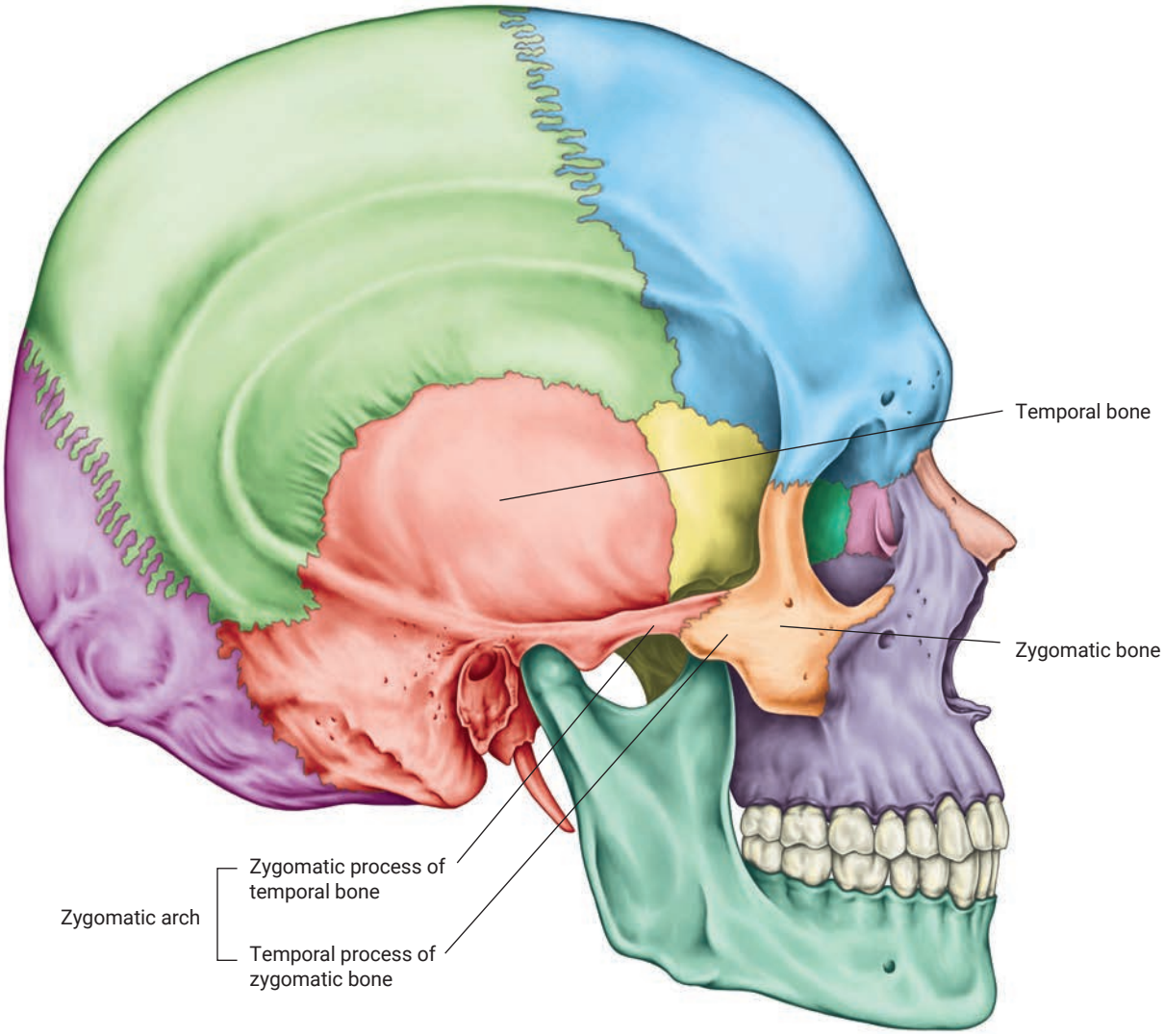
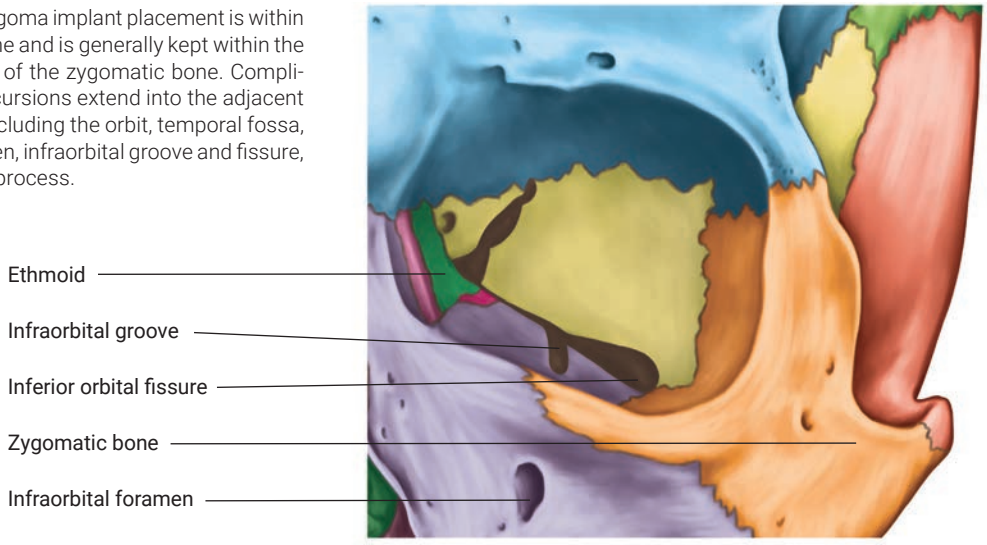



**FIG 1-5** Proper zygoma implant placement is within the zygomatic bone and is generally kept within the temporal process of the zygomatic bone. Complications arise if incursions extend into the adjacent vital structures, including the orbit, temporal fossa, infraorbital foramen, infraorbital groove and fissure, or the zygomatic process.



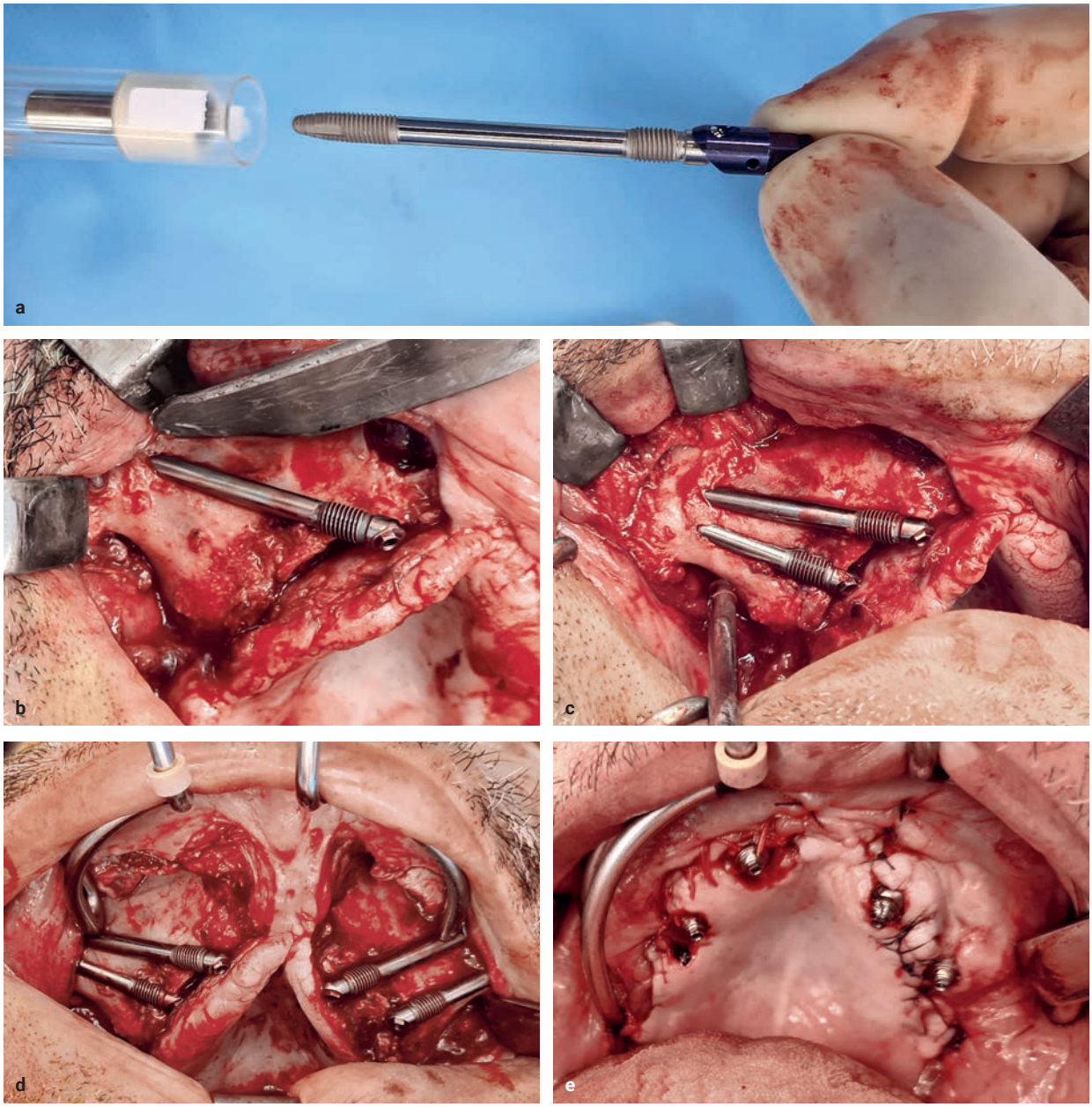



**FIG 1-6** *(a)* Zygoma implant with roughened threads designed to engage both the zygomatic bone and the crestal alveolar bone being removed from its sterile packaging immediately prior to placement. *(b)* Placement of the first of four zygoma implants using an extrasinus approach with adequate flap reflection. *(c)* The second of the four zygoma implants in position. *(d)* All four of the zygoma implants in place and the hex oriented appropriately over the alveolar crest for prosthetics. *(e)* The flaps sutured back into position.

emergence on the alveolar ridge (for superior prosthetic performance) and the patient's own zygomatic bone anatomy control implant length and apical placement. Thus, the points of emergence and apical placement determine whether the implant's path is intrasinus, extrasinus, or some combination of the two.[48–50]

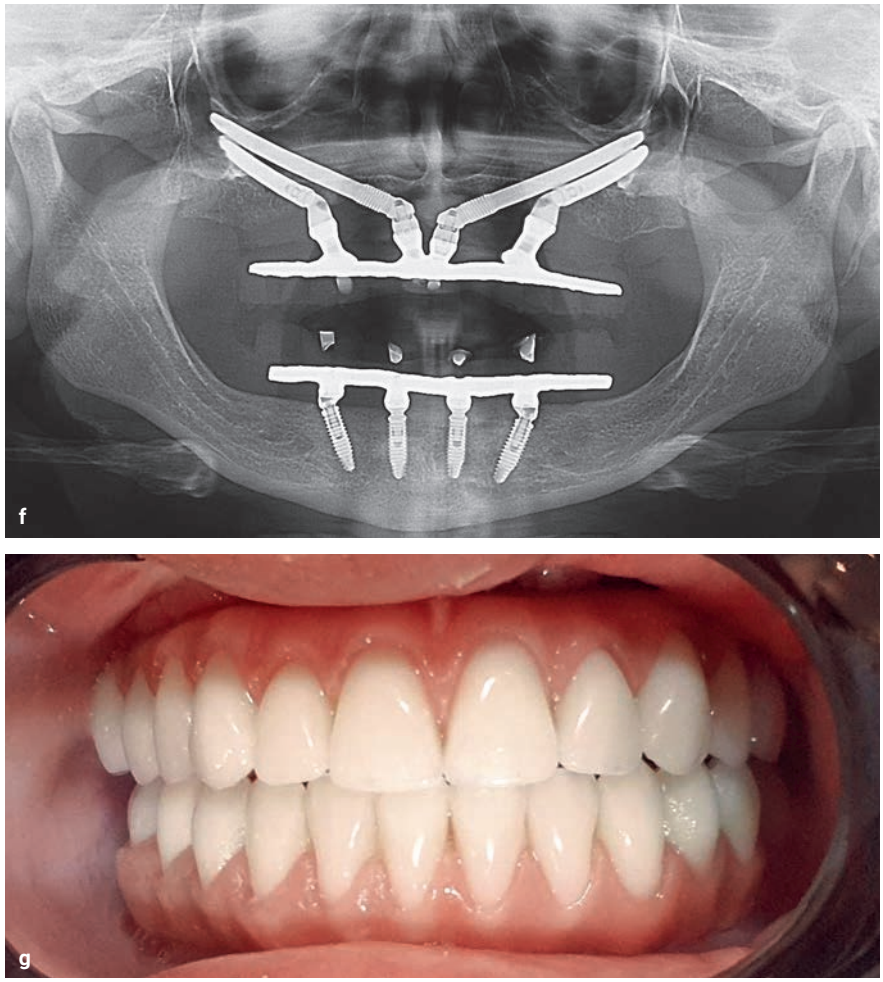



**FIG 1-6** *(cont) (f)* Radiographic appearance of the four zygoma implants in the maxilla and the four tilted implants in the mandible. *(g)* The transitional maxillary and mandibular prostheses in place.

## Conclusion

The zygoma implant procedure is generally safe, predictable, and cost-efficient. The literature continues to show that zygomatic bone anatomy and the anchoring systems designed to take advantage of that anatomy can guide the interdisciplinary surgical/restorative team in patient selection and patient-specific treatment planning. When maxillary implants cannot be used to restore the severely atrophied maxilla to function and esthetics, zygoma implants can often provide not only the means for efficient and effective anchoring of a prosthesis but also immediate function with fewer implants and a reduced treatment time. For these benefits, many patients are willing to undergo general or deep sedation for the procedure and to accept the risk of complications associated with a deep-anatomy implant failure.

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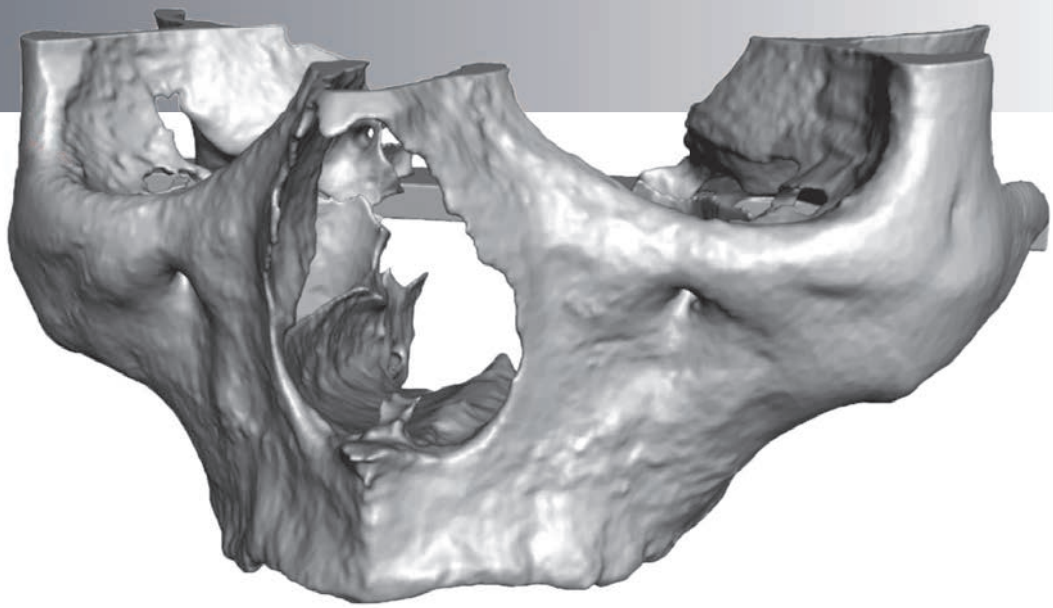
Chapter 2



# The ZAGA Concept: A Multifaceted Approach to Zygoma Implant Rehabilitation

Carlos Aparicio

Total or partial rehabilitation in patients with severely atrophic maxillae has always been a significant challenge for surgeons. Historically, the uncertainties involved in performing such a procedure have meant that many clinicians choose conventional methods even though they can be more costly, time-consuming, and complex for the patient. Yet the inadequate bone architecture of severely atrophic maxillae makes it difficult, if not impossible, to augment using standard protocols. But the learning curve for the placement of zygoma implants can be significant, even for highly experienced surgeons. Add to this the risk of late complications, and it is easy to see why clinicians are somewhat apprehensive when faced with the oral rehabilitation of a patient with a severely atrophic maxilla.

That said, most clinicians understand that patients with this condition are facing their last chance to receive a fully functioning set of teeth, recover esthetics, and regain masticatory function. Therefore, successful treatment is paramount.

After several initial reports on the possibility of using zygomatic anchorage for dental prosthetic fixation, mainly in discontinuous or severely atrophic jaws,[1,2] in 2004 Brånemark et al[3] presented the first long-term study on the results of using zygoma implants alone and in combination with bone grafts. The literature has since shown that zygoma implant placement according to this original procedure is predictable in terms of achieving implant and prosthesis stability. In 2009, Davó[4] reported a 5-year retrospective study on two-stage loaded zygoma implants. Implant surfaces were pure machined titanium, and the 5-year survival rate was 98.5%. In 2010, Bedrossian[5] reported a prospective follow-up of 36 patients followed for 5 to 7 years with an implant survival rate of 97.2%.