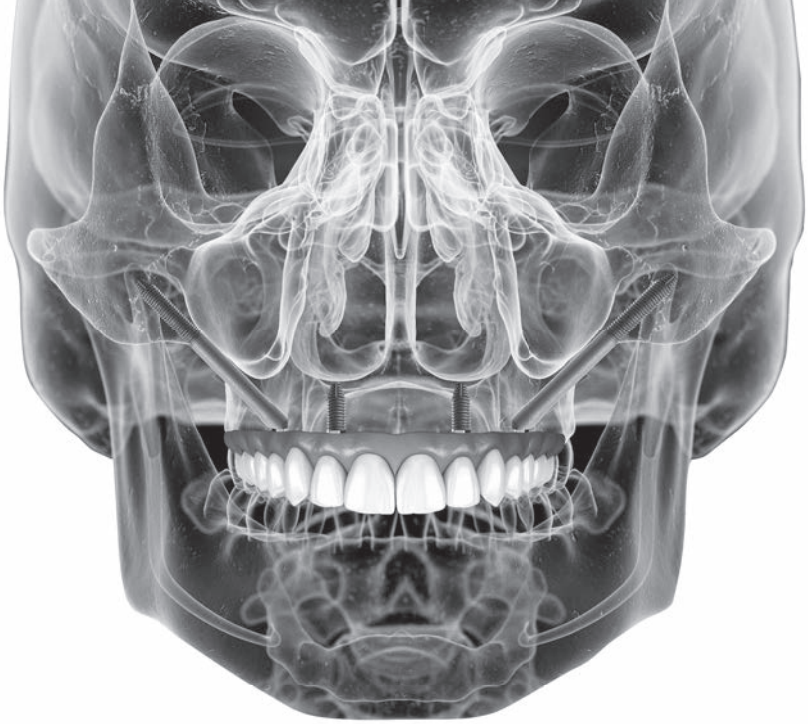

ZYGOMA IMPLANTS

STEP BY STEP

Edited by

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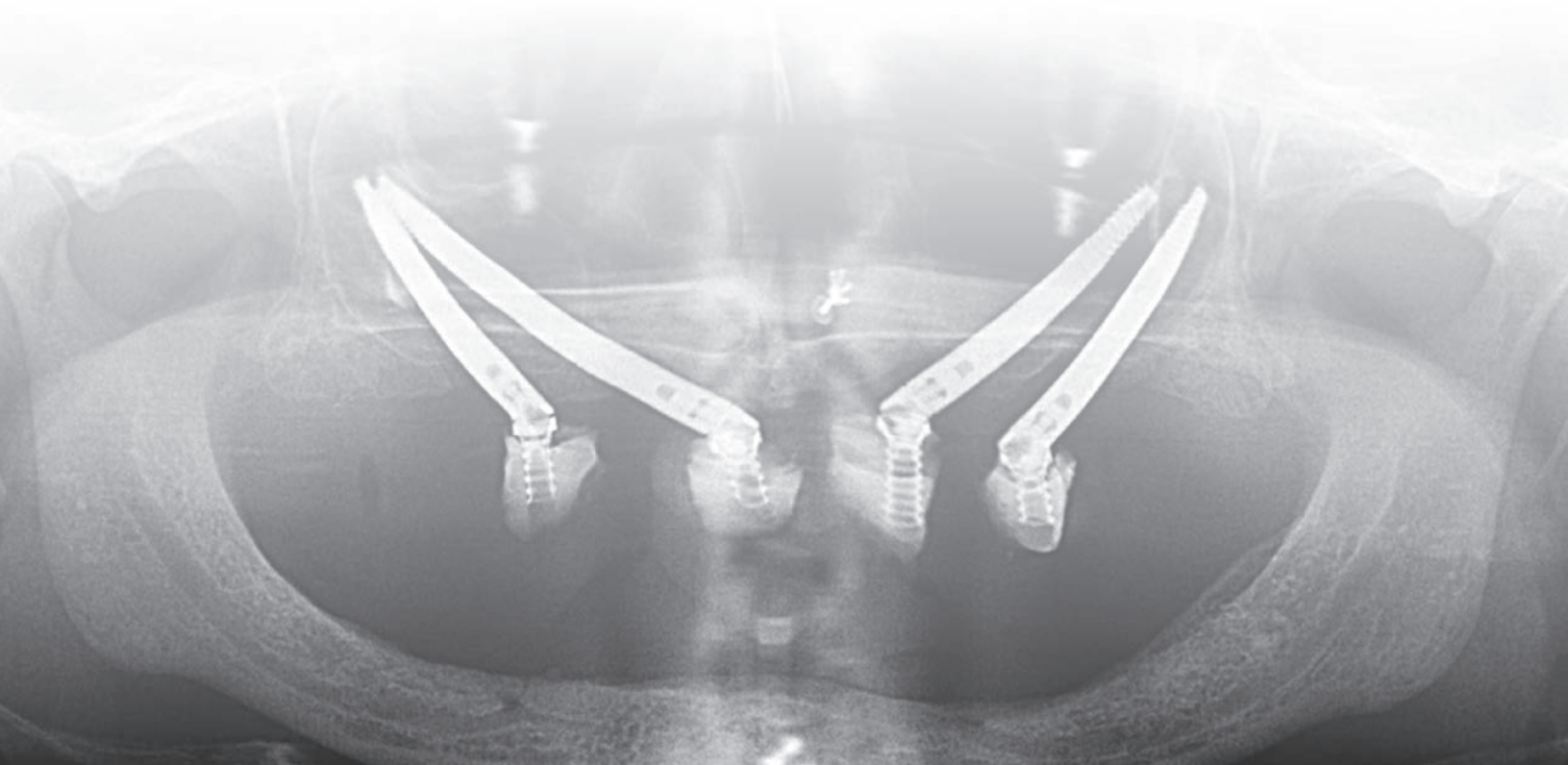

Preface

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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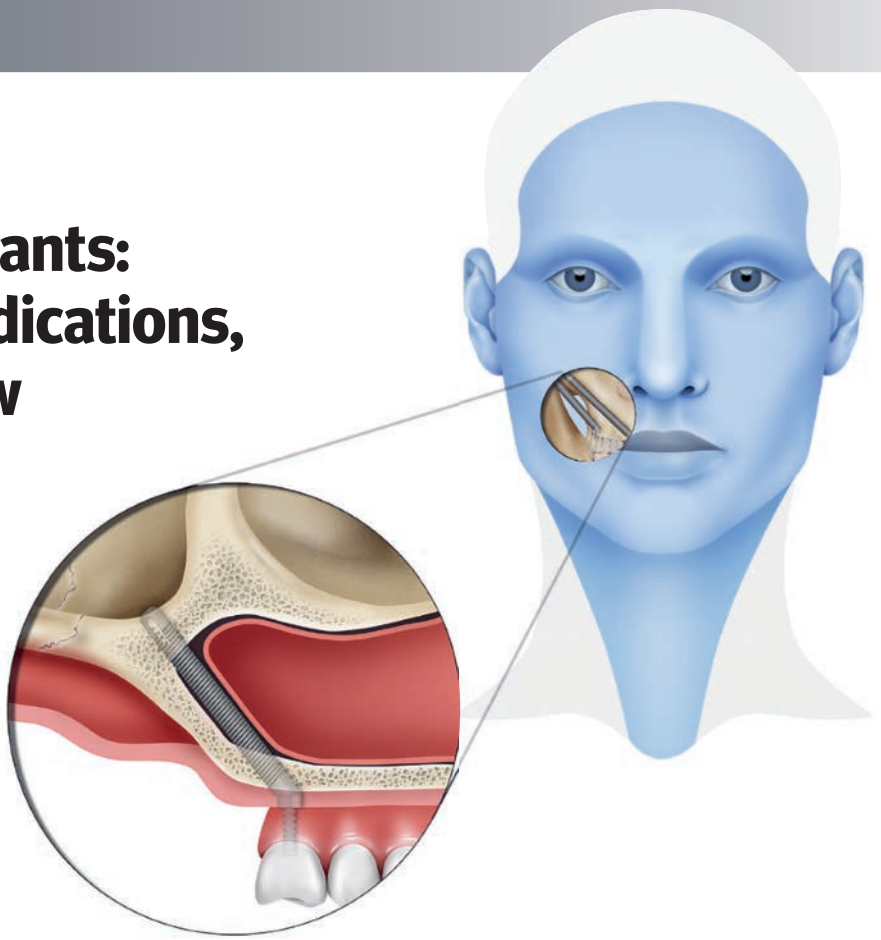
Chapter 1

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.

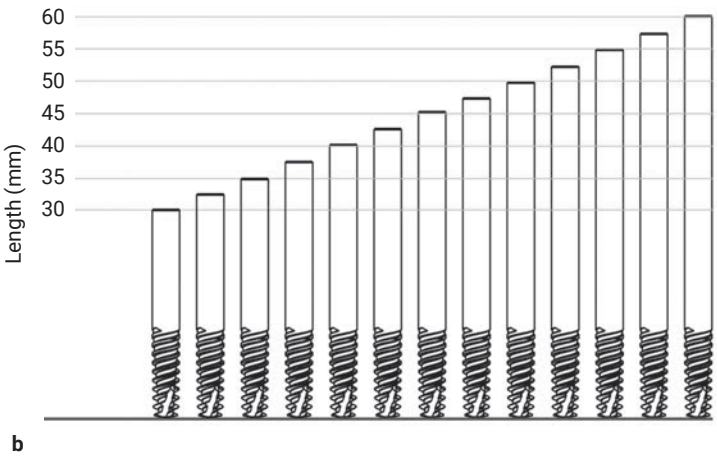


FIG 1-2 *(a)* Zygoma implants come in a variety of designs. The apical portion is always intended to osseointegrate within the zygomatic bone. *(b)* Zygoma implants are commercially available in a variety of lengths to accommodate differences in distance between the zygomatic bone and residual alveolar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

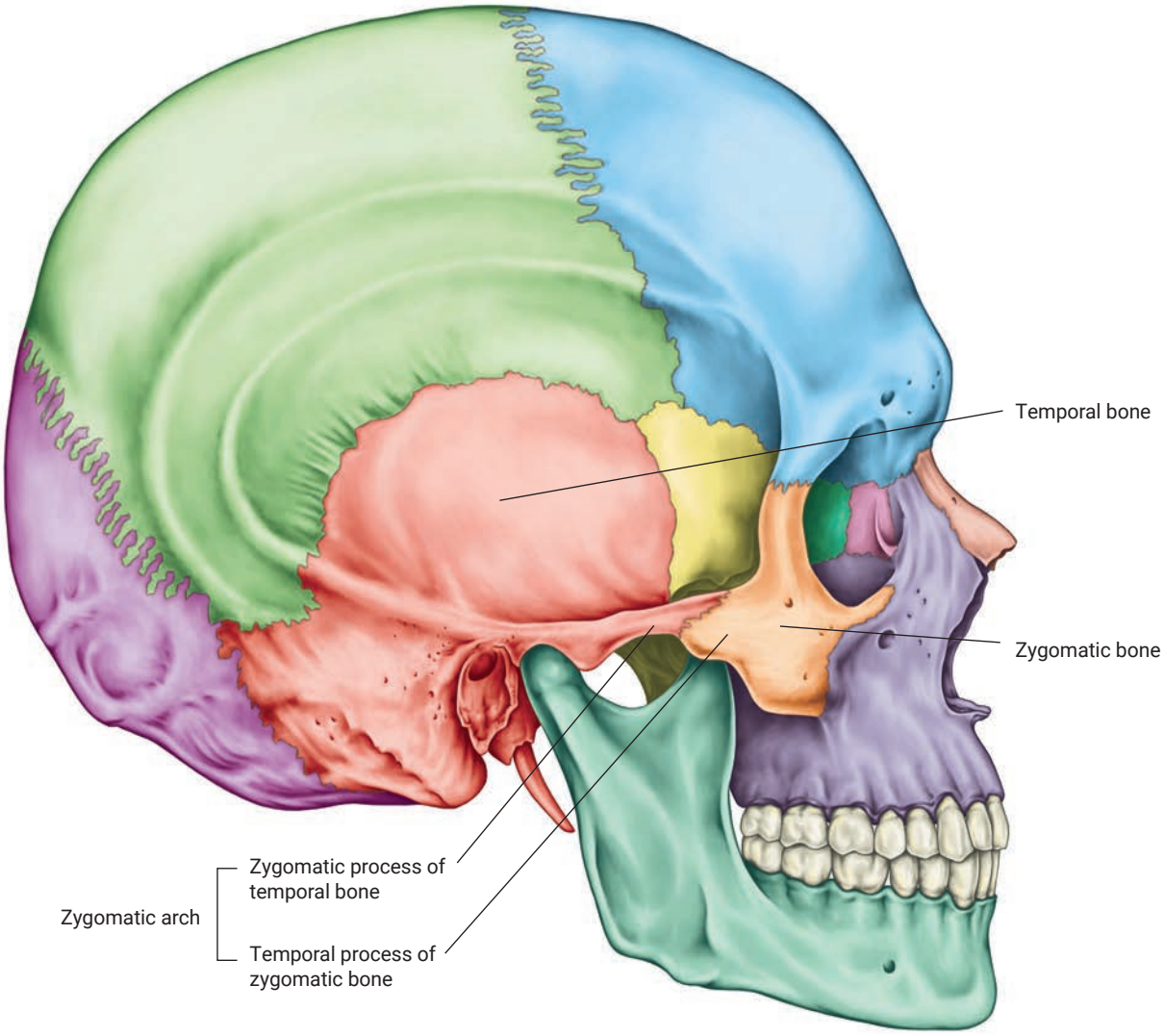
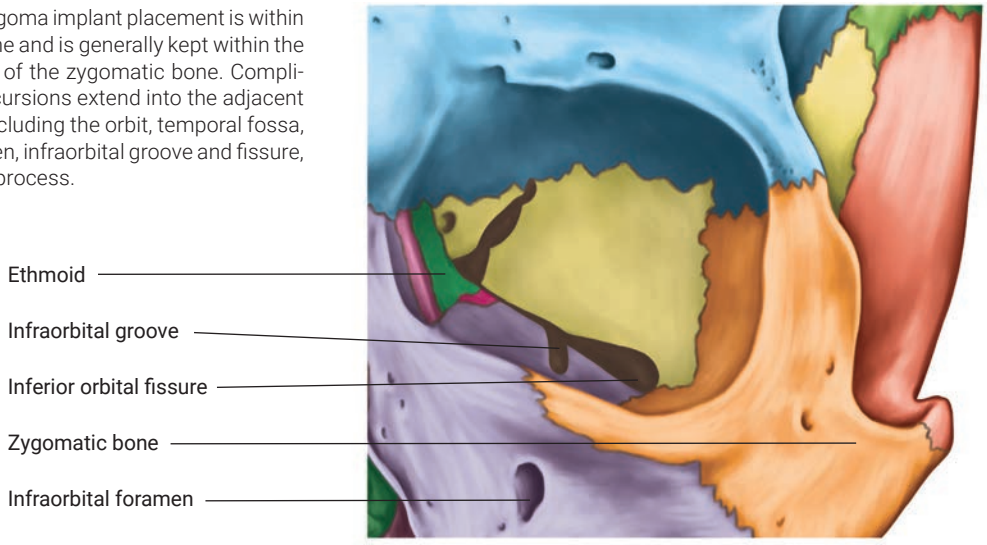


FIG 1-5 Proper zygoma implant placement is within the zygomatic bone and is generally kept within the temporal process of the zygomatic bone. Complications arise if incursions extend into the adjacent vital structures, including the orbit, temporal fossa, infraorbital foramen, infraorbital groove and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



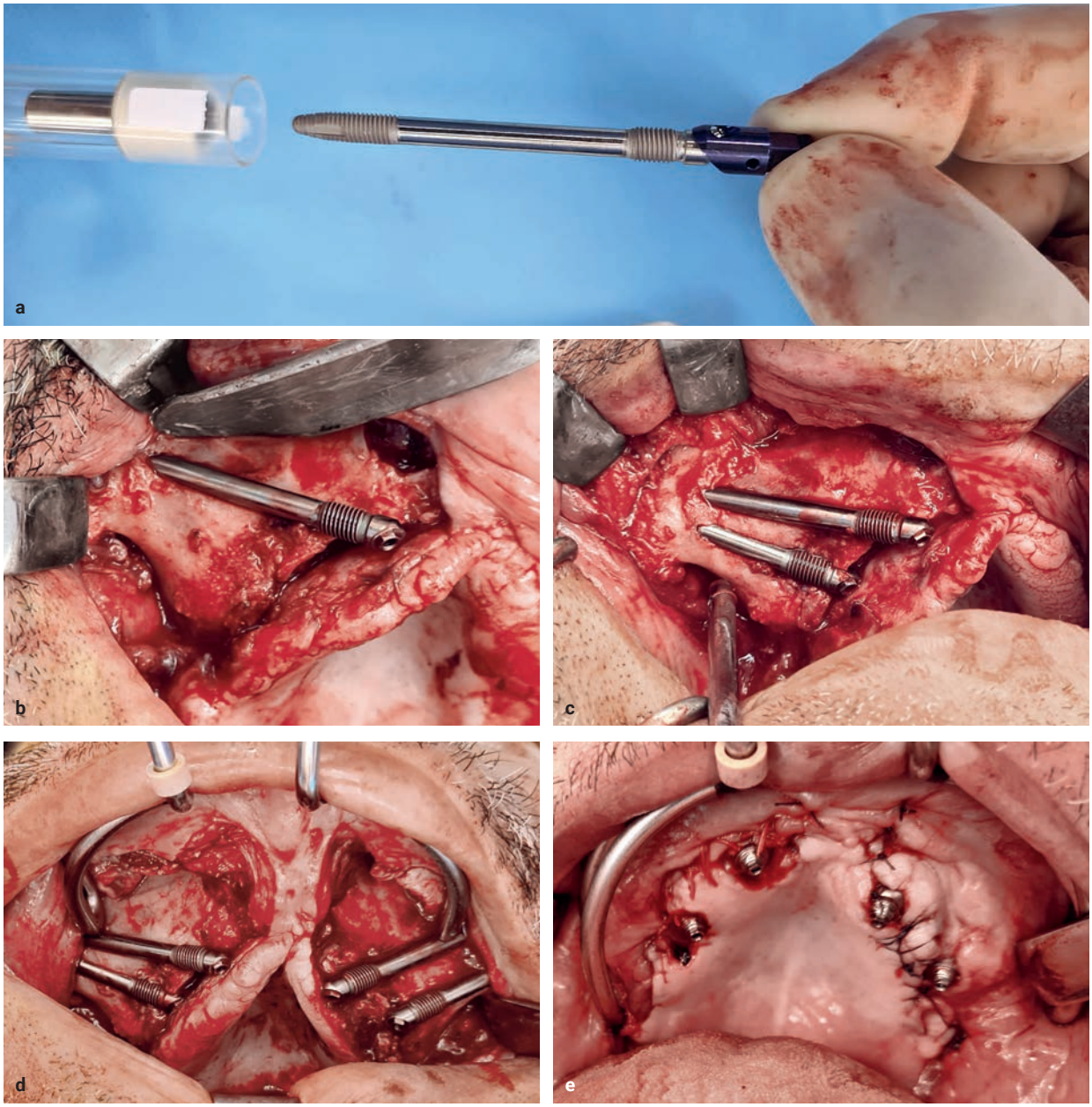


FIG 1-6 *(a)* Zygoma implant with roughened threads designed to engage both the zygomatic bone and the crestal alveolar bone being removed from its sterile packaging immediately prior to placement. *(b)* Placement of the first of four zygoma implants using an extrasinus approach with adequate flap reflection. *(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]

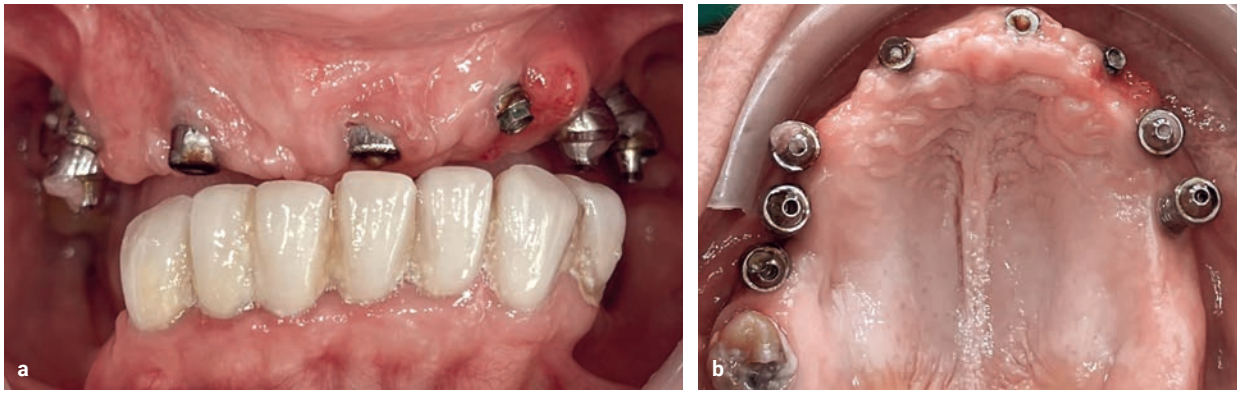


FIG 2-11 *(a)* Intraoral clinical aspect of the patient. Note the exposures of the implants as well as the soft tissue inflammation. *(b)* Intraoral occlusal view. Note the position of the implants as well as the bone loss and lack of keratinized mucosa on the vestibular side of the implants.

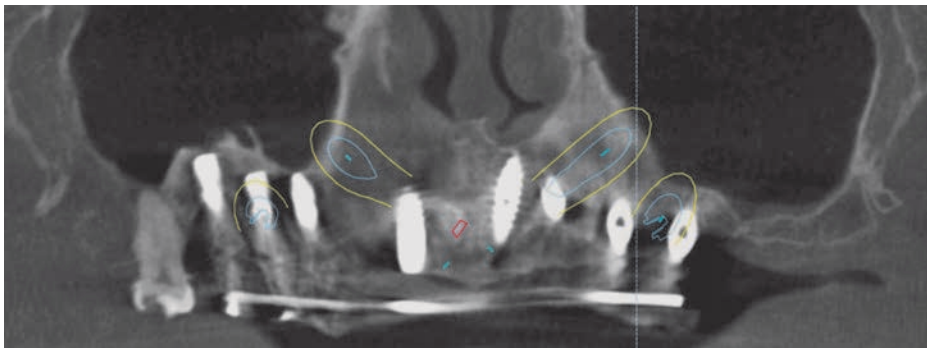


FIG 2-12 Panoramic view showing the current radiologic situation.

Case Discussion

Patient

The patient presented to the clinic with the chief complaint of poor esthetics and a desire to obtain a fixed prosthesis to solve her esthetic problem (Fig 2-11). She had multiple implants in her maxilla in positions that could not be restored with a fixed prosthesis, and she had a dental history of failed bone grafts. She reported no remarkable medical history and no known allergies.

Clinical and radiologic examination confirmed generalized peri-implantitis and several implant exposures through soft tissues with inflammatory signs and remnants of failed bone grafts (Fig 2-12). Both sinuses were pneumatized with insufficient residual alveolar bone for placement of new conventional implants.

Planning

The treatment plan in the maxilla was explantation of the implants and extraction of the only molar present followed by placement of four zygoma implants and an immediate prosthesis. The treatment plan in the mandible was the extraction of the remaining teeth followed by placement of four regular implants with immediate prosthetic loading. The final prosthetic rehabilitation was to be done jointly in both jaws.

The virtual path of the implants was chosen according to ZAGA protocols. That is, the anatomy of the residual alveolar bone was analyzed both at the sinus floor level and at the nasal floor level for anterior implants. Next, the anatomy of the palate and maxillary wall and the architecture of the zygomatic bone were determined. From these anatomical, prosthetic, and biomechanical parameters, the position of the ZAGA zones and the subsequent

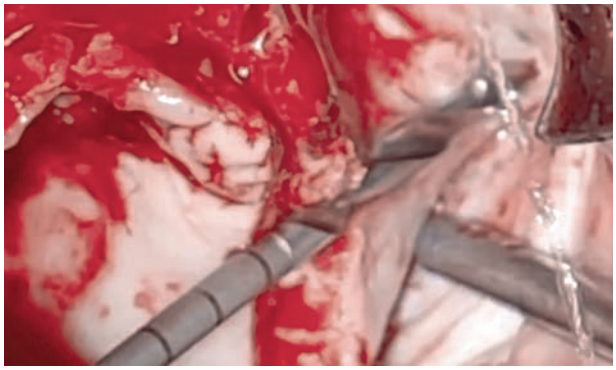


FIG 2-30 The twist drill rests horizontally on the entire channel to maintain its direction. Before drilling with the twist drill, smooth, sliding entering and exiting movements are made with the drill resting on the channel. When there is a feeling of smoothness and lack of resistance in the movement, it is time to penetrate the zygomatic bone under profuse irrigation.

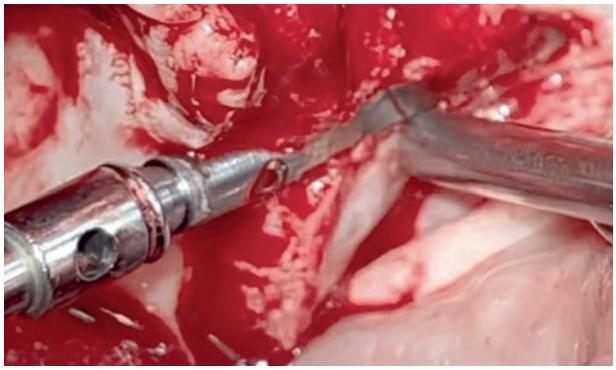


FIG 2-31 Profile of the ZAGA Flat implant fully integrated into the jaw wall. This reduces the chance of soft tissue dehiscence.

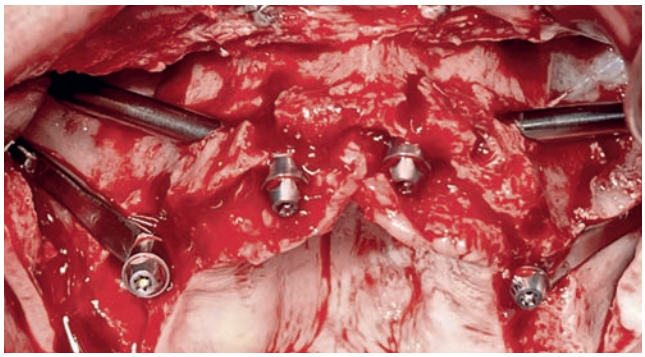


FIG 2-32 Occlusal photograph showing the four implants placed with their abutments. The anterior two are ZAGA Round implants and the posterior two are ZAGA Flat implants. Both models were designed and patented by ZAGA Centers.

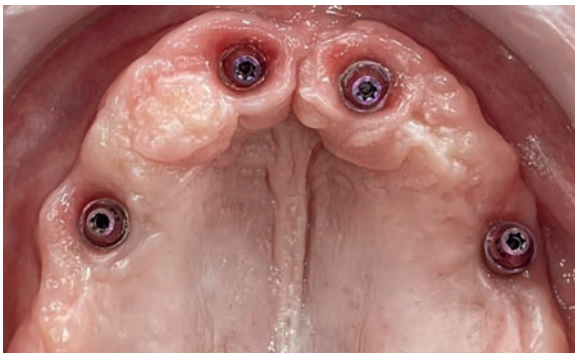


FIG 2-33 Occlusal photograph showing the condition of the soft tissues in a control 2 years after surgery.

FIG 2-34 Before and after rehabilitation. Prosthesis made by Dr Alexandra Marquez and Dr Marina Praetere (Lisbon, Portugal).

Chapter 4

Zygoma Implants: Step-by-Step Surgical Protocol

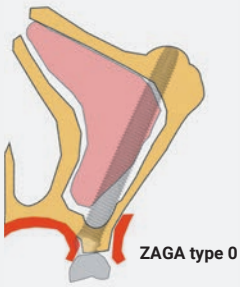
Komal Majumdar

In clinical practice, the use of complete dentures immediately following extraction is the first line of treatment for many edentulous patients. Complete dentures, despite their pitfalls, are typically used for several years after extraction because of their acceptable retention and stability.

However, as time progresses and alveolar bone atrophy sets in, mandibular dentures start losing their retention. At this point, the patient may opt for an implant-supported restoration. Even with severe atrophy, an All-on-4 tilted implant protocol remains possible in the mandible. While maxillary dentures generally remain functional for longer than mandibular dentures, eventually they too will become unstable as bone atrophy accelerates. In the atrophic maxilla, however, restoration with conventional implants is not as simple or predictable, especially in instances of bilateral sinus pneumatization extending to the premolars. In cases of severe atrophy, full-arch rehabilitation with conventional or tilted implants is not feasible.

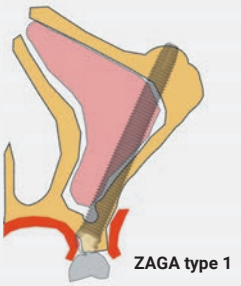
One possible solution for this condition involves extreme grafting using bone from extraoral sites, such as iliac[1,2] and sinus bone. Although considered the gold standard, autogenous bone harvesting carries its own risks, including graft failure and patient morbidity. In addition, maintaining the internal and external blood supply for grafts of this size can be challenging.[3] Patient reticence to opt for such surgeries and their added costs is another issue with this solution, not to mention the amount of time patients are left edentulous, which is a deal-breaker for many. They may not even be able to wear a denture until healing is complete, because this could cause overloading on the grafted sites. In the end, the success rate for these bone augmentation techniques ranges from 60% to 90%.[4,5]

FIG 4-17 ZAGA implant pathways per the anatomy.



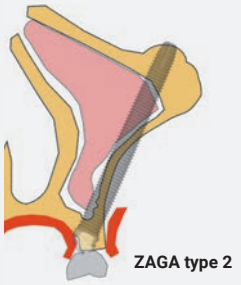
ZAGA type 0: intrasinus path

- In this type, the lateral wall of the maxillary sinus is flat, and the implant takes an intrasinus path.
- The implant head is usually purely in crestal bone.
- No window is made. Like in the original Brånemark intrasinus protocol, the implant passes through the sinus. The sinus membrane usually heals in 2 to 3 weeks.
- The implant contacts the bone at the crest, zygoma, and sometimes the lateral wall of the sinus.



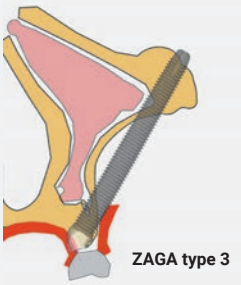
ZAGA type 1: extra-intrasinus path

- In this type, the anterior maxillary wall is slightly concave, and the implant takes an extra-intrasinus path.
- Osteotomy is slightly through the wall.
- Although the implant can be seen through the wall, most of the implant body takes an intrasinus path.
- The head of the implant is on the crest.
- The implant contacts the bone at the crest, zygoma, and lateral wall of the sinus.



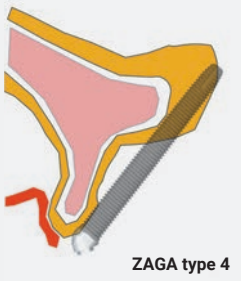
ZAGA type 2: extra-intrasinus path

- In this type, the anterior maxillary wall is concave, and the implant takes an extra-intrasinus path.
- Osteotomy is slightly through the wall.
- Although the implant can be seen through the wall, most of the implant body has an extrasinus path.
- The head of the implant is on the crest.
- The implant contacts the bone at the crest, lateral wall of the sinus, and zygoma.



ZAGA type 3: extrasinus path

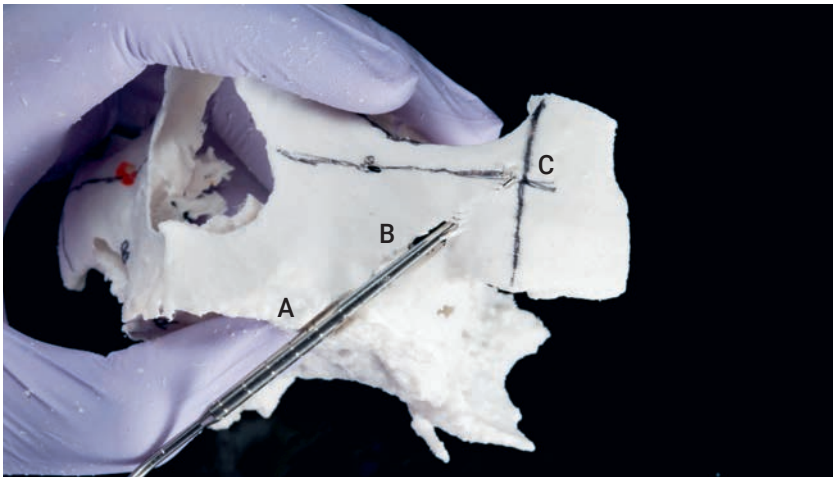
- In this type, the anterior maxillary wall is very concave, and the implant takes an extrasinus path.
- Osteotomy starts from the palatal aspect of the crest, keeping the head on the alveolar crest.
- The implant then passes buccally to the concave part of the wall of the sinus and penetrates the zygoma.
- The implant contacts the coronal alveolar bone and the apical part of the zygoma.



ZAGA type 4: extramaxillary path

- The extramaxillary approach is taken when there is extreme vertical and horizontal atrophy.
- The implant head is buccal to the alveolar crest.
- This approach avoids perforation of the very thin palatal wall.
- Additionally, correct prosthetic positioning of the implant is ensured.

FIG 4-41 The depth probe should protrude slightly from the surface of the zygoma.



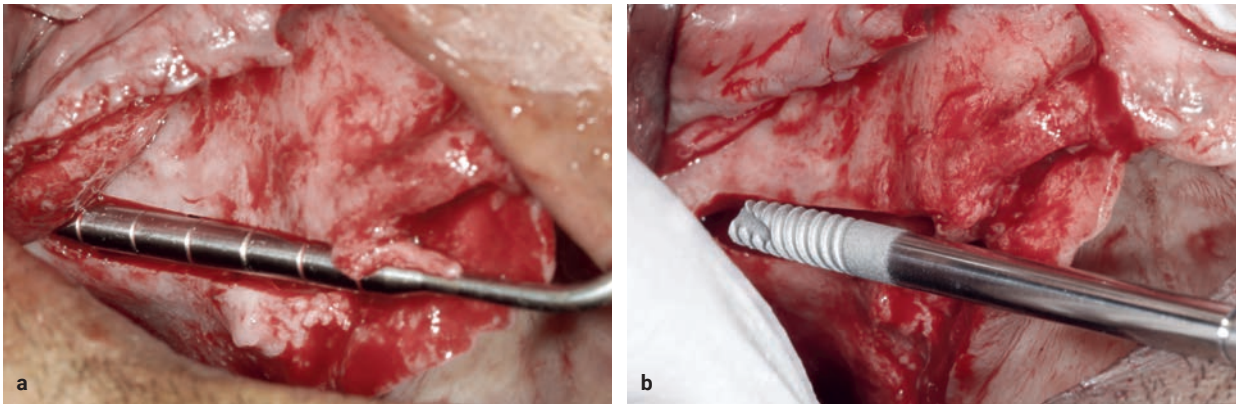
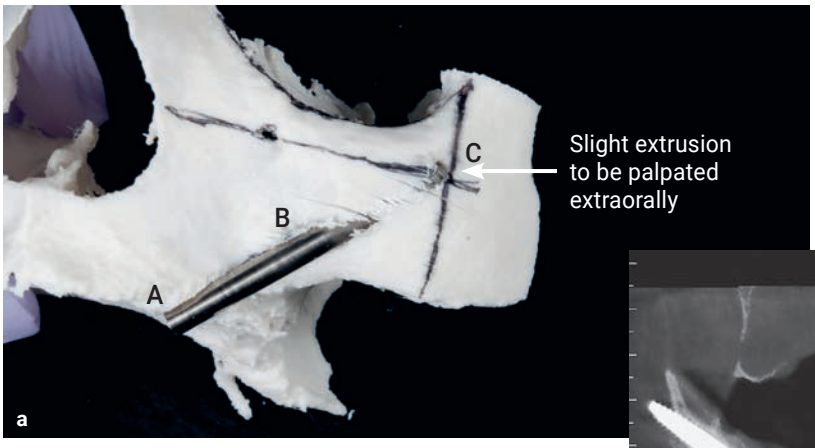


FIG 4-42 *(a)* Final verification of the osteotomy length. *(b)* Final placement of the implant.



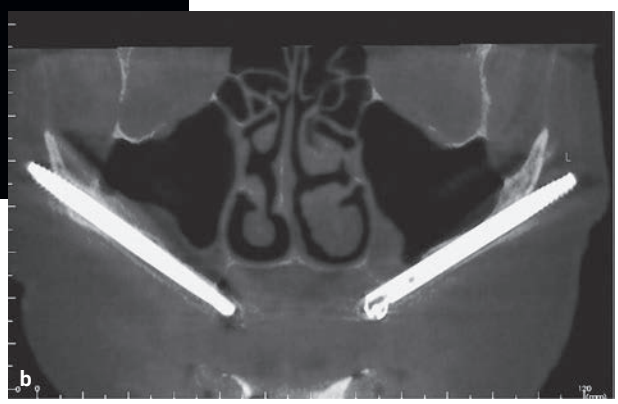


FIG 4-43 *(a)* Slight protrusion of the implant from the zygoma should be palpable extraorally. *(b)* Excessive protrusion should be avoided.

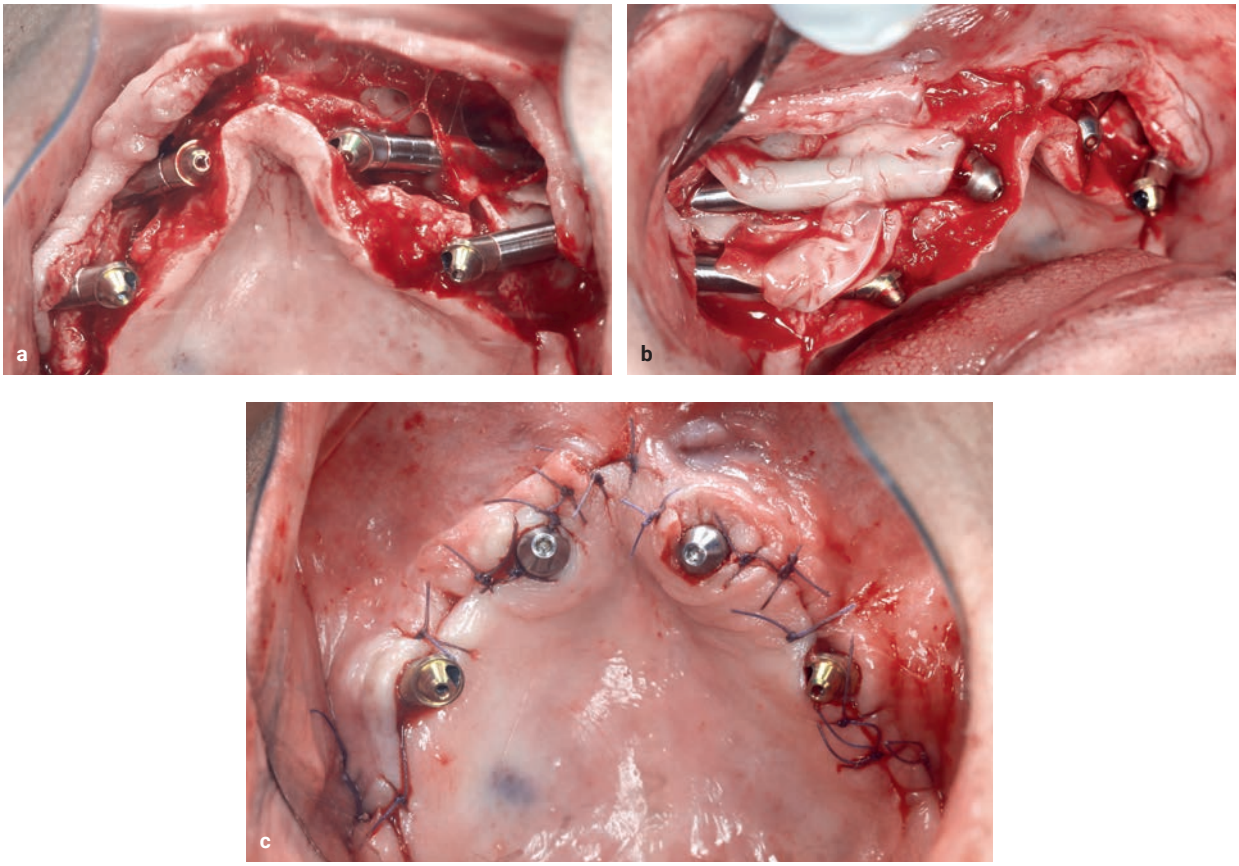


FIG 4-90 *(a)* MUAs placed. *(b)* PRF applied over implants. *(c)* Final sutures.

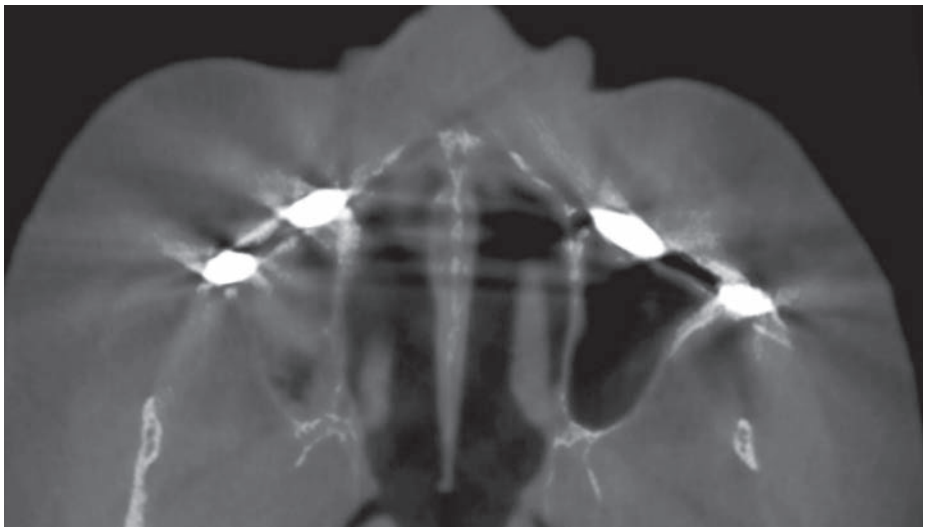


FIG 4-91 Ideal placement of implants within the zygoma.

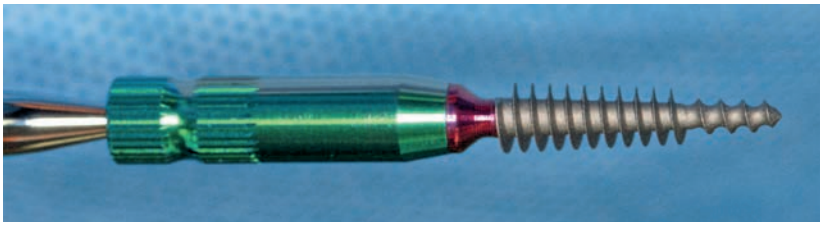


FIG 5-1 Pterygoid implant.

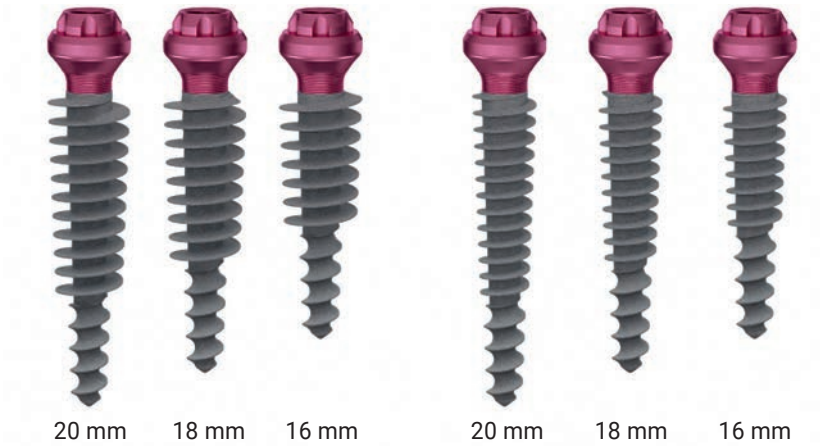


FIG 5-2 The 4.5- and 3.5-mm-diameter pterygoid implants from TRATE.

in the pterygomaxillary region provides posterior bone support without sinus augmentation or supplemental grafts.

This chapter describes a clinical procedure for the restoration of the severely resorbed maxilla that uses a new pterygoid implant in combination with a conventional or cortically fixed implant system.

Description and Brief History of Pterygoid Implants

The pterygoid implant is a single-piece axial implant placed through the maxillary tuberosity with fixation apically in the pterygoid process of the sphenoid bone and the pyramidal process of the palatine bone. Pterygoid implants were introduced specifically to address the problem of inadequate retention and implant stability in the posterior maxilla due to the presence of the maxillary sinus and the poor quality and quantity of bone in that region.[1]

Pterygoid implants were first proposed by Linkow in 1975,[11] and the method was first described by French maxillofacial surgeon JF Tulasne in 1992.[12] Tulasne and Tessier were the first to describe the technique for implant placement in the pterygoid plate without grafting procedures.

Pterygoid implants are relatively long, ranging in size from 16 to 26 mm, and are specifically manufactured with the characteristics of the pterygoid region in mind[13] (Fig 5-1). They have a pointed, self-tapping apex to ensure strong anchorage,[14] and the implant neck has a wide thread profile to provide compression in the region of the tuberosity, where the bone is often of low density.

The pterygoid implants introduced in this chapter were designed under the guidance of Henri Diederich (Luxembourg) in collaboration with the Swiss company TRATE. These single-piece implants have a hydroxyapatite/tricalcium phosphate (HA/TCP) coating and a conical shape with compressive threads. They have diameters of 3.5 or 4.5 mm and come in lengths of 16, 18, 20, 22, and 24 mm[13] (Fig 5-2).

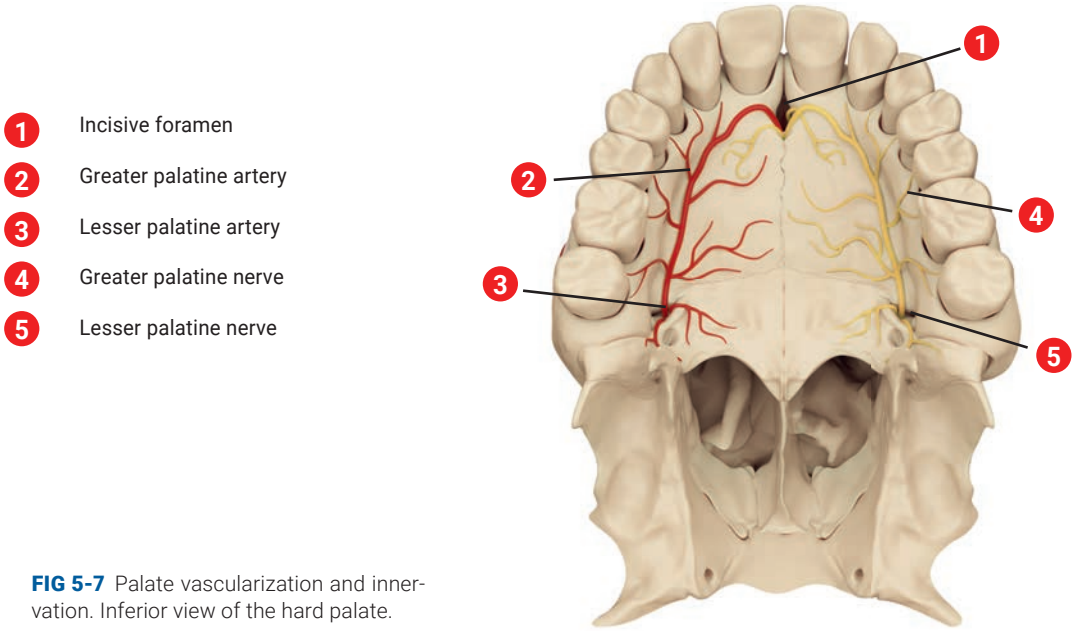


FIG 5-7 Palate vascularization and innervation. Inferior view of the hard palate.

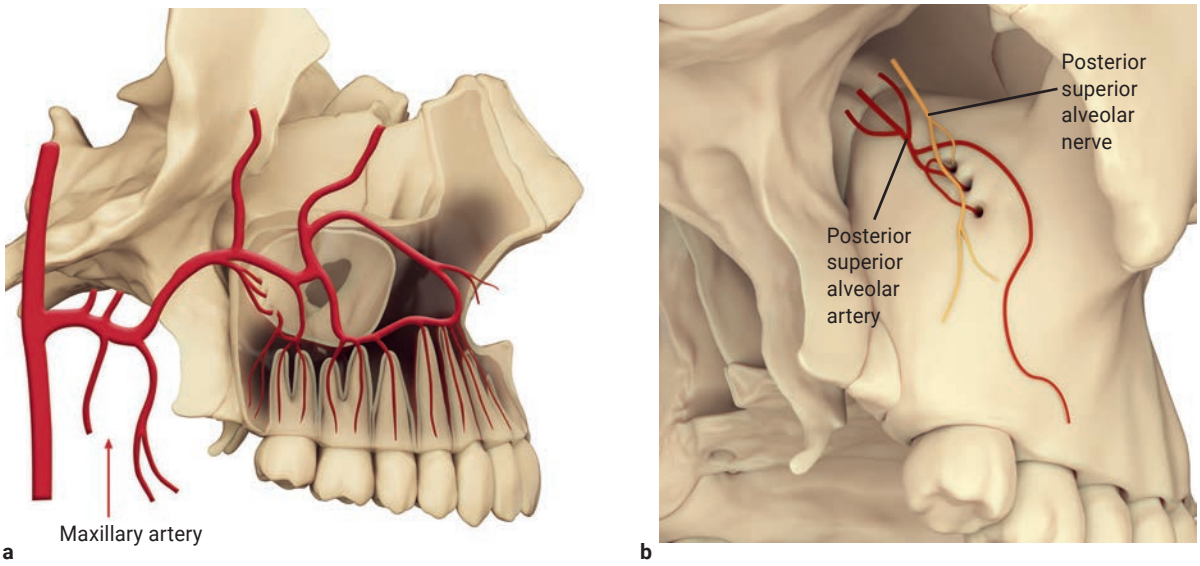


FIG 5-8 *(a)* Maxillary artery. *(b)* Posterior superior alveolar nerve and artery.

Blood and Nerve Supply of the Posterior Maxilla

The hard and soft palates are supplied by the palatine artery, which is a branch of the third part of the maxillary artery. The maxillary artery takes a course that is either superficial or deep to the lateral pterygoid muscle until it reaches the pterygopalatine fossa via the pterygomaxillary fissure. The molars, the premolars, and the lining of the maxillary sinus are supplied by the posterior superior alveolar artery, which is also a branch of the third part of the maxillary artery. It descends upon the tuberosity of the maxilla and splits into numerous branches, some of which enter the alveolar canals. The blood and nerve supply of the hard palate is shown in Fig 5-7.

The posterior superior alveolar nerve, also known as the *posterior superior dental nerve*, is the first

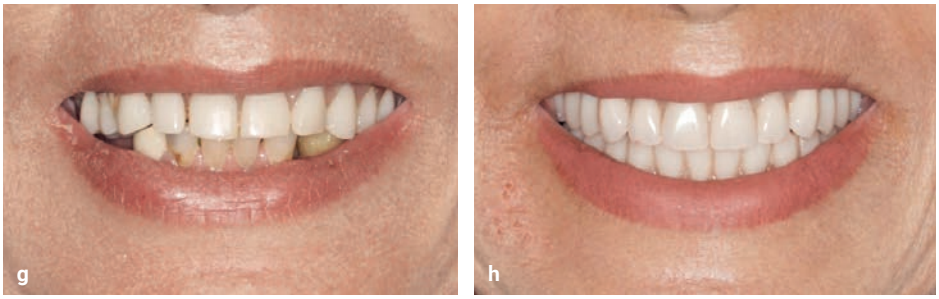


FIG 8-2 *(cont) (g and h)* Smile before and after treatment.

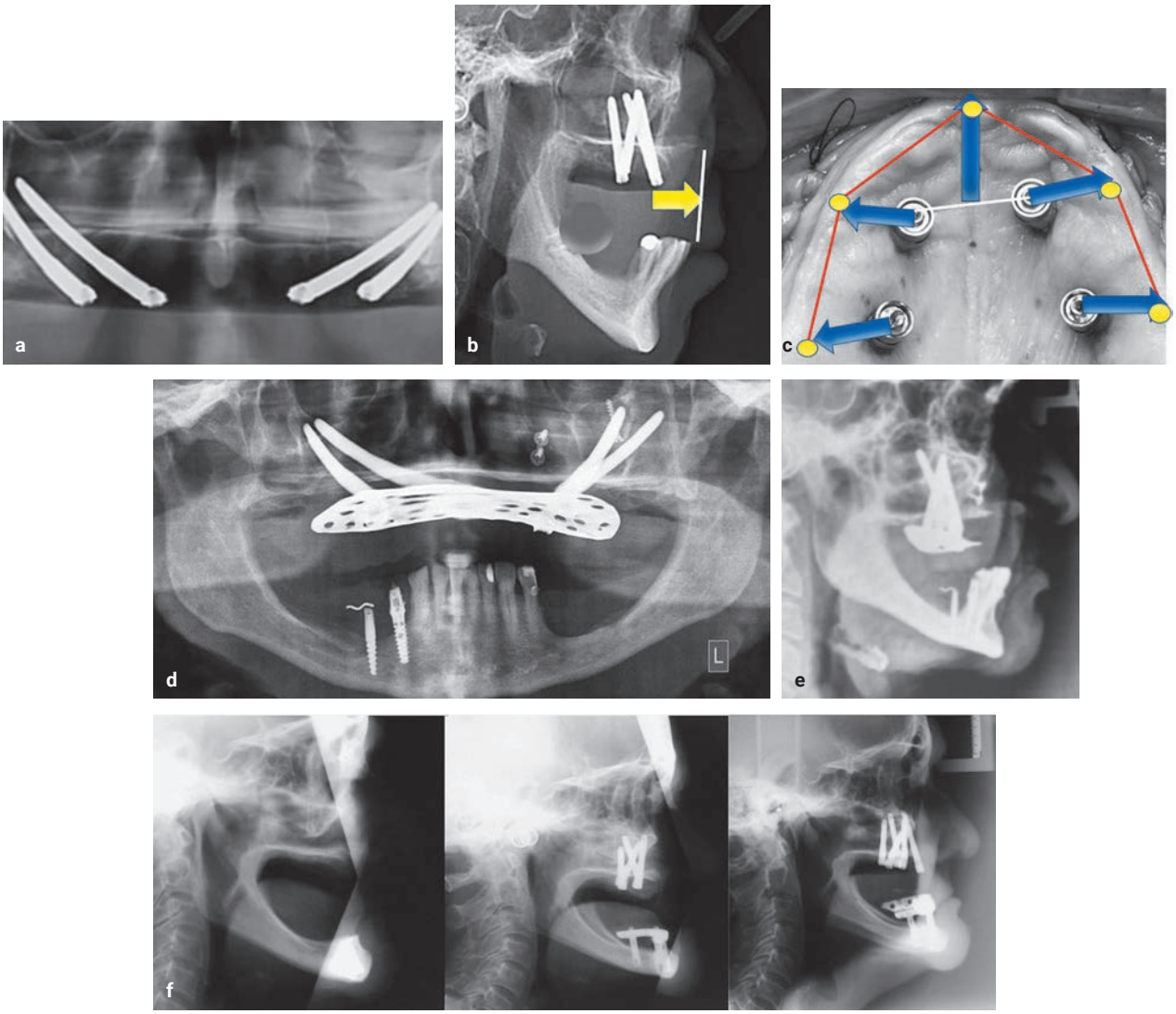


FIG 8-3 *(a to f)* Radiographs of three patients *(a–c, d/e, and f)* who had complications secondary to major cantilever extensions due to poor biomechanics planning. The lateral cephalometric images demonstrate the lack of anterior projection and need for extra anchorage. In cases like this, the first sign of prosthetic failure is screw loosening and fractures, followed by implant failure and finally oroantral communication. The third patient (in *f*) was treated by adding a single zygoma implant in the piriform rim up to the infraorbital rim.

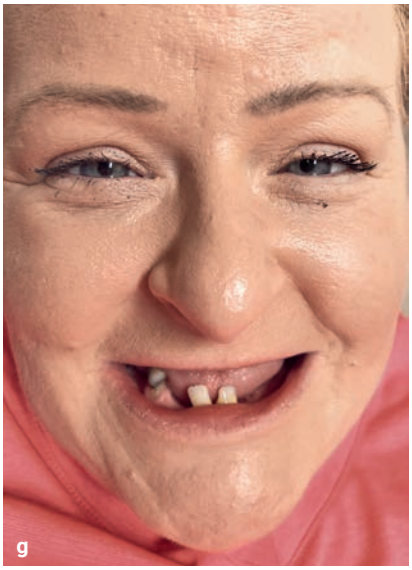


FIG 8-4 *(cont) (g to i)* Smile before and after treatment.

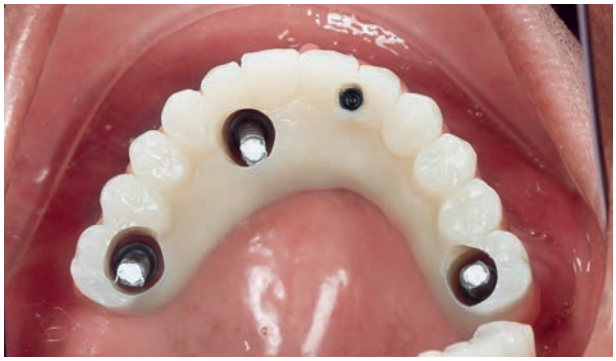
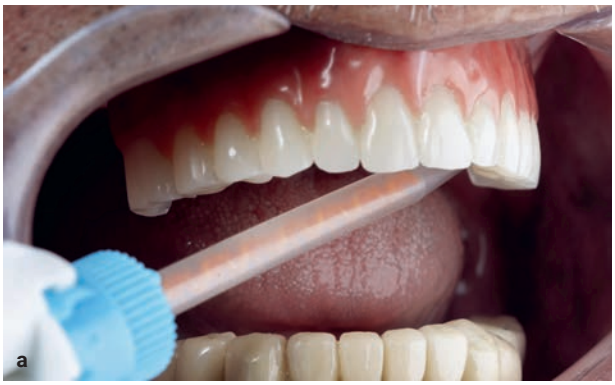


FIG 10-29 Spaces around titanium cylinders. A thicker provisional is less prone to fracture.



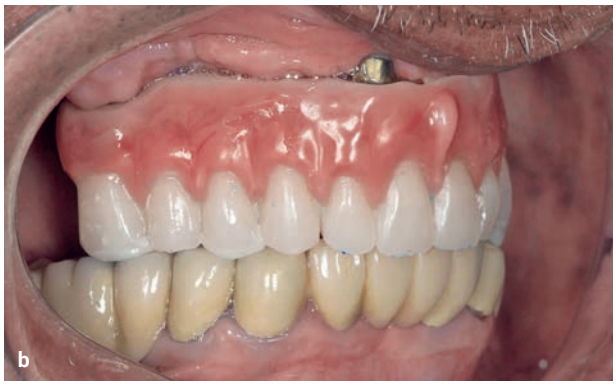


FIG 10-30 *(a)* Pickup technique. *(b)* Final provisional prosthesis.

4. The provisional is placed over the cylinders. The integrated titanium cylinder engages the provisional over a single MUA. Full 360-degree spaces should be ensured around all cylinders in the prosthesis. Any hindrances should be eliminated (Fig 10-29).
5. The rest of the cylinders are picked up using Protemp 4 or any similar hard-setting material. Any residual space in the intaglio surface is filled with material, and the intaglio surface is thoroughly polished. The passivity of the prosthesis is checked with the Sheffield test, and the occlusion, phonetics, and esthetics of the prosthesis are verified (Fig 10-30).

Digital Impression with Fabrication of a Metal Bar and Snap-on PMMA Prosthesis

The two pillars of immediate loading are *(1)* high primary implant stability and *(2)* rigid splinting that keeps micromovements below the threshold level of 100 microns. Clinical and experimental animal trials have shown that long-term success of removable and fixed prostheses of immediately loaded dental implants can be achieved.[15–21] Immediate implant loading with fixed provisional restorations has very high predictability. It is safe to say that rigid acrylic resin provisional restorations are able to confine the occlusal forces applied to the bone-implant interface to a physiologic range.[21,22]

Material stability and fracture strength are essential for maintaining the rigidity of provisional restorations on immediately loaded implants over extended time periods. However, long-term acrylic resin restorations are subject to flexion and fracture under occlusal forces.[23] To avoid the problem of flexion, the implants should ideally be connected by a metal connection. This can be achieved either by intraoral welding or by fabricating a milled bar joining all the implants. This metal connection will prevent fractures and require fewer repairs over time.

The following quad zygoma case shows the protocol for immediate loading with a screw-retained

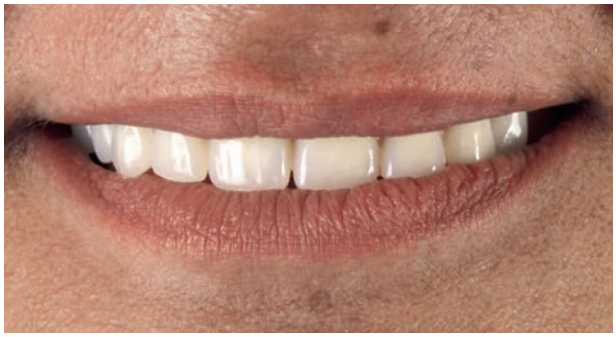


FIG 10-54 Teeth setting trial.

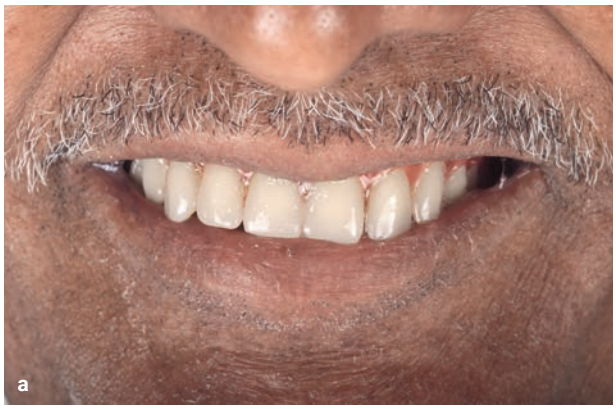


FIG 10-55 *(a)* Cant should be identified and corrected in the trial stage (example from a different case). *(b)* Gingival shade tab.

It is wise to make an extra full-contour PMMA trial restoration and give it to the patient on the day of final delivery of the prosthesis as an additional provisional prosthesis. It can be used by the patient at a later stage if any corrections or repairs to the final prosthesis are needed after a few years.

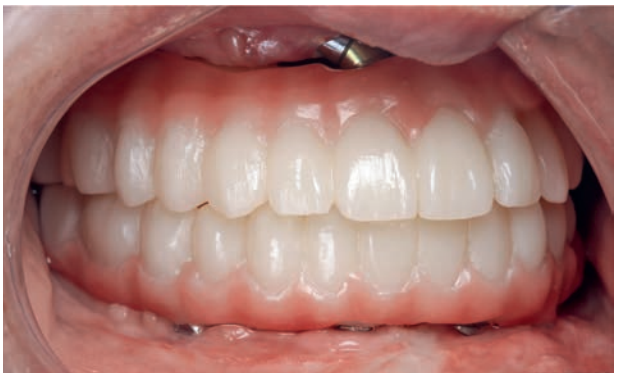
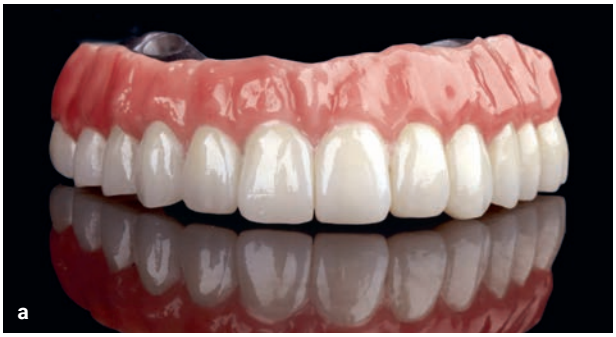
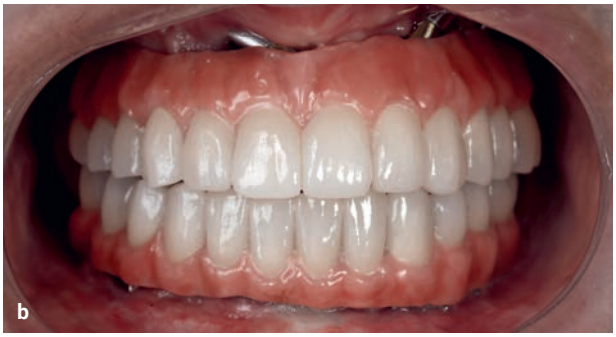


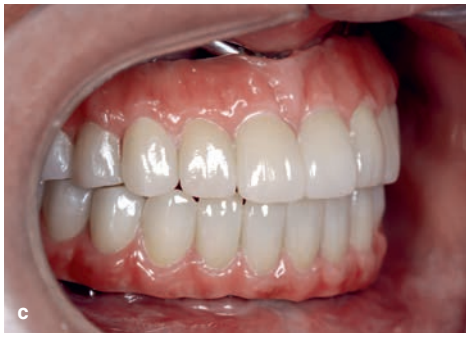
FIG 10-56 PMMA trial.

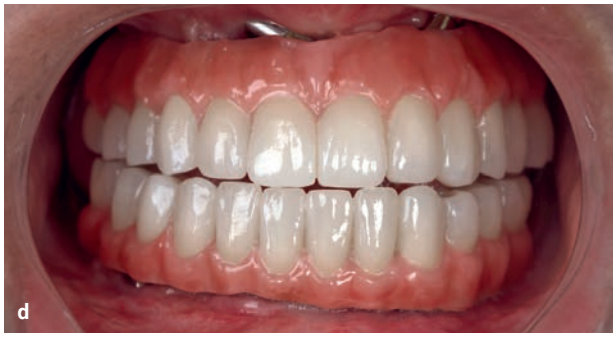
PMMA trial

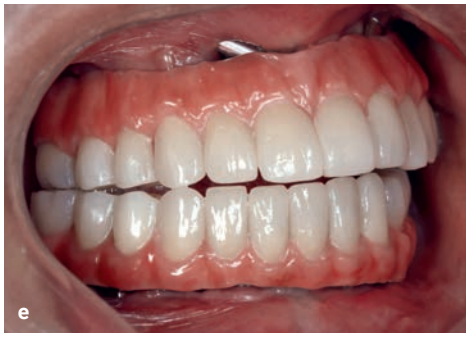
Milled titanium frameworks cannot be predictably laser soldered. They must be redone if there are any misfits, and no corrections are possible once they are milled and delivered. To avoid additional costs, a PMMA trial fit of the prosthesis should be performed. In this trial, the passivity of the framework, occlusal scheme, phonetics, and esthetics are checked, and results are communicated to the laboratory. Any changes to the final restoration can be made easily, and any gaps between the intaglio surface and soft tissue can be corrected in the final restoration (Fig 10-56).

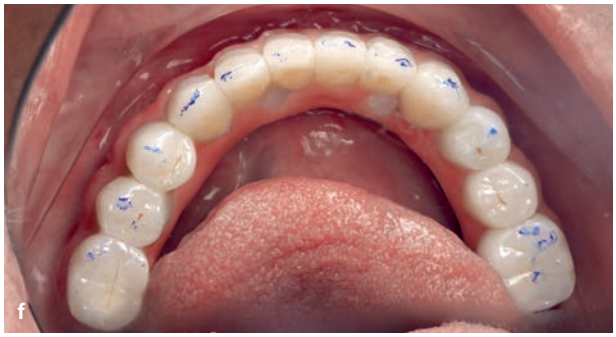


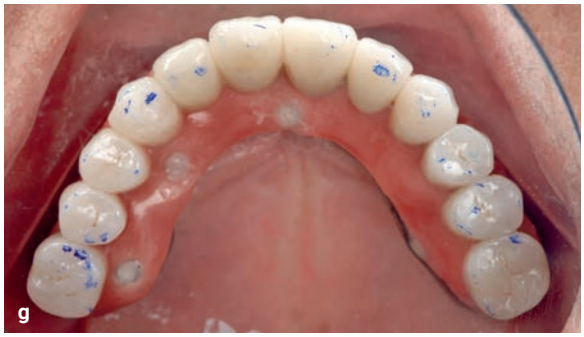












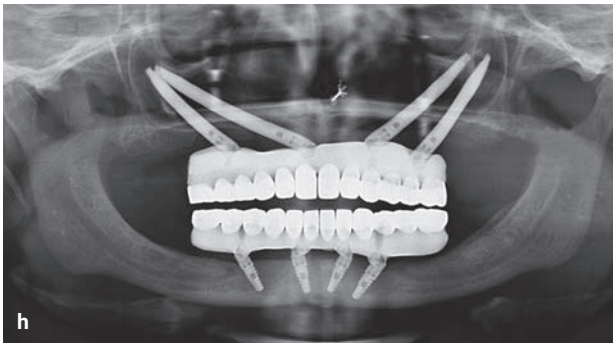


FIG 10-59 *(a)* Extraoral presentation of the prosthesis. *(b)* Maximum intercuspation (frontal view). *(c)* Maximum intercuspation (lateral view). *(d)* Protrusion. *(e)* Lateral excursion. *(f)* Occlusal contact points. *(g)* Implant-protected occlusal scheme with flat cusp pattern. *(h)* Postoperative panoramic radiograph. *(i)* Restoration of function and esthetics.

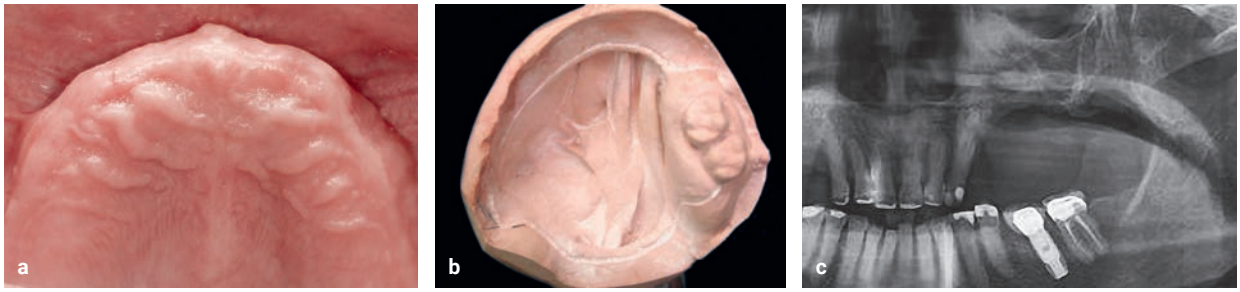


FIG 11-2 Reasons for patient consultations. *(a)* Flat maxillary anatomy that provides no retention for a complete denture. *(b)* Cast of a patient with oronasal communication. *(c)* Left maxillary resection due to a cystic adenoid carcinoma.

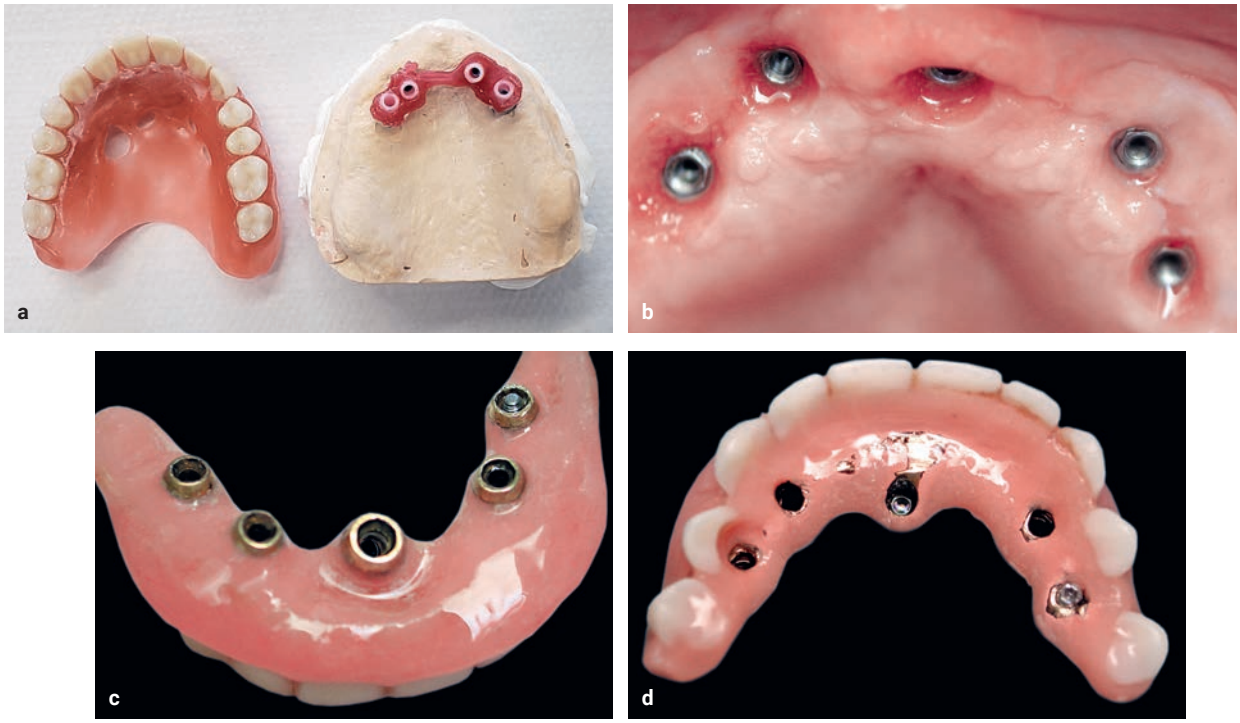


FIG 11-3 *(a to d)* Palatal implant emergences in the oral cavity generate mechanical obstacles that may interfere with phonetics, chewing, and swallowing. Patients should be advised of this potential situation before surgery to manage their expectations.

main factors to discuss with patients concerning zygoma implants are surgery, phonetics, hygiene, loading, and prognosis.

Phonetic problems include the escape of air between the prosthesis and the mucosa, which occurs as a consequence of using a hygienic pontic at the provisional stage. Also, palatal implant emergences in the oral cavity generate mechanical obstacles that may interfere with phonetics and, in some cases, with swallowing (Fig 11-3). For this reason, the zygoma anatomy-guided approach (ZAGA)[18] should be used when possible. This technique allows either intrasinus or extrasinus placement of zygoma implants according to patient-specific anatomy, which promotes better phonetics and swallowing (Fig 11-4).

The difficulty of maintaining oral hygiene is influenced by the prosthesis type, pontic design,[13] cantilevers, and implant location. Informing the patient ahead of time about the supplies they may need to

FIG 11-6 The arc of the smile flattens with age. Note the very flat arc in this older individual.

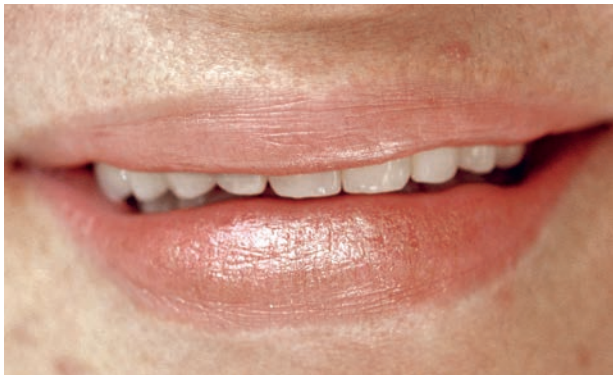


FIG 11-7 A discrepancy up to 6 mm between the facial midline and maxillary interincisal midline is not perceptible from a normal social distance.

Midline

The maxillary interincisal midline should coincide with the facial midline. When this is not possible, it should lie parallel to the facial midline.[56] A discrepancy up to 6 mm between the facial midline and the maxillary interincisal midline is not perceptible to either patients or dental professionals[57,58] (Fig 11-7).

Lip support

Two major types of structures provide lip support. The first are soft tissue structures consisting of underlying musculature, fibrous connective tissue, and glands. The second are the hard tissues, namely the anterior teeth and alveolar processes. When these structures are lost or atrophied, it is believed that the face collapses due to the unopposed contraction of the buccinator and orbicularis oris muscles. As a result, the position of the modiolus is altered in two directions, medially and posteriorly, affecting facial expression.[59,60]

Clinical analysis of maxillary lip support is extremely subjective, and its evaluation depends on clinician expertise. There are two areas of maxillary lip support to assess, one at the pedestal of the lip and the other at the tip. These two areas are affected by many factors: maxillary anterior tooth positions; cervical edge contours; alveolar ridge resorption; muscle tone and thickness of the lips related to age and sex; length of the nose; morphology of the cartilaginous part of the lower nose, nasal septum, and anterior nasal spine; angulation of the nasal tip; projection of the chin; and facial hair, including mustaches and beards.[19,61–63]

The labial flange is also a part of the lip support, defined as "the portion of the flange of a denture that occupies the labial vestibule of the mouth."[64] By nature, full-arch fixed implant-supported prostheses do not have a labial flange, but they may have gingival replacement incorporated to provide esthetic tooth proportions and a hygienic emergence profile. Depending on the atrophy of the maxilla, the gingival aspect of a maxillary fixed implant-supported prosthesis may occupy the space in the labial vestibule formerly held by the labial flange and contribute to lip support.[65,66]

Lip movement

When the patient is observed making movements involved with speech or facial expression, the effects of the amount of lip support on the underlying musculature and the structures controlled by it become apparent. Observations can best be made by the clinician when standing directly in front of the patient and then at a 45-degree angle to the right and to the left of the patient.[67]

Esthetic objectives should be based on the harmonious interrelationship of each esthetic factor. Natural beauty, while involving basic symmetry, also involves small asymmetries. By employing this artifice of nature, the appearance of artificiality in the denture can be minimized.

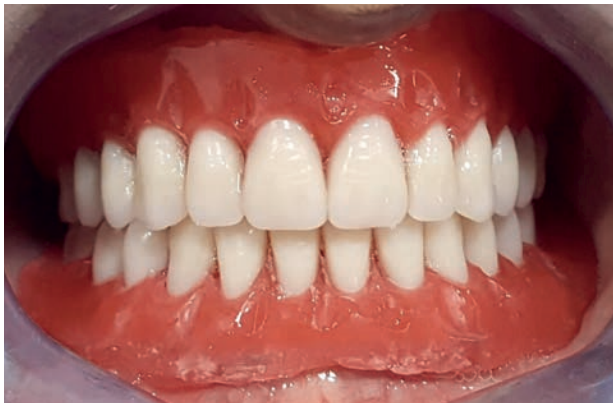


FIG 11-10 Tooth selection and setup try-in. The cusp height should be as short as esthetics allow.

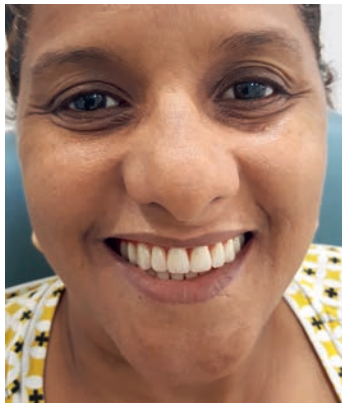


FIG 11-11 The patient is happy with the provisional restoration upon try-in and verification of the esthetics and function. (Same patient as in Fig 11-10.)

At this point, the treatment plan should be reevaluated by the team with consideration of the biomechanical protocols for zygoma implant rehabilitation.

1. *Tooth selection and setup try-in:* It is important to evaluate the cusp height, tooth color and form, VDO, lip and lower third support, lip length, smile line, midline, occlusion, phonetics, interocclusal space, swallowing, facial harmony, and esthetics. Patient approval of the provisional restoration is essential at this stage (Fig 11-10).
2. *Occlusion:* Aiming for balanced occlusion, the clinician may consider a shorter cusp height. Because occlusal registration is taken at centric relation, some adjustments are advised to achieve a more physiologic relation.
3. *Patient acceptance:* A selfie and video are recommended for patient verification of esthetics and function, and a mirror should be used for more detailed discussion (Fig 11-11).
4. *Complete denture delivery:* Once the provisional restoration is accepted by the patient, it can be adapted for delivery.

Prosthetic Considerations for a Fixed Restoration

The surgical protocol for achieving either immediate or delayed implant loading requires taking several restorative factors into consideration. These factors include VDO records, implant selection and placement, abutment selection and insertion, and provisional conversion and delivery.

VDO/occlusal records

Before sedation starts, the clinician must measure and index the VDO as a reference point for the provisional conversion or reline. For that purpose, two points in a nonmovable area (nose and chin) are marked with indelible ink on the patient's face either with the provisional prosthesis or natural dentition intercuspated. This distance is measured with a ruler or a tongue depressor and recorded. The marks should remain on the patient's face for the entire surgery (Fig 11-12a).

At this point, interocclusal registration at centric occlusion is recorded with a bite registration of

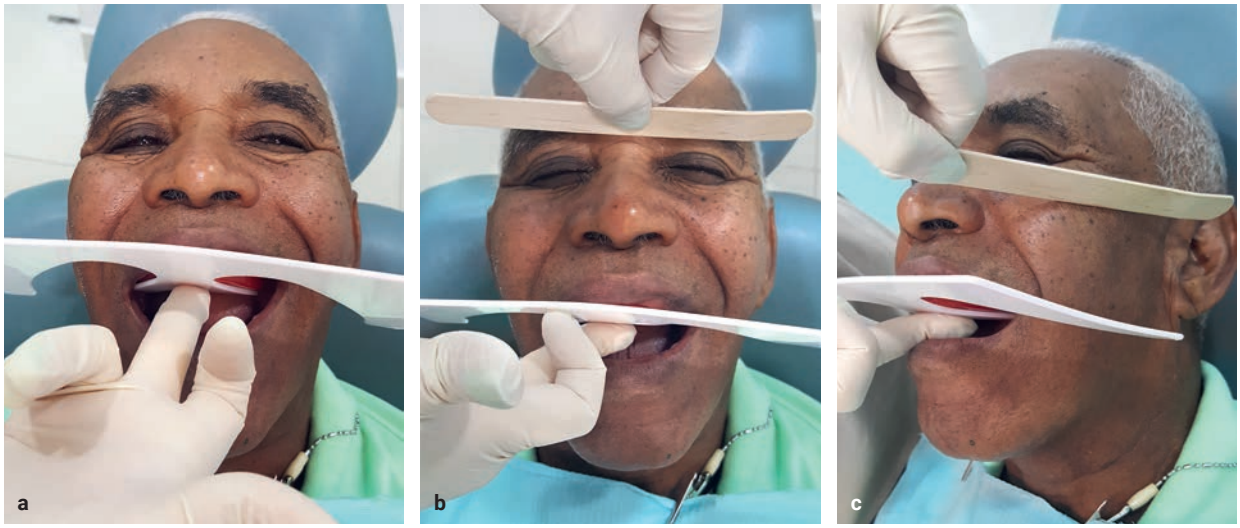


FIG 11-24 *(a to c)* In a completely edentulous patient, the maxilla should be oriented anatomically in the patient's mouth with a Fox occlusal plane (FOP), where the anterior portion of the FOP is parallel to the interpupillary line and the posterior portion runs parallel to the ala-tragus line.

The impression is made in one step using a PVS material. A putty consistency is loaded in the impression tray, while a light-body material is syringed around the copings, underneath the impression jig, and over the soft tissue. Once the impression material is set according to manufacturer guidelines, the screws within the impression copings are loosened and removed, allowing the impression to be removed from the patient's mouth.

The impression comes with the impression copings, to which the MUA analogs (implant and the MUA replica) are attached with the long screw and manually tightened with a screwdriver. The impression is now ready to be used to create a working model with a soft tissue replica. An impression of the opposing arch should also be made and reproduced as a model.[94]

At this point, the laboratory will need to make several records for manufacture of the framework. Vertical dimensions and interocclusal relationships must be captured to determine the width and height of the framework, and a verification jig must be fabricated to ensure an accurate final framework. A maxillary screw-retained record base and occlusal rim are also fabricated from the working model. At least two or three abutments should be embedded for the purpose of stabilizing and affixing the rim. In a maxillomandibular scenario, both a maxillary and a mandibular occlusal rim should be made.

The screw-retained record base will be tried in the patient's mouth and adjusted for VDO, lip length, smile line, midline, lip support, and facial harmony. The smile height will be marked into the wax at the canine position and midline. At this time, photographs, videos, and selfies should be taken.

The maxilla should be oriented anatomically in the patient's mouth with a Fox occlusal plane (FOP), where the anterior portion of the FOP is parallel to the interpupillary line and the posterior portion runs parallel to the ala-tragus line when the patient is in an upright position (Fig 11-24).

Now is the time to register the maxillomandibular relationship. The occlusal rim is screwed back in the patient's mouth, and silicone material is syringed into its occlusal surface. The patient is instructed to open their mouth as wide as possible and then to close it very slowly with the tongue sitting as far palatal as possible to register the centric relations as a reference point for the prosthesis.

The occlusal rim is then unscrewed and integrated into the master cast to be transferred to the semi-adjustable articulator and/or scanned to proceed with the structure design. At this point the provisional prosthesis should be placed back in the patient's mouth.

Some indentations are made in the master cast as a guide for setting a silicone matrix. A putty matrix should be fabricated for consideration of the