

Zygomatic Implants, an Excellent Alternative for the Rehabilitation of Atrophic Jaws without Bone Grafts

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Abstract

When the upper jaw loses its teeth, it atrophies and its bone structure decreases horizontally and vertically, and is usually accompanied by a pneumatization of the maxillary sinus.

We also see these characteristics in mutilated facial patients due to trauma or after resection of tumors.

These patients are not possible to rehabilitate with conventional implants only since they would be impossible to place in the posterior area of the maxilla without first performing a surgical preparation of the ground.

Cranial bone grafts, iliac crest of the hip, xenografts fixed with titanium meshes and screws, chin block or mandibular branch grafts and maxillary sinus floor elevation are some of the surgical bone regeneration techniques required for the preparation of the terrain and thus to be able to place titanium root implants, and then, yes, to be able to make a rehabilitation of the system with implant-supported fixed prosthesis in the maxillary.

They are very effective techniques and applicable to many patients, but they are also very complex, invasive and need intra or extra oral donor areas.

If the resorption is severe, the graft will have to be bulky, therefore it must be extraoral and there will be a post-operative with important morbidity.

The post-operative times of these techniques are quite extensive, not less than 6 months, and are usually performed in more than one surgical act.

Zygomatic implants offer another alternative to the surgeon when planning implant prosthetic treatment supported implant, especially in those patients with an extremely atrophic maxilla in which bone grafts cannot be performed or they have failed.

Keywords: Dental Implants; Extra-Oral Implants; Zygomatic Implants; Prosthesis Bucomaxillofacial Facial

Introduction

The zygomatic implant was developed by Prof. Per-Ingvar Brånemark in 1989 as an anchor for reconstructive and rehabilitative treatment in those patients who had been totally or partially maxillectomized.

He searched the cranial structure of these patients, reinforced bone pillars to anchor implants and thus rehabilitate the system.

These pillars were the zygomatic bone, the canine abutment and the lower edge of the orbit.

The osseous braces frame the nasal, orbital spaces and the region of the paranasal sinuses, at the same time that they provide an optimal structure to support the forces of masticatory tension.

He considered malar or zygomatic bone, as an excellent pillar, for its great bone density, and at the same time allows an adequate distribution in the crestal remnant of the maxilla to adapt to the functions of the stomatognathic system [1,2].

Brånemark developed an implant with an angled head at 45 degrees, 4.5 millimeters in diameter at its widest point, 3.9 in its thinnest zone and which can measure between 30 and 53 millimeters in length (Figure 1).

This implant is inserted from the palatal area of the alveolar process, following the alveolar zygomatic crest to anchor in the body of the malar or zygomatic bone, and in the case of maxillectomized patients, entering directly into the body of the malar.

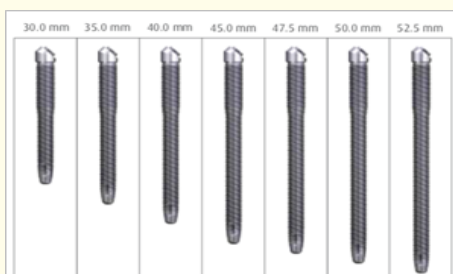


Figure 1: Zygomatic implants external connection Neodent system.

Indications

How any specific technique has its indications for certain cases and types of maxillary atrophies:

- Patients who have undergone a partial or total resection of the upper jaw, of traumatic or tumoral origin.
- Patients with sufficient volume in the anterior area of the maxilla to be able to install conventional implants, while the posterior alveolar ridge has undergone a resorption that makes it impossible to place additional fixings, necessary for the support of prosthetic reconstruction.
- Patients who have undergone bone grafts and failed.
- Patients with premature dental losses and the passage of time caused bone resorption and pneumatization of the maxillary sinuses (Figure 2 and 3) [2].

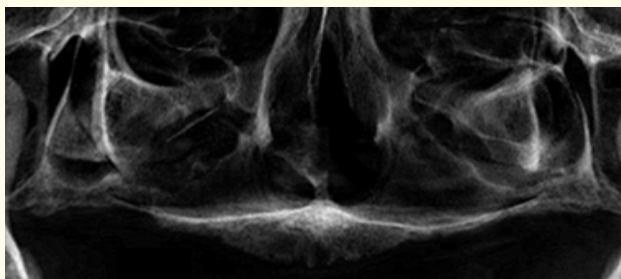


Figure 2: Orthopantomography of atrophic maxilla.

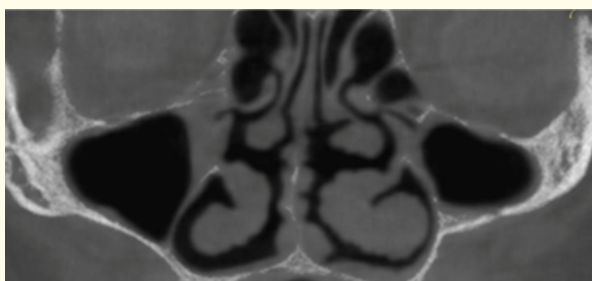


Figure 3: Frontal section of atrophic maxilla tomography.

Paraclinical studies

Although in some occasions the placement of a single zygomatic implant and some conventional or radicular ones where the surgery can be performed with enhanced local anesthesia, the patient must have a general state of health in perfect conditions to support a general anesthesia, which will be evaluated by Conventional routine paraclinical exams for this type of procedure.

The imaging studies will include an orthopantomography, a Waters projection and a computed tomography (CT) of the middle third of the face, from which it would be convenient if it were possible to perform a three-dimensional reconstruction in a stereolithographic model printed in 3D.

In this model we can simulate the surgery of this patient in a virtual way, so that we will reach the surgical block with a knowledge of the anatomy and bone dimensions of the patient, which will favor our three-dimensional orientation and allow us to choose the instruments and the appropriate implants for the surgery [3].

Maxillary bone

The maxillary bone is formed by a hollow body by the existence of the maxillary sinus, and four apophyses:

- The frontal apophysis that joins the frontal bone.
- The zygomatic or pyramidal process that articulates with the malar bone.
- The palatal process, horizontal, which together with the palatine process of the other maxillary bone, forms the main anterior part of the hard palate.
- The curved alveolar process extends downward and contains the alveoli that house the roots of the teeth of the maxilla.

The body of the maxillary bone is described as a triangular pyramid with a base toward the midline, facing the nasal fossa (Figure 4).

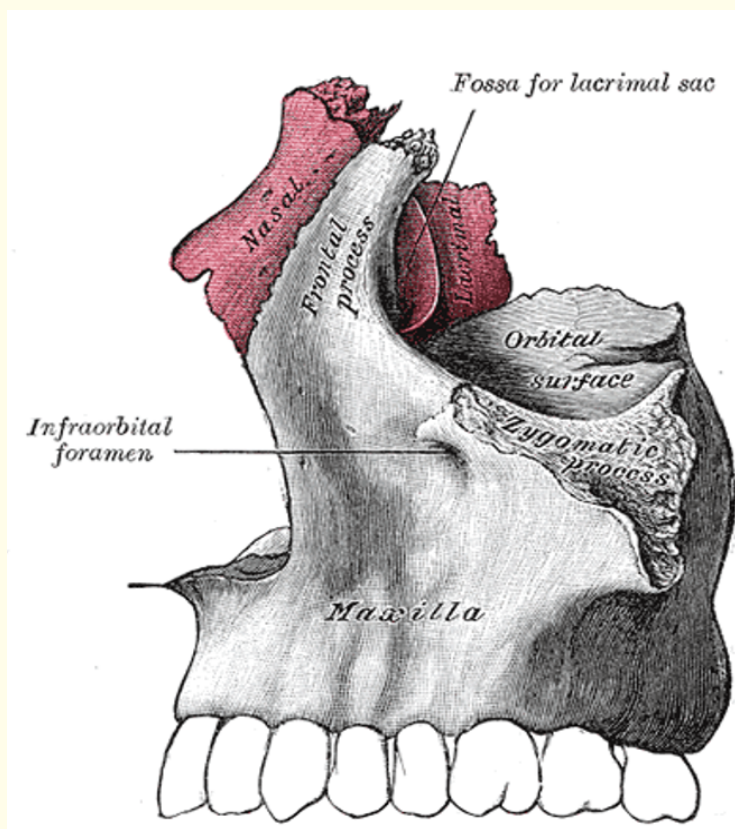


Figure 4: Maxillary bone.

This pyramid has three walls:

- Superior or orbit that is part of the floor of the orbit.
- Anterior, which shows the canine fossa and above the infraorbital foramen. On this face we will make the entrance window to the maxillary sinus to be able to guide us during the placement of the zygomatic implant in the case that we perform the intrasinusal technique.
- Posterior, which represents the anterior face of the zygomatic and pterygomaxillary fossa.

The base of the pyramid would be the nasal side of the body of the upper jaw, which in its back contains the maxillary hiatus that communicates with the maxillary sinus [4].

Malar or zygomatic bone

Bone of the endochondral ossification facial mass and therefore with a high cortical proportion and a high bone density. The zygomatic or malar bone is located between the orbit and the temporal fossa and constitutes the anatomical support of the cheekbone (Figure 5).

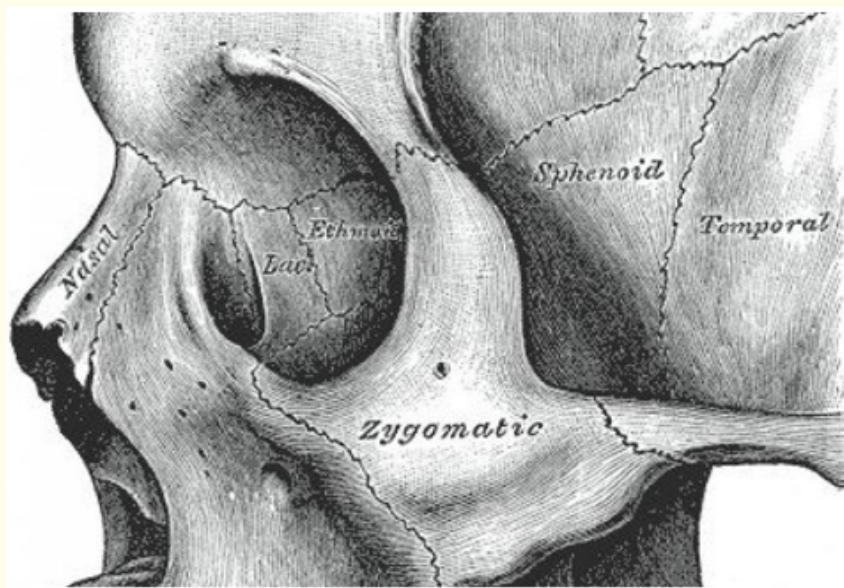


Figure 5: Malar or zygomatic bone.

It is constituted by a body and three apophyses:

- The frontal or frontosphenoidal process that goes upwards to articulate with the frontal bone and the sphenoid bone.
- The temporal apophysis that, going horizontally and backwards, articulates with the zygomatic apophysis of the temporal bone forming the zygomatic arch.
- The maxillary process is the anteroinferior border and forms suture with the maxilla. The alveolar zygomatic crest of the maxilla is continued, which is directed to the alveolar process of the maxilla approximately at the height of the first upper molar.

Between the frontal process of the malar and the zygomatic apophysis of the same, an angle of great importance is formed in this type of surgical intervention, because in it the separator is placed in the form of a hook of Brånemark that exposes us the body of the malar.

The body of the malar is where we will to anchor the zygomatic implant.

On the outer side of the body of the zygomatic bone there is a small foramen where the zygomatic facial canal ends.

Through it emerges the zygomatic sensory facial nerve, which when decorating the musculoperiosteal flap, we will section it, leaving a small area of anesthesia or paresthesia in the cheekbone that will be rapidly reinserted by other fibers.

On this outer face of the malar bone is also where the major and minor zygomatic muscles originate [4].

Surgical technique

Classically, Brånemark described the intrasinusal technique, which is based on the realization of a window in the antral area, the detachment of the breast membrane and the placement of the fixation from the alveolar crest to the zygomatic bone through the maxillary sinus, ensuring the integrity of the Schneider membrane (Figure 6) [5].

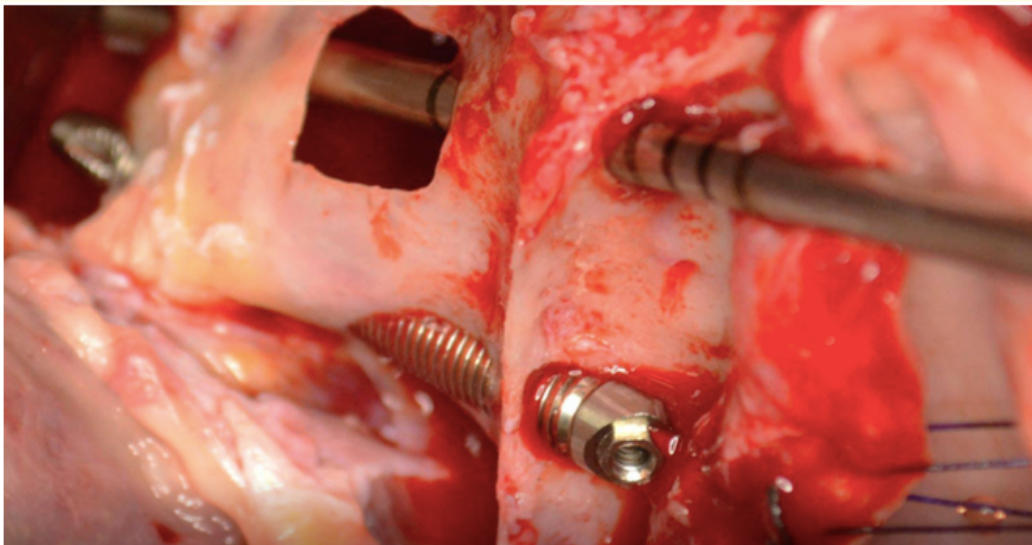


Figure 6: Incision technique of cigarette implants.

Subsequently, the Sinus Slot technique described by Stella and Warner (Figure 7 and 8) was developed, which involves making a groove in the external face of the maxilla with a diamond cut to visualize the body of the malar bone, without considering the integrity of the sinus membrane.

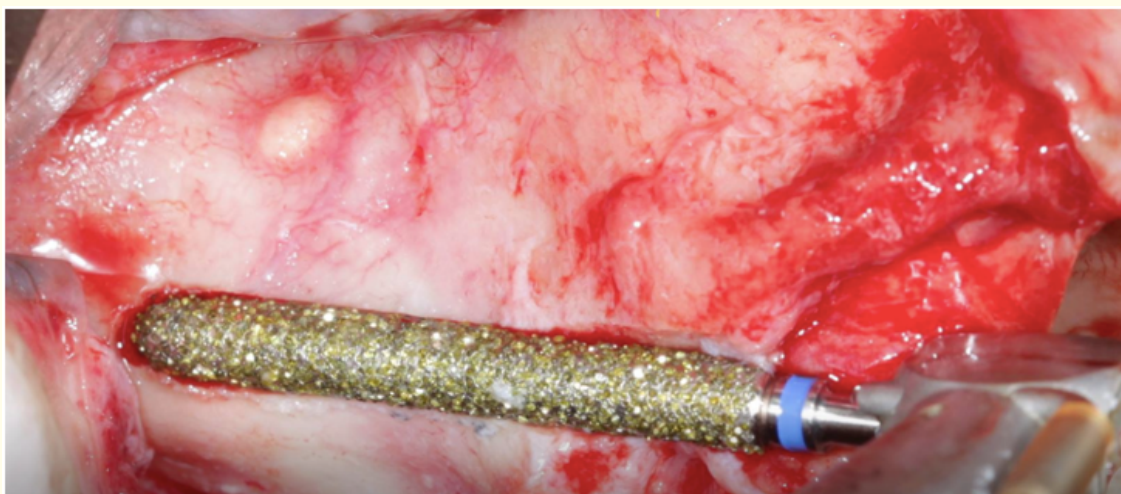


Figure 7: Diamond saw to mark the slot outside the breast.

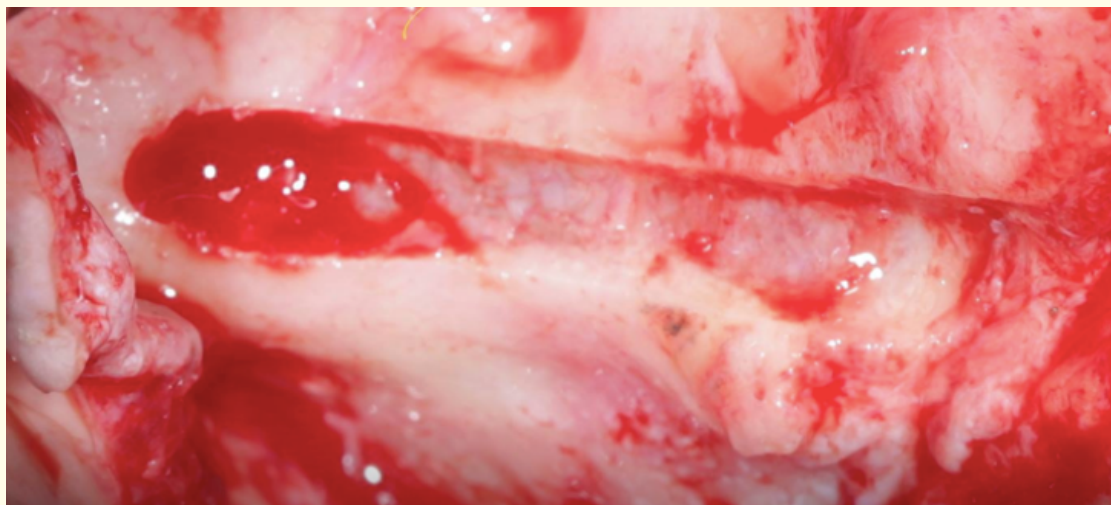


Figure 8: Slot for Sinus Slot technique.

The last technique described is based on the placement of the zygomatic implant in an extra-sinus situation (Figure 9), having anchorage in alveolar bone and zygomatic bone, keeping the implant body all the way out of the maxillary sinus [6].

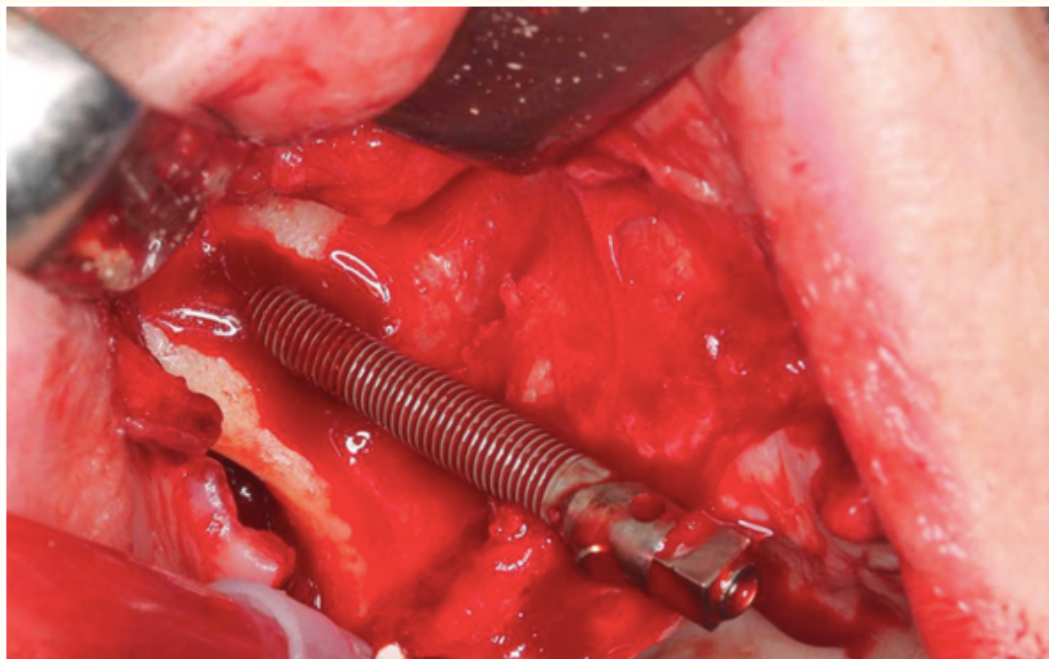


Figure 9: Extrasinual zygomatic implant technique.

We will describe the original intranasal technique, although personally we try to avoid it, depending on whether the patient's anatomy allows it, since it is the most complex to perform, but once mastered, we can perform the others without any inconvenience.

Once the general anesthesia and the patient with nasotracheal intubation were completed, we blocked with local anesthesia and epinephrine the posterior superior alveolar nerves, middle and anterior; infraorbital nerves, nasopalatine, anterior palatine, and the zygomatic region in a terminal infiltrative manner.

Routes of approach and incisions

The approach is intraoral and we start with a crestal incision with midline discharge and bilateral discharges (Figure 10) cranially following the alveolar zygomatic crest in front of the secretory duct of the parotid, the Stensen duct; These discharges are essential for the flap to yield without tearing and can be moved up and sideways to expose the zygomatic bone [7].

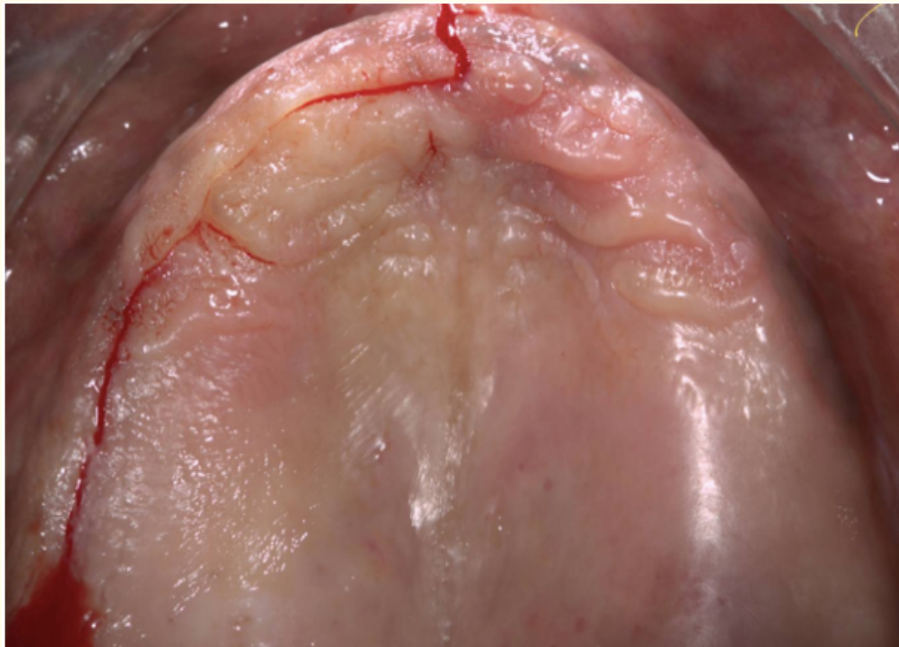


Figure 10: Inscription in right hemimaxillary.

Decoction of the mucous flap and periosteal muscle

We decorate a mucoperiosteal flap and periosteal muscle depending on the area of the same, as well as all the facial muscles that are inserted in the anterolateral face of the upper jaw, common elevator of the upper lip and wing of the nose, levator superioris, and canine muscle.

Throughout the intervention, we will be careful not to draw the infraorbital vasculonervioso package, artery, vein and sensory nerve of the 2nd branch of the trigeminal nerve that innervates the lower eyelid, the wing of the nose, and the upper lip [8].

We decorate laterally following the alveolar zygomatic crest, until reaching the lower edge of the zygomatic bone, where the insertion of the masseter muscle originates.

To be able to place the separator in the form of a hook and move the flap, we have to decorate the tendinous fibers of this muscle in its most anterior part.

We continue to dissect all the muscles that originate in the body of the malar, major and minor zygomatic, we cut the facial zygomatic nerve that presents anastomosis with the infraorbital nerve and the auriculotemporal nerve, nerves that will supply the post-surgical anesthesia of the area.

We decorate posteriorly looking for the angle formed by the frontal and temporal apophysis of the zygomatic bone (Figure 11).

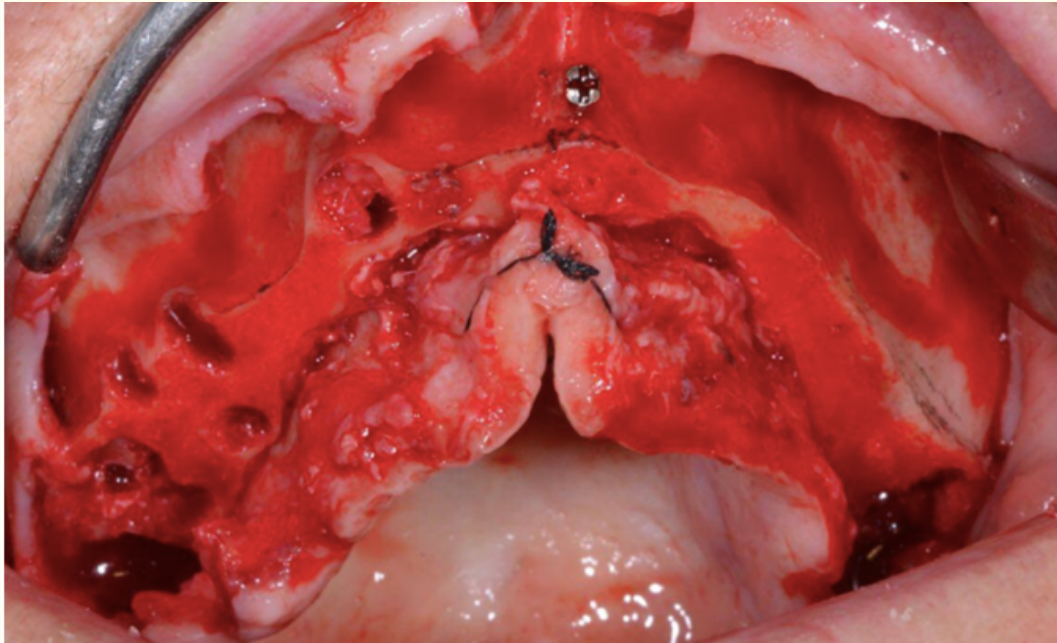


Figure 11: Decorated flaps. Screw placed in anterior nasal spine to fix surgical guide.

Fundamental is always to be stuck to the bone with the instruments, since in the cutaneous plane are the branches of the facial nerve that will innervate the different facial muscles that we have been decorating and thus avoid injury [9].

We carved a window in the lateral wall of the maxillary sinus with a round diamond drill, as if we were going to do an elevation of the floor of the breast, where we will control the milling in the zygomatic bone.

We take off the maxillary sinus mucosa and separate it from the area where we are going to mill to protect it.

We place in the angle the Brånemark retractor, and a curved separator below the zygomatic arch to expose both sides of the malar and give us an exact idea of the inclination and direction that we want to give the implant, facilitating the correct three-dimensional orientation when performing the milling, with extreme care to avoid penetration into the floor of the orbit and not injure the eyeball and avoid complications [10].

We will try to place the zygomatic implant as soon as possible, with the head of it as close to the alveolar crest as possible to facilitate rehabilitation, taking it through the maxillary sinus, following the direction of the alveolar zygomatic crest, sometimes even milling it in part of its thickness and trying to drill with the apex of the implant the cortical of the zygomatic bone in the vicinity of the angle between both apophyses.

We will control the entire process through the window made in the lateral wall of the pyramidal process of the maxilla, inside the maxillary sinus, without damaging Schneider's membrane [11].

Bone milling

We will use the following cutters, with the respective variants according to the type of implant system that we use (Figure 12):

- Round cutter 2.7/2.9 mm in diameter.
- 2.7 mm diameter helical drill.
- Pilot mill 2.7/3.5 mm in diameter.
- 3.5 mm diameter helical drill.
- 4.0 mm diameter countersink in palatal (optional).
- Countersink (optional).

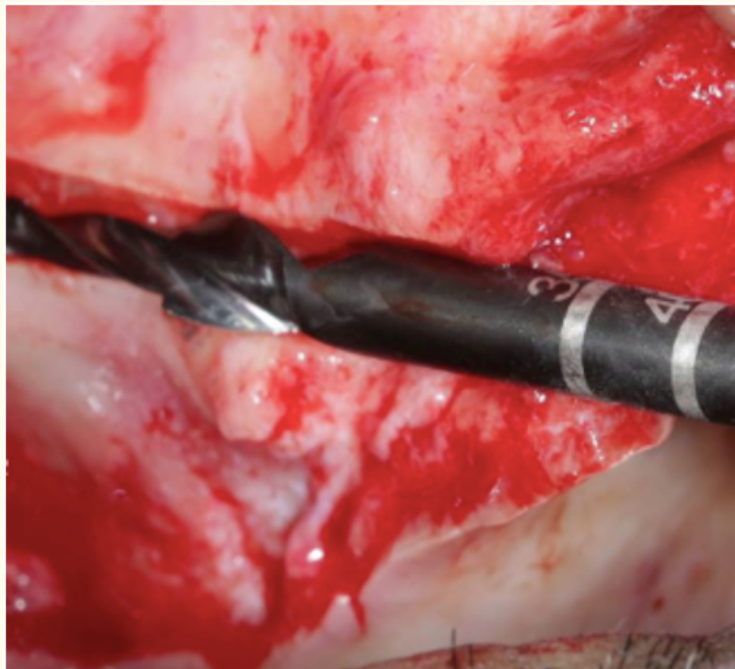


Figure 12: Milling with 3.5 mm spiral cutter.

We make the palatal mark for the entrance of the fixation, with a round bur, we penetrate into the maxillary sinus and verify the milling direction through the window made in it.

The drill should be directed towards the Brånemark retractor that has previously been positioned at a 90 degree angle to the malar bone [12].

We make an entry mark in the upper posterior part of the roof of the maxillary sinus and continue milling with a 2.7 mm diameter spiral bur to perforate the outermost layer of the zygomatic bone cortex.

We widened with the 3.5 mm diameter pilot drill, and we milled with the 3.5 mm diameter spiral until we noticed that we touched with the drill in the retractor piercing both cortices.

The last instrument to be used is the 4.0 mm diameter countersink and/or countersink bur that we use to introduce the threaded and wide portion of the fixation and the head of the same.

We will only use it when the palatal bone at that level is wide and of good quality, but we ignore it and place the implant directly [13].

Implant placement

We will use the angled depth gauge that comes in all the surgical kits for this technique and thus determine the length of the zygomatic implant (between 30 and 53 mm), taking into account that the apex of the fixation can protrude 1 or 1.5 mm from the cortex of the malar, being palpated many times by the patient in that lateral zone of the face (Figure 13).

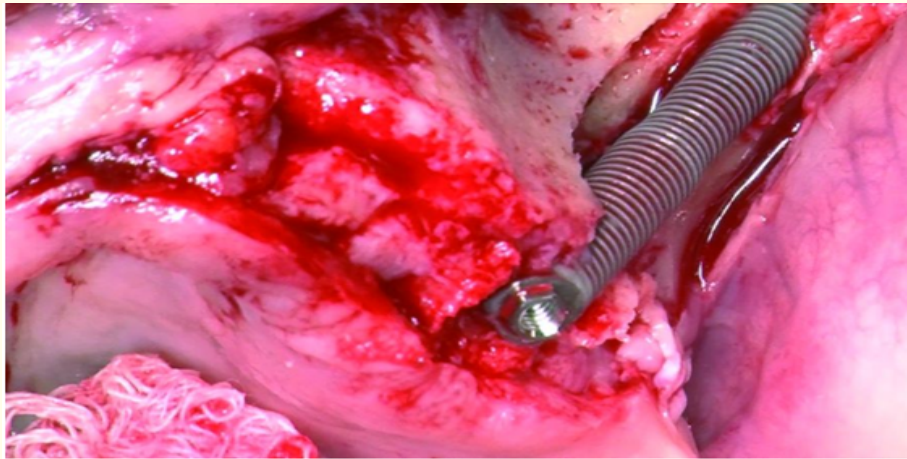


Figure 13: *In situ zygomatic implant.*

We will guide the implant in the correct direction through the maxillary sinus, preventing it from dragging and enrosque Schneider's membrane, in the case that the technique is intrasinusal.

We can place it at the beginning with the motor at low speed and when the implant is fixed we will use the manual key until the complete setting of the fixation in place [14].

Connection of pillars and somatoprosthesis

The pillars that we use are straight or angulated transepithelial and of different heights, depending on the case and the gingival biotype of the patient, in order to parallelize as much as possible the exit of the fixation screws of the prosthesis.

The great advantage of this prosthetic surgical technique is that we have the possibility of fixing a somatic prosthesis made before entering the surgical block, which will immediately rehabilitate the patient's stomatognathic system.

It is convenient, especially in cases where the bone at the level of the alveolar process offers limited support, perform an immediate splinting, to avoid torsion loads on the individual implants.

A rigid bar bolted to the implants is connected, relieving the provisional prosthesis and adjusting it with a tissue conditioner, or directly splinting with a complete acrylic prosthesis on previously acrylic plastic pillars.

The prosthetic procedure must be carried out according to the standard protocol for this type of rehabilitation, obtaining a good passive adjustment [15].

They are very bulky prostheses that replace teeth, gingiva and maxillary bone, so they are somatoprothesis and that is why we must look for the balance between aesthetics (vestibular cantilever and labial support), function and hygiene [16].

Biomechanical considerations

If we compare a zygomatic implant and a standard implant, the first has a greater tendency to flex under the action of horizontal forces, this is due to three factors:

- The great length of these implants (30 to 53 mm).
- The oblique orientation with respect to the occlusal plane.
- The fact that in the vast majority of cases there is a lack of bone support in the area.

The horizontal forces that cause moments of flexion are the most unfavorable for the implants, being able to alter the long-term stability of the implant supported restoration (Figure 14) [17].



Figure 14: Full hybrid fixed prosthesis screwed to 4 zygomatic implants.

We will counter the bending moments by:

- Ferulization and stabilization of the complete arch.
- Minimize the vestibular and distal lever arms, taking into account that the intensity of the forces generated are proportional to the extension of the distal cantilever of the prosthesis.
- Decrease of the occlusal surface, reaching the first molar in the prosthesis.
- Control of occlusion and movements of laterality and protrusion/retrusion.

The most widely used technique with this type of implants is called All-on-4[®], where with 4 implants placed in three-dimensional and well distributed, we are able to perform a fixed somatoprothesis without problems (Figure 15).

This technique is based on the fact that 90% of the loads received in the prosthesis is exerted in the most distal implant, therefore, it is not necessary to place more anterior implants.



Figure 15: Técnica All-on-4® zygomatic pura.

You can perform a pure zygomatic technique, using 2 implants of this type in each zygomatic bone, or a hybrid technique, in the case that in the premaxilla we can place 1 or 2 conventional implants and so we will only place 1 zygomatic implant in any of the areas posterior atrophic of the maxilla, or in the case of a hemi-maxillectomy for example where we have bony remnant on one side of the maxilla and absence on the other.

Zygomatic implants offer the patient with an atrophic maxilla a reduction of the treatment time.

They are an excellent option for patients who do not want bone grafts from other areas away from the jaws and represents a second opportunity for those patients who have undergone a bone graft treatment and these have been reabsorbed.

Conclusion

The use of zygomatic implants is currently a predictable therapeutic alternative and consolidated in the rehabilitation of patients with atrophic maxilla without the need for pre-implantation bone grafts and the possibility of rehabilitating the patient immediately in aesthetics and function of the stomatognathic system.

In the severely atrophic jaws, perhaps, the shortest way to rehabilitate is the extramaxillary anchor.

Conform with the bone remnant, accept it as such and go to find that primary fixation suggestive of clinical success as stability beyond that jaw.

This gives the possibility of rapid transfer in an impression and put into operation as soon as possible the entire capacity of the stomatognathic system.

However, like all surgical techniques, it presents a series of complications that should not be overlooked.

The fact that sinusitis relates to intrasinusal technique has entailed the development of techniques in order to avoid it, such as extra-sinusal implant placement or use of surgical techniques combined as raising simultaneous sinus implant placement or the coverage with the adipose ball of Bichat (Figure 16) [18,19].

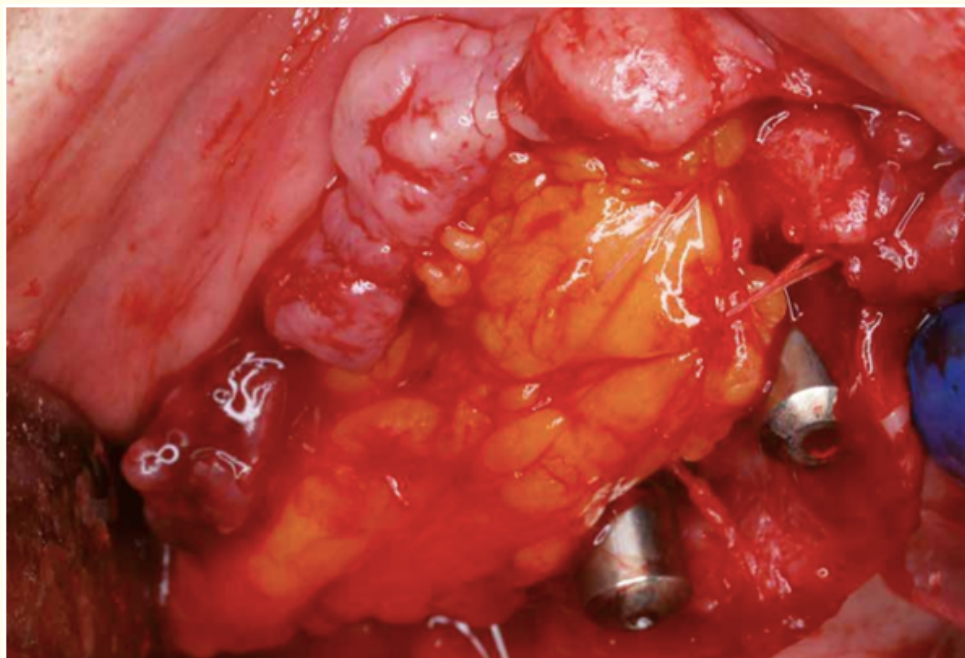


Figure 16: Suture of Bichat ball with its corresponding pedicles covering the zygomatic implants.

All of them valid and predictable, having to study personally in an excellent clinical history of each case.

The grateful patient, the iliac crest and the cranial calotte also.

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