Technical note

ZYGOMATIC IMPLANT WITH SELF-TAPPING APEX AND MACHINED BODY: A CLINICAL TRIAL THROUGH A STEREOLITHOGRAPHIC MODEL

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ABSTRACT

Zygomatic and pterygoid implants are used in cases of severe atrophy of the edentulous upper jaw. This trial uses the sinus slot technique and stereolithographic model to place a zygomatic implant with a self-tapping apex and machined body. A model was fabricated using 3D printing technology (SprintRay, Dental model). To allow implant placement, a replica of the entire maxilla and zygomatic bone was manufactured in actual scale model size. A shallow hole was made in the zygomatic bone using a marking bur to prepare for the osteotomy. Subsequently, a groove using a diamond cutter with a conical tip was inserted into the site previously in the zygomatic bone. If necessary, milling cutters could be used with medium- and fine-grit burs to smooth the sharp ends of the bone. A calibrated truncated cone drill was then used to complete the osteotomy by passing through the previously created slot (i.e., tunnel). Finally, the implant was placed after choosing the appropriate length. The proposed protocol simplifies using zygomatic implants in cases of severe maxillary atrophy.

KEYWORDS: *zygomatic implants, pterygoid implant, maxillary atrophy, fixed prosthesis, dental implant*

INTRODUCTION

Severe maxillary atrophy is accompanied by impaired masticatory and phonetic function that makes rehabilitation with conventional techniques difficult(1). Many different approaches were used to increase hard and soft tissue reconstruction with autologous from intraoral and / or extraoral grafts, sometimes associated with Type I Le Fort osteotomies (2, 3). In this context, the use of zygomatic and pterygoid implants may represent a treatment option in situations where there is severe partial or total maxillary atrophy (4, 5). The first clinical study using a zygomatic implant was Brånemark et al. (7), who described a placement technique that involved the insertion of implants through the sinus intra route and guided insertion through the execution of a lateral trapdoor bone without lifting the Schneider membrane,

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experiencing a high predictability of the procedure. This technique has been modified to preserve and lift the sinus membrane, contextual to the procedure (6, 7). To avoid sinus complications, Stella and Warner have proposed a zygomatic implant placement technique (sinus slot technique) variant, which does not require detachment of the Schneider membrane (8). Another technical variant was the proposed extrasinus approach, whose implant route is external to the maxillary sinus cavity. The literature suggests different geometries and implant designs to facilitate optimal fixture positioning and long-term maintenance of osseointegration of the placed implants.

This trial aimed to propose using an implant with a spiral self-tapping apex and a machined body that facilitated implant placement in a stereolithographic model. This trial used implants with spiral self-tapping apex and machined body implants (Isomed, Padova, Italy) (Fig. 1).

MATERIALS AND METHODS

Fig. 1. *Zygomatic implants with machined body and self-tapping apex.*

The implants used in this study are characterized by a self-tapping apex of 13 mm with surface treatment, while the remaining part is by a machined surface. The implant has an internal hexagonal connection that allows screwing a Multi-Unit Abutment (MUA) to allow prosthetic anchoring. After examination by three-dimensional X-ray (CBCT), a 3D printing of the atrophic jaws was done to simulate the surgery and confirm the previously planned implant length using 3D planning software (Isomed, Padova, Italy) (Fig. 2-4). CT/CBCT-derived models were fabricated using 3D printing technology (SprintRay, Dental model). To allow implant placement, a replica of the entire maxilla and zygomatic bone was manufactured in actual scale model size.

In clinical practice, an initial osteotomy was performed with a 5 mm round bur in the highest part of the bone ridge. A furrow in the crestal direction was performed with a second diamond bur with a machining tip (Fig. 2). The third bur perforated the cortical bone of the maxillary sinus and entered into the zygomatic bone for about 14 mm, impacting forwards at about 1 cm from the orbital cavity. The distance between the point of crestal bone and the apical point was measured with a probe based on the tomography measurement. The suitable length of the implant was confirmed, and it was screwed into the implant bed. The relationship between the alveolar crest and zygomatic area influences the implant position, and the final preparation was performed with a calibrated bur of the predetermined length. The implant was inserted with an axis extending from the second premolar or canine from the highest point of the cheekbone, precisely in the corner formed by the frontal and temporal process. The point of entry was palatally in the premolar area.

During the placement, the implant leans against the maxillary sinus wall after a small detachment of Schneider's membrane. The implants present a geometric shape characterized by self-tapping threads that allow easy positioning and, above all, a high primary stability. This shape lets the implant slide along the osteotomy and engage in the zygomatic hole simply and predictably.

Implant bed preparation

1) Using a marking bur, a shallow hole was made in the bone zygomatic bone in preparation for the osteotomy.
2) A groove was made extending from the first bur to the alveolar ridge using a diamond cutter with a conical tip. The tip was previously inserted into the site of the zygomatic bone. The coarse-grained cutter then created the groove. If necessary, milling cutters were used with medium- and fine-grit burs to smooth the sharp ends of the bone (Fig. 2-3).

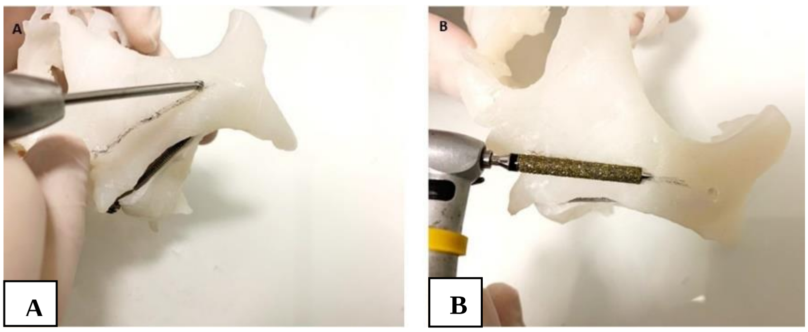

Fig. 2. *3D printing of the atrophic jaws.* ***A****): A bur is used to make an osteotomy at the superior extent of the contour of the zygomatic;* ***B****): A groove that extends from the first cut to the alveolar ridge using a diamond cutter with a conical tip. The conical tip must be inserted into the site previously in the zygomatic bone. The coarse-grained cutter was used to make the groove, and, If necessary, milling cutters is used with medium- and fine-grit burs to smooth the sharp ends of the bone.*

Fig. 3. ***A***): *medium-grit burs;* ***B***): *fine-grit burs.*

3): A calibrated truncated cone drill was used to complete the osteotomy by passing through the previously created slot (i.e., tunnel) (Fig. 4A) and implant placement (appropriate length implant was chosen) (Fig. 4B).

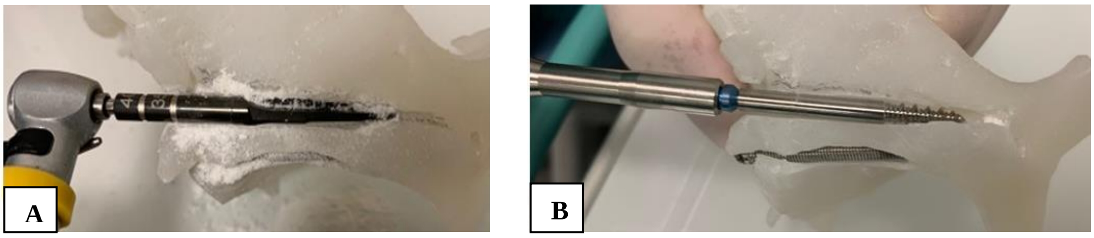

Fig. 4. *A): A calibrated truncated cone drill was used to complete the osteotomy by passing through the previously created slot (i.e., tunnel); B): Zygomatic implant placement. Implants with a self-tapping apex of 13 mm with surface treatment, while the remaining part is by a machined surface.*

RESULTS

All implants with spiral self-tapping apex and a machined body were inserted without any difficulty. The tunnel technique can be used to prepare a simple and secure implant site without involving the maxillary sinus. The simulation of the operation on 3D-printed upper jaw models before the zygomatic implant placement enables better predictability of clinical cases.

DISCUSSION

In literature, five different surgical approaches were used for zygomatic implant placement: the classic approach (9), the sinus slot technique (8), the exteriorized approach (2), the minimally invasive approach by use of custom-made drill guides (10), and the computer-aided surgical navigation system approach (11).

In this trial, the implant is easily placed thanks to the tunnel technique described by Stella (8). The zygomatic implant proved to be an effective option in managing atrophic edentulous maxilla and defects in the maxillectomy.

This technique was introduced by Brånemark (7), for prosthetic rehabilitation of patients with significant defects of the jaw caused by tumor resection, trauma, and congenital defects. The zygomatic bone arc is used to anchor the implant, which, together with conventional implants, could be used as an anchor for the prosthesis and/or shutters. The technique allowed the successful rehabilitation of these patients, providing functional recovery and improved aesthetics, allowing for a normal social life and relationships. Many authors have suggested using multiple zygomatic implants (two or three on each side) to support a prosthesis.

The technique for atrophic patients, not subjected to maxillectomy, involves opening the maxillary sinus without lifting the sinus membrane to drive the cutter toward the zygomatic bone. Subsequently, several changes were made, including lifting the membrane to preserve its integrity. The protocol, subsequently further modified, foresees the realization of a groove that extends from the zygomatic bone up to 5 mm from the alveolar crest sinus (slot technique) without lifting the sinus membrane (12). The surgical techniques for inserting the zygomatic implants are essentially two: an intrasinusal technique and an extra-sinus procedure, and the approach depends upon the concavity or convexity that describes the outer wall of the maxillary sinus. The sinus morphology affects the passage or otherwise of the alveolar crest to anchor to the zygomatic bone (12).

Despite numerous publications with long-term positive results, there are no randomized controlled trials comparing the clinical efficacy of alternative means of rehabilitating patients with atrophic edentulous jaws. Retrospective studies document a percentage of implant survival rate of 90-100% (13). In addition, few prospective studies, especially long-term randomized clinical studies, confirm this technique's usefulness. No specific and well-defined criteria help the clinician evaluate rehabilitation success with zygomatic implants. After initial clinical use in patients with neoplastic disease, an indication of zygomatic implants has been expanded to fully edentulous patients with severe maxillary atrophy. Since then, the main indication for zygomatic implants remains unchanged. In the most common cases, zygomatic implants are combined with two or four anterior maxillary axial implants.

CONCLUSIONS

Computed tomography is crucial for evaluating the zygomatic implant site, the sinus condition, and the implant path. With the original technique, the zygomatic implant path was within the maxillary sinus. The emergence of the head of the implant into the alveolar crest bone depends on the spatial zygomatic relationship with the maxillary sinus and the alveolar ridge dimension (14).

The use of this technique provides for the possibility of an extra-sinus implant path with promising results. This research used a zygomatic implant per side and 2 implants in the anterior maxilla. The results observed in the present study show the ease of implant placement with self-tapping apex, making it possible to center the hole in the zygomatic bone easily. Zygomatic implants represent an excellent alternative to regenerative surgery, taking advantage of the available bone anchored in the zygomatic region and native and non-regenerated bone, with obvious biomechanical advantages (15, 16).

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