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MINIMALLY INVASIVE TRANS–ZYGOMATIC AND PTERYGOID IMPLANT SURGERY TECHNIQUE IN THE REHABILITATION OF PATIENTS WITH SEVERE MAXILLARY ATROPHY

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SUMMARY

Angular and trans-zygomatic implants are an alternative to most augmentation procedures on the upper jaw. Priority application of trans-zygomatic, pterygoid and traditional implants on the upper jaw in different techniques and combinations. Extensive possibilities for rehabilitation of patients with severe and extreme atrophy and post-traumatic changes of the upper jaw. Trans-zygomatic implants provide immediate functional loading with prosthetic constructions according to the protocol of intraoperative direct prosthetics. Treatment time, cost and the need for augmentation procedures are reduced. Specialists strive to reduce the risks and invasiveness of techniques by optimising surgical access techniques.

KEY WORDS: *angular and trans-zygomatic implantation, intraoperative direct prosthesis, trans-zygomatic implant protocol, intraoperative implant positioning, conical screw abutments, screw fixation of prostheses, minimally invasive technique.*

CONFLICT OF INTEREST. *The authors declare no conflict of interest.*

Introduction

With the long-term absence of teeth and reduced functional load, the volume and density of the bone tissue in the distal part of the maxillary sinus decreases and is insufficient for the placement of traditional dental implants [1]. Clinicians use the method of maxillary sinus floor elevation (sinus lifting surgery) to solve this problem. The use of sinus lifts is widespread in modern dental practice. [2]. A variety of surgical protocols, the anatomy and functional features of the maxillary sinuses, associated pathology and unfavourable factors lead to the development of complications that reduce the effectiveness of the technique or lead to the absence of predictable results [3, 4, 5]. Trans-zygomatic and angulated implantation protocols are now widely used in practice and are progressive and demanded designs by dental professionals and maxillofacial surgeons [6, 7]. Often, trans-zygomatic implants are used, in independent solutions – the «quad zygoma» or «4+» protocol, when there is extreme atrophy of the upper jaw, flattened and atrophied upper jaw frontal region with minimal bone [8, 9]. Rehabilitation of laterally atrophied regions of the upper jaw in various combinations with standard, angular and pterygoid implants is more often in demand [10, 11]. [10, 11]. A large number of studies are devoted to implantation in the extraction site of the maxillary teeth, surgical sanation, and peculiarities of implant positioning in this area. [12]. The literature discusses the effectiveness of tilted and angled implantation protocols in the lateral zone of the maxilla. The anatomy and the presence of a bone supply have of great importance, which is so telling for these protocols. [12]. Surgical protocols, depending on the prosthetic platform of the implant, involve both bicortical as well as multicortical fixation of the implant. A large proportion of the structure ends up in the zygomatic bone thickness, which significantly improves the quality and strength of the anchoring of the structure. [13].

The angular and trans-zygomatic implant protocols fall under the category of the intraoperative direct prosthetic technique. A denture with an individual metal or composite framework is placed on the day of surgery or 24–72 hours after the intervention. This depends on the individual indication, the INP protocol and the capacity of the clinic and dental laboratory [14]. Modern prosthodontic planning of this surgical protocol minimises surgical trauma and avoids flap detachment. This leads not only to an accelerated, simplified surgical protocol, but also to improved treatment quality. [15]. The literature compares different techniques and protocols for transsseous and angular implantation: classic technique (Branemark), advanced extrasinus techniques (Sinus Slot technique, Stella &

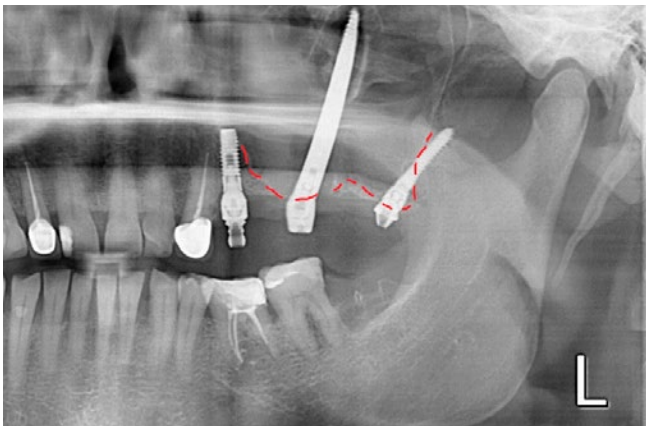

Fig.1. Height of the maxillary alveolar process laterally to the floor of the maxillary sinus on the left

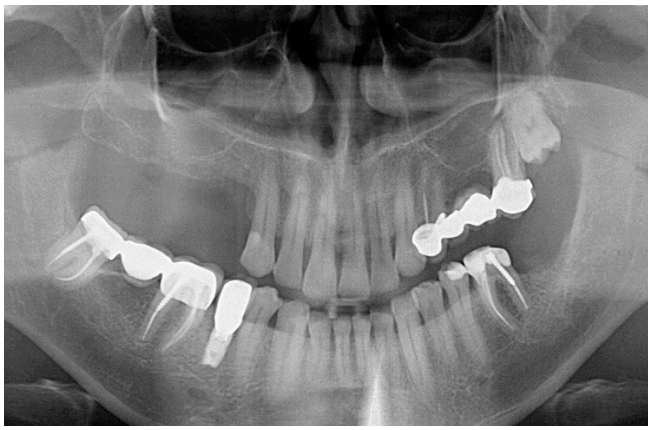

Fig.2. Height of the maxillary alveolar process in the maxillary sinus area on the right.

Warner 2003., Migliorança et al. 2005, 2006,. and intrasinus, extramaxillary technique., Malevez C. et al. 2004, ZAGA Carlos Aparicio 2005, 2011). The preparation, design and implementation of the above treatment protocols should be performed by a team of specialists with extensive surgical experience in maxillofacial surgery and implant-supported prosthetics [16, 17]. This article presents clinical experience with trans-zygomatic angular implantation protocols in the lateral region of the upper jaw using the original minimally invasive protocol, followed by intraoperative prosthetics.

The aim of the study is to improve angular and trans-zygomatic implantation protocols for the rehabilitation of atrophied maxillary lateral regions, minimising surgical access.

Patients, materials and methods

The patient group consisted of 44 patients (21 females and 23 males) aged between 37 and 73 years, from 2014 to March 2020. The patients were divided into two groups. The first group included 20 patients with severe maxillary alveolar atrophy who underwent the classic Branemark trans-zygomatic implant technique with mucosal-periosteal flap folding, opening of a window on the anterior surface of the zygomatic bone, Schneider membrane detachment and placement of trans-zygomatic implants. Fifty trans-zygomatic implants and 31 standard implants were placed. Three trans-zygomatic implants and 2 standard implants were rejected. [17]. In the second group, we used our improved minimally invasive technique of angular and trans-zygomatic implantation in the rehabilitation of 24 patients with severe atrophy of the maxillary alveolar process. Fifty-two trans-zygomatic implants and 35 standard implants were placed. Two trans-zygomatic implants and one standard implant were rejected. We used the ZAGA accesses and technique of implant placement without reclining the mucosal-periosteal flap through punctures or soft tissue incisions to minimise hard tissue atrophy, postoperative complications and to reduce the surgical time. [18].

In preparation for the surgery, a CBCT of the patient's head was carried out and an individual stereolithographic maxilla model was produced using a 3-D printer. The maxilla prototype was used for the development of intraosseous canals for titanium structures using osteotomes, piezosurgical technique, diamond cutters and conical drill, implant insertion routes and optimal positioning parameters for the prosthesis.

Clinical examples. The maxillary alveolar process in the lateral region to the floor of the maxillary sinus was 1 mm to 3 mm in height and 2 mm to 4 mm in width (*Fig.1–2*).

Depending on the anatomical features of the pterygoid-mandibular region, the implant was positioned either in the medial lamina of the pterygoid process of the sphenoid bone or directly in the body of the pterygoid process of the sphenoid bone. *(Fig. 3–4*)

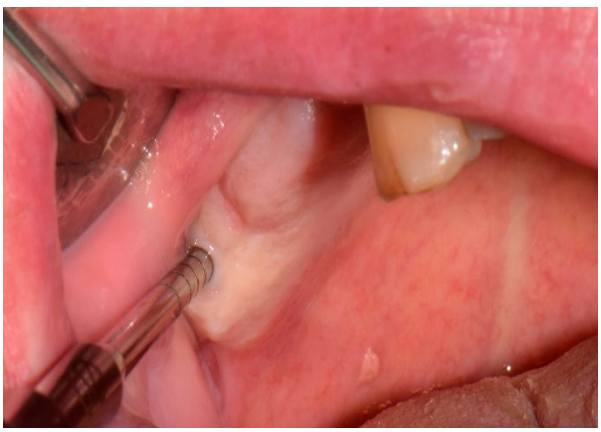

Fig. 3. Minimally invasive bone canal formation for pterygoid implantation with an osteotome.

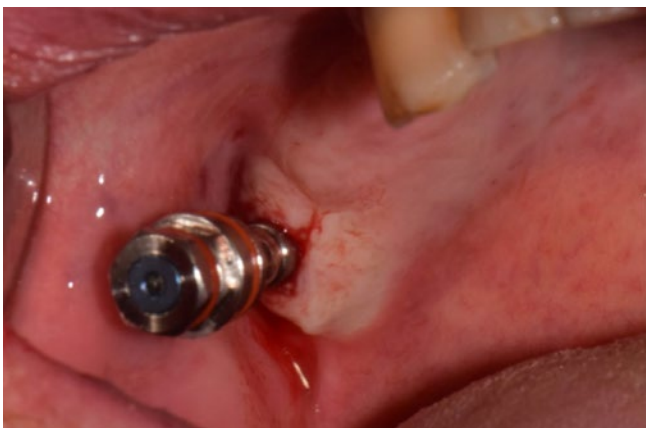

Fig. 4. Placement of a pterygoid implant without retracting the mucosal-periosteal flap.

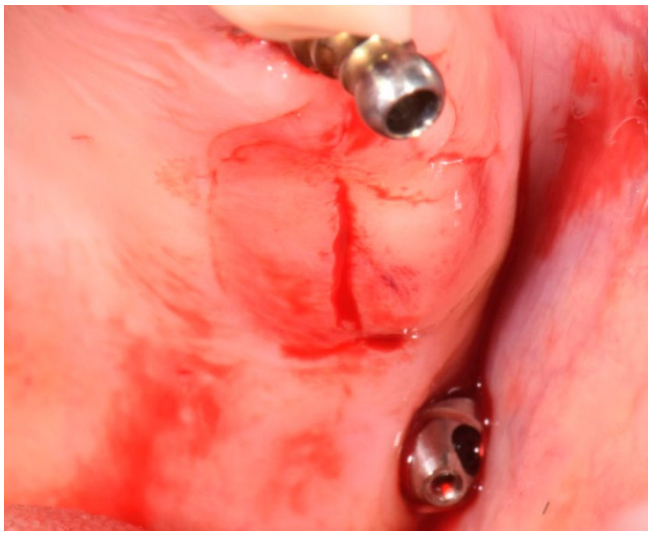

Fig. 5. Full-thickness soft tissue incision along the alveolar ridge of the maxilla for placement of a transcuneal implant.

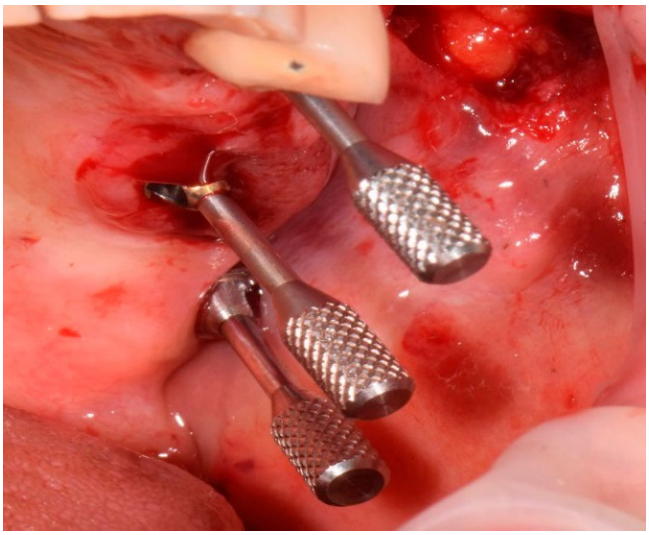

Fig. 6. View of the transitional fold incision on the upper jaw for inserting a trans-zygomatic implant.

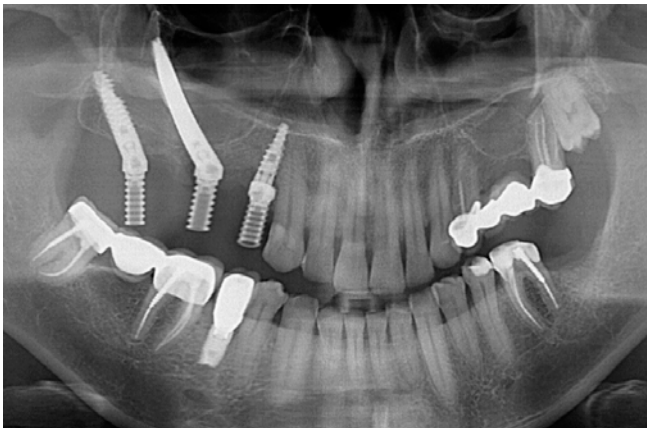

Fig. 7. Orthopantomogram with 3 implants on the maxilla, placed for immediate denture loading.

In the first stage of surgery a pterygoid implantation was performed. If the pterygoid implant was unsuccessful, a second option with two trans-zygomatic implants up to 60 mm long was used. We use a double soft-tissue incision technique of 10 mm each for insertion. The first incision was made along the apex of the maxillary alveolar process at a distance of 5 mm from the border of the attached and movable mucosa of the vestibule of the mouth. (*Fig. 5*) The second incision was made according to the Caldwell-Luke method in the projection of the premolars (*Fig. 6*).

Infiltrative anaesthesia was enough in the surgical area in the first stage. In the case of unilateral missing teeth with severe maxillary alveolar ridge atrophy, 3 implants were desirable for immediate loading. (*Fig. 7*) Implants were less overloaded compared to a 2-implant construction.

If the implants are not in parallel to each other and the implant abutments are not in line with the alveolar ridge, they form a triangle between them, which reduces the functional overload during lateral masticatory movements (*Fig. 8*). Increasing the area of this triangle within the dental arch area reduces the risk of complications.

When inserting a third implant, if at all possible, we minimise the incision or use a set of osteotomes for the subsequent insertion of a classic implant through the soft tissue puncture.

The success of rehabilitation of patients with severe maxillary alveolar atrophy using the immediate loading method depends on primary stability, optimal positioning of abutments in the dental arch area, splinting with titanium skeleton for the entire structure. (*Fig. 9*)

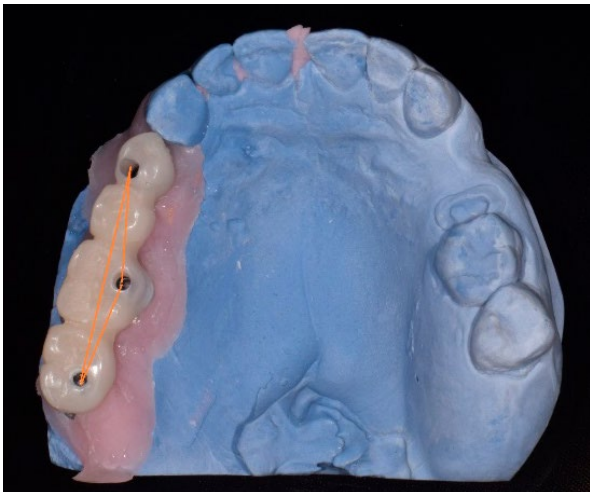

Fig. 8. Positioning of the mines exits for triangular screw fixation of the denture.

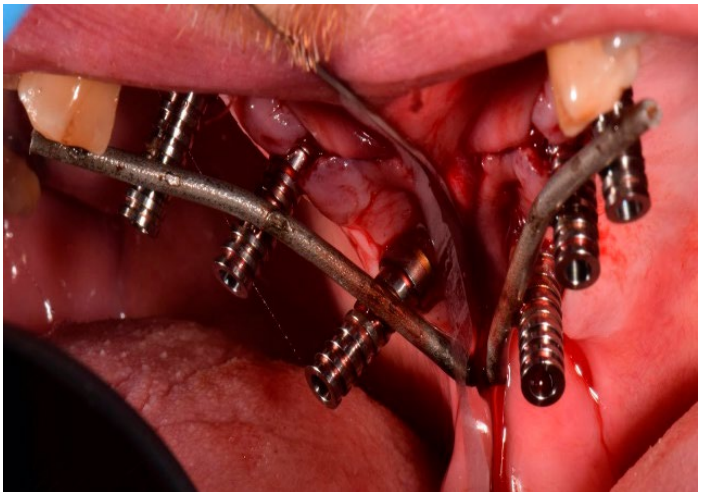

Fig. 9. Structural splinting with intraoral contact welding.

Table 1

Analysis of the clinical status of patients after surgery

	Classic trans-zygomatic implant technique	Minimally invasive trans-zygomatic implant technique
Pain syndrome	Up to 5 days	one day
General medical condition on a 5-point scale	3	4
Swelling (oedema)	Up to 10 days	one or two days
Restriction of mouth opening	in 40% of cases	0
Surgery time	Up to two hours	30–40 min
Anaesthesia	narcosis	infiltrative anaesthesia

The upper and lower jaw rows must be fully restored with dentures to prevent uneven distribution of the chewing load.

Results

The evaluation was based on clinical assessment of the implants and prostheses, postoperative patient questionnaire and radiographic analysis of the patients. *Table 1* presents an analysis of the clinical status of the patients after surgery. Based on the clinical assessment of the implants and radiographic analysis of the patients who underwent minimally invasive angular and trans-zygomatic implantation compared to the patients rehabilitated using the classic Branemark technique, no worsening of the postoperative condition was detected.

Conclusion

Trans-zygomatic implants have been clinically used for the past 30 years in the rehabilitation of patients with severe maxillary atrophy. They allow predictable support for screw-retained prostheses. Guided surgical approaches are used for optimal placement of the prosthetic platform of such implants. [20]. The formation of this access is sufficient for visualisation of the surgical field, objective assessment of the situation and minimally invasive placement of implants. An undeniable advantage of this method is the minimisation of factors that provoke hard tissue atrophy by preserving the integrity of the periosteum. There is virtually no haematoma or pain in the postoperative period. Due to the absence of the necessity to fold back the complete mucosal-periosteal flap, additional hemostasis of the damaged vessels in this area, finishing repositioning and double-row suturing of the flap to prevent divergence of the wound edges, the intervention time is reduced and the operation itself is simplified. This has been confirmed by other researchers. [21, 22, 23]. When passing a rotary cutter, depth gauge or implant near the orbital floor, it is very important to have bilateral contact with the patient. This makes it possible to change the insertion trajectory in time and avoids possible complications. The minimally invasive technique of implant placement in the treatment of patients with severe maxillary alveolar atrophy can be used by the surgeon on an outpatient basis and makes it possible to achieve a predictable result in 1 day. [24].

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SINUS LIFTING SURGERY WITH SIMULTANEOUS SANATION OF THE LOWER SECTIONS OF THE MAXILLARY SINUS

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SUMMARY

This article presents a new method of reconstruction of the atrophied distal alveolar process of the maxilla in patients with chronic polyposis sinusitis that we have developed and introduced into clinical practice. The method provides for bone grafting using open sinus inlay technique with simultaneous removal of polyps from the maxillary sinus and immediate or delayed placement of dental implants. Previously, the presence of extranasal sinus polyps was a contraindication to sinus lifting surgery. Treatment required an additional stage of the sinus sanation, which is possible only in the in-patient department, prolongs the rehabilitation time for patients with tooth loss, and extends the prosthetics period for dental implants. Moreover, it is not always possible to predict the exact time of the in-patient stage of treatment because of the individual characteristics of the body and the risk of possible complications, which in turn can increase the total period of surgical treatment. The developed method makes it possible to exclude the stage of in-patient treatment involving sanation of the maxillary sinus in this category of patients and thus reduces the duration of surgical treatment by 3–4 months.

KEY WORDS: *bone grafting, reconstruction, distal maxillary process, bone atrophy, maxillary sinus, sinus lifting surgery, chronic polyposis maxillary sinusitis, dental implantation.*

CONFLICT OF INTEREST. *The authors declare no conflict of interest.*