Zygoma implant–related rehabilitation has proven to be an effective option in the management of the atrophic edentulous maxilla. Currently, there are several studies demonstrating the long-term survival of zygomatic implants. Indeed, recent studies show that the rehabilitation of atrophic arches with the placement of zygomatic implants has higher success rates than bone reconstructions using large bone grafts from intraoral or extraoral origin.

The original ad modum Brånemark zygomatic implant placement technique requires the preparation of a “window osteotomy” in the lateral wall of the maxillary sinus to visualize the trajectory of the implant. The technique also prescribes an intrasinus implant route with palatal entry into the maxillary sinus. The greater the concavity of the anterior wall of the maxilla, the greater the palatal position of the implant head. Concave anatomical situations often lead to bulky prostheses, hygiene problems, and late sinus infections. Potential complications in treatment with zygomatic implants, especially those that occur in the long term and recurrently, can be extremely complex to treat.

In 2000, Stella and Warner described the sinus-slot technique in a technical note. To supervise the passage of the implant through the sinus, they proposed the drilling of a slot on the lateral maxillary wall following an imaginary implant trajectory in opposition to standard antrostomy or “sinus window osteotomy.” The authors did not provide specific criteria to understand where to drill that slot, nor did they define when curvature of the maxillary wall made the slot unnecessary or where to start the crestal drilling in the presence of extreme atrophy. However, they recommended for the first time a less-invasive osteotomy, a crestal incision, a less-palatal emergence of the zygomatic implant, and the possibility of using intravenous sedation. The use of the sinus-slot technique

Different surgical approaches including the slot and the extrasinus techniques have been described to overcome disadvantages of the original Brånemark technique for the placement of zygomatic implants. A new concern associated with zygomatic implants placed externally to the maxillary wall is the possibility of disturbing buccal soft tissues, ending up with a dehiscence and a potential infective problem. Recently, a new methodology known as the Zygoma Anatomy-Guided Approach (ZAGA) has been described based on the concept of delivering specific therapy for each patient. ZAGA involves a variety of possibilities of implant trajectory from the intrasinus to an eventual extrasinus passage according to variations in patient anatomy. ZAGA methodology includes a rationale of how to prevent most of the reported complications of zygomatic implants. The objective of this technical note is to introduce the “Scarf Graft” as a part of the ZAGA protocol intended to prevent soft tissue dehiscence around extrasinus zygomatic implants. A pediculated connective tissue graft is placed around the neck of the extrasinus zygomatic implants. The increased connective tissue thickness consistently gives stable gingival tissue for prevention of recession. Currently, the treatment of soft tissue dehiscence around zygomatic implants does not have predictable results. Protocols for its prevention, such as the proposed ZAGA Scarf Graft, should be incorporated if an eventual dehiscence is foreseen. Int J Oral Maxillofac Implants 2020;35:e21–e26. doi: 10.11607/jomi.8065

Keywords: extrasinus implants, Scarf Graft, soft tissue dehiscence, soft tissue recession, ZAGA, zygomatic implants

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Submitted September 14, 2019; accepted November 8, 2019.
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in a series of patients was reported by Peñarrocha et al. Although all the implants and prostheses were in place at the time of the report, 2 out of the 10 zygomatic implants reported could not be placed at the alveolar ridge position. The author recommends caution in treatment of the alveolar process showing extreme atrophy.

In 2006, the Aparicio group in English, and simultaneously Miglioranza et al. in Portuguese, described for the first time a new approach for zygomatic surgery known as the exteriorized technique. In the presence of a concave maxillary wall, the implants are partially placed outside the maxillary sinus wall and covered just with soft tissue. This approach eliminates the need for maxillary “window antrostomy” or the creation of a slot prior to the surgery. The approach has fewer surgical stages than classic and sinus slot methods, is less invasive, reduces surgical time, and provides a shorter cantilever by the position of the implant emerging from the crest at the level of the first molar region. Initially, the extrasinus/exteriorized procedure was indicated for patients with pronounced maxillary concavities. Maló et al., in a subsequent pilot report, introduced a modification of the extrasinus approach, an extramaxillary approach, as a possibility to treat the resorbed maxilla independent of the maxillary shape/anatomy. The authors of the extramaxillary approach recommended discarding the remains of alveolar bone and using the zygomatic bone as exclusive implant anchorage. The extramaxillary technique was used not only for concave maxillary walls, as indicated by the extrasinus technique authors, but in a generalized manner to also cover all types of anatomies. With disregard to the name, the externalized, extrasinus, or extramaxillary technique did not describe clear protocols of where to start the drilling, nor of the way the osteotomy should be performed. Moreover, a current concern when placing zygomatic implants externally to the maxillary bone wall, specifically in the presence of maxillary walls that are not so concave or convex, is the possibility of disturbing soft tissues, ending up with a dehiscence and a potential infective problem. This event would be facilitated by two facts: (1) the use of extramaxillary implant position irrespective of patient anatomy characteristics may compromise soft tissue vascularization; and (2) discarding the remains of alveolar bone crest prior to implant placement, as described in the extramaxillary approach, may end up reducing the possibility for soft tissue connective fibers to reattach.

A relatively new concept called the zygomatic anatomically guided approach (ZAGA) has been evaluated with promising results. ZAGA is a development of the original zygomatic Brånemark technique, the sinus slot, and the extrasinus approach focused on interindividual anatomical differences. Indeed, ZAGA methodology is based on the concept of delivering specific therapy for each patient. ZAGA embraces a variety of possibilities of implant trajectory from the intrasinus to an eventual extrasinus passage according to variations in the patient anatomy. The ZAGA concept includes a rationale of how to prevent most of the reported complications in the literature of zygomatic implant treatments.

ZAGA criteria for establishing the implant trajectory recommend placing the head of the implant at the middle of the crest. Provided a 4-mm minimal bone height on the sinus floor is left, a crestal bone entrance may be performed through the membrane with no added risk for sinus infection or soft tissue recession. The circular osteotomy on the sinus floor is matched (sealed) with a round implant profile. Zygomatic implants would have an intrasinus path.

Maxillary anatomies showing advanced atrophies may involve a residual amount of pristine alveolar bone not suitable for a circular implant osteotomy, while still maintaining sinus integrity at its floor level. ZAGA criteria would then recommend that the surgeon choose an open channel–type osteotomy with the shape of a circumference arc. That type of osteotomy on the alveolar bone/maxillary wall is ideally matched (sealed) with a flat implant profile. The flat profile implant is sunken from the buccal side to avoid soft tissue compression. The depth of such indentation is determined by the preservation of as much alveolar bone as possible at the zygomatic implant head/neck level. As a consequence, the membrane integrity is not compromised, and bone-to-implant contact is also maximized at the alveolar level. The objective of this technical note is to introduce the ZAGA Scarf Graft as a part of the ZAGA protocol intended to prevent soft tissue dehiscence around extramaxillary zygomatic implants.

**DESCRIPTION OF THE TECHNIQUE**

The Scarf Graft is a scarf around the neck of the implant head made of pediculated connective tissue. The goal of the procedure is to protect gingival tissue from implant compression by increasing the amount of connective tissue buccal to the implant neck.

The technique is based on the dissection of a palatal pediculated connective tissue graft that will be secured around the implant head with the help of a round osteotomy on the remaining bone crest.

With the assumption that gingival capillary compression, caused by an extramaxillary implant, will lead to a compromise on the soft tissue vascularization and subsequent dehiscence, the procedure is indicated...
to prevent soft tissue recession as a consequence of zygomatic implants that are placed too buccally. Soft tissue complications should be expected in relation to extreme maxillary atrophy as it has been described in ZAGA type 4 anatomies. Tobacco is considered as a relative contraindication for the procedure.

A case report involving two extramaxillary zygomatic implants placed in a patient presenting ZAGA type 4 anatomy is used to illustrate the technique (Figs 1 to 8). To prevent future soft tissue complications, the palatal flap is splinted into two parts to obtain a pediculated connective tissue graft long enough to cover the zygomatic implant neck (Fig 2). For a predictable result of the procedure, it is strongly recommended for the graft to be firmly secured in the required position. To achieve that, the mesial remains of the alveolar bone crest closer to the implant head are buccolingually perforated (Fig 3). Figure 4 illustrates the suturing procedure. The suture runs from the epithelial side of the palatal flap through the bone tunnel, then in the graft, returns through the opposite side of the graft, then the tunnel, and traverses the connective side of the palatal flap, stabilizing the graft in the required position around the zygomatic implant.
Once there, the needle catches the graft from inside to outside, then outside to inside, and returns to the palate again through the bone perforation. Finally, it runs again through the palatal flap in a connective to epithelium direction. With a double knot, the flap and the connective tissue graft are secured in a scarf-like position around the head of the zygomatic implant (Fig 5). A similar procedure was performed to prevent an eventual soft tissue dehiscence of the mesial zygomatic implant. Figures 6 and 7 illustrate the possibility of using the neighboring connective tissue located on the first quadrant to also extend the procedure to the mesial implant. The new pediculated graft is secured around the mesial implant using the same alveolar bone osteotomy. After the surgery, an immediate, implant-supported, provisional prosthesis was placed. Three months after the surgery, the prosthesis was unscrewed to assess the healed soft tissues; a large quantity of keratinized tissue buccal to the zygomatic implants could already be observed (Fig 8).

**DISCUSSION**

In a systematic review\(^1\) to determine the importance of keratinized tissue around osseointegrated oral implants, 11 cross-sectional or prospective studies were selected reporting data for periods of more than 6 months of follow-up. Available data thus far suggest that a lack of adequate keratinized mucosa around endosseous dental implants is associated with more plaque accumulation, tissue inflammation, attachment loss, and mucosal recession.

A clinical study conducted by Schrott et al\(^1\) found that in patients exercising good oral hygiene and receiving regular implant maintenance therapy, implants with a reduced 2-mm width peri-implant keratinized mucosa were more prone to lingual plaque accumulation and bleeding as well as buccal soft tissue recession over a period of 5 years.

Vervaek et al\(^1\) tried to elucidate the influence of initial soft tissue thickness on peri-implant bone
remodeling. The research hypothesis was that implants placed in patients or at sites with thin mucosal tissues would show increased peri-implant bone loss. Their study suggests that implants with lower abutments, reflecting the initial gingival thickness, lose more peri-implant bone, possibly by a reestablishment of the biologic width.

Puisys and Linkevicius\(^20\) evaluated, in a prospective controlled clinical trial, how bone-level implants maintain crestal bone stability after thickening of thin mucosal tissues with allogeneic membrane. Their results suggest that significantly less bone loss can occur around bone-level implants placed in naturally thick mucosal tissues, in comparison with the thin biotype. Augmentation of thin soft tissues with allogeneic membrane during implant placement could be a way to reduce crestal bone loss.

Lekholm et al\(^21\) reported findings from a retrospective study involving 27 subjects with 38 test regular machined implants (with exposed threads at surgery) and 30 control machined implants (fully submerged with no threads exposed). The results from the clinical and radiographic examinations demonstrated that marginal defects and fenestrations present at the time of implant insertion did not lead to progressive bone loss during the first 5 years of function. Carmagnola et al\(^22\) examined bone tissue alterations that occurred around implants in which the marginal level of bone support at implant placement was different at the buccal and lingual surfaces. The findings from the histomorphometric measurements demonstrated that the number of bone multicellular units per mm\(^2\) (n.BMU/mm\(^2\)) was approximately 10 times larger in the bone tissue at the test than at the control sites. Since BMUs are considered as indicators of bone activity, they demonstrate that even after 7 months of healing, the process of remodeling was much more active in the test than in the control regions.

The analysis of the soft tissues at the test and control implants revealed that bone tissue remodeling in the test group was accompanied by a certain recession of the margin of the peri-implant mucosa.

One specific concern with the use of zygomatic implants following the extrammary technique may be the long-term effect of the exposed implant surface toward the soft tissue at the lateral aspect of the zygomatic implants. Soft tissue dehiscence leads to both partial exposure of the implant and uncovering of the thin bone layer between the neck of the implant and the sinus cavity. The exposed bone remodels more actively over time, although it is usually a painless situation. If the condition persists, and is maintained in this critical area of minimum bone thickness, a sinus communication may appear. Due to the retention of bacterial film, which is increased in implants characterized with threads and/or rough surfaces, chronic soft tissue inflammation might be further added to this situation; bone remodeling and appearance of subsequent complications can be accelerated.

An uncertainty raised by Aparicio et al\(^10\) is the long-term effect the extrasinus implant contacting/compressing the mucosae may have on gingival stability. Another aspect introduced by Aparicio's group\(^23,24\) is the long-term maintenance of the gingival health, in the presence of partial exposure of the zygomatic implant surface. The extrammary location of the zygomatic implant involves direct contact of the surface of the implant body with the mucoperiosteal flap. Compression of the soft tissue by the zygomatic implant body would be in accord with how much residual tension of the soft tissue is created after postsurgery healing, and how significantly the implant is protruding to the buccal side. The pressure of the soft tissue by the zygomatic implant body may compromise the soft tissue vascularization, which entails the risk of mucosa fenestration and the exposure of the implant head/body.

In this regard, Migliorança et al\(^12\) presented the short-term clinical results of a retrospective follow-up of at least 12 months of 150 extrasinus zygomatic implants in which they denote the event of vestibular dehiscence at the level of the cervical portion with thread exposure, without signs of inflammation at that level, in two implants considered as survivors.

Based on these data, it can be considered that the exposure of the implant body is not associated per se with zygomatic implant failure. However, it is clear that soft tissue dehiscence exposing the implant body does make it difficult to clean that area and may lead to additional complications, such as sinus communications, esthetic complaints, mucositis, or cellulitis, which can even reach the orbit.

CONCLUSIONS

In the authors’ experience, the treatment of soft tissue dehiscence around zygomatic implants is difficult and does not have standardized predictable results. Protocols for its prevention, such as the proposed ZAGA Scarf Graft, should be incorporated if an eventual dehiscence is foreseen.

ACKNOWLEDGMENTS

The authors reported no conflicts of interest related to this study.
REFERENCES


