Int. J. Oral Maxillofac. Surg. 2021; xx: 1–5
https://doi.org/10.1016/j.ijom.2022.10.011, available online at https://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Technical Note
Pre-implant Surgery

‘Pillow technique’ to improve lip support in the context of zygoma implant rehabilitation

F. Hernández-Alfaro[a,b], G.-M.-M. Ragucci[b], M. Giralt-Hernando[b], J. Caramês[c], A. Valls-Ontañón[a,b]

[a]Maxillofacial Institute, Teknon Medical Center, Barcelona, Spain; [b]Department of Oral and Maxillofacial Surgery, Universitat Internacional de Catalunya (UIC), Barcelona, Spain; [c]Faculdade de Medicina Dentária, Universidade de Lisboa, Lisbon, Portugal

F. Hernández-Alfaro, G.-M.-M. Ragucci, M. Giralt-Hernando, J. Caramês, A. Valls-Ontañón: ‘Pillow technique’ to improve lip support in the context of zygoma implant rehabilitation. Int. J. Oral Maxillofac. Surg. 2021; xx: 1–5.

Abstract. This study proposes a simple, off-the-shelf ancillary method for application in the dental rehabilitation of severe maxillary atrophy with zygoma implants, allowing simultaneous improvement of lip support in cases with a moderate lack of premaxillary projection. Three consecutive patients with an atrophic maxilla were evaluated retrospectively. All were treated with a fixed rehabilitation over four zygomatic implants and the pillow technique. The study variables included radiological assessment of the premaxilla volume, upper lip and perinasal soft tissue changes, clinical complications, and subjective evaluation of functional and aesthetic patient satisfaction based on a visual analogue scale. All of the zygomatic implants showed osseointegration. The survival rate was 100%. The immediate postoperative course was uneventful, and no surgical complications were noted at the follow-up visits. Radiological assessment of the premaxilla volume enhancement showed a final mean skeletal projection improvement of +9.4 mm, while the nasolabial angle decreased an average of + 0.6 mm. On the other hand, only small changes in nasal width were detected. Patient satisfaction with the functional and aesthetic outcomes at the 1-year follow-up was excellent. The pillow graft is an easy-to-handle technique that can be included in the armamentarium for moderately incrementing the maxillary sagittal dimension and enhancing lip support in the context of zygoma implant rehabilitation.

Keywords: Bone grafting; Dental implants; Edentulous jaw; Immediate dental implant loading; Oral surgery; Zygoma.

Accepted for publication 14 October 2022
Available online xxxx

Rehabilitation of the severely atrophic maxilla remains a challenge due to alveolar bone atrophy and pneumatization of the maxillary sinus, which preclude oral rehabilitation using conventional implants.[1] Moreover, in advanced maxillary bone atrophy, resorption of the maxilla simulates the clinical situation of a Class III skeletal relationship, matched by the three-dimensional (3D) resorption patterns to which the maxilla is subjected, with resorption in a superomedial direction. This results in inadequate soft tissue support and, consequently, an aged appearance and worsened overall facial aesthetics. In addition to bone loss, the upper lip becomes thin and elongated,

due to the atrophy of muscles, fat, and connective tissue.[2] Therefore, in these cases, apart from dental rehabilitation, the patient also seeks the restoration of facial aesthetics.

Several solutions have been proposed in the literature to date, both prosthetic and surgical. Regarding the prosthetic strategies, conventional full dentures and overdentures with a labial flange can restore the correct aesthetic position of the upper lip by enlarging the prosthesis in the vestibule and pushing the lip outward. However, they alter functional muscle traction and subsequent tissue movement, with the development of an unsightly subnasal convexity. In addition, a large labial flange complicates the maintenance of oral hygiene by the patient.[3]

On the other hand, a number of surgical strategies have been proposed to three-dimensionally rehabilitate the highly atrophic maxilla, such as the use of composite grafts, employing both particulate and bone block grafts of different origins for inlay and onlay grafting,[4] Le Fort I osteotomy with downward and forward repositioning of the maxilla,[5] and distraction osteogenesis.[6] However, all of these complex procedures are associated with surgical morbidity and an increased total rehabilitation treatment period. Moreover, taking into account that these patients are generally elderly people with reduced soft and hard tissue regenerative capacity,[7] alternative and less invasive procedures have been proposed. Since the introduction of zygomatic implants (ZIs) by Brånemark et al.,[8] numerous reports have supported them as a fast, safe, and valid option for restoring the severely atrophic maxilla, providing the patient with an immediate functional fixed prosthesis and eliminating the need for bone grafting.[9]

Nonetheless, ZIs by themselves do not improve the sagittal projection of the upper lip and the overall facial aesthetic profile of these patients. Therefore, overdentures with a labial flange are required, with the associated functional and hygiene problems mentioned above. In order to concomitantly address the maxillary projection, the current authors' team proposed the use of Le Fort I maxillary repositioning with simultaneous ZI placement in 2019.[5] However, this technique is quite invasive and, according to the protocol, is indicated only when a maxillomandibular sagittal discrepancy of > 10 mm is present.

This study proposes a simple, effective, off-the-shelf ancillary method for application in the context of dental rehabilitation with ZIs, allowing simultaneous lip support in cases with a moderate maxillomandibular discrepancy (< 10 mm).

Technique

Patient selection

The technique was applied in three patients who fulfilled the following inclusion criteria: patient with a fully edentulous upper maxilla that cannot be treated with conventional implants, and where bone grafting, Le Fort I osteotomy, and distraction osteogenesis procedures are ruled out (Fig. 1, Supplementary Material Table S1). All participants signed an informed consent agreement prior to surgery, as well as a form giving permission for photographs to be published.

Treatment planning

The preoperative diagnosis and planning included a physical intraoral and facial examination with photographic records, as well as diagnostic cone beam computed tomography (CBCT) (i-CAT system; Imaging Sciences International, Hatfield, PA, USA).

In the first stage, a new full acrylic removable denture was made following the correct occlusal and aesthetic parameters: correct occlusal plane, as well as adequate position of the superior central incisal edge in rest and smile positions. A duplicate was made and used as a radiological stent, simulating the ideal position of the teeth, and then a new CBCT scan was performed. Implant planning was conducted using LimaGuide software (LimaGuide, Barcelona, Spain) according to the ideal implant position regarding final tooth position, ensuring proper emergence of the implant platform, fully surrounded by alveolar bone whenever possible, and maximum malar bone anchorage. An acrylic surgical stent was then generated with a 3D printer (Tiertime UP Box3D; Beijing Tiertime Technology Co., Ltd, Beijing, China) with a polymer filament (Innofil3D polymer; Beijing Tiertime Technology Co., Ltd), and this was then sterilized at 121 °C for 15 min (Lina Autoclave Class B; W&H, Bürmoos, Austria).

Surgical procedure

All surgical procedures were performed under general anaesthesia by a single experienced surgeon (F.H.A.). A crestal incision from tooth 16 to tooth 26 with two posterior vertical releasing incisions were made to reflect the buccal and palatal flaps for sub-periosteal dissection and localization of both the infraorbital nerve foramina and the zygomatic buttresses. The drilling was guided through the surgical stent and was followed by ZI placement (Neodent Zygoma External Hex implants; Institut Straumann AG, Basel, Switzerland). Then, a pedicled buccal fat pad flap was herniated through the vertical releasing incision until it covered the mesial implant, and was sutured with simple resorbable stitches (Vicryl 4–0; Ethicon, Somerville, NJ, USA) at the palatal mucosa.

The pillow graft was made using a 2-mm thick square of acellular porcine dermal matrix (APDM) (OsteoBiol Derma standard 30 × 30 × 2; Tecnoss Dental, Giaveno, Italy) folded onto itself and sutured with resorbable stitches at two of its three open borders (Vicryl 5–0, Ethicon). It was then filled with 2 g of composite bovine-derived xenograft Bio-Oss (Geistlich Pharma AG, Wolhusen, Switzerland), and the third open border was then also sutured. The pillow graft had a sagittal thickness of between 5 mm and 10 mm, depending on the degree of atrophy, based on the preoperative planning and intraoperative upper lip response to the added volume. The pillow graft was positioned on top of the premaxilla in between the two anterior ZIs, and was secured superiorly to the perinasal muscles and inferiorly to the palatal flap using resorbable stitches (Vicryl 5–0, Ethicon) (Fig. 2). This position provided anterior upper lip projection while the lateral aspects of the graft were placed in the maxillary anterior curvature, thus affording a harmonic lip shape.

Finally, periosteal releasing incisions were made at the buccal flap to allow tension-free closure of the flap while covering the pillow graft. The flap was then sutured (Vicryl 4–0, Ethicon), leaving the four zygoma multiunit abutments exposed (Fig. 2).

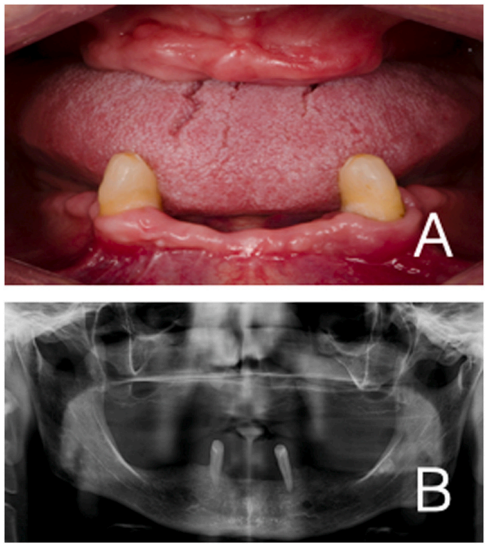

Fig. 1. Preoperative clinical (A) and radiographic (B) images of a typical case satisfying the inclusion criteria: fully edentulous upper maxilla that cannot be treated with conventional implants, and where bone grafting, Le Fort I osteotomy, and distraction osteogenesis procedures are ruled out.

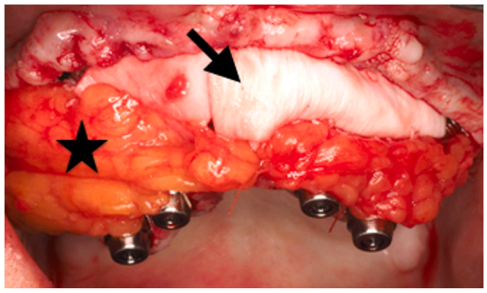

Fig. 2. Intraoperative images showing pillow graft placement (arrow) and covering of the buccal zygomatic implant surface with the pedicled buccal fat pad (star).

Prosthetic loading

Impressions of both dental arches and a bite registration were obtained immediately after surgery, and a provisional metal–resin prosthesis was placed 24 h after the operation. After 3 months of healing, the prosthetic stage was started, and fixed full-arch ceramic–metal prostheses on multi-unit abutments were placed (Supplementary Material Table S2). All prostheses were designed without flanges (no lip support), thus indicating that the sagittal enlargement of the lip was due to the pillow graft technique performed during surgery (Fig. 3).

Preliminary outcome evaluation

Pillow graft and ZI surgical success was evaluated objectively in terms of the clinical and radiological outcomes.

The clinical outcomes were determined by recording complications such as infraorbital nerve (V2) injury, infection, peri-implantitis, flap dehiscence, and sinusitis. The postoperative course proved uneventful in all cases.

Upper lip and perinasal aesthetics and projection, pillow graft stability, and ZI osseointegration were evaluated in the radiological assessment performed at the 1-year follow-up. The measurement assessment was performed by means of surface matching between pre- and postoperative image datasets regarding the premaxilla skeletal changes, soft tissue labial support, and nasal width (Fig. 4). The following were determined: (1) the projected distance from A-point to nasion perpendicular (A–Nper) and sella–nasion–A-point cephalometric angle (SNA) in the skeletal sagittal plane; (2) the pillow graft dimension in the sagittal plane, i.e. the projected distance from the most anterior pillow graft (APG) point to nasion perpendicular (APG–Nper) to the same projected preoperative maxillary point when tracing a true horizontal line (preAPG); (3) the projected distance from the most anterior point of the upper lip (UL) to nasion perpendicular (UL–Nper) in the sagittal plane; (4) the nasolabial angle (NLA), i.e. nasal tip–columella–UL; and (5) the nasal width, i.e. the distance between the two distal points of the nasal alae (NA_R–NA_L).

With regard to the evaluation of premaxilla volume enhancement, the final skeletal projection at A-point improved notably (mean [(APG–Nper) − [preAPG–Nper] change: +9.4 mm), as did the UL projection (mean UL–Nper change: +6.4 mm), while the nasolabial angle decreased (mean NLA change: −7.6°). Moreover, only small changes in nasal width were detected (mean NA_R–NA_L change: +0.6 mm) (Fig. 5, Supplementary Material Table S3).

Furthermore, subjective assessment of patient satisfaction with the functional and aesthetic outcomes and satisfaction of the treating team was also conducted. For this purpose, a visual analogue scale (VAS) ranging from 0 (not satisfied at all) to 10 (greatest possible satisfaction) was used. Accordingly, the patient satisfaction score at the 1-year follow-up proved excellent for both function and aesthetics (range 9–10); in addition the treating team satisfaction score was also excellent (10 points on the VAS) (Supplementary Material Table S2).

Discussion

The ZI approach is not without its shortcomings because of the severe 3D lack of maxillary bone. To resolve these 3D maxillary deficiencies, the present authors' team proposed the use of Le Fort I maxillary repositioning with simultaneous ZI placement in 2019.[5] However, this technique is quite invasive and is mostly indicated in cases with more than 10 mm of maxilla–mandible sagittal discrepancy. For less severe cases, the authors have found the simple, effective, and off-the-shelf onlay graft technique reported here to improve maxillary sagittal projection and afford a youthful appearance, while avoiding the functional and hygiene problems associated with a

Fig. 3. Facial pictures before surgery (A) and at the 1-year follow-up (B) of a patient treated with zygoma implants and the 'pillow technique'. Enhancement of the premaxilla volume can be appreciated, with better upper lip projection and decreased nasolabial angle.

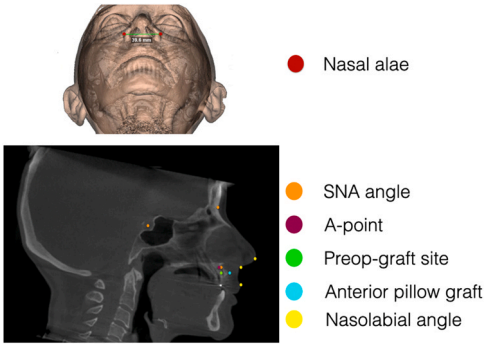

Fig. 4. Landmarks identified during the radiological evaluation for the assessment of upper lip and perinasal aesthetics and projection, as well as pillow graft stability.

large prosthetic labial flange. The literature has described other techniques for increasing the maxillary sagittal dimension, such as the use of onlay grafts of several origins, particulate bone, or a pedicled buccal fat pad.[10] However, the pillow technique has shown predictable and stable results over time, since no material rejection or resorption has been reported (mean APG enlargement of +9.4 mm). Moreover, apart from improving the skeletal projection of the premaxilla, it consequently provided better UL projection (mean UL–Nper upturn of +6.4 mm) and a decreased nasolabial angle (mean NLA reduction of −7.6°) (Fig. 5, Supplementary Material Table S3), which implies aesthetic enhancement of the nasolabial area.

A xenograft was chosen for the pillow graft, since it is a slowly reabsorbing biomaterial that maintains its volume over time. The use of autologous bone would have meant greater invasiveness in the operation and implies a high rate of resorption, as is also the case for allograft.[4,11] Another alternative proposed in the literature to increase the sagittal length of the upper lip is the use of a bilateral pedicled buccal fat pad flap to fill the premaxilla, paranasal, and upper lip areas.[10]

Although the novel technique presented here resolves the sagittal dimension atrophy problem, the remaining vertical and transverse dimension-related problems may persist. Regarding the vertical plane, a reduced vertical dimension also leads to an aged appearance. This can be prosthetically restored easily with a longer pink gingiva; the application of gingiva-coloured pink porcelain onto the cervical area of the implant fixed dental prosthesis can aid in re-establishing natural crown ratios and harmonious mucogingival contours, while eliminating the need for technique-sensitive surgical procedures with high relapse rates, in situations of complex atrophy.[12]

On the other hand, the lack of alveolar ridge bone in the transverse plane makes it difficult to achieve proper emergence of the implant platform. As widely reported, the palatal emergence of ZIs requires a palatal extension of the prosthesis, and this makes it difficult to clean under the bridge and decreases the space available for the tongue, producing speech problems.[3,13] Therefore, the conventional technique has been modified, and currently ZI placement is based on a prosthetically guided position, which allows for a more vestibular position of the implants in order to place them as centred as possible in the residual crest of the alveolar ridge, and usually following an extra-maxillary and extra-sinus path.[14] However, severe transverse atrophy makes it difficult to place the implants completely surrounded by bone. This is where virtual surgical planning and the use of surgical guides play an important role. Even so, when the ZI vestibular surface remains uncovered, several techniques have been described in order to prevent gingival recession and peri-implantitis, such as covering the implants with Bichat's fat pad,[15] or with a pediculated connective tissue graft or so-called 'scarf graft'.[16]

Although further research is needed to corroborate the results of this preliminary study, the findings presented suggest that the pillow technique can be included in the routine armamentarium for increasing the maxillary sagittal dimension and consequently improving lip support when treating severe maxillary atrophy.

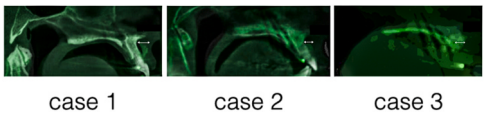

Fig. 5. Pre- and postoperative CBCT superimposition to evaluate premaxilla enhancement.

Ethical approval

Ethical approval was obtained from the Ethics Committee of Teknon Medical Center (Barcelona, Spain).

Funding

None.

Competing interests

None.

Patient consent

Patient written consent was obtained to access the photographic and CBCT database.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ijom.2022.10.011.

References

1. Cawood JI, Howell RA. A classification of the edentulous jaws. *Int J Oral Maxillofac Surg* 1988;**17**:232–6.
2. Perkins SW, Sandel HD. Anatomic considerations, analysis, and the aging process of the perioral region. *Facial Plast Surg Clin N Am* 2007;**15**:403–7.
3. Ushijima M, Kamashita Y, Nishi Y, Nagaoka E. Changes in lip forms on three-dimensional images with alteration of lip support and/or occlusal vertical dimension in complete denture wearers. *J Prosthodont Res* 2013;**57**:113–21.
4. Hernández-Alfaro F, Sancho-Puchades M, Guijarro-Martínez R. Total reconstruction of the atrophic maxilla with intraoral bone grafts and biomaterials: a prospective clinical study with cone beam computed tomography validation. *Int J Oral Maxillofac Implants* 2013;**28**:241–51.
5. Hernández-Alfaro F, Ragucci GMM, Méndez-Manjón I, Giralt-Hernando M, Guijarro-Martínez R, Sicilia-Blanco P, Ventura-Martínez N, Valls-Ontañón A. Rehabilitation of the severely atrophic maxilla using Le Fort I maxillary advancement and simultaneous zygoma implant placement: proof of concept. *Int J Oral Implantol* 2019;**12**:359–72.
6. Nogueira RLM, Osterne RLV, Abreu RT, Araújo PM. Alternative distraction osteogenesis technique after implant placement for alveolar ridge augmentation of the maxilla. *J Oral Maxillofac Surg* 2017;**75**:1402.e1–8.
7. Locatello LG, Comini LV, Bettiol A, Vannacci A, Spinelli G, Mannelli G. A model to predict postoperative complications for otorhinolaryngology and maxillofacial surgery procedures in elderly patients. *Eur Arch Otorhinolaryngol* 2020;**277**:3459–67.
8. Brånemark PI, Gröndahl K, Ohrnell LO, Nilsson P, Petruson B, Svensson B, Engstrand P, Nannmark U. Zygoma fixture in the management of advanced atrophy of the maxilla: technique and long-term results. *Scand J Plast Reconstr Surg Hand Surg* 2004;**38**:70–85.
9. Davó R, Felice P, Pistilli R, Barausse C, Marti-Pages C, Ferrer-Fuertes A, Ippolito DR, Esposito M. Immediately loaded zygomatic implants vs conventional dental implants in augmented atrophic maxillae: 1-year post-loading results from a multicentre randomised controlled trial. *Eur J Oral Implantol* 2018;**11**:145–61.
10. Rubio-Bueno P, Ardanza B, Piñas L, Murillo N. Pedicled buccal fat pad flap for upper lip augmentation in orthognathic surgery patients. *J Oral Maxillofac Surg* 2013;**71**:e178–84.
11. Sbordone L, Toti P, Menchini-Fabris GB, Sbordone C, Piombino P, Guidetti F. Volume changes of autogenous bone grafts after alveolar ridge augmentation of atrophic maxillae and mandibles. *Int J Oral Maxillofac Surg* 2009;**38**:1059–65.
12. Coachman C, Salama M, Garber D, Calamita M, Salama H, Cabral G. Prosthetic gingival reconstruction in a fixed partial restoration. Part 1: introduction to artificial gingiva as an alternative therapy. *Int J Periodontics Restor Dent* 2009;**29**:471–7.
13. Bothur S, Garsten M. Initial speech problems in patients treated with multiple zygomatic implants. *Int J Oral Maxillofac Implants* 2010;**25**:379–84.
14. Migliorança RM, Coppedê A, Dias Rezende RC, de Mayo T. Restoration of the edentulous maxilla using extrasinus zygomatic implants combined with anterior conventional implants: a retrospective study. *Int J Oral Maxillofac Implants* 2011;**26**:665–72.
15. Guennal P, Guiol J. Use of buccal fat pads to prevent vestibular gingival recession of zygomatic implants. *J Stomatol Oral Maxillofac Surg* 2018;**119**:161–3.
16. Aparicio C, Antonio S. Zygoma anatomy-guided approach "scarf graft" for prevention of soft tissue dehiscence around zygomatic implants: technical note. *Int J Oral Maxillofac Implants* 2020;**35**:e21–6.

Correspondence to: Maxillofacial Institute
Teknon Medical Center
Carrer de Vilana
12
Box 185
08022 Barcelona
Spain.
E-mail: avalls@institutomaxilofacial.com