Extramaxillary Zygomatic Implant Coverage with a Pedicled Buccal Fat Pad Flap Through a Tunnel Approach: A Prospective Case Series

Federico Hernández-Alfaro, MD, DDS, PhD, FEBOMS[1,2]/Gian Maria Ragucci, DDS, MSc[1]/
Adaia Valls-Ontañón, DDS, PhD, FEBOMS[1,2]/Ali Adnan Hamawandi, DDS, MSc[1]/Jorge Bertos-Quílez, DDS, MSc, PhD[1]

Purpose: To describe the benefits of covering the extrasinusal length of extramaxillary zygomatic implants with a pedicled buccal fat pad flap through a tunnel approach. ***Materials and Methods:*** Four extramaxillary zygomatic implants were placed in 10 patients and loaded immediately with an acrylic provisional fixed prosthesis. The extrasinusal length of every implant was covered with a pedicled buccal fat pad flap. Study variables were implant survival rate, peri-implant soft tissue recession (PISTR), peri-implant soft tissue condition (PISTC), modified Bleeding Index (mBI), and suppuration. The statistical analysis comprised the Brunner-Langer model of longitudinal data for each variable and the analysis of variance to assess main effects and interactions. ***Results:*** All the zygomatic implants showed osseointegration, resulting in a survival rate of 100%. The PISTR was evaluated after surgery (T0) and after 12 months (T1), statistically significant differences being observed ($P = .014$). Recession also depended on specific implant positioning; zygomatic implants in the anterior were found to have a higher risk of recession vs implants in the posterior ($P = .065$). The PISTC was assessed at T0 and T1, and no statistically significant changes were observed ($P = .718$). Bleeding on probing was present in 10% of the implants at T0 and in 15% at T1, the difference being nonsignificant ($P = .317$). ***Conclusion:*** The use of a pedicled buccal fat pad flap to cover the extrasinusal length of extramaxillary zygomatic implants appears to reduce the risk of soft tissue recession and exposure of the implant surface to the oral cavity. *Int J Oral Maxillofac Implants 2022;37:400–406. doi: 10.11607/jomi.9332*

Keywords: buccal fat pad, oral and maxillofacial, zygomatic implant

Progressive bone loss caused by dental extraction and maxillary sinus pneumatization can lead to advanced degrees of maxillary alveolar bone atrophy, such as types V and VI of Cawood and Howell.[1] Our main efforts tend toward bone reconstruction. However, such surgical procedures are expensive, require long healing periods, and are not without complications.[2–4] As reported in a recent study by Davó et al comparing clinical outcomes of immediately loaded zygomatic implants versus conventional implants placed in augmented bone, zygomatic implants were seen to be associated with significantly lower implant and prosthetic failures, and to less required time to functional loading. The authors concluded that even if more complications were recorded for zygomatic implants, these proved to be a better rehabilitation option for severely atrophic maxillae.[5]

[1]Department of Oral and Maxillofacial Surgery, Universitat Internacional de Catalunya, Barcelona, Spain.
[2]Institute of Maxillofacial Surgery, Teknon Medical Center, Barcelona, Spain.

Correspondence to: Dr Gian Maria Ragucci, Department of Oral and Maxillofacial Surgery, Universitat Internacional de Catalunya, Josep Trueta, s/n, 08195 Sant Cugat del Vallès. Email: gian1@uic.es

Submitted March 2, 2021; accepted September 15, 2021.

Zygomatic implants have been shown to be a valid therapeutic alternative in cases of extreme atrophy of the maxilla, exhibiting high survival rates of up to 96.7% after 12 years.[6] Since their introduction by Brånemark et al in 1998, the surgical technique has undergone important modifications seeking to avoid or reduce the number of complications related to maxillary sinus disease and implant 3D positioning, as the palatal emergence of the zygomatic implants renders prosthetic rehabilitation uncomfortable.[7–10] In the year 2000, Stella and Warner described the sinus slot technique, in which a window affords access to the maxillary sinus, with detachment of the sinus membrane and the placement of zygomatic implants without damaging the membrane, resulting in fewer postoperative complications and an implant platform closer to the residual alveolar crest.[11,12] In 2006, Migliorança et al described the "sinus exteriorization of the zygoma fixtures."[13] Maló et al in 2008 described the extramaxillary technique, in which the implant does not cross the maxillary sinus at any point, reaching the bone crest resting on the lateral wall of the sinus and thus securing a 3D position of the implant, with a lesser risk of complications related to the maxillary sinus.[14] However, despite its advantages, this new path increases the risk of buccal exposure of the threads of the implants due to gingival recession, facilitating the accumulation of plaque and the presence

of mucositis, and finally yielding an unsatisfactory outcome from the esthetic perspective.[14] In this context, de Moraes in 2012 proposed covering the extrasinusal length of extramaxillary zygomatic implants with the buccal fat pad to prevent and treat complications.[15] In 2018, Guennal and Guiol published more results about this procedure to treat soft tissue recessions in extramaxillary zygomatic implants, showing no postoperative soft tissue recession.[16]

Under appropriate conditions, the buccal fat pad also contains a population of stem cells with a phenotype similar to that of adipose-derived stem cells (AdSCs) from abdominal subcutaneous adipose tissue, which are likewise able to differentiate into the chondrogenic, adipogenic, or osteogenic lineage.[16,17] These observations define fat pad as a new, rich, and accessible source of AdSCs for tissue engineering purposes. In this context, Khojasteh and Sadeghi recently used buccal fat pad adipose stem cells (BFPSCs) in conjunction with iliac bone block graft and evidenced an increase in new bone formation and a decrease in secondary bone resorption in extensive atrophic jaws.[18]

The present study was conducted to describe the benefits of covering the extrasinusal length of extramaxillary zygomatic implants with a pedicled buccal fat pad flap through a tunnel approach.

MATERIALS AND METHODS

Study Design

Ten consecutive patients with a fully edentulous Cawood and Howell type VI atrophic[1] maxilla treated from January 2017 to January 2019 were included in the study. Four zygomatic implants were placed in each patient and loaded immediately using a provisional fixed full-arch acrylic prosthesis. Surgery was performed by the Department of Oral and Maxillofacial Surgery and the prosthesis by the Department of Prosthodontics (International University of Catalonia, Spain).

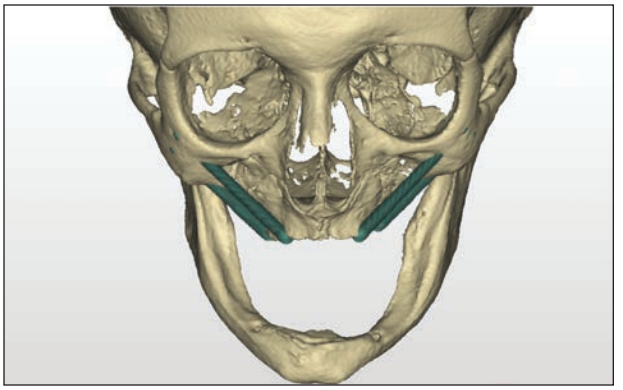
Patient Selection

The inclusion criteria were as follows: patients with a fully edentulous maxilla with Cawood and Howell type VI atrophy; a posterior maxilla that could not be treated without using bone grafting procedures, including sinus grafting or vertical bone regeneration; and an anterior maxilla with insufficient width to place implants at least 3.3 mm in diameter and/or insufficient height to allow the placement of implants longer than 8.5 mm. Good systemic health (ASA score I-II) was moreover required, along with patient commitment to attend all the study visits.

Patients were excluded if they presented a medical history contraindicating surgery; any disease, condition, or medication that might compromise soft and hard tissue healing (uncontrolled diabetes, liver functional disorders, immune system disease, immunosuppressant drugs, etc); or the presence of sufficient maxillary bone to allow rehabilitation with conventional implants (maxillary bone crest measuring a minimum of 10 mm in height and 5 mm in width from canine to canine) or to allow the placement of two zygoma implants and four conventional implants in the anterior region. Patients with active or chronic sinus disorders, toxic habits capable of compromising recovery and bone healing, or who had undergone chemotherapy or head and neck radiotherapy in the previous 5 years were also excluded.

Surgical Procedure

All surgical procedures were performed at the Hospital General de Catalunya, Sant Cugat, Spain, by a single experienced surgeon (F.H.A.). Before implant placement, the diagnostic protocol included a new complete denture in transparent self-curing resin (Paladur), with correct occlusion and vertical dimension in order to obtain a radiologic guide. A CBCT scan (iCAT, Imaging Sciences International) was taken, and implant planning was carried out using the Simplant Pro 18.0 software (Simplant, Dentsply Sirona) according to implant alveolar emergency and maximum malar anchorage (Fig 1). Implant surgery was performed under general anesthesia and local anesthesia (articaine 4% plus epinephrine 1:100,000, Normon). A mucoperiosteal flap was reflected from 1.6 to 2.6 with two vertical releasing incisions at that level. Reflection of the buccal flap was done until localization of the following anatomical structures: infraorbital nerve foramen and the maxillozygomatic buttress. Reflection of the palatal flap was done until the alveolar crest width could be properly appraised. Zygomatic implant placement was carried out freehand following some anatomical references and structures described by Rigolizzo et al[19] and Rossi et al[20] (Fig 2). A pedicled buccal fat pad flap was herniated through the small (< 1 cm) vertical releasing incision at the level of the maxillary first molar, and a full-thickness mucoperiosteal tunnel flap was made using a periosteal elevator, subsequently, with surgical scissors access through which the buccal fat pad was pedicled with gentle and gradual traction until covering both implants using a mosquito homeostatic forceps, followed by suturing with resorbable simple stitches (Vicryl 4.0, Ethicon) at the palatal mucosa (Fig 3). Abutment screws were placed on each implant, and the mucoperiosteal flaps were readapted and sutured back into position with resorbable sutures (Vicryl 4.0). Impressions of both dental arches and a bite registration were obtained immediately after surgery, and a provisional metal-resin prosthesis was placed 48 hours after surgery (Fig 4). Patients received antibiotic treatment



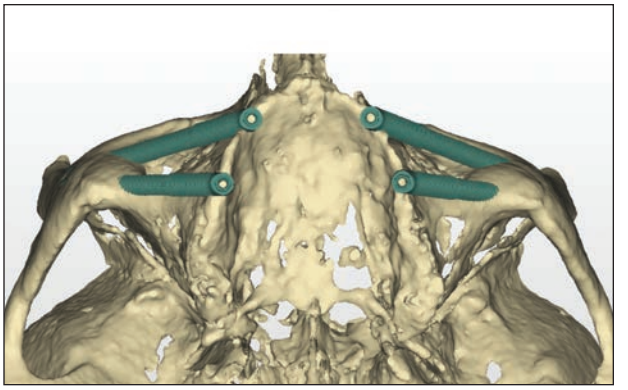


Fig 1 CBCT planning.

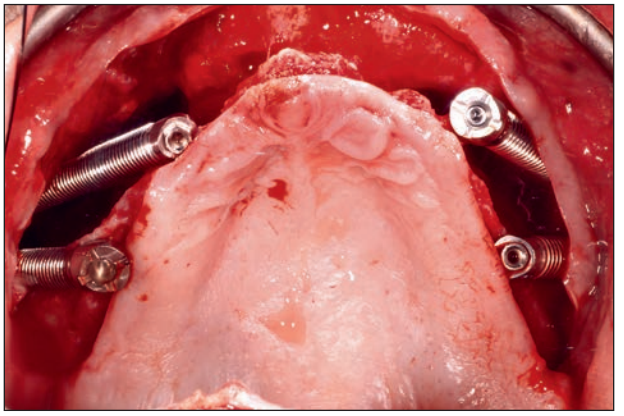
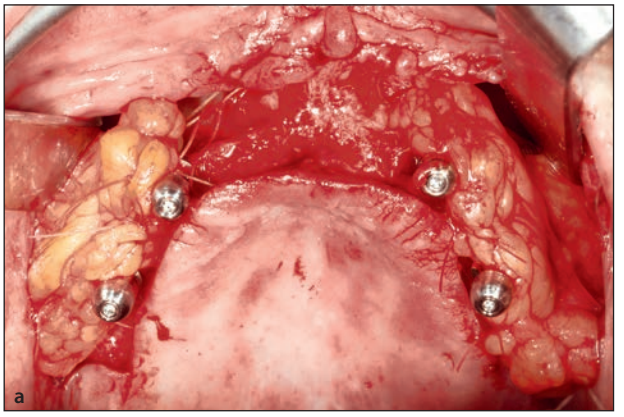
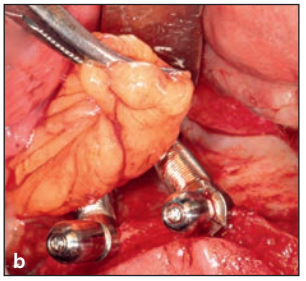
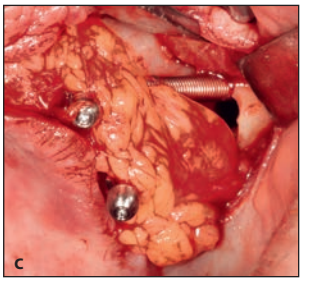


Fig 2 Extramaxillary zygomatic implants.







Figs 3a to 3c Pedicled buccal fat pad flap.

(875/125 mg amoxicillin/clavulanic acid every 8 hours for 7 days; in case of penicillin allergy, 300 mg clindamycin every 6 hours was prescribed for 7 days), anti-inflammatory and analgesic treatment (prednisone 40 mg once daily for 4 days; dexketoprofen 25 mg every 8 hours for 7 days; metamizole 575 mg every 8 hours for 7 days), and chlorhexidine rinses (Dentaid, Perio-Aid 0.20%) twice a day for 1 week. After 7 days, the patients were recalled for suture removal and then again after 1 month. After 3 months of healing, the prosthetic phase was started and fixed full-arch ceramometallic prostheses on multi-unit abutments were placed (Fig 5). Patients were assessed after 12 months to collect the study variables (Fig 6).

Study Variables and Measurements

The following study variables and measurements were recorded:

- *Implant survival rate* (implants remaining in situ without mobility).
- *Peri-implant soft tissue recession (PISTR).* The PISTR was evaluated by clinical examination and was scored on an ordinal scale: I = no recession; II = slight recession (implant head visible); III = recession with up to seven exposed threads.
- *Peri-implant soft tissue condition (PISTC).* The PISTC was evaluated by clinical examination and was scored on an ordinal scale: 0 = normal mucosa; 1 = minimal inflammation with color change and minor edema; 3 = moderate inflammation with redness, edema, and glazing; 4 = severe inflammation with redness, edema, ulceration, and spontaneous bleeding without probing.
- *Modified Bleeding Index (mBI).* The mBI was evaluated by inserting a periodontal probe (UNC 15, Hu-Friedy) 1 mm into the sulcus (circumferentially around the implant/abutment). Bleeding on probing was determined as the presence of bleeding 15 seconds after gentle probing, and was scored on an ordinal scale from 0 to 3 (0 = no visible bleeding; 1 = isolated bleeding

Fig 4 Provisional prosthesis.

Fig 5 Final prosthesis.

spot visible; 2 = blood forming a confluent red line on the margin; 3 = heavy or profuse bleeding).
- *Suppuration*. This parameter was evaluated by applying finger pressure to the peri-implant mucosa and was registered as either present or absent.

Clinical parameters and examinations were evaluated independently by two investigators (G.M.R. and A.A.) at both prosthesis delivery follow-up 3 months after surgery (T0) and at 1-year follow-up (T1).

Statistical Analysis

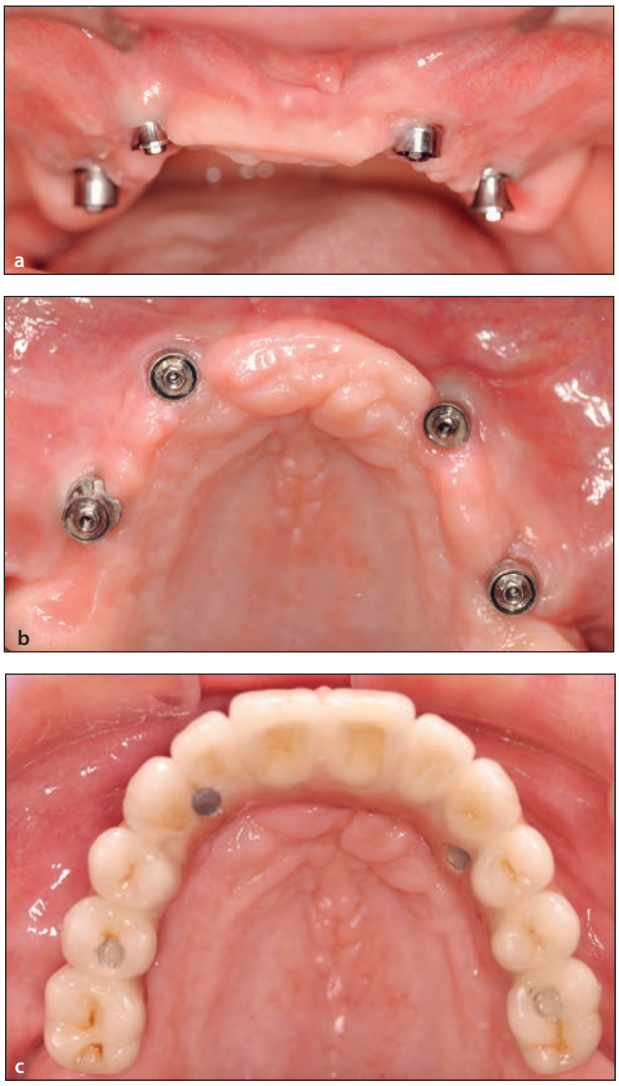
A descriptive analysis was made of the most relevant statistics: mean, standard deviation (SD), minimum, maximum, and median for quantitative variables; absolute and relative frequencies for categorical variables. The inferential analysis comprised estimation of a nonparametric Brunner-Langer model of longitudinal data for each variable. Analysis of variance (ANOVA) was calculated to assess main effects and interactions. The level of significance used in the analyses was 5% ($\alpha = .05$).

RESULTS

The demographic data and initial situation of the 10 clinical cases are summarized in Table 1. The study sample comprised 5 males and 5 females, with a mean age of 60.5 ± 4.2 years (range 54 to 66 years). All patients underwent zygoma quad rehabilitation based on the extramaxillary technique, and all implants were covered with a buccal fat pad through a tunnel approach. Immediate loading was performed in all cases using metal acrylic provisional prostheses. No surgical complications (infraorbital nerve damage; excessive bleeding; orbital, infratemporal fossa, or intracranial alterations) were noted, and the immediate postoperative course proved uneventful in all cases. Forty zygomatic implants were placed: 18 Neodent Zygoma CMTM and 22 Neodent Zygoma EHTM implants.

Outcome Measurements

All the zygomatic implants underwent osseointegration, resulting in a survival rate of 100%. The PISTR was



Figs 6a to 6c Twelve-month follow-up.

evaluated after surgery (T0) and after 12 months (T1) in all 40 implants, with statistically significant differences being recorded between T0 and T1 ($P = .014$). At T0, all implants presented some degree of gingival recession: 90% corresponding to grade I, 7.5% to grade II, and 2.5% to grade III. At the 1-year follow-up (T1), 80%, 17.5%, and 2.5% of the implants presented gingival recession corresponding to grades I, II, and III, respectively

Table 1 Characteristics of the Included Patients

Patient	Age (y)	Gender	Zi: length (mm)	Position	Loading	Implant survival (%)	Peri-implant recession		Peri-implant condition		mBi		Suppuration T0–T1
							T0	T1	T0	T1	T0	T1	
1	54	M	16: 45	P	Immediate	100	I	I	0	0	0	0	0
			13: 50	A			I	II	0	0	0	0	0
			26: 50	P			I	I	0	0	0	1	0
			23: 52.5	A			III	III	1	0	1	1	0
2	62	M	16: 50	P	Immediate	100	I	II	0	0	0	0	0
			13: 40	A			I	I	0	0	0	0	0
			26: 45	P			I	I	1	0	0	0	0
			23: 50	A			I	I	0	0	0	0	0
3	66	F	16: 45	P	Immediate	100	I	I	0	0	0	0	0
			13: 50	A			I	I	0	0	0	0	0
			26: 50	P			I	I	0	1	0	0	0
			23: 52.5	A			I	I	0	0	0	0	0
4	59	F	16: 50	P	Immediate	100	I	I	0	0	0	0	0
			13: 45	A			I	I	0	0	0	1	0
			26: 50	P			I	I	0	0	0	0	0
			23: 40	A			I	I	0	0	0	0	0
5	65	M	16: 50	P	Immediate	100	I	I	1	1	1	1	0
			13: 52.5	A			I	II	1	1	0	0	0
			26: 52.5	P			I	I	1	1	0	0	0
			23: 50	A			II	II	1	1	0	0	0
6	61	M	16: 45	P	Immediate	100	I	I	0	0	0	0	0
			13: 40	A			I	I	0	0	0	0	0
			26: 50	P			I	I	0	0	1	0	0
			23: 50	A			II	II	0	0	0	0	0
7	58	F	16. 40	P	Immediate	100	I	I	0	1	0	0	0
			13: 40	A			I	I	0	0	0	0	0
			26: 45	P			I	I	1	1	0	1	0
			23: 35	A			I	I	0	0	0	0	0
8	62	M	16: 40	P	Immediate	100	I	I	0	0	0	0	0
			13: 45	A			II	II	0	1	0	0	0
			26: 40	P			I	I	0	0	0	0	0
			23: 50	A			I	I	0	0	1	1	0
9	54	F	16. 45	P	Immediate	100	I	I	0	0	0	0	0
			13: 50	A			I	I	0	0	0	0	0
			26: 50	P			I	I	0	0	0	0	0
			23: 50	A			I	I	0	1	0	0	0
10	64	F	16. 50	P	Immediate	100	I	I	0	0	0	0	0
			13: 50	A			I	I	0	0	0	0	0
			26: 40	P			I	I	1	0	0	0	0
			23: 45	A			I	II	0	0	0	0	0

Zi = zygomatic implant site, FDI numbering system; P = posterior; A = anterior; M = male; F = female; mBi = modified Bleeding Index.

(Fig 7). The analysis also suggested that recession, as an average of T0 and T1, depended on specific implant positioning, as implants in the anterior position were more likely to suffer recession ($P = .065$). This difference remained constant over time ($P = .537$; Fig 8).

No statistically significant changes on PISTC throughout the follow-up were observed ($P = .718$). At T0, 80% of the implants had a score of 0 and 20% had a score of 1. At T1, 77.5% had a score of 0 and 22.5% a score of 1, without significant differences among the different implant positions ($P = .658$).

Bleeding on probing was found to be present in four implants (10%) at T0 and in six implants (15%) at T1. No significant differences between T0 and T1 were observed ($P = .317$), and there were no significant differences among the four positions involved ($P = .661$; Fig 9).

The presence of suppuration was only assessed at the 12-month follow-up; all implants showed healthy surrounding tissue without suppuration.

DISCUSSION

The rehabilitation of atrophic maxillae with zygomatic implants has proven to be a reliable option, with high survival rates of between 92.3% and 100%.[6] Thanks to the evolution of the surgical technique, the main complications related to zygomatic implants have been resolved.[6,21–24] Although the extramaxillary technique offers many advantages, it is not without complications, the most important being related to recession of the peri-implant soft tissues, resulting in the exposure

of implant threads in the oral cavity due to the extraosseous position of the medium and coronal part of the implant. In 2008, El Haddad et al proposed the use of a buccal fat pad for root coverage of severe gingival recession around teeth, securing a clinically significant quantity of keratinized tissue that covered root recession.[25]

Similarly, the buccal fat pad was proposed by de Moraes in 2012 to improve the quality of soft tissue surrounding zygomatic implants.[15] Guennal and Guiol in 2018 proposed a pedicled buccal fat pad to cover zygomatic implants, which resulted in no soft tissue recession. However, in their study, only five patients received zygoma quad rehabilitations, and only immediate postsurgical outcomes without follow-up were reported.[16] The present study proposes a buccal fat pad through a tunnel approach to cover the extrasinusal length of the extramaxillary zygomatic implants.

A minimally invasive procedure is defined as a surgical technique that limits the size of the incisions and so requires less healing time, associated pain, and risk of infection. In the present authors' surgical technique, using the same incision for implant placement, it is possible to herniate the buccal fat pad through the vertical release incision until it covers the mesial implant. There is no need for further incisions or a second surgical donor site. The buccal fat pad has several advantages compared with other local flaps: it is closer to the surgical site, has a blood supply being a pedunculated flap, and is pliable and adaptable to the implant's position.

Recently, Aparicio and Antonio proposed the "scarf graft" to gain width of keratinized mucosa around zygomatic implants through a pedicled connective tissue flap.[26] Likewise, Peñarrocha-Diago et al analyzed the use of connective tissue or free connective tissue grafts, and in both studies[26,27] soft tissue grafting procedures were seen to offer short-term promising results, with less bleeding on probing and marginal bone loss.[27] It would be interesting to analyze the postoperative morbidity between the use of a free connective tissue graft, which usually has a certain postoperative morbidity, and a pedicle graft of buccal fat pad.

In the present study, soft tissue recession affected 17.5% of the implants, with visibility of the implant neck; one implant showed exposure of four threads, which didn't imply oseointegration interferences. The remaining 80% of the implants showed no recession. The literature reports soft tissue recession rates up to the first thread in 60% of zygomatic implants and up to four to five threads in 18%, while 22% of implants exhibited no recession.[28] Implants in the anterior position in the present study showed a higher risk of recession, possibly due to the fact that in this position the buccal fat pad is less vascularized and has a greater risk of necrotizing, resulting in less efficient coverage of the exposed portion of the implants. The shape of the dental arches also may be relevant to the increased risk of recession of anterior implants, since in triangular arches the emergence of the anterior implant would be farther away than in square arches, requiring a greater elongation of the buccal fat pad and so increasing the risk of necrosis. Changes in the macro design at the neck level of zygomatic implants, making it narrower or with a flat surface, could help to reduce the risk of recession. Also, the use of guided surgery to achieve an ideal 3D implant position could help to reduce this risk. However, as reported by Migliorança et al in a retrospective study of 150 zygomatic implants placed with the extramaxillary technique, soft tissue recession does not carry signs of inflammation, and the implants

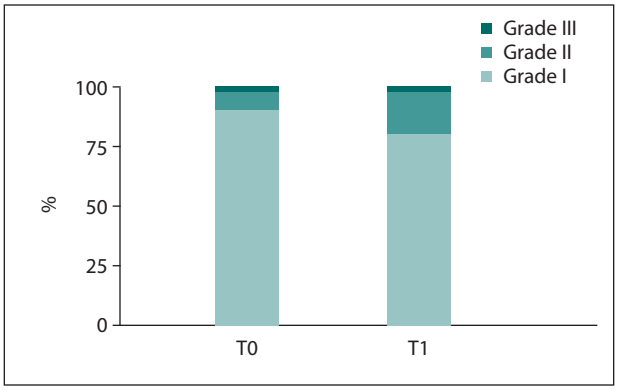


Fig 7 Changes in peri-implant soft tissue recession between T0 and T1.

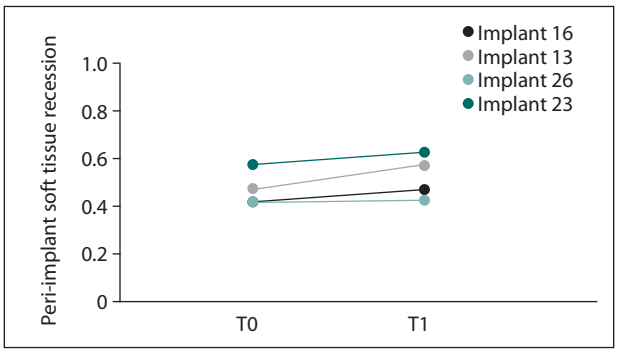


Fig 8 Changes in peri-implant soft tissue recession: analysis of implant position (FDI numbering system).

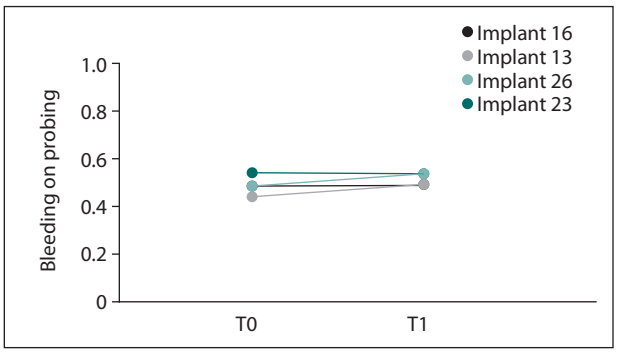


Fig 9 Changes in bleeding on probing: analysis of implant position (FDI numbering system).

are thus considered to be successful.[29] Therefore, zygomatic implant exposure is not associated with zygomatic implant failure, though the study by Migliorança et al was based on only 12 months of follow-up. On the other hand, dehiscence of the soft tissues by leaving the implant surface exposed to the oral cavity can become a problem because of the accumulation of bacterial film, with painful soft tissue inflammation that presents difficulty in carrying out oral hygiene, and therefore could be perceived as a failure from the patient's view. This in turn can induce peri-implantitis and consequent orosinusal communication.

For all these reasons, longer-term studies are needed to analyze the influence of soft tissue recession on the survival and success of zygomatic implants, and above all to analyze the advantages that surgical techniques can bring to minimize this recession around zygomatic implants.

CONCLUSIONS

The extrasinusal length coverage of extramaxillary zygomatic implants with a pedicled buccal fat pad flap through a tunnel approach appears to reduce the risk of soft tissue recession and exposure of the implant surface to the oral cavity. Zygomatic implants in the anterior position were found to have a higher risk of recession. However, longer-term randomized studies involving larger samples and longer follow-up periods are needed to draw firm conclusions.

ACKNOWLEDGMENTS

The authors do not have any financial interests, either directly or indirectly, in the products or information included in this article.

REFERENCES

1. Cawood JI, Howell RA. A classification of the edentulous jaws. Int J Oral Maxillofac Surg 1988;17:232–236.
2. Chiapasco M, Zaniboni M. Failures in jaw reconstructive surgery with autogenous onlay bone grafts for pre-implant purposes: Incidence, prevention and management of complications. Oral Maxillofac Surg Clin North Am 2011;23:1–15, v.
3. Marchetti C, Pieri F, Corinaldesi G, Degidi M. A long-term retrospective study of two different implant surfaces placed after reconstruction of the severely resorbed maxilla using Le Fort I osteotomy and interpositional bone grafting. Int J Oral Maxillofac Implants 2008;23:911–918.
4. Iyer S, Thankappan K. Maxillary reconstruction: Current concepts and controversies. Indian J Plast Surg 2014;47:8–19.
5. Davó R, Felice P, Pistilli R, et al. 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;11:145–161.
6. Chrcanovic BR, Abreu MH. Survival and complications of zygomatic implants: A systematic review. Oral Maxillofac Surg 2013;17:81–93.
7. Brånemark PI. Zygomaticus Fixture Clinical Procedures, ed 1. Goteborg, Sweden: Nobel Biocare, 1998.
8. Brånemark PI, Gröndahl K, Ohrnell LO, et al. 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. Malevez C, Abarca M, Durdu F, Daelemans P. Clinical outcome of 103 consecutive zygomatic implants: A 6–48 months follow-up study. Clin Oral Implants Res 2004;15:18–22.
10. Bothur S, Garsten M. Initial speech problems in patients treated with multiple zygomatic implants. Int J Oral Maxillofac Implants 2010;25:379–384.
11. Stella JP, Warner MR. Sinus slot technique for simplification and improved orientation of zygomaticus dental implants: A technical note. Int J Oral Maxillofac Implants 2000;15:889–893.
12. Peñarrocha M, García B, Martí E, Boronat A. Rehabilitation of severely atrophic maxillae with fixed implant-supported prostheses using zygomatic implants placed using the sinus slot technique: Clinical report on a series of 21 patients. Int J Oral Maxillofac Implants 2007;22:645–650.
13. Migliorança R, Ilg JP, Serrano AS, Souza RP, Zamperlini MS. Sinus exteriorization of the zygoma fixtures: A new surgical protocol [in Portuguese]. Implant News 2006;3:30–35.
14. Maló P, Nobre Mde A, Lopes I. A new approach to rehabilitate the severely atrophic maxilla using extramaxillary anchored implants in immediate function: A pilot study. J Prosthet Dent 2008;100:354–366.
15. de Moraes EJ. The buccal fat pad flap: An option to prevent and treat complications regarding complex zygomatic implant surgery. Preliminary report. Int J Oral Maxillofac Implants 2012;27:905–910.
16. Guennal P, Guiol J. Use of buccal fat pads to prevent vestibular gingival recession of zygomatic implants. J Stomatol Oral Maxillofac Surg 2018;119:161–163.
17. Farré-Guasch E, Martí-Pagè C, Hernádez-Alfaro F, Klein-Nulend J, Casals N. Buccal fat pad, an oral access source of human adipose stem cells with potential for osteochondral tissue engineering: An in vitro study. Tissue Eng Part C Methods 2010;16:1083–1094.
18. Khojasteh A, Sadeghi N. Application of buccal fat pad-derived stem cells in combination with autogenous iliac bone graft in the treatment of maxillomandibular atrophy: A preliminary human study. Int J Oral Maxillofac Surg 2016;45:864–871.
19. Rigolizzo MB, Camilli JA, Francischone CE, Padovani CR, Brånemark PI. Zygomatic bone: Anatomic bases for osseointegrated implant anchorage. Int J Oral Maxillofac Implants 2005;20:441–447.
20. Rossi M, Duarte LR, Mendonça R, Fernandes A. Anatomical bases for the insertion of zygomatic implants. Clin Implant Dent Relat Res 2008;10:271–275.
21. Bedrossian E, Bedrossian EA. Prevention and the management of complications using the zygoma implant: A review and clinical experiences. Int J Oral Maxillofac Implants 2018;33:135–145.
22. Esposito M, Worthington HV. Interventions for replacing missing teeth: Dental implants in zygomatic bone for the rehabilitation of the severely deficient edentulous maxilla. Cochrane Database Syst Rev 2013;5:CD004151.
23. Prithviraj DR, Vashisht R, Bhalla HK. From maxilla to zygoma: A review on zygomatic implants. J Dent Implant 2014;4:44–47.
24. Fernández H, Gómez-Delgado A, Trujillo-Saldarriaga S, Varón-Cardona D, Castro-Núñez J. Zygomatic implants for the management of the severely atrophied maxilla: A retrospective analysis of 244 implants. J Oral Maxillofac Surg 2014;72:887–891.
25. El Haddad SA, Abd El Razzak MY, El Shall M. Use of pedicled buccal fat pad in root coverage of severe gingival recession defect. J Periodontol 2008;79:1271–1279.
26. 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–e26.
27. Peñarrocha-Diago M, Bernabeu-Mira JC, Fernández-Ruíz A, Aparicio C, Peñarrocha-Oltra D. Bone regeneration and soft tissue enhancement around zygomatic implants: Retrospective case series. Materials (Basel) 2020;13:1577.
28. Farzad P, Andersson L, Gunnarsson S, Johansson B. Rehabilitation of severely resorbed maxillae with zygomatic implants: An evaluation of implant stability, tissue conditions, and patients' opinion before and after treatment. Int J Oral Maxillofac Implants 2006;21:399–404.
29. 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;26:665–672.