LAJOMS

Clinical case

April - June 2024
Vol. 4, no. 2 / p. 86-91

Surgical versatility of the lateral window technique for sinus floor elevation used in the rehabilitation of atrophic maxilla with dental implants: case reports

Versatilidad quirúrgica de la técnica de ventana lateral para elevación del piso del seno utilizada en la rehabilitación del maxilar atrófico con implantes dentales: informes de casos

Edgar Cabrera,* Erika de Santos,‡ Liseth Chacón,§ Henry García-Guevara,¶ Jesús Ostos,‖ Ana Del Valle,** Bianca de Fatima Borim-Pulino‡‡

Keywords:
maxillary sinus, atrophy, regeneration, alveolar process, lateral window, rehabilitation.

Palabras clave:
seno maxilar, atrofia, regeneración, proceso alveolar, ventana lateral, rehabilitación.

ABSTRACT

Introduction: among the numerous existing surgical techniques for upper jaw reconstruction, sinus floor elevation represents the most used three-dimensional complex surgical approach to overcome pneumatization problems caused by the patient's own physiological or pathological conditions. It allows for the correct placement of conventional length implants in areas of insufficient bone quantity. **Material and methods:** the aim of this study is to report 11 clinical cases addressing the versatility of the surgical technique of lateral sinus approach for maxillary sinus elevation in the rehabilitation of atrophic maxillae with dental implants and the protocols that should be taken into consideration for patient rehabilitation. **Results:** our sample consisted of 11 cases, nine of them female (81.8%) and two male (18.2%), aged between 18 and 78 years, with a mean of ± 48.7 years. The comorbidities presented varied between diabetes (one patient), allergic rhinitis (one patient) and smokers (two patients); despite being important for the surgical technique, only one patient presented postoperative complications, in which the graft was lost. There were no intraoperative or immediate complications; likewise, all patients underwent cone beam tomography, which allowed us to visualize anatomical variations and thus avoid complications as described by Hsun-Liang Chan and Hom-Lay. The etiology for the development of the technique was 90.9% due to partial edentulism, while only 9.1% was due to bilateral premolar agenesis. **Conclusion:** the minimally invasive approach to posterior maxilla reconstruction using special reamer-type instrumentation remains an easy, safe, and effective

RESUMEN

Introducción: *entre las numerosas técnicas quirúrgicas existentes para la reconstrucción del maxilar superior, la elevación del piso del seno representa el abordaje quirúrgico complejo tridimensional más utilizado para superar los problemas de neumatización causados por las propias condiciones fisiológicas o patológicas del paciente. Se trata de un bordaje quirúrgico complejo dimensional ya que permite la correcta colocación de implantes de longitud convencional en zonas de cantidad insuficiente de hueso.* ***Material y métodos:*** *el objetivo de este estudio es reportar 11 casos clínicos que tratan la versatilidad de la técnica quirúrgica de abordaje del seno lateral para la elevación del seno maxilar en la rehabilitación de maxilares atróficos con implantes dentales y los protocolos que se deben tomar en consideración para la rehabilitación del paciente.* ***Resultados:*** *nuestra muestra estuvo compuesta por 11 casos, nueve de ellos femeninos (81.8%) y dos masculinos (18.2%), con edades comprendidas entre 18 y 78 años, con una media de ± 48.7 años. Las comorbilidades presentadas variaron entre diabetes (un paciente), rinitis alérgica (un paciente) y tabaquismo (dos pacientes); a pesar de ser importante para la técnica quirúrgica, sólo un paciente presentó complicaciones postoperatorias, en las que se perdió el injerto. No hubo complicaciones intraoperatorias ni inmediatas; asimismo, a todos los pacientes se les realizó tomografía de haz cónico, lo que permitió visualizar variaciones anatómicas y así evitar complicaciones como lo describen Hsun-Liang Chan y Hom-Lay. La etiología para el desarrollo de la técnica fue en 90.9% por edentulismo parcial, mientras que sólo 9.1% se debió a agenesia premolar bilateral.*

* OMFS; CEO INTEGRITY; Private Practice. Madrid, Spain.
‡ Masters in surgery, Periodontics; implant rehabilitation; UCAM. Madrid, Spain.
§ OMFS, Domingo Luciani Hospital. Caracas, Venezuela.
¶ OMFS, Ortopédico Infantil Hospital. Caracas, Venezuela.
‖ Specialist in Implantodontics CEO INTEGRITY; Private Practice. Madrid, Spain.
** OMFS Fellow «Dr. Cabrera» CBMF-INTEGRITY. Madrid, Spain.
‡‡ Institute of Teaching and Research, Sírio Libanês Hospital; Leforte Group, Brazil,

Received: 04/15/2024
Accepted: 04/20/2024

doi: 10.35366/116728

How to cite: Cabrera E, de Santos E, Chacón L, García-Guevara H, Ostos J, Del Valle A et al. Surgical versatility of the lateral window technique for sinus floor elevation used in the rehabilitation of atrophic maxilla with dental implants: case reports. Lat Am J Oral Maxillofac Surg. 2024; 4 (2): 86-91. https://dx.doi.org/10.35366/116728

technique with a comfortable recovery for patients, considering the prior diagnostic evaluation of cases that merit reconstruction of the atrophic posterior maxilla.

Conclusión: *el abordaje mínimamente invasivo para la reconstrucción del maxilar posterior utilizando instrumentación especial tipo escariador sigue siendo una técnica fácil, segura y efectiva con una recuperación cómoda para los pacientes, considerando la evaluación diagnóstica previa de los casos que ameritan reconstrucción del maxilar posterior atrófico.*

Introduction

The rehabilitation of atrophic jaws has become a real challenge for clinicians today. Due to its anatomo-physiological aspects, the resorption of the maxillary bone in the posterior sector specifically, presents limitations in the placement of dental implants by means of the conventional technique and in order to develop it, numerous reconstructive surgical and oral rehabilitation techniques must be combined, which must follow the same line, from the diagnosis, planning and treatment phase with the correct execution of a reverse protocol that allows achieving esthetic-functional results that are long-lasting in time. One of the biggest challenges we face as clinicians today is to rehabilitate severely atrophied alveolar ridges in partially and completely edentulous patients with implants. Bone recurrence is aggravated by the physiological process of pneumatization of the paranasal sinuses, especially in the posterior maxillary area.[1]

Among the numerous existing surgical techniques for the reconstruction of the upper jaw, sinus floor elevation represents the most commonly used three-dimensional complex surgical approach to overcome pneumatization problems caused by the patient's own physiological conditions (agenesis) or pathological conditions (traumatic extraction without alveolar preservation, failed endodontics, periapical lesions, sequelae of trauma and odontogenic sinusitis, among others), as the sinus floor elevation represents the most commonly used three-dimensional complex surgical approach, (traumatic extraction without alveolar preservations, failed endodontics, periapical lesions, sequelae of trauma and odontogenic sinusitis, among others) since it allows the correct placement of implants of conventional length in areas of insufficient amount of bone (allowing to recover not only its height but also the width of the alveolar bone crest).[2,3]

The aim of this study is to report 11 clinical cases addressing the versatility of the surgical technique of lateral sinus approach for maxillary sinus elevation in the rehabilitation of atrophic maxillae with dental implants and the protocols that should be taken into consideration for patient rehabilitation.

Material and methods

In this research were selected 11 patients as the need to perform maxillary sinus lift for subsequent oral rehabilitation with the use of dental implants. The patient was prepared with antibiotic prophylaxis: amoxicillin + clavulanic acid 875/125 mg one tablet orally every 12 hours for 10 days, starting three days before surgery (in case of allergy to penicillin clindamycin 300 mg was used), combined with nasal decongestant: oxymetazoline nasal spray 1 puff in each nostril every 12 hours (morning-night) three days before surgery and anti-allergic: desloratadina 10 mg one tablet at night, starting three days before surgery and continuing seven days after the surgical procedure. The anesthesiology team performed the conscious sedation procedure for each patient, along with the local anesthesia technique for the region operated on by the surgeon. Analgesia was given with dexketoprofen 25 mg (oral solution) every 8 hours for three continuous days and dexamethasone 8 mg/day administered intravenously by the anesthesiologist and 8 mg orally 24 hours after the surgical procedure.

The anesthesia team was responsible for conscious sedation of the patients, monitoring vital signs, and that at the time of induction assisted in obtaining 06 blood tubes from each patient by venipuncture in order to perform the APRF-SPRF protocol described by Dr. Joseph Choukron,[4] as well as the intravenous administration of the aforementioned analgesics, antibiotics, and corticosteroids. The anesthetic technique used was infiltrative with a short needle, a syringe that allows suction, and using lidocaine with epinephrine at 2% concentration.

Intraoperative

We performed the semilunar incision, described by Partsch (mucoperiosteal, full thickness) with a 15C scalpel blade, in cases that we will call as single (S) by applying a single surgical technique (SLA-sinus floor elevation). On the other hand, in cases where we combine the SLA technique with dentoalveolar surgery procedures (complex extraction, enucleation of cysts, bone curettage, closure of bucosinusal communications), placement of immediate dental implants and ROG (sausage technique, sticky bone, among others) RTG regenerative surgery procedures, we will call them with the letter (C).

In these cases a modification in approach was performed, making a wider flap design with a wide base, oriented towards the palatal area, continuing with two buccal lateral relaxing incisions (papillary preservation of neighboring tooth structures) until the area of future entry into the sinus cavity is exposed *(Figure 1)*.

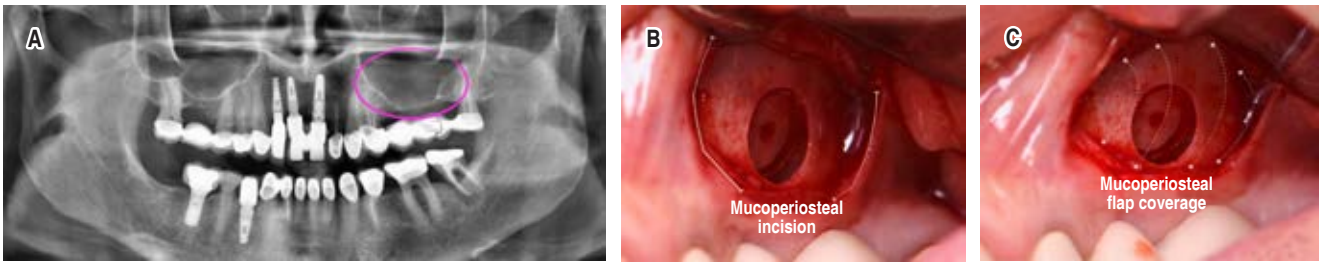

Figure 1: A) *Panoramic x-ray showing a high degree of pneumatization in the left maxillary sinus.* ***B)*** *Partsch semilunar incision with full thickness.* ***C)*** *Mucoperiosteal detachment and access to the anterior wall of the maxillary sinus.*

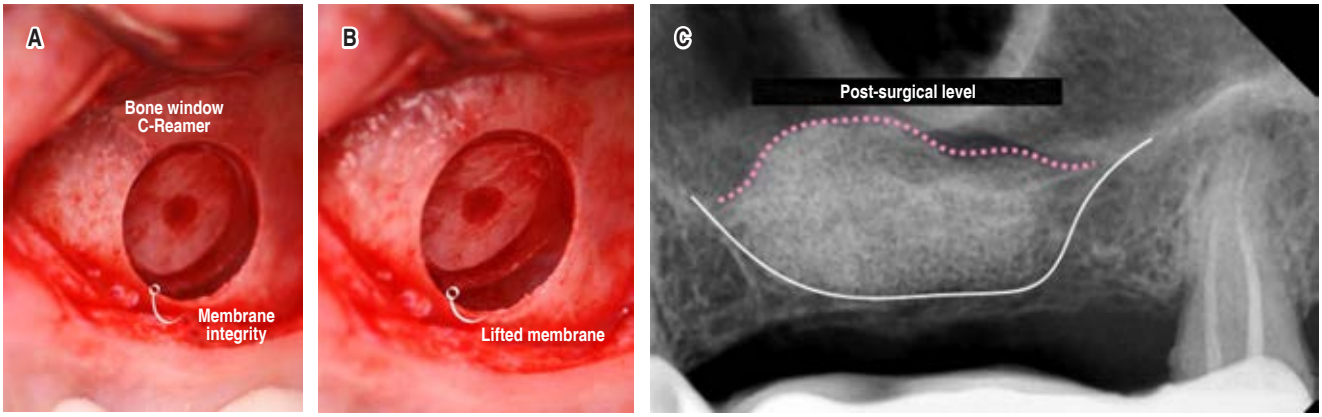

Figure 2: A) *Performing the central access to the anterior wall of the maxillary sinus with surgical drill performed using counter angle.* ***B)*** *Detachment of the maxillary sinus membrane.* ***C)*** *Radiographic image of the maxillary sinus after performing a bone graft.*

The SLA technique was applied using the principles described by Heo et al.[5] using the SLA (NEO Sinus All) kit from NeoBiotech®, which was used sequentially for each drill, remembering our anatomical repairs regarding buccal cortical bone (cork selection thickness), emergence of the vasculonervous bundle, specific location of the central access point to the cavity (taking into account the guarantee of a minimum height of 1-2 mm, from the lowest portion of the alveolar process) and future arrangement of the dental implants). We started with number 1 (C-REAMER inferior depth) corresponding to the C-Guide, which as its name indicates, served as the central support point of the guide, including the other reamers, creating our central access window to the maxillary sinus, calibrating our 20:1 contra-angular handpiece between 800 to 1,000 rpm (depending on bone density) with abundant and constant irrigation of lightly refrigerated 0.9% NaCl. Subsequently, based on our central reference and depth: cortical thickness (C-Guide + Stopper) we moved on to the next one which was the LS-Reamer with which we continued the osteotomy of our lateral window wearing down the external bone cortex in a controlled way until we obtained better visibility of the Schneider membrane *(Figure 2)*.

Once the osteotomy was completed, the bone window itself was carefully detached, and with the elevator #1 of the kit, to undo the layer of cilia that connect the pseudostratified ciliated cylindrical epithelium with the floor (bone) of the maxillary sinus, detaching the membrane from the floor of the maxillary sinus, using the instruments #2 and #3 respectively, always directing the blunt part of the elevators toward the membrane to avoid injuring or perforating it, and the active part toward the bone. Once the total detachment was performed, the Valsalva maneuver and verification of the membrane integrity coinciding with the physiological movements of the nasomaxillary complex, a matrix obtained from the A-PRF Choukron Cols protocol was used to introduce it into the cavity at the interface between the epithelium and the floor, adhering it to the epithelium. We continued with the regenerative phase of the bone graft previously obtained, in most cases we chose to use a 50% regenerative protocol: 50% for these cases, that is, 50% autogenous graft, obtained as the name suggests from the patient, preferably from the maxillary tuberosity or from the area of the retromolar trigone, with the use of the self-harvesting drill from the same commercial company NeoBiotech® AUTO BONE CHIP-

MAKER and 50% xenograft (from 100% spongy bovine origin with particles between 0.1 and 1. 0 mm), combined with A-PRF+ membranes.

The graft was positioned all along the maxillary sinus floor (future implant positioning area), making sure of the correct positioning inside the sinus cavity all along the floor (vestibulo-palatal direction) until the cavity was filled laterally, compacting it sequentially *(Figure 3)*.

Once this process is accomplished, the cortical bone window obtained at the beginning of the process is placed as a door, which was reserved in physiological solution. Finally, a resorbable collagen membrane of medium absorption covered on the outside by an A-PRF matrix is placed as a «sandwich», which will be fixed with Vycril 5/0 suture to the periosteum or with pins in the 4 points (vestibular and palatal), repositioning the initial flap to obtain a primary tissue closure, without tension sutured with 5/0 monifilament. Once the surgery was completed, periapical and panoramic radiographs and CT scans were taken, and postoperative instructions (verbal and written) were given, as well as dietary recommendations, reminding the patient of the medication schedule and postoperative control.

Postoperative

The cases were reevaluated in one week to check the healing process, verifying that the surgical wound was stable, with no associated secretions or dehiscences and that the respiratory (nasal) condition was also stable. Fourteen days after surgery, the stitches were removed. Establishing control guidelines for the patient in six weeks, to perform control radiographs and check the stability of the bone graft. And finally, at least six months after the sinus floor elevation surgery, implant placement was planned.

Results

Our sample consisted of 11 cases, nine of them female (81.8%) and two male (18.2%), aged between 18 and 78 years, with a mean of ± 48.7 years. The comorbidities presented varied between diabetes (one patient), allergic rhinitis (one patient) and smokers (two patients); despite being important for the surgical technique, only one patient presented postoperative complications, in which the graft was lost. There were no intraoperative or immediate complications; likewise, all patients underwent cone beam tomography, which allowed us to visualize anatomical variations and thus avoid complications as described by Hsun-Liang Chan and Hom-Lay.[6] The etiology for the development of the technique was 90.9% due to partial edentulism, while only 9.1% was due to bilateral premolar agenesis.

In all cases xenografts were used, followed by A-PRF and membrane. In 10 patients the installation of the implants occurred within six months after the sinus lift surgery, and in only one patient the installation was performed after 8 months, as shown in *Table 1*.

Discussion

The two most commonly described approaches in the literature regarding the three-dimensional treatment of the maxillary sinus, which depend on the height of the existing alveolar bone as the anchorage remnant that will provide the primary stability of our dental implants, and is the one we perform through an osteotomy lateral to the maxillary sinus when the residual bone volume is less than ≤ 5 mm (main reason for the description in this article) and the second approach through a closed transalveolar osteotomy, widely described by Summers.[7]

In 1976, Tatum first described the lateral sinus elevator (LSFE) technique, which requires creating a surgical access by preparing an opening window in the external maxillary sinus wall. Through the lateral access, allowing Schneider's membrane to be carefully separated from the internal aspect of the sinus cavity.[8]

After filling the space between the elevated membrane and the floor of the maxillary sinus with an osteogenic graft, implants can be placed after a period of approximately six months. This is what we have studied as a classical technique, however in 1994 Summers first demonstrated the osteotome sinus floor elevation (OSFE) procedure, a type of transcrestal

Figure 3: A) *Realization of the implants in the grafted area of the maxillary sinus.* ***B)*** *Positioning of intra-oral implants after six months.* ***C)*** *Radiographic image of the maxillary sinus after performing bone grafting, implant installation and dental rehabilitation.*

Table 1: It presents all the treatments performed on the patients of the research.

Case	Genero	Age	Treatment	Graft type	Implant	Immediate complication	Postoperative complication	Precondition
1	Female	28	SLA (S)	Xenograft A-PRF + membrane	Deferred 6 months	No	No	Failed previous sinus lift
2	Female	18	SLA bilateral (C)	Xenograft A-PRF + membrane	Deferred 6 months	No	Loss of ROG in right maxillary sinus	—
3	Female	58	SLA (S)	Xenograft A-PRF + membrane	Deferred 6 months	No	No	Smoker of 10 cigarettes a day
4	Female	65	SLA (S)	Xenograft A-PRF + membrane	1 prior to defect	No	No	Occasional smoker
5	Male	72	SLA (S)	Xenograft A-PRF + membrane	Deferred 6 months	No	No	—
6	Female	42	SLA (S)	Xenograft A-PRF + membrane	Deferred 6 months	No	No	—
7	Female	62	SLA (S)	Xenograft A-PRF + membrane	Deferred 6 months	No	No	Controlled diabetic
8	Female	42	SLA (exodonation + enucleation of apical OD cyst 14) (C)	Xenograft A-PRF + membrane	Deferred 6 months	No	No	—
9	Male	48	SLA bilateral (C)	Allograft PRGF + membrane	Deferred 6 months	No	No	Allergic rhinitis
10	Female	52	SLA+ROG 3D (C)	Xenograft A-PRF + membrane	Deferred 8 months	No	No	Predisplacement of implant into maxillary sinus
11	Female	49	SLA (C)	Xenograft, Autologous Graft, A-PRF + and collagen membrane	Deferred 6 months	No	No	—

sinus floor elevation. After elevating the maxillary sinus floor by tapping with an osteotome, leaving 1-2 mm of free space with the alveolar bone. The bone graft is simultaneously placed in the elevated space, and implants are most often inserted simultaneously. Thanks to continuous improvements, the indication of traditional OSFE has gradually expanded.[9]

With the advent of new technologies, new protocols, new surgical techniques have been developed, which are selected according to what was reported by Gargallo et al, when residual ridge height and vertical elevation height are considered as risk determinants, also reporting the performance of a maxillary sinus floor elevation (closed technique) using the SCA-brand NeoBiotech® kit with a safety parameter of 5 mm without the use of bone grafting in implant placement.[10]

Recently, short 8 mm implants have been considered as the standard implants in several published articles. They have a high acceptance rate because they are associated with a less invasive procedure, leading to a smaller scale intervention, shorter intraoperative time, lower morbidity and lower treatment cost.[11,12]

Sinus elevation is the most widely used technique for the rehabilitation of atrophic jaws in the posterior region; the lateral window technique has evolved in the last decade with the presence of instruments that facilitate its development, such as the NeoBiotech SLA Kit.

An important aspect in our report is the development of our surgical technique, as the use of the SLA kit in conjunction with autologous bone graft + xenograft + A-PRF+ mixture allowed for an increase in length sufficient for the placement of conventional sized implants within 6 months in 81.8% of the cases. Sbordone et al. recorded a 100% success rate at 3 years in sinus lifts performed with autologous iliac crest and chin grafts;[13] On the other hand, a study by Georges Tawil indicates that bovine bone has proven to be an effective slow resorbing osteoconductive material.[14] Galindo-Moreno et al. conclude that inorganic bovine bone and porcine bone mineral combined with autogenous maxillary cortical bone show similar biological and radiological characteristics in terms of biomaterial resorption, osteoconduction and osteogenesis when used for maxillary sinus floor augmentation.[15,16]

This is what we found in our study where, despite the 50/50 mixture, we can guarantee osteogenesis, osteoinduction and osteoconduction in our preparation and thus obtain adequate volume for implant placement within a maximum period of up to 6 months afterward.

Conclusion

The minimally invasive approach to posterior maxilla reconstruction using special reamer-type instrumentation remains an easy, safe, and effective technique with a comfortable recovery for patients, considering the prior diagnostic evaluation of cases that merit reconstruction of the atrophic posterior maxilla. Similarly, the combination of biomaterials shows that inorganic bovine bone and porcine bone mineral combined with autogenous maxillary cortical bone have similar biological and radiological characteristics in terms of biomaterial resorption, osteoconduction and osteogenesis when used to augment the maxillary sinus floor. Likewise, their implementation with tissue engineering techniques allows us to combine them to facilitate intraoperative manipulation and ensure their stability over time, providing an adequate and long-lasting treatment. However, precise studies are needed to quantify their effectiveness.

References

1. Velasco-Torres M, Padial-Molina M, Avila-Ortiz G, García-Delgado R, O'Valle F, Catena A. Maxillary sinus dimensions decrease as age and tooth loss increase. Implant Dent. 2017; 26 (2): 288-295.
2. Misch CE. Divisions of available bone in implant dentistry. Int J Oral Implantol. 1990;7(1):9-17.
3. Avila G, Wang HL, Galindo-Moreno P, Misch CE, Bagramian RA, Rudek I, et al. The influence of the bucco-palatal distance on sinus augmentation outcomes. J Periodontol. 2010; 81 (7): 1041-1050.
4. Miron RJ, Choukroun J, Ghanaati S. Reply from authors: RE: Optimized platelet-rich fibrin with the low-speed concept: Growth factor release, biocompatibility, and cellular response: Necessity for standardization of relative centrifugal force values in studies on platelet-rich fibrin. J Periodontol. 2019; 90 (2): 122-125.
5. Wolff R, Hsu A, Heo Y, Zhang L, Evans MD, Seong W. Two-year follow-up comparison of three surgical techniques for implant placement in posterior maxilla with limited alveolar bone height. Int J Oral Maxillofac Implants. 2022; 37 (1): 171-180.
6. Chan HL, Wang HL. Sinus pathology and anatomy in relation to complications in lateral window sinus augmentation. Implant Dent. 2011; 20 (6): 406-412.
7. Wang HL, Katranji A. ABC sinus augmentation classification. Int J Periodontics Restorative Dent. 2008; 28 (4): 383-399.
8. Summers RB. A new concept in maxillary implant surgery: the osteotome technique. Compendium. 1994; 15 (2): 152, 154-156, 158 passim; quiz 162.
9. Esposito M, Pellegrino G, Pistilli R, Felice P. Rehabilitation of posterior atrophic edentulous jaws: prostheses supported by 5 mm short implants or by longer implants in augmented bone? One-year results from a pilot randomised clinical trial. Eur J Oral Implantol. 2011; 4 (1): 21-30.
10. Gargallo-Albiol J, Tattan M, Sinjab KH, Chan HL WH. Schneiderian membrane perforation viatranscrestal sinus floor elevation: a randomized *ex vivo* study with endoscopic validation. Clin Oral Implants Res. 2019; 30 (1): 11-19.
11. Plonka AB, Urban IA, Wang HL. Decision tree for vertical ridge augmentation. Int J Periodontics Restorative Dent. 2018; 38 (2): 269-275.
12. Neldam CA, Pinholt EM. State of the art of short dental implants: a systematic review of the literature. Clin Implant Dent Relat Res. 2012; 14 (4): 622-632.
13. Sbordone L, Toti P, Menchini-Fabris G, Sbordone C, Guidetti F. Implant success in sinus-lifted maxillae and native bone: a 3-year clinical and computerized tomographic follow-up. Int J Oral Maxillofac Implants. 2009; 24 (2): 316-324.
14. Tawil G, Mawla M. Sinus floor elevation using a bovine bone mineral (Bio-Oss) with or without the concomitant use of a bilayered collagen barrier (Bio-Gide): a clinical report of immediate and delayed implant placement. Int J Oral Maxillofac Implants. 2001; 16 (5): 713-721.
15. Galindo-Moreno P, Hernández-Cortés P, Mesa F, Carranza N, Juodzbalys G, Aguilar M, et al. Slow resorption of an organic bovine bone by osteoclasts in maxillary sinus augmentation. Clin Implant Dent Relat Res. 2013; 15 (6): 858-866.
16. Galindo-Moreno P, Avila G, Fernández-Barbero JE, Aguilar M, Sánchez-Fernández E, Cutando A, Wang HL. Evaluation of sinus floor elevation using a composite bone graft mixture. Clin Oral Implants Res. 2007; 18 (3): 376-382.

Funding information: the authors declare no sources of funding.

Ethics statement: the guidelines in the Declaration of Helsinki were always followed during this work. Institutional review board approval was not required.

Conflict of interest: the authors declare that they have no conflict of interest.

Correspondence:
Edgar Cabrera
E-mail: edgarcabreramaxilofacial@gmail.com