

Lefort I and zygomatic implant for severe atrophic maxilla: a literature review and technique description

Lefort I e implantes zigomáticos en maxilar atrófico severo: una revisión literaria y descripción de técnica

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ABSTRACT: The treatment of atrophic maxilla has multiple options were zygomatic implants with simultaneous Lefort I osteotomy correspond to an effective non-grafting and prosthetically viable alternative. The objective of this article is to present a literature review of Lefort with zygomatic implant placement for the treatment of severe atrophic maxilla and the description of this technique. A systematic search was carried out for identify the existing relevant literature. A descriptive analysis is made for each identified study that described or compare the use of zygomatic implants and Lefort osteotomy. The general technique is described. All databases were consulted with the systematic search strategy and all the included studies references were revised for more articles that meet the inclusion criteria. Four articles have been published that described the Lefort I osteotomy and simultaneous zygomatic implant placement, all of them are case reports. No comparative studies were identified. Regardless that the main evidence identified is based only in series of cases published by different authors and that no comparative evidence exists, this technique could be a viable and effective option for the treatment of this patients without the need of a complementary bone graft and other associated morbidities.

KEY WORDS: Zygomatic implants, lefort I, atrophic maxilla.

INTRODUCCIÓN

Face aging corresponds to a process that involves skin superficial textural and volume changes due to the modification of the underlying soft and hard tissues (Coleman & Grover, 2006; Fitzgerald *et al.*, 2010). Soft tissues are affected by many factors such as gravity, fat redistribution, hormonal imbalance, smoking, among other. The phenotypic presentation in soft tissues is a downward migration of the face (Donofrio, 2000; Little, 2000; Coleman & Grover, 2006). In the other hand, hard tissue changes such as tooth loss and bone resorption contribute to a fewer support of soft tissues. For example, in an atrophic maxilla do to edentulism, the upper lip loose support which contributes to a loss of projection, false prognathism,

wrinkling and a downward position (Coleman & Grover, 2006; Hernández-Alfaro & Valls-Ontañón, 2023).

The treatment of severe atrophic maxilla has multiple options that goes from dental implants, bone augmentation, sinus elevation, maxillary osteotomies with complementary interposition of bone graft, etc. Due to bone quality and quantity, conventional dental implants have lower osteointegration rates than mandibular implants even in non-atrophic maxilla. In the other hand, bone graft procedures imply an elevated morbidity because of interventions in a donor site, elevated surgical time and an elevated risk of infection (Block *et al.*, 2009; Rosenstein & Dym., 2021).

Zygomatic implants (ZI) correspond to an effective non-grafting and prosthetically viable alternative for patients with severe atrophic maxilla. Treatment designs for these patients varies in the location of the ZI and in the number of units installed in each side of the maxilla. Although there are different option designs, they have reported over 95% of success rates (Aparicio *et al.*, 2000; Rosenstein & Dym, 2021).

BLefort I osteotomy has also been used as a complementary implant-based rehabilitation procedure, using this technique with an interpositional bone grafts and with conventional dental implants installation (Keller *et al.*, 1987; Grecchi *et al.*, 2009; Matsuo *et al.*, 2010; Nocini *et al.*, 2014; Grecchi *et al.*, 2022).

The objective of this article is to present a literature review of the use of Lefort I osteotomy in combination with ZI for the treatment of severe atrophic maxilla and the description of this technique.

METHODOLOGY

A systematic search was carried out for identify the existing relevant literature. A search strategy was conducted in Pubmed, Epistemonikos and Cochrane databases. The following clinical terms were used: ((Zigomatic) OR (Zygomatic*) OR (Zigoma*) OR (Cigomatic*) OR (Malar*)) AND ((implant*) OR (dental implant*)) AND ((lefort osteotomy) OR (Lefort*)).

Table I. Description of included studies.

Author, year	Study Design (patients included)	Technique description	Follow up and complications	Comments
Grecchi <i>et al.</i> , 2022	Case series (8 patients with severe atrophic maxilla).	Simultaneous Le Fort I osteotomy and zygomatic/dental implant placement was performed with patient-specific anatomical models and surgical guides produced through three-dimensional virtual planning methods.	93% of zygomatic implant survival and no other surgical complication reported. 1-year follow-up.	One zygomatic implant was lost after a period of 9 months in function, was retired and a new ZI was installed postponing 3 months the definitive rehabilitation.
Nocini <i>et al.</i> , 2014	Case series (Four patients with severe atrophic maxilla).	One-step surgical rehabilitation of severe atrophic maxilla by means of Le Fort I osteotomy for maxillary forward repositioning and simultaneous insertion of four ZI with immediate prosthetic loading.	100% of ZI survival and no other surgical complications reported. Four months follow up.	Abutment connections were realized at three months post-surgery and definitive rehabilitation at four months post-surgery.
Goker <i>et al.</i> , 2022	Case report (one bilateral cleft lip palate patient and with severe atrophic premaxilla).	Le Fort I osteotomy, palatoplasty and two zygomatic implant insertions.	100% of ZI survival and no other surgical complications. Follow up: one-month post-surgery, every three months for the first year.	Patient with partial denture, cleft palate and atrophic maxilla.
Hernández-Alfaro <i>et al.</i> , 2019	Case series (three patients with severe atrophic maxilla).	Le Fort I osteotomy, two zygomatic implant insertions in each side.	Complications and post-surgery follow-up: seven days, one month, six months, one year. 100% ZI survival, 0 % surgical complications.	The amount of advancement was determined by a pre-surgical teeth-try in articulator. Surgical 3D planification was programed based on the determined advancement.

There were no filters applied in the search strategy and all studies that described or compare the use of zygomatic implants and Lefort osteotomy for the treatment of severe atrophic maxilla were included. All studies were analyzed, described and presented with their main findings and results.

RESULTS

All databases were consulted with the systematic search strategy and all the included studies references were revised for more articles that meet the inclusion criteria. Four articles have been published that described the Lefort and ZI technique, all of them are described in Table I (Nocini *et al.*, 2014; Hernández-Alfaro *et al.*, 2019; Goker *et al.*, 2022; Grecchi *et al.*, 2022).

TECHNIQUE DESCRIPTION

A clinical and radiographic assessment is performed. Clinical evaluation considers oral conditions such as periodontal status of remanent dentition and rehabilitation viability of the remaining tooth. Facial sagittal maxillary position, soft tissues support analysis and aesthetics facial considerations are assessed in lateral projection (Fig. 1). Pre-operative casts should be taken, and occlusal, front and lateral facial photographic views should be registered. Before the surgical



Fig. 1. Preoperative lateral telerradiograph of a patient with severe atrophic maxilla treated with simultaneous Lefort I and bilateral ZI placement.

procedure, the maxillary final position is determined by the use of traditional intermaxillary articulation of maxillary and mandibular casts. A wax try-in superior dental arch is realized and a model surgery is performed to advance the maxilla to the ideal prosthetic position. Finally, an immediate superior prosthesis is made in the maxillary final position (Fig. 2).

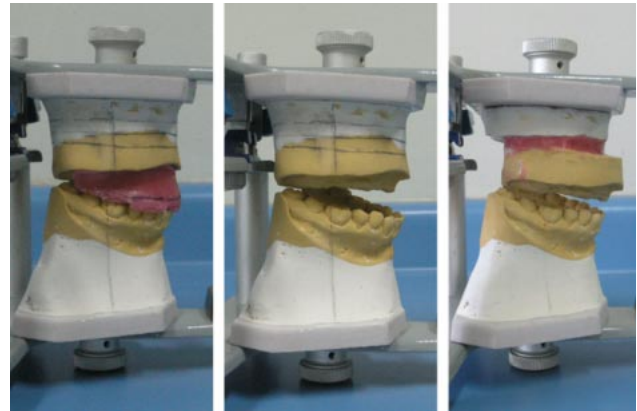


Fig. 2. Maxillary final position determined by the use of traditional intermaxillary articulation of both, maxillary and mandibular casts. A wax try-in superior dental arch is realized and a model surgery is performed to advance the maxilla to the ideal prosthetic position.

This procedure is performed under general anesthesia and nasotraqueal intubation. The immediate prosthesis is fixed to the superior maxilla with at least two screws in the palatine alveolar bone, then the intermaxillary fixation is realized. A linear incision is performed in the maxillary vestibule, a full thickness flap is elevated for the access to the hole maxilla and malar area considering the exposition of the inferior and lateral orbital rims. A high Lefort I osteotomy is performed. The maxilla is mobilized to the final occlusion and intermaxillary fixation is made with the interposition of the immediate superior prosthesis. Rigid fixation is performed by two 2.0 straight plates in the anterior/canine osseus pilar. Then, the intermaxillary fixation and the superior immediate prosthesis are retired.

Finally, two zygomatic implants are installed in each side using the zygoma anatomy guided approach (ZAGA) protocol (Martin, 2013; Aparicio *et al.*, 2021). The first step for zygomatic implant installation is to decide the intraoral coronal entrance point, followed by the extraoral apical entrance point. Finally, the path of the zygomatic implant body is determined by the joint of both apical and coronal points without the need of creating any window in the maxillary sinus (Martin, 2013; Aparicio *et al.*, 2021).

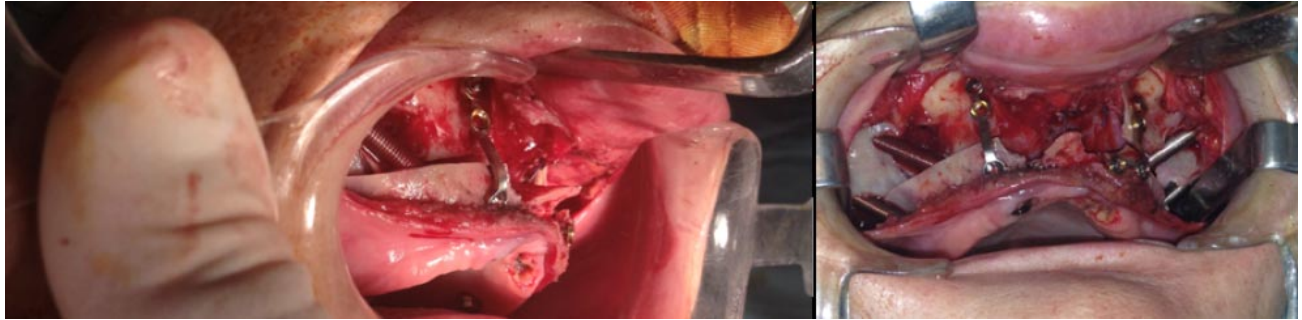


Fig. 3. Atrophic maxilla post-Lefort I osteotomy fixed by two anterior plates and four ZI.

Two zygomatic implants should be installed in each zygomatic buttress with emergencies in the first molar position (posterior implant) and in the canine position (anterior implant). Finally, the maxillary access is closed with vycril 4-0 suture or similar (Figs. 3 and 4). Postoperative indications are: soft diet three to four months, neat oral hygiene, local cold and relative rest. Follow-up is at seven days post-surgery where local conditions, soft tissue healing and oral hygiene are assessed. A post operative lateral radiographic projection should be considered for before and after result analysis (Fig. 5).

Temporal prosthetic placement should be considered at one-week post-surgery using a removal total prosthesis. Definitive rehabilitation should be realized at six months post-surgery, considering an intermediate occlusal charge at four months post-surgery (Fig. 6).



Fig. 5. Postoperative lateral telero radiograph of a patient with severe atrophic maxilla treated with simultaneous Lefort I and bilateral ZI placement.

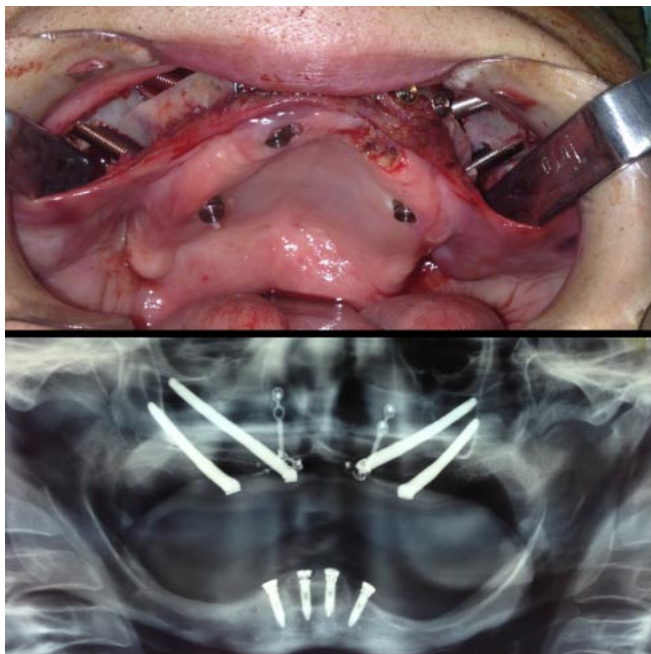


Fig. 4. Frontal view of the atrophic maxilla post-Lefort I osteotomy fixed by two anterior plates and four ZI. Control panoramic radiography.



Fig. 6. Zygomatic implant based total prosthesis post simultaneous Lefort I and ZI placement.

DISCUSSION

Atrophic maxilla leaves few alternatives for rehabilitation and implant-based treatment due to the bone defect. Bone resorption in all space planes limits the correct implant rehabilitation due to the loss of the intermaxillary relationship of the alveolar ridges (Cawood *et al.*, 1988). For these cases, reposition of the maxilla with Lefort I osteotomy with bone graft interposition have been described with positive outcomes (Nocini *et al.*, 2014). The introduction of ZI presents a new complementary tool for the maxillary reposition and rehabilitation in cases where atrophy doesn't allow a correct maxillo-mandibular relation.

Ellis & McFadden (2007) described the diagnostic set up and the step-by-step planification of a complete maxillary rehabilitation using dental implants and a complementary Lefort osteotomy. They proposed an intermaxillary articulation followed by a posterior wax try-in and upper-model surgery to determine the ideal intermaxillary final relation. With this method they planned the maxillary advancement by a Lefort I osteotomy and interpositional bone graft and final rehabilitation with single dental implants.

Nocini *et al* (2014) published first a case series treated with Lefort I osteotomy and ZI. They used a custom-made dental arch guide that was fixed in the superior alveolar ridge posterior to the Lefort I osteotomy, the maxilla was then advanced and repositioned with the use of a surgical splint between the inferior teeth and the superior custom dental guide. Subsequently, two windows were performed in both anterior maxillary buttresses to installed two zygomatic implants in each side. Rehabilitation in this study initiated at three months post-surgery with the abutment connection and at four months post-surgery with the final rehabilitation. In this study the ZAGA protocol wasn't considered and traditional planification was made.

Grecchi *et al.* (2022) reported a case series where they realized Lefort I osteotomy and the installation of four ZI (two in each side). They applied a virtual 3D surgical and prosthetic simulation for the pre-operative confection of surgical guides for the Lefort I osteotomy, drilling guides for the ZI installations, and custom-made surgical plates. One zygomatic implant was lost after a period of nine months in function, it was retired and a new ZI was installed postponing three months the definitive rehabilitation.

Hernandez-Alfaro *et al* (Hernández-Alfaro *et al.*, 2019) also published a case series report where they used the same technique. Like the protocol proposed by Grecchi *et al.* (2022), these authors used the 3D virtual planning for the confection of surgical guides and splints and to estimate the correct ZI position with the atrophic maxilla.

Goker *et al.* (2022) reported in a bilateral cleft lip-palate patient with severe atrophic pre-maxilla and oronasal communication treated with Lefort I osteotomy, ZI installation and palatoplasty. This case was performed to correct a skeletal class III alteration due to the multiple unknown interventions that the patient received at childhood, the severe resorption of the premaxilla and an oronasal remaining fistula. They installed the one ZI in each side with emergency in the canine area and fixed the Lefort I osteotomy with two plates in the maxillary posterior buttress achieving successful aesthetic and functional results.

This review didn't identify any comparative studies that can specify the magnitude and the precision of the effect of this intervention in comparison to other treatments. Nevertheless, the report series available in the relevant literature suggest that this technique may be an effective method for the treatment of patients with severe atrophic maxilla.

CONCLUSION

This study presents a review of the available evidence in regard to the severe atrophic maxilla treatment with a Lefort I osteotomy and simultaneous bilateral ZI installation and a detailed technique description. Regardless that the main evidence identified is based only in series of cases published by different authors and that no comparative evidence exists, this technique could be a viable and effective option for the treatment of this patients without the need of a complementary bone graft and other associated morbidities.

Conflict of interests: The authors of this study don't have any conflict of interests.

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RESUMEN: El tratamiento del maxilar atrófico tiene múltiples opciones donde los implantes zigomáticos con osteotomía Lefort I simultánea corresponden a una alternativa efectiva sin injertos y protésicamente viable. El objetivo de este artículo fue presentar una revisión de la literatura sobre Lefort con colocación de implante zigomático para el tratamiento del maxilar atrófico severo y la descripción de esta técnica. Se llevó a cabo una búsqueda sistemática para identificar la literatura relevante existente. Se realiza un análisis descriptivo para cada estudio identificado que describa o compare el uso de implantes zigomáticos y la osteotomía de Lefort. Se describe la técnica general. Se consultaron todas las bases de datos con la estrategia de búsqueda sistemática y se revisaron las referencias de todos los estudios incluidos para obtener más artículos que cumplieran con los criterios de inclusión. Se han publicado cuatro artículos que describen la osteotomía Lefort I y la colocación simultánea de implantes zigomáticos, todos ellos son reportes de casos. No se identificaron estudios comparativos. Independientemente de que la principal evidencia identificada se basa únicamente en series de casos publicados por diferentes autores y que no existe evidencia comparativa, esta técnica podría ser una opción viable y efectiva para el tratamiento de estos pacientes sin necesidad de un injerto óseo complementario y otros asociados. morbilidades.

PALABRAS CLAVE: Implantes zigomáticos, Lefort I, maxilar atrófico.

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