



MAXILLARY SINUS LIFT TECHNIQUES: INDICATIONS AND CRITERIA FOR REHABILITATION OF ATROPHIC MAXILLAE

TÉCNICAS DE LEVANTAMENTO DE SEIO MAXILAR: INDICAÇÕES E CRITÉRIOS PARA REABILITAÇÃO DE MAXILAS ATRÓFICAS

TÉCNICAS DE ELEVACIÓN DEL SENO MAXILAR: INDICACIONES Y CRITERIOS PARA LA REHABILITACIÓN DE MAXILARES ATRÓFICOS

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ABSTRACT

The present study consists of a narrative literature review aimed at discussing maxillary sinus lift techniques, their clinical indications, and the criteria for rehabilitation of atrophic maxillae. Tooth loss in the posterior maxillary region, combined with maxillary sinus pneumatization, results in insufficient bone volume for implant placement, making sinus floor elevation a fundamental and predictable surgical technique. The methodology was based on a search in the PubMed database, selecting articles published in the last five years in Portuguese and English. The results indicate that the choice between the lateral window technique and the transcrestal approach should be based on residual bone height, with the lateral approach indicated for remnants smaller than 4 to 5 mm. Technological advances are highlighted, particularly the osseodensification technique and the use of piezoelectric devices to reduce complications, such as perforation of the Schneiderian membrane. Regarding biomaterials, although autogenous bone remains the gold standard, xenografts and the use of platelet concentrates (L-PRF) show excellent results in accelerating new bone formation and healing. It is concluded that maxillary sinus lift is a safe procedure when preceded by careful three-dimensional planning, enabling satisfactory functional rehabilitation in patients with severe maxillary atrophy.

Keywords: Maxillary Sinus Lift. Dental Implants. Biomaterials. Atrophic Maxilla.

RESUMO

O presente estudo consiste em uma revisão bibliográfica narrativa que objetiva discutir as técnicas de levantamento de seio maxilar, suas indicações clínicas e os critérios para

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reabilitação de maxilas atroficas. A perda dentária na região posterior da maxila, aliada à pneumatização do seio maxilar, resulta em volume ósseo insuficiente para a instalação de implantes, tornando o levantamento do assoalho sinusal uma técnica cirúrgica fundamental e previsível. A metodologia baseou-se em busca na base de dados PubMed, selecionando artigos dos últimos cinco anos em português e inglês. Os resultados indicam que a escolha entre a técnica de janela lateral e a abordagem transcrestal deve fundamentar-se na altura óssea residual, sendo a via lateral indicada para remanescentes menores que 4 a 5 mm. Destaca-se o avanço tecnológico com a técnica de osseodensificação e o uso de dispositivos piezoelétricos para redução de complicações, como a perfuração da membrana de Schneider. Quanto aos biomateriais, embora o osso autógeno seja o padrão-ouro, os xenoinxertos e o uso de concentrados plaquetários (L-PRF) apresentam excelentes resultados na aceleração da neoformação óssea e cicatrização. Conclui-se que o levantamento de seio maxilar é um procedimento seguro, desde que precedido por planejamento tridimensional criterioso, permitindo a reabilitação funcional satisfatória em pacientes com atrofia maxilar severa.

Palavras-chave: Levantamento do Seio Maxilar. Implantes Dentários. Biomateriais. Maxila Atrófica.

RESUMEN

El presente estudio consiste en una revisión bibliográfica narrativa que tiene como objetivo discutir las técnicas de elevación del seno maxilar, sus indicaciones clínicas y los criterios para la rehabilitación de maxilares atroficos. La pérdida dentaria en la región posterior del maxilar, asociada a la neumatización del seno maxilar, produce un volumen óseo insuficiente para la colocación de implantes, convirtiendo la elevación del piso sinusal en una técnica quirúrgica fundamental y predecible. La metodología se basó en una búsqueda en la base de datos PubMed, seleccionando artículos publicados en los últimos cinco años en portugués e inglés. Los resultados indican que la elección entre la técnica de ventana lateral y el abordaje transcrestal debe basarse en la altura ósea residual, siendo la vía lateral indicada para remanentes menores de 4 a 5 mm. Se destacan los avances tecnológicos con la técnica de osseodensificación y el uso de dispositivos piezoelétricos para reducir complicaciones, como la perforación de la membrana de Schneider. En cuanto a los biomateriales, aunque el hueso autógeno es el estándar de oro, los xenoinjertos y el uso de concentrados plaquetarios (L-PRF) presentan excelentes resultados en la aceleración de la neoformación ósea y la cicatrización. Se concluye que la elevación del seno maxilar es un procedimiento seguro, siempre que esté precedido por una planificación tridimensional rigurosa, permitiendo una rehabilitación funcional satisfactoria en pacientes con atrofia maxilar severa.

Palabras clave: Elevación del Seno Maxilar. Implantes Dentales. Biomateriales. Maxilar Atrófico.



1 INTRODUCTION

The rehabilitation of edentulous patients in the posterior region of the maxilla is often hampered by the presence of an insufficient amount of bone. This scenario is due to a combined process of alveolar ridge resorption after tooth loss and progressive pneumatization of the maxillary sinus (Alshamrani et al., 2023). To overcome these anatomical limitations and allow the installation of dental implants with primary stability, the maxillary sinus floor lift procedure has established itself as one of the most predictable techniques in contemporary implant dentistry (Alsharekh et al., 2024).

Rehabilitation of atrophic maxillae with implant-supported prostheses requires maxillary sinus floor augmentation procedures to ensure sufficient bone volume for implant placement and maintain their stability. The sinus lift procedure (also called sinus lift), or maxillary sinus floor augmentation, has been a standard technique in oral surgery and implant dentistry since its introduction by Tatum in 1976 and presented in its first publication by Boyne and James in 1980 (Radoslaw et al., 2024)

To fill the space created under the Schneider membrane (or sinus membrane), different bone graft materials are recommended and the most common ones that have been used include autogenous bone, allografts, xenografts and alloplastic materials. Although autogenous bone is considered the so-called "gold standard" due to its osteogenic, osteoinductive, and osteoconductive properties and characteristics, limitations related to donor site morbidity and limited availability have led to the development and use of these biomaterials as an alternative (Ada et al., 2022).

Over the past few decades, approaches have evolved from highly invasive techniques to more conservative and technologically advanced procedures. The choice between the lateral window technique (open access) and the transcrestal approach (closed access) is based primarily on the remaining bone height and the complexity of the case (Alshamrani et al., 2023). In addition, the integration of autologous platelet biomaterials and concentrates has sought to accelerate bone neoformation and reduce treatment time (Malcangi et al., 2023; Otero et al., 2022).

Oral rehabilitation with implants in the posterior region of the maxilla represents a frequent clinical challenge due to progressive alveolar bone resorption after tooth loss, associated with pneumatization of the maxillary sinus, factors that culminate in insufficient bone volume for the safe installation of dental implants. In view of this scenario, maxillary sinus floor lifting has established itself as a predictable surgical technique widely



supported by the scientific literature, with high rates of implant success and survival when correctly indicated and executed. Recent studies have shown that the choice of technique, whether for the lateral window approach or for the transcrestal approach, should be based on anatomical and biological criteria, especially in the residual bone height and in the morphology of the maxillary sinus, previously evaluated by means of three-dimensional imaging studies. In addition, the development of new technological and biological approaches, such as the use of osteoconductive biomaterials, autologous platelet concentrates, and less invasive surgical techniques, have provided relevant clinical benefits. These advances are directly related to the decrease in postoperative morbidity, the improvement of the bone formation process, and the increase in the predictability of results, consolidating maxillary sinus lift as a safe and fundamental alternative for the rehabilitation of patients with atrophic maxillae (Alshamrani et al., 2023; Alsharekh et al., 2024; Malcangi et al., 2023; Otero et al., 2022).

This review aims to discuss the main techniques for maxillary sinus lifting, their clinical indications, and the biological and anatomical criteria that govern the success of rehabilitation in atrophic maxillae.

2 METHODOLOGY

The present study is characterized as a narrative literature review, developed with the aim of synthesizing and analyzing the most recent scientific evidence related to maxillary sinus lifting and atrophic maxillary rehabilitation techniques. The search was carried out in the PubMed database, using the descriptors "Maxillary sinus lift" and "Procedures", combined by means of the Boolean operators AND and OR, according to the terminology of Medical Subject Headings (MeSH). Articles published in the last five years, available in full and written in Portuguese or English, that directly addressed the topic, were included. Studies that did not have a direct relationship with maxillary sinus management, duplicate publications, narrative reviews with low methodological rigor, and articles not indexed in the database used were excluded. The selection of studies was conducted in two stages: screening of titles and abstracts, followed by the evaluation of full texts to confirm relevance. The information extracted was organized in a descriptive and qualitative way.



3 RESULTS AND DISCUSSION

The technical literature highlights that the anatomy of the maxillary sinus, including the thickness of the lateral wall and the presence of septa, is determinant for surgical predictability. Accurate morphological classifications help the surgeon to anticipate difficulties and select the appropriate instruments (Jadach et al., 2024). Currently, the two main access routes have different indications: the lateral window technique is preferred when the residual bone height is less than 4 or 5 mm, while the transcrestal technique is indicated for lower elevations, aiming to optimize the primary stability of the implant (Alshamrani et al., 2023; Alsharekh et al., 2024).

The choice between the maxillary sinus lift technique by lateral window or the transcrestal approach should be based on well-defined clinical and anatomical criteria, with residual bone height being one of the determining factors for decision making. In general, the literature indicates that the lateral window technique is more predictable in situations in which the remaining bone height is less than 4–5 mm, allowing greater control of the elevation of the Schneider membrane and the volume of graft inserted. On the other hand, the transcrestal approach is adequate in cases with higher residual bone height, in which a more limited elevation is sought, associated with the simultaneous installation of the implant and the achievement of primary stability. In this context, cone beam computed tomography plays a fundamental role in planning, enabling the three-dimensional evaluation of the anatomy of the maxillary sinus, the presence of septa, and the available bone thickness, reducing the risk of complications and contributing to the predictability of the procedure (Alshamrani et al., 2023; Alsharekh et al., 2024).

One of the most discussed innovations is the osseodensification technique. Unlike traditional osteotomy that removes tissue, the use of specific drills in reverse mode promotes the compaction of the trabecular bone against the walls of the osteotomy, significantly increasing local bone density and facilitating the elevation of the sinus floor in a less traumatic way (Gaspar et al., 2024). In addition, the use of autologous platelet concentrates, such as Platelet and Leukocytes-Rich Fibrin (L-PRF), has shown significant clinical benefits. These biomaterials function as reservoirs of growth factors, accelerating soft tissue healing and enhancing bone gain when associated with grafts (Malcangi et al., 2023; Otero et al., 2022).

Among the biomaterials most routinely used in maxillary sinus augmentation, xenografts stand out, widely used due to their high availability, adequate biocompatibility,



low degradation rate, and limited but predictable osteoconductive potential. In addition to xenografts, allografts and alloplastic materials have also been used; however, these may present specific unfavorable characteristics that are not observed in xenografts, which justifies the preference for the latter as the main biomaterials in maxillary sinus lift procedures. At the same time, studies involving guided bone regeneration (GBR) have been widely conducted, often with the use of collagenous barriers, with the purpose of isolating soft tissues and favoring bone neoformation, a strategy commonly associated with maxillary sinus augmentation techniques. In order to establish protocols that promote hemostasis and accelerate the healing process, fibrin has been widely investigated as a biomaterial. It is an easy-to-obtain and accessible resource for both patients and health professionals. The use of fibrin as an adjuvant biomaterial has shown favorable results in several studies, since it contributes to the increase of the local concentration of growth factors, promoting a more efficient and predictable healing. (Otero, A. I. P. et al., 2022).

Despite the high success rate, intraoperative complications should not be neglected, with Schneider's membrane perforation being the most common (Alshamrani et al., 2023). The literature indicates that small perforations can be managed with the use of collagen membranes or sutures, and that, if properly treated, they do not necessarily compromise the long-term survival of the implants installed (Díaz-Olivares et al., 2021). Technological evolution, including the use of piezoelectric devices and balloon lifting techniques, has contributed to the reduction of these complications, making the maxillary sinus lift procedure an indispensable and safe tool for the functional rehabilitation of patients with severe maxillary atrophy (Alsharekh et al., 2024).

4 CONCLUSION

In light of the evidence analyzed in this narrative review, it is observed that maxillary sinus floor lifting endures as a predictable, safe surgical procedure that is widely based on the scientific literature for the rehabilitation of atrophic maxillae. An in-depth understanding of the anatomical, biological and technical factors involved is crucial for the success of the treatment, reinforcing the need for careful and individualized planning.

Placing implants in the back of the maxilla can be hampered by the lack of bone, especially after long periods without teeth. The studies analyzed show that procedures to increase the amount of bone make this type of treatment possible, as long as the planning is done carefully and individually.



The available surgical techniques present good results when chosen according to the condition of each patient. Broader procedures allow for greater bone gain and are indicated in more complex cases, although they require greater experience from the professional. Complications involving the maxillary sinus can occur, however, when well conducted, they usually do not compromise the success of the implants.

Regarding the materials used, in addition to the patient's own bone, other options have shown positive results. The use of biological materials obtained from the body itself has been shown to be useful for helping healing, favoring the formation of new bone and reducing recovery time. Despite the advances, there are still important differences between the methods used in the studies, which reinforces the need for new research with more standardized criteria and follow-up for longer periods.

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