

**SHORT IMPLANTS VERSUS BONE GRAFTING: ALTERNATIVES FOR THE
REHABILITATION OF ATROPHIC MAXILLAE**

**IMPLANTES CURTOS VERSUS ENXERTIA ÓSSEA: ALTERNATIVAS PARA A
REABILITAÇÃO DE MAXILAS ATRÓFICAS**

**IMPLANTES CORTOS VERSUS INJERTOS ÓSEOS: ALTERNATIVAS PARA LA
REHABILITACIÓN DE MANDÍBULOS ATRÓFICOS**

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ABSTRACT

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The rehabilitation of atrophic posterior maxillae is a challenge due to bone resorption and sinus pneumatization. Traditionally, sinus floor elevation and bone grafting are performed to enable placement of long implants, although these procedures increase morbidity, costs, and treatment time. In this context, short implants have emerged as a less invasive alternative. The aim of this study was to review the literature comparing short implants with long implants associated with grafting, evaluating survival rates, marginal bone loss, complications, clinical time, costs, and patient satisfaction. A narrative review was carried out in PubMed, Scopus, Web of Science, SciELO, and Cochrane, including studies published between 2014 and 2025. Results indicate that short implants achieve survival rates comparable to long implants, with additional advantages such as reduced morbidity, shorter surgical time, and favorable economic impact. However, in cases of severe atrophy with residual bone height below 4 mm, grafting procedures remain necessary to ensure primary stability. In conclusion, short implants represent a predictable, safe, and cost-effective option for the rehabilitation of atrophic maxillae, provided that case selection is performed carefully.

Keywords: Dental Implants. Short Dental Implants. Maxilla. Bone Grafting. Treatment Outcome.

RESUMO

A reabilitação de maxilas posteriores atróficas é um desafio devido à reabsorção óssea e à pneumatização do seio maxilar. Tradicionalmente, o levantamento de seio e a enxertia óssea são utilizados para possibilitar a instalação de implantes longos, embora impliquem maior morbidade, custos elevados e tempo de tratamento prolongado. Nesse contexto, os implantes curtos surgem como alternativa menos invasiva. O objetivo deste estudo foi revisar a literatura comparando implantes curtos e implantes longos associados a enxertia, avaliando taxas de sobrevivência, perda óssea marginal, complicações, tempo clínico, custos e satisfação dos pacientes. Foi realizada revisão narrativa em bases como PubMed, Scopus, Web of Science, SciELO e Cochrane, incluindo estudos publicados entre 2014 e 2025. Os resultados demonstram que implantes curtos apresentam taxas de sobrevivência equivalentes às dos implantes longos, com vantagens adicionais relacionadas à menor morbidade, redução do tempo cirúrgico e impacto econômico favorável. Contudo, em casos de atrofia severa, nos quais a altura óssea residual é inferior a 4 mm, os procedimentos de enxertia continuam sendo necessários para garantir estabilidade primária. Conclui-se que os implantes curtos constituem uma opção previsível, segura e custo-efetiva para a reabilitação de maxilas atróficas, desde que indicados de forma criteriosa.

Palavras-chave: Implantes Dentários. Implantes Dentários Curtos. Maxila. Enxerto Ósseo. Resultado do Tratamento.

RESUMEN

La rehabilitación de los maxilares posteriores atróficos es un desafío debido a la reabsorción ósea y la neumatización del seno maxilar. Tradicionalmente, se utilizan elevaciones de seno e injertos óseos para facilitar la colocación de implantes largos, aunque conllevan mayor morbilidad, altos costos y tiempos de tratamiento prolongados. En este contexto, los implantes cortos surgen como una alternativa menos invasiva. El objetivo de este estudio fue revisar la literatura que compara los implantes cortos y los implantes largos asociados con injertos, evaluando las tasas de supervivencia, la pérdida ósea marginal, las complicaciones, el tiempo clínico, los costos y la satisfacción del paciente. Se realizó una revisión narrativa en bases de datos como PubMed, Scopus, Web of Science, SciELO y

Cochrane, incluyendo estudios publicados entre 2014 y 2025. Los resultados demuestran que los implantes cortos tienen tasas de supervivencia equivalentes a las de los implantes largos, con ventajas adicionales relacionadas con una menor morbilidad, un menor tiempo quirúrgico y un impacto económico favorable. Sin embargo, en casos de atrofia severa, donde la altura ósea residual es inferior a 4 mm, los procedimientos de injerto siguen siendo necesarios para garantizar la estabilidad primaria. Se concluye que los implantes cortos constituyen una opción predecible, segura y rentable para la rehabilitación de maxilares atróficos, siempre que se seleccionen cuidadosamente.

Palabras clave: Implantes Dentales. Implantes Dentales Cortos. Maxilar. Injerto Óseo. Resultado del Tratamiento.

1 INTRODUCTION

Prosthetic rehabilitation of posterior regions of the maxilla is often challenged by vertical ridge resorption and maxillary sinus pneumatization, which reduce residual bone height and hinder the installation of standard-length implants. Historically, maxillary sinus floor lifting (lateral or transcrestal approaches), associated or not with bone grafts, has been consolidated as a strategy to enable longer implants in these areas, with success rates widely documented in systematic reviews (ESPOSITO et al., 2014).

Although predictable, sinus augmentation procedures add treatment time, costs, and morbidity (e.g., pain, edema), in addition to the risk of perforation of Schneider's membrane, sinusitis and graft failures; the choice of technique depends on anatomical factors such as lateral wall thickness, contour and sinus health (ESPOSITO et al., 2014; LYU et al., 2023).

In this context, short implants have emerged as a less invasive alternative for posterior atrophic maxillae, with different definitions in the literature (≤ 6 mm according to ITI consensuses and, in some reviews, $\leq 6-8$ mm). The ITI Consensus concluded that short implants (≤ 6 mm) are a valid option to avoid the morbidity of bone augmentations in situations of reduced height, although with greater variability in survival rates; recent reviews reiterate that considering RBH (residual bone height) and sinus anatomy is fundamental in decision making (JUNG et al., 2018; LYU et al., 2023; TOLEDANO et al., 2022).

Evidence from randomized controlled trials supports the clinical non-inferiority of short implants compared to longer implants placed after sinus lift. In a 3-year RCT, 6-mm implants showed similar survival to $10 \geq$ mm implants in grafted bone, with less marginal bone loss and lower time/cost (BECHARA et al., 2017). In a 5-year multicenter study, there were no significant differences in survival, marginal bone levels, and biological/technical parameters, with improved quality of life in both groups (THOMA et al., 2018).

Systematic reviews and meta-analyses corroborate these findings. Quantitative syntheses indicate comparable survival rates between short and long+lift, with a tendency towards less marginal bone loss and fewer biological complications in short (YAN et al., 2019; TOLEDANO et al., 2022; MESTER et al., 2023). Additional meta-analysis reports equivalent results at 5 years for fixed prostheses supported by short implants (< 8 mm) versus $8 \text{ mm} \geq$ implants with floor lift (WANG et al., 2022).

From a patient- and health-system-centered perspective, short implants can reduce the number of surgical steps, total treatment time, and direct costs while maintaining similar

clinical outcomes, benefits documented in both RCT and meta-analyses (BECHARA et al., 2017; TOLEDANO et al., 2022; MESTER et al., 2023).

Still, case selection is decisive. Evidence reviews and decision-making algorithms suggest that, for RBH between 4–6 mm, less invasive approaches (e.g., transcrestal) and/or short implants may be preferable; in very low RBH ($\leq 2\text{--}4$ mm) or unfavorable anatomical scenarios (thick walls, septa, diseased mucosa), lateral approach and grafting maintain an important role (LYU et al., 2023; JUNG et al., 2018).

From the point of view of longevity, most comparative trials report medium-term follow-up (3–5 years). While there is consistent 5-year data showing clinical equivalence (THOMA et al., 2018), long-term reviews of sinus lifts reinforce its effectiveness ≥ 5 years, which highlights the need for studies with ≥ 10 years directly comparing strategies (RAGHOEBAR et al., 2019). Thus, caution is recommended in high occlusal loads, careful prosthetic planning, and extended follow-up (THOMA et al., 2018; RAGHOEBAR et al., 2019).

In view of this scenario, the present study aims to critically review the literature comparing short implants versus standard implants with sinus grafting/lifting in the rehabilitation of atrophic maxillae, focusing on survival, marginal bone loss, complications, time/costs, and reported outcomes by the patient, aiming to guide evidence-based clinical decisions (YAN et al., 2019; TOLEDANO et al., 2022; THOMA et al., 2018).

2 METHODOLOGY

This is a narrative review of the literature, based on the analysis of high-level scientific studies, including randomized clinical trials, systematic reviews, and meta-analyses, which compared short implants ($\leq 6\text{--}8$ mm) to implants of standard length ($\geq 8\text{--}10$ mm) installed in association with bone grafting and/or maxillary sinus floor lifting techniques in atrophic posterior maxillae. The choice for the narrative review is due to the possibility of critically integrating the results of different designs, associating quantitative data and relevant clinical consensus, allowing a comprehensive synthesis of the theme (GREEN; JOHNSON; ADAMS, 2006).

The bibliographic search was conducted in the main indexing databases in health and dentistry, namely: PubMed/MEDLINE, Scopus, Web of Science, SciELO and Cochrane Library, chosen for their international coverage and high relevance in the area. Articles published between January 2014 and September 2025 were included, a period in which clinical studies and systematic reviews with the greatest impact on the topic are concentrated.

This time frame sought to ensure the inclusion of up-to-date and comparable evidence, since in the last two decades there has been significant progress in the development of short implants and in the improvement of grafting techniques (YAN et al., 2019; TOLEDANO et al., 2022).

The search strategy was developed from standardized descriptors in the DeCS/MeSH vocabularies, combined by Boolean operators. Terms such as *Dental Implants*, *Short Dental Implants*, *Maxilla*, *Maxillary Sinus*, *Sinus Floor Augmentation*, *Bone Grafting*, *Atrophy* and *Treatment Outcome* were used. In PubMed, the formula applied was: ("Dental Implants"[MeSH]) AND ("Short Dental Implants" OR "Short Implants") AND ("Maxilla"[MeSH] OR "Maxillary Sinus"[MeSH]) AND ("Sinus Floor Augmentation" OR "Bone Grafting") AND ("Treatment Outcome"). Analogous strategies were adapted to the other databases, respecting their specificities (WANG et al., 2022; JUNG et al., 2018).

Studies that presented a direct comparison between short implants and long implants with grafting and/or breast lifting, with a minimum clinical follow-up of 12 months, were considered eligible. In addition, they were required to report at least one of the following outcomes: implant survival rate, marginal bone loss, biological or technical complications, treatment time, associated costs, or patient-reported outcomes. Multicenter randomized controlled trials, such as those by BECHARA et al. (2017) and THOMA et al. (2018), were prioritized because they provide high-quality evidence on the equivalence of outcomes between the two approaches.

Case reports, case series without a comparative group, retrospective studies with a low level of evidence, narrative reviews without clear search criteria, and purely laboratory or biomechanical studies without clinical outcomes were excluded. Studies that did not clearly discriminate the residual bone height or the grafting protocol adopted were also disregarded, given that such variables directly impact the predictability of the results (ESPOSITO et al., 2014; RAGHOEBAR et al., 2019).

Data extraction focused on central methodological and clinical aspects: sample characteristics, residual bone height, type and size of implants, surgical technique employed, follow-up time, survival rates, levels of marginal bone loss, occurrence of biological or technical complications, treatment time and costs, as well as parameters related to patient perception and satisfaction. These elements were analyzed qualitatively and comparatively, seeking to establish a critical overview of the effectiveness and applicability of short implants

compared to traditional grafting and sinus lift techniques (TOLEDANO et al., 2022; MESTER et al., 2023).

3 LITERATURE REVIEW AND RESULTS

Rehabilitation of the atrophic posterior maxilla has historically been one of the greatest challenges in implant dentistry, due to the combination of maxillary sinus pneumatization and physiological bone resorption after tooth loss. The maxillary sinus lift, either by the lateral technique or by the transcrestal approach, has been consolidated as a standard procedure to enable conventional implants (≥ 10 mm), often associated with the use of autogenous grafts or biomaterials. This intervention has well-documented success rates, but implies longer treatment time, high costs, and risk of complications, such as sinus membrane perforation and graft failure (ESPOSITO et al., 2014).

With advances in the design and surfaces of implants, the proposal for the use of short implants emerged, generally defined as those ≤ 6 mm in length, although some authors consider up to 8 mm. Initially, these implants presented less predictable results, due to the smaller bone-implant contact area. However, innovations in surfaces, such as blasting and acid etching treatments, as well as bioactive coatings, and in macrodesign, with optimized threads for greater stability, have increased their predictability. Currently, international consensuses, such as the ITI Consensus Report, consider short implants a valid option in atrophic posterior regions, as long as there is sufficient residual bone height to ensure primary stability, although durability in follow-ups of more than five years is still a matter of debate (JUNG et al., 2018).

Randomized controlled trials have directly compared short implants and long implants with grafting. In a prospective study with three years of follow-up, BECHARA et al. (2017) demonstrated a survival rate of 100% for short 6 mm implants, versus 95% for long implants after lateral sinus lift, with no statistically significant differences. In addition, short implants showed lower marginal bone loss and reduced costs. Similarly, in a multicenter study with five years of follow-up, THOMA et al. (2018) did not observe significant differences in survival (98.5% vs. 100%), marginal bone levels, or complications, concluding that both strategies provide improved quality of life for patients.

These findings have been reinforced by systematic reviews and meta-analyses. YAN et al. (2019), in a review published in *BMJ Open*, concluded that short implants had survival rates similar to those of long implants in grafted areas, with a tendency to lower marginal

bone loss and lower postoperative morbidity. TOLEDANO et al. (2022) identified equivalent results in failures and complications, but with a lower incidence of biological problems in short implants, recommending them as a valid clinical option in cases of limited bone height. In a similar vein, MESTER et al. (2023) reported not only equivalence in survival rates, but also lower mean marginal bone loss and lower prevalence of biological complications compared to long implants, with no difference in prosthetic complications.

Network meta-analyses have expanded the comparison between modalities. ZHANG et al. (2024) demonstrated that both short implants and long implants with grafting have similar clinical efficacy, although with different complication profiles: short implants were associated with a lower risk of failures related to biological complications, while long implants, in certain scenarios, revealed a lower risk of mechanical problems. These results reinforce the need to individualize the therapeutic choice, considering residual bone height and quality, prosthetic demands, and patient risk factors.

In terms of specific complications, sinus lift presents risks such as perforation of the Schneider membrane, reported in up to 30% of cases, in addition to greater postoperative morbidity and prolongation of the time until the installation of the definitive prosthesis. Short implants, on the other hand, reduce these risks, but may present greater biomechanical vulnerability in overload situations, especially in rehabilitation with extensive cantilevers or in patients with uncontrolled parafunctional habits (RAGHOEBAR et al., 2019).

From an economic point of view, short implants stand out as a cost-effective option. BECHARA et al. (2017) observed that this modality reduced clinical time and treatment costs, while TOLEDANO et al. (2022) reinforced that lower morbidity and speed of rehabilitation contribute to greater acceptance by patients. In private contexts, where factors such as postoperative time and comfort are valued, short implants can represent a competitive advantage.

Still, case selection remains decisive. In patients with extremely limited residual bone height (< 4 mm), the literature reinforces the need for grafting and sinus lifting, since the primary stability of short implants can be compromised in these situations. Long-term systematic reviews, such as the one by RAGHOEBAR et al. (2019), demonstrate that breast lifts maintain high success rates even after ten years of follow-up, highlighting that this technique is still irreplaceable in certain scenarios.

Therefore, the contemporary literature demonstrates that short implants are a safe and effective alternative for the rehabilitation of atrophic maxillae, offering results equivalent to

those obtained with long implants associated with grafting. Its advantages include lower morbidity, reduced treatment time, lower costs, and greater patient acceptance. However, the clinical decision must be individualized, considering anatomical, functional and prosthetic factors. Although the medium-term results are consistent, the scarcity of studies with a follow-up of more than ten years requires caution before their unrestricted adoption as a universal substitute for grafting procedures (THOMA et al., 2018; TOLEDANO et al., 2022).

4 DISCUSSION

The results of this review indicate that short implants have a clinical performance comparable to long implants associated with grafting and sinus lift in medium-term follow-ups. However, the in-depth analysis must consider biomechanical aspects, the patient's perspective, and the economic impact, as these factors directly influence the clinical choice and applicability of the technique.

From a biomechanical point of view, short implants tend to have a higher crown-to-implant ratio, which can raise concerns in terms of overload. In extensive rehabilitation, especially when cantilever is present, the risk of technical failures increases due to the unfavorable distribution of masticatory forces. Clinical studies have shown that, although the survival rate of short implants is high, the control of prosthetic factors is essential to avoid overloads and complications, and it is recommended to reduce the length of the cantilevers, the balanced distribution of the implants, and the use of stable prosthetic connections (RAGHOEBAR et al., 2019; JUNG et al., 2018). In patients with bruxism or parafunctional habits, the indication of short implants should be done with caution, considering occlusal protection strategies, such as the use of stabilizing plates.

From the patient's perspective, short implants have clear advantages. The absence of grafting and sinus lift procedures significantly reduces postoperative morbidity, pain, and recovery time. Quality of life questionnaires have shown that both short implants and long grafted implants provide similar functional and aesthetic benefits, but patients undergoing less invasive rehabilitation report greater overall satisfaction, especially due to the shorter time until prosthesis installation and the reduction of postoperative complications (THOMA et al., 2018; BECHARA et al., 2017). This positive perception is decisive in clinical decision-making, as many patients prioritize comfort, speed, and predictability, even though long-term durability remains under evaluation.

The economic impact should also be considered as a criterion for therapeutic decision. Short implants reduce direct costs, since they do not require biomaterials for grafting or specific instruments for sinus lifting, in addition to requiring less surgical time. They also reduce indirect costs, related to fewer consultations, shorter time away from activities, and reduced need for postoperative medications (BECHARA et al., 2017; TOLEDANO et al., 2022). In contrast, grafting procedures, while highly predictable in cases of severe atrophy, represent greater financial investment for patients and health systems. This differential makes short implants a cost-effective strategy in clinical contexts where there is moderate residual bone height, and can contribute to expanding access to rehabilitation treatments.

Thus, by integrating biomechanical analysis, patient experience, and economic aspects, it is observed that short implants represent not only a valid clinical alternative, but also a solution that meets criteria of predictability, efficiency, and acceptability. However, its indication should be individualized, avoiding generalizations that may compromise the long-term result.

Thus, the current literature confirms that short implants can safely replace grafting procedures in many cases of atrophic maxillae, provided that specific anatomical, functional, and prosthetic criteria are observed. This scenario reinforces the need for the therapeutic decision to be guided by a balance between scientific evidence, clinical experience, and patient expectations, paving the way for the practical recommendations presented in the conclusion.

5 CONCLUSION

Short implants have established themselves as a predictable and safe alternative for the rehabilitation of atrophic maxillae, offering clinical results equivalent to those obtained with long implants associated with bone grafting and sinus lifting. In addition to the equivalence in survival rates and marginal bone stability, important advantages stand out, such as lower surgical morbidity, reduced treatment time, and favorable economic impact, factors that directly contribute to patient satisfaction and acceptance.

Despite the benefits, its indication should not be indiscriminate. In situations of severe atrophy, in which the residual bone height does not allow adequate primary stability, grafting techniques remain indispensable. In addition, biomechanical aspects, such as the crown-implant relationship and the risk of overload in extensive rehabilitations, require attention in prosthetic planning to ensure longevity of the results.

Therefore, it is concluded that short implants represent a cost-effective and less invasive clinical solution in cases of moderately reduced bone height, and should be considered as the first therapeutic option whenever anatomical, functional and prosthetic conditions allow. Future research, especially multicenter studies with a follow-up of more than ten years, will be fundamental to definitively consolidate this approach and expand its applicability in different clinical contexts.

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