REVISTA INVECOM
ISSN en línea: 2739-0063

Efficacy of cartilaginous graft use in rhinoplasty: a systematic review

Eficacia del uso del injerto cartilaginoso en rinoplastia: una revisión sistemática

Received: 07/04/2025 - **Accepted:** 05/07/2025

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Abstract

This study analyzes the efficacy of the use of cartilaginous grafts in rhinoplasty, comparing them with conventional rhinoplasty in terms of aesthetic and functional results. A systematic review was performed using PRISMA methodology, with a search in biomedical databases such as PubMed, Scopus, ScienceDirect and SciELO. Original studies published between 2015 and 2025 were included; strict inclusion criteria were also established to ensure the methodological quality of the 30 selected studies. The results show that cartilage grafts improve nasal stability and functionality, with autologous cartilage being the most widely used option due to its biocompatibility. However, costal cartilage presents risks of postoperative deformation, and synthetic or allogeneic alternatives require further validation. In conclusion, graft selection should be individualized, considering both structural benefits and possible risks. Rhinoplasty should not only focus on aesthetics, but also on improving respiratory function. Advances in tissue engineering could revolutionize this field, but its clinical implementation still requires further studies to ensure its long-term safety and efficacy.

Keywords: Rhinoplasty, grafts, aesthetics.

Resumen

Este estudio analiza la eficacia del uso de injertos cartilaginosos en rinoplastia, comparándolos con la rinoplastia convencional en términos de resultados estéticos y funcionales. Se realizó una revisión sistemática utilizando la metodología PRISMA, con una búsqueda en bases de datos biomédicas como PubMed, Scopus, ScienceDirect y SciELO. Se incluyeron estudios originales publicados entre 2015 y 2025, también se establecieron criterios de inclusión estrictos para garantizar la calidad metodológica de los 30 estudios seleccionados. Los resultados evidencian que los injertos cartilaginosos mejoran la estabilidad y funcionalidad nasal, siendo el cartílago autólogo la opción más utilizada por su biocompatibilidad. Sin embargo, el cartílago costal presenta riesgos de deformación posoperatoria, y las alternativas sintéticas o alogénicas requieren mayor validación. Como conclusión, la selección del injerto debe ser individualizada, considerando tanto los beneficios estructurales como los posibles riesgos. La rinoplastia no solo debe enfocarse en la estética, sino también en la mejora de la función respiratoria. Avances en ingeniería de tejidos podrían revolucionar este campo, pero su implementación clínica aún requiere más estudios para garantizar su seguridad y eficacia a largo plazo.

Palabras clave: Rinoplastia, injertos, estética.

Introduction

Rhinoplasty is one of the most commonly performed surgical procedures in plastic and reconstructive surgery, aimed at improving both respiratory function and nasal aesthetics (Casanueva, 2016). Over time, the techniques employed in this surgery have evolved from reductive approaches to structural methods that seek to preserve and reinforce nasal anatomy. In this context, the use of cartilage grafts has gained significant relevance, as it enhances stability, projection, and symmetry of the nose, particularly in patients with fragile nasal structures or those undergoing secondary rhinoplasties (Espinosa et al., 2017).

Cartilage grafts can be obtained from various sources, with septal, auricular, and costal cartilage being the most commonly utilized. Each of these materials presents specific advantages and challenges; however, their use has generally proven to be a fundamental tool in nasal reconstruction. In addition to providing structural support, these grafts can improve airway functionality, reducing the risk of postoperative nasal collapse (Wang et al., 2023). Nonetheless, their implementation is not without complications, as there is a possibility of partial resorption, graft mobility, or the need for additional procedures to obtain the cartilage material.

Despite advancements in surgical techniques and the extensive experience accumulated in this field, a debate persists regarding the necessity and efficacy of using grafts compared to conventional rhinoplasty, which aims to improve nasal structure without incorporating additional materials (Gentile & Cervelli, 2022). In this regard, it is essential to analyze the available scientific evidence to determine in which cases the use of cartilage grafts represents a significant advantage and in which cases their application may not be indispensable.

In light of this question, the present article aims to examine the efficacy of using cartilage grafts in rhinoplasty, describing their benefits, limitations, and potential complications. Through a systematic review of the literature, we seek to provide a comprehensive and evidence-based perspective on the impact these grafts can have on the aesthetic and functional outcomes of nasal surgery.

Methodology

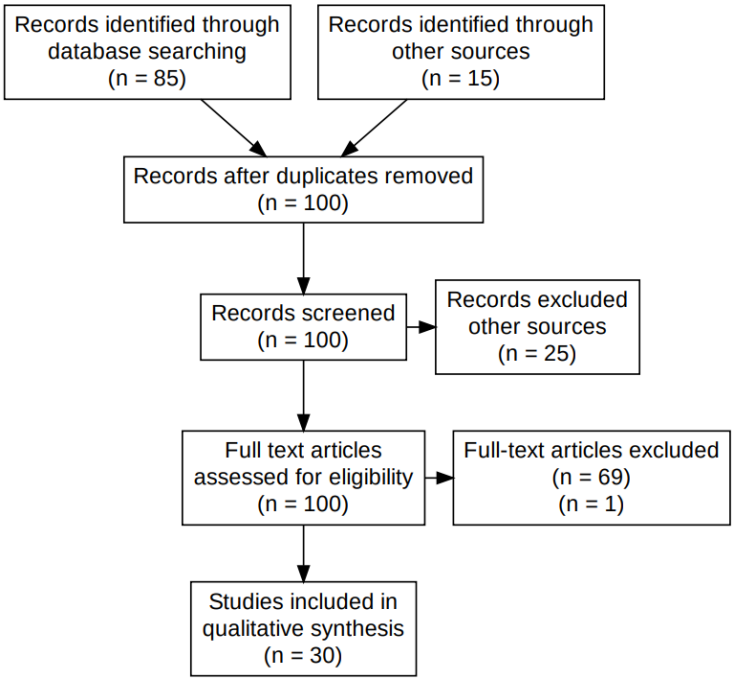
To conduct this article, a systematic review was carried out following the PRISMA methodology, which allows for a comprehensive view of the existing literature, highlighting the most relevant findings regarding functional and aesthetic outcomes, as well as the advantages and limitations of each surgical technique.

The information search was performed in recognized scientific databases in the biomedical field, including PubMed, Scopus, ScienceDirect, and SciELO, to ensure broad and representative coverage of the most recent studies. Specific descriptors were utilized in both English and Spanish, following the controlled terms of the Medical Subject Headings (MeSH) and Health Sciences Descriptors (DeCS) thesauri. Some of the terms employed included "Rhinoplasty," "cartilaginous graft," "nasal cartilage graft," "autologous graft in rhinoplasty," "functional outcomes in rhinoplasty," "aesthetic outcomes in rhinoplasty," as well as their Spanish equivalents.

The search period encompassed the last ten years, covering from 2014 to 2024, to include the most recent and relevant studies in the evolution of rhinoplasty surgical techniques. No language restrictions were applied, in order to maximize the inclusion of relevant literature across different clinical and population contexts.

To ensure the quality and relevance of the selected studies, inclusion and exclusion criteria were established. Only original studies, such as clinical trials, observational studies, systematic reviews, and meta-analyses comparing conventional rhinoplasty with the use of cartilage grafts, were considered. Additionally, articles published in indexed journals with clearly described methodologies reporting functional and/or aesthetic outcomes in patients undergoing rhinoplasty were prioritized. Conversely, letters to the editor, isolated case reports, and expert opinions lacking empirical support, as well as studies with small sample sizes or deficient methodologies that lacked rigorous statistical analysis, were excluded. Duplicate works or those with redundant information were also discarded.

Figure 1
PRISMA methodology



The selected articles are presented in the following table along with their authors and titles:

Table 1
Articles and authors

	Authors	Title
1	Casanueva, (2016)	Nasal tip grafts in primary rhinoplasty
2	Chau, (2024)	Rhinoplasty surgery with sculpted silicone nasal tip graft performed in a clinic in Lima, Peru in 2022
3	Anchan & Naik, (2018)	Efficacy of diced cartilage graft in dorsal augmentation rhinoplasty and comparison with solid block cartilage
4	Costa et al. (2015)	The bundle of twigs cartilage graft for augmentation of the nasal dorsum
5	Espinosa et al., (2017)	Sculpted cartilaginous grafts in primary rhinoplasty
6	Gentile & Cervelli, (2022)	Nasal Tip Remodeling Using Autologous Cartilage Grafts: Systematic Review
7	Harutyunyan & Hakobyan, (2025)	Dorsal Augmentation Rhinoplasty by Cartilage Allograft
8	Hassan et al., (2023)	Nose dorsum augmentation with diced cartilage graft versus Block cartilage graft in mild saddle nose.
9	Ho et al., (2018)	Cartilage Graft Donor Site Morbidity following Rhinoplasty and Nasal Reconstruction
10	Jiang et al., (2024)	Current practice in autologous rib and costal-cartilage harvest for rhinoplasty: A systematic review
11	Kandulu, (2023)	Revision rhinoplasty with free diced cartilage grafts: Outcome evaluations with the Nasal Obstruction Symptom Evaluation (NOSE) scale: Outcome of revision rhinoplasty
12	Karpiuk et al., (2024)	Tissue engineering approach to the creation of grafting material for rhinoplasty: clinical case reports
13	Ledo et al., (2021)	Outcome of Free Diced Cartilage Grafts in Rhinoplasty: A Systematic Review
14	Lopes et al., 2011)	Single block costal cartilage graft in rhinoplasty

15	Manafi et al., (2017)	Evidence-Based Efficacy of Autologous Grated Cartilage in Primary and Secondary Rhinoplasty
16	Nikparto et al., (2024)	The current techniques in dorsal augmentation rhinoplasty: a comprehensive review
17	Nuara et al., (2016)	Reconstructive Rhinoplasty Using Multiplanar Carved Costal Cartilage
18	Ortega F et al., (2017)	Costal graft for nasal reconstruction: Six-year experience at San Juan de Dios Hospital
19	Park et al., (2023)	Asian rhinoplasty using a thin rib cartilage graft and ultrafine diced cartilage wrapped in fascia: A comparative study between septal cartilage graft and rib cartilage graft
20	Perry & Adesida, (2024)	Tissue Engineering Nasal Cartilage Grafts with Three-Dimensional Printing: A Comprehensive Review
21	Rajbhandari & Kao, (2021)	Costal Cartilage Graft in Asian Rhinoplasty: Surgical Techniques
22	Read et al., (2018)	The Use of Allogeneic Cartilage for Grafting in Functional and Reconstructive Rhinoplasty
23	Salzano et al., (2024)	Fresh Frozen Homologous Rib Cartilage: A Narrative Review of a New Trend in Rhinoplasty
24	Segreto et al., (2024)	Mechanically fragmented cartilage grafts in rhinoplasty: An up-to-date systematic review
25	Shafik et al., (2020)	Evaluation of the effectiveness of the use of free diced cartilage in dorsal and tip nasal rhinoplasty
26	Szychta, (2024)	Enhanced revision rhinoplasty with processed costal cartilage guided by preoperative computed tomography and 3D scanning
27	Taş, (2021)	Ultra Diced Cartilage Graft in Rhinoplasty: A Fine Tool
28	Trivisonno et al., (2019)	Fluid Cartilage as New Autologous Biomaterial in the Treatment of Minor Nose Defects: Clinical and Microscopic Difference Amongst Diced, Crushed, and Fluid Cartilage
29	Vidal et al., (2015)	Diced cartilage graft to increase the nasal radix
30	Wang et al., (2023)	A Modified Technique in Rhinoplasty: A Septal Extension Graft Complex Using Septal Cartilage, Ethmoid Bone, and Auricular Cartilage

Results and discussion

Rhinoplasty has significantly evolved over time, and the use of cartilage grafts has become a crucial tool in the pursuit of high-precision aesthetic and functional outcomes. This systematic review explored thirty studies addressing various surgical techniques and graft materials, highlighting the efficacy of cartilage compared to conventional procedures. The findings reveal not only a notable technical advancement but also a diversification in graft sources and modalities, indicating a trend toward more personalized and safer nasal surgery.

One of the first aspects that stands out is the diversity of applications for cartilage grafting. Casanueva (2016) and Espinosa et al. (2017) reported satisfactory outcomes in primary rhinoplasties, particularly in defining the nasal tip. Complementarily, Chau (2024) introduced the application of synthetic grafts, such as sculpted silicone, which, although not autologous, provide a viable alternative in selected cases. Meanwhile, Gentile and Cervelli (2022) identified that the use of autologous grafts significantly improves nasal symmetry, while Karpiuk et al. (2024) and Perry and Adesida (2024) ushered in a new era of grafts generated through bioengineering and 3D technology, shaping a promising horizon in nasal tissue regeneration.

Crushed cartilage has gained prominence as a technique that optimizes tissue integration and minimizes the risk of resorption. Anchan and Naik (2018) demonstrated its advantages over solid grafts, while Ledo et al. (2021) and Segreto et al. (2024) supported its efficacy in secondary rhinoplasties, where tissue quality and availability are critical. Taş (2021) and Trivisonno et al. (2019) proposed innovative modalities such as ultra-crushed cartilage and fluid cartilage, respectively, which expand reconstructive possibilities with a less invasive approach. Similarly, Shafik et al. (2020) observed functional and aesthetic improvements when applying crushed grafts to both the tip and dorsum of the nose.

Costal cartilage emerges as an essential pillar in cases requiring a substantial volume of graft. Nuara et al. (2016), Lopes et al. (2011), and Rajbhandari and Kao (2021) highlighted its firmness and versatility, albeit acknowledging risks such as deformation and partial resorption. Ortega et al. (2017), through prolonged clinical experience, confirmed its utility in nasal reconstruction. Meanwhile, Salzano et al. (2024) introduced the use of

fresh frozen costal cartilage, facilitating its availability without compromising its structural properties. This line of innovation was further explored by Szychta (2024), who incorporated tomographic imaging and 3D scanning to plan the carving of costal grafts, enhancing surgical precision.

The studies also emphasized the comparison between different sources of cartilage. Park et al. (2023) and Wang et al. (2023) analyzed the applicability of septal cartilage versus costal cartilage in Asian patients, concluding that while the latter provides more significant projection, it also entails greater risks. Additionally, Ho et al. (2018) documented the morbidity associated with donor sites, a key variable influencing graft type selection.

The functional aspect was not overlooked. Kandulu (2023), utilizing the NOSE scale, demonstrated substantial respiratory improvements following the use of crushed cartilage in revision rhinoplasties. Vidal et al. (2015) added that when employed in the nasal radix region, this type of graft can also contribute to greater projection without compromising functionality. Hassan et al. (2023) analyzed its efficacy in saddle noses, observing better adaptation and less stiffness compared to solid grafts. Concurrently, Costa et al. (2015) developed a technique known as the “bundle of branches,” which promotes stability without sacrificing flexibility, and Manafi et al. (2017) reaffirmed that autologous cartilage remains the most reliable option to avoid immunological reactions and ensure integration.

Other unconventional approaches also brought value. Read et al. (2018) and Harutyunyan and Hakobyan (2025) explored the use of allogenic grafts, particularly in reconstructive contexts, yielding acceptable results under rigorous clinical monitoring. Nikparto et al. (2024) provided a comprehensive overview of current techniques for dorsal augmentation, highlighting the versatility of crushed grafts. Jiang et al. (2024), in a review of costal cartilage extraction, pinpointed the safest methods for its procurement. Finally, Ortega et al. (2017), in addition to their reconstructive experience, emphasized the value of costal grafts as a durable structural pillar in patients with complex deformities.

Conclusions

The use of cartilage grafts in rhinoplasty has solidified as a fundamental tool for achieving optimal aesthetic and functional outcomes. Despite their evident benefits, the selection of the graft type must be approached with an individualized focus, considering both patient characteristics and the inherent risks associated with each material.

Autologous cartilage remains the reference option due to its biocompatibility and lower complication rates, although its procurement may entail morbidity at the donor site. Alternatives such as allogenic and synthetic grafts offer advantages in terms of availability and reduced surgical time, but further studies are required to validate their long-term safety and efficacy.

Advances in bioengineering and 3D printing open new perspectives in graft personalization, potentially revolutionizing the field of rhinoplasty in the coming years. However, their clinical implementation will depend on the development of standardized protocols and scientific validation of their durability and safety.

Rhinoplasty should not only focus on aesthetic enhancement but also on optimizing respiratory function. It is essential to continue investigating techniques that minimize complications and maximize the structural stability of grafts, thus ensuring predictable and satisfactory outcomes for patients.

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