




NASAL RECONSTRUCTION STRATEGIES AFTER EXCISION OF MALIGNANT CUTANEOUS TUMORS: A SYSTEMATIC REVIEW

ESTRATÉGIAS DE RECONSTRUÇÃO NASAL APÓS EXCIÇÃO DE TUMORES CUTÂNEOS MALIGNOS: UMA REVISÃO SISTEMÁTICA

ESTRATEGIAS DE RECONSTRUCCIÓN NASAL TRAS LA EXCIÓN DE TUMORES CUTÁNEOS MALIGNOS: UNA REVISIÓN SISTEMÁTICA

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ABSTRACT

Introduction: Nasal reconstruction after excision of malignant cutaneous tumors is surgically demanding because oncologic clearance must be integrated with restoration of nasal contour, airway function, aesthetic subunits, and patient-centered appearance. **Objective:** The main objective of this systematic review was to evaluate contemporary reconstructive strategies after excision of malignant nasal cutaneous tumors. Secondary objectives were to compare reconstructive techniques, assess anatomical decision-making, summarize complications, evaluate aesthetic and functional outcomes, and determine the certainty of evidence supporting current practice. **Methods:** PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and ICTRP were searched for studies evaluating nasal reconstruction after excision or Mohs micrographic surgery for malignant cutaneous tumors. Human studies published within the last five years were prioritized, with extension to ten years allowed if fewer than ten eligible studies were identified. Study selection and data extraction were performed independently, risk of bias was assessed using RoB 2, ROBINS-I, or QUADAS-2 when applicable, and certainty of evidence was evaluated using GRADE. A narrative synthesis was performed because of methodological and clinical heterogeneity. **Results and Discussion:** Twenty studies were included in the final qualitative synthesis. The evidence showed that local flaps are highly versatile for small-to-moderate nasal defects, full-thickness skin grafts remain useful for selected superficial defects, secondary intention healing may provide satisfactory outcomes in carefully selected wounds, and paramedian forehead flaps remain essential for large, deep, multi-subunit, or structurally complex defects. Functional outcomes, particularly nasal obstruction and alar support, were less consistently reported than aesthetic outcomes. The certainty of evidence was low to very low because of retrospective designs, small samples, heterogeneous populations, and inconsistent outcome measures. **Conclusion:** Contemporary nasal reconstruction after malignant cutaneous tumor excision should be guided by oncologic safety, defect anatomy, nasal subunit involvement, structural support, airway preservation, patient comorbidity, and patient preference. Evidence

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supports structured individualized decision-making rather than a universal reconstructive hierarchy.

Keywords: Nose Neoplasms. Reconstructive Surgical Procedures. Mohs Surgery. Skin Neoplasms.

RESUMO

Introdução: A reconstrução nasal após a excisão de tumores cutâneos malignos é cirurgicamente exigente, pois a margem oncológica deve ser integrada à restauração do contorno nasal, função das vias aéreas, subunidades estéticas e aparência centrada no paciente. **Objetivo:** O objetivo principal desta revisão sistemática foi avaliar as estratégias reconstrutivas contemporâneas após a excisão de tumores cutâneos nasais malignos. Os objetivos secundários foram comparar técnicas reconstrutivas, avaliar a tomada de decisão anatômica, sintetizar complicações, avaliar resultados estéticos e funcionais e determinar a certeza da evidência que apoia a prática atual. **Métodos:** PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e ICTRP foram pesquisados em busca de estudos que avaliassem a reconstrução nasal após excisão ou cirurgia micrográfica de Mohs para tumores cutâneos malignos. Estudos em humanos publicados nos últimos cinco anos foram priorizados, com extensão a dez anos permitida se menos de dez estudos elegíveis fossem identificados. A seleção de estudos e a extração de dados foram realizadas de forma independente, o risco de viés foi avaliado usando RoB 2, ROBINS-I ou QUADAS-2 quando aplicável, e a certeza da evidência foi avaliada usando GRADE. Uma síntese narrativa foi realizada devido à heterogeneidade metodológica e clínica. **Resultados e Discussão:** Vinte estudos foram incluídos na síntese qualitativa final. A evidência mostrou que os retalhos locais são altamente versáteis para defeitos nasais pequenos a moderados, os enxertos de pele de espessura total permanecem úteis para defeitos superficiais selecionados, a cicatrização por segunda intenção pode proporcionar resultados satisfatórios em feridas cuidadosamente selecionadas, e os retalhos frontais paramedianos permanecem essenciais para defeitos grandes, profundos, de múltiplas subunidades ou estruturalmente complexos. Os resultados funcionais, particularmente a obstrução nasal e o suporte alar, foram relatados de forma menos consistente do que os resultados estéticos. A certeza da evidência foi baixa a muito baixa devido a desenhos retrospectivos, amostras pequenas, populações heterogêneas e medidas de resultado inconsistentes. **Conclusão:** A reconstrução nasal contemporânea após excisão de tumor cutâneo maligno deve ser guiada pela segurança oncológica, anatomia do defeito, envolvimento das subunidades nasais, suporte estrutural, preservação das vias aéreas, comorbidade do paciente e preferência do paciente. A evidência apoia a tomada de decisão individualizada estruturada em vez de uma hierarquia reconstrutiva universal.

Palavras-chave: Neoplasias Nasais. Procedimentos Cirúrgicos Reconstrutivos. Cirurgia de Mohs. Neoplasias Cutâneas.

RESUMEN

Introducción: La reconstrucción nasal tras la excisión de tumores cutáneos malignos es quirúrgicamente exigente porque el margen oncológico debe integrarse con la restauración del contorno nasal, la función de las vías respiratorias, las subunidades estéticas y la apariencia centrada en el paciente. **Objetivo:** El objetivo principal de esta revisión sistemática fue evaluar las estrategias reconstructivas contemporáneas tras la excisión de tumores cutáneos nasales malignos. Los objetivos secundarios fueron comparar técnicas reconstructivas, evaluar la toma de decisiones anatómica, resumir complicaciones, evaluar resultados estéticos y funcionales y determinar la certeza de la evidencia que respalda la práctica actual. **Métodos:** Se realizaron búsquedas en PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov e ICTRP de estudios que evaluaran la



reconstrucción nasal tras excisión o cirugía micrográfica de Mohs para tumores cutáneos malignos. Se priorizaron los estudios en humanos publicados en los últimos cinco años, con extensión a diez años permitida si se identificaban menos de diez estudios elegibles. La selección de estudios y la extracción de datos se realizaron de forma independiente, el riesgo de sesgo se evaluó usando RoB 2, ROBINS-I o QUADAS-2 cuando fue aplicable, y la certeza de la evidencia se evaluó usando GRADE. Se realizó una síntesis narrativa debido a la heterogeneidad metodológica y clínica. Resultados y Discusión: Veinte estudios se incluyeron en la síntesis cualitativa final. La evidencia mostró que los colgajos locales son altamente versátiles para defectos nasales pequeños a moderados, los injertos de piel de espesor total siguen siendo útiles para defectos superficiales seleccionados, la cicatrización por segunda intención puede proporcionar resultados satisfactorios en heridas cuidadosamente seleccionadas, y los colgajos frontales paramedianos siguen siendo esenciales para defectos grandes, profundos, de múltiples subunidades o estructuralmente complejos. Los resultados funcionales, particularmente la obstrucción nasal y el soporte alar, se informaron de forma menos consistente que los resultados estéticos. La certeza de la evidencia fue baja a muy baja debido a diseños retrospectivos, muestras pequeñas, poblaciones heterogéneas y medidas de resultado inconsistentes. Conclusión: La reconstrucción nasal contemporánea tras la excisión de tumor cutáneo maligno debe guiarse por la seguridad oncológica, la anatomía del defecto, el involucramiento de las subunidades nasales, el soporte estructural, la preservación de las vías respiratorias, la comorbilidad del paciente y la preferencia del paciente. La evidencia respalda la toma de decisiones individualizada estructurada en lugar de una jerarquía reconstructiva universal.

Palabras clave: Neoplasias Nasales. Procedimientos Quirúrgicos Reconstructivos. Cirugía de Mohs. Neoplasias Cutáneas.



1 INTRODUCTION

Malignant cutaneous tumors of the nose represent a major reconstructive challenge because oncologic clearance must be achieved within a highly visible, structurally complex, and functionally indispensable facial unit.¹ Basal cell carcinoma (BCC) is the most frequent malignant tumor affecting the nasal skin, followed by squamous cell carcinoma (SCC) and, less commonly, melanoma, each of which imposes different requirements for margin control and reconstruction.¹ The nose is particularly vulnerable because chronic ultraviolet exposure, thin soft-tissue envelopes, convex aesthetic subunits, and limited adjacent laxity increase both tumor incidence and reconstructive difficulty.¹ Reconstruction after nasal tumor excision therefore requires simultaneous restoration of skin cover, contour, airway patency, alar support, nasal valve competence, and facial symmetry.² Inadequate planning may lead to conspicuous scarring, trapdoor deformity, alar notching, nostril stenosis, external nasal valve collapse, or distortion of adjacent aesthetic subunits.² These risks are especially relevant in the distal third of the nose, where thick sebaceous skin, weak mobility, and cartilage-dependent architecture limit the reliability of simple linear closure.²

The surgical management of nasal cutaneous malignancy is inseparable from the method of tumor extirpation because defect dimensions, depth, and margin status determine the reconstructive ladder.³ Mohs micrographic surgery (MMS) provides maximal tissue preservation and complete peripheral and deep margin assessment, making it particularly valuable for high-risk BCC and SCC located on the nose.³ Standard surgical excision remains widely used when MMS is unavailable, but it may require delayed reconstruction or wider excision margins in aggressive histologic subtypes or recurrent lesions.³ Immediate reconstruction can be appropriate when margin assessment is reliable and the expected oncologic risk is low, whereas delayed reconstruction may be preferred when margin uncertainty could compromise tumor control.⁴ This distinction is clinically important because premature closure with a complex flap can obscure residual disease, complicate re-excision, and increase morbidity.⁴ Conversely, excessive delay may increase patient distress, wound contraction, and technical complexity, particularly in full-thickness or multi-subunit defects.⁴

Nasal reconstruction is traditionally guided by the reconstructive ladder, but modern practice often requires a more nuanced approach based on aesthetic subunits, defect thickness, patient comorbidity, and surgeon expertise.⁵ Primary closure may be suitable for selected small defects in areas with adequate laxity, especially along relaxed skin tension lines or near the upper two-thirds of the nose.⁵ Full-thickness skin grafting (FTSG) may provide a simpler option for superficial defects, particularly in concave or relatively flat regions, but color mismatch, contour depression, and graft contraction remain important

limitations.⁵ Local flaps, including bilobed, nasolabial, dorsal nasal, advancement, rotation, and island flaps, are commonly selected because they recruit adjacent tissue with similar color, texture, and thickness.⁶ However, flap selection must account for defect size, nasal subunit, vascular reliability, standing-cone management, and the risk of deforming free margins such as the alar rim.⁶ For larger or deeper defects, regional flaps and staged reconstruction may be necessary to restore the external lining, internal lining, and structural support.⁶

The paramedian forehead flap remains a cornerstone for reconstruction of large, complex, or multi-layered nasal defects after malignant tumor excision.⁷ Its robust axial vascularity, generous tissue availability, and favorable color match make it especially useful for defects involving the ala, tip, sidewall, soft triangle, and multiple nasal subunits.⁷ Although classically performed in staged fashion, refinements in design, thinning, cartilage grafting, and inset have improved aesthetic outcomes and reduced contour deformities.⁷ Structural grafting is frequently required when resection compromises lower lateral cartilage, alar support, or the nasal valve, because skin replacement alone cannot prevent collapse in full-thickness defects.⁸ Cartilage grafts may be harvested from the septum, auricle, or rib, and allograft options have been explored when autologous donor morbidity is undesirable.⁸ The need for lining reconstruction further increases complexity, as vestibular mucosa, nasolabial tissue, folded flaps, composite grafts, and graft-based techniques may be required to preserve airway function.⁸

Outcomes in nasal reconstruction cannot be evaluated solely by flap survival or wound closure because patient-centered appearance, nasal breathing, scar quality, and need for revision are equally relevant.⁹ Traditional surgical series often emphasize technical feasibility, complication rates, recurrence, and reconstructive choice, but many lack standardized functional and aesthetic outcome measures.⁹ Patient satisfaction may diverge from surgeon-rated outcomes, especially when small irregularities are located in highly visible nasal subunits or when airway symptoms persist despite acceptable external appearance.⁹ Scar assessment scales, nasal obstruction scores, quality-of-life instruments, and standardized photographic analysis may improve comparability across studies.¹⁰ Nevertheless, the literature remains heterogeneous because studies differ in tumor histology, defect depth, subunit involvement, timing of reconstruction, follow-up duration, and outcome definitions.¹⁰ This heterogeneity limits the ability to generate high-certainty recommendations for choosing between secondary intention healing, FTSG, local flaps, regional flaps, and staged composite reconstruction.¹⁰

The evidence base for nasal reconstruction after malignant cutaneous tumor excision is dominated by retrospective cohorts, case series, technical reports, and expert algorithms rather than randomized comparative trials.¹¹ This design profile is understandable because reconstruction must be individualized, randomization is often impractical, and defect anatomy varies substantially after tumor clearance.¹¹ However, low-level evidence increases the risk of selection bias, performance bias, incomplete outcome reporting, and confounding by surgeon experience.¹¹ Comparative studies evaluating local flaps, FTSG, and secondary intention healing after MMS suggest that multiple strategies can be acceptable in selected distal nasal defects, but conclusions are constrained by small samples and limited standardization.¹² Recent algorithmic studies have attempted to classify nasal defects by size, location, cutaneous characteristics, and subunit involvement to improve decision-making.¹² Such algorithms are clinically useful, but they must be interpreted as structured guidance rather than rigid rules because patient anatomy, oncologic risk, comorbidities, and preferences often modify the optimal reconstructive plan.¹²

A systematic review is justified because the available literature is dispersed across dermatologic surgery, plastic surgery, otolaryngology, head and neck surgery, oral and maxillofacial surgery, and reconstructive journals.¹³ Existing studies frequently address isolated techniques, specific subunits, or single-institution experiences, making it difficult for clinicians to compare reconstructive strategies across the full spectrum of malignant nasal defects.¹³ A structured synthesis can clarify which techniques are most frequently used, which outcomes have been reported, where evidence is insufficient, and how reconstruction should be individualized according to defect characteristics and patient factors.¹³ The present review therefore evaluates contemporary strategies for nasal reconstruction after excision of malignant cutaneous tumors, prioritizing recent human evidence while acknowledging the limitations of small observational studies.¹⁴ It also examines whether the current literature supports specific technique selection according to nasal subunit, defect size, depth, oncologic context, and functional requirements.¹⁴ By integrating surgical outcomes, patient-centered endpoints, risk of bias, and certainty of evidence, this review aims to support multidisciplinary, evidence-based decision-making in nasal oncologic reconstruction.¹⁴

2 OBJECTIVES

The main objective of this systematic review is to evaluate contemporary nasal reconstruction strategies after excision of malignant cutaneous tumors, with emphasis on the relationship between defect characteristics, reconstructive technique, aesthetic outcomes, functional outcomes, complications, and oncologic safety. The first secondary objective is to

compare the reported use and outcomes of primary closure, secondary intention healing, full-thickness skin grafts, composite grafts, local flaps, regional flaps, interpolated flaps, and staged multilayer reconstruction. The second secondary objective is to analyze how nasal subunit involvement, defect size, defect depth, cartilage exposure, mucosal involvement, and tumor-related factors influence reconstructive decision-making. The third secondary objective is to assess postoperative complications, including infection, partial flap or graft loss, necrosis, trapdoor deformity, alar distortion, contour irregularity, hypertrophic scarring, nasal obstruction, and need for revision surgery. The fourth secondary objective is to summarize patient-centered and surgeon-reported aesthetic and functional outcomes, including scar quality, nasal symmetry, airway preservation, satisfaction, and quality-of-life measures when available. The fifth secondary objective is to evaluate the risk of bias and certainty of evidence supporting each reconstructive approach, identifying persistent methodological limitations and future research priorities in oncologic nasal reconstruction.

3 METHODOLOGY

This systematic review was designed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. A structured search strategy was applied to PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and the International Clinical Trials Registry Platform (ICTRP). The search combined controlled vocabulary and free-text terms related to nasal reconstruction, nose defects, skin cancer, basal cell carcinoma (BCC), squamous cell carcinoma (SCC), melanoma, Mohs micrographic surgery (MMS), tumor excision, local flaps, forehead flap, full-thickness skin graft, secondary intention healing, composite graft, functional outcomes, aesthetic outcomes, and complications. No language restriction was applied, and studies published within the last five years were prioritized, with expansion to ten years allowed if fewer than ten eligible studies were identified.

Eligible studies included human investigations evaluating reconstructive strategies after excision or MMS for malignant cutaneous tumors involving the nose. Randomized trials, prospective cohorts, retrospective cohorts, comparative observational studies, case series, and clinically relevant technical studies were eligible when they reported reconstructive outcomes, complications, functional results, aesthetic results, recurrence-related considerations, or decision algorithms. Small samples were accepted because nasal oncologic reconstruction is highly individualized and often reported through institutional series, but sample size limitations were explicitly considered during evidence appraisal. Studies were excluded when they addressed trauma, congenital deformity, cosmetic



rhinoplasty without oncologic resection, non-nasal facial reconstruction, benign lesions only, purely educational descriptions without patient data, or non-human experimental evidence unless such evidence was suitable for separate contextual discussion.

Two reviewers independently screened titles and abstracts, assessed full texts for eligibility, and resolved disagreements through consensus or consultation with a third reviewer. Duplicate records were removed before screening, and the study flow was summarized according to PRISMA principles. Extracted data included author, year, country, study design, sample size, tumor type, excision method, nasal subunit, defect size and depth, reconstructive technique, use of cartilage or lining reconstruction, timing of reconstruction, follow-up duration, aesthetic outcomes, functional outcomes, complications, revision procedures, recurrence-related information, and major conclusions. When multiple publications appeared to describe overlapping cohorts, the most complete and recent dataset was prioritized.

Risk of bias was assessed according to study design. Randomized trials were planned for evaluation using the revised Cochrane risk-of-bias tool for randomized trials (RoB 2), non-randomized comparative and observational studies using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I), and diagnostic or assessment-focused studies using the Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2) when applicable. Certainty of evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework, considering risk of bias, inconsistency, indirectness, imprecision, and publication bias. Because substantial methodological and clinical heterogeneity was expected, a narrative synthesis was planned as the primary analytical strategy, with quantitative pooling considered only when studies were sufficiently homogeneous in population, intervention, comparison, and outcome definitions.

The review was justified by the lack of high-certainty comparative evidence guiding selection among reconstructive options after nasal skin cancer excision. Nasal reconstruction involves a unique intersection of oncologic dermatologic surgery, plastic surgery, otolaryngology, maxillofacial surgery, ophthalmic-adjacent periocular planning, and patient-centered facial rehabilitation. For this reason, the synthesis prioritized not only closure success but also nasal subunit restoration, airway preservation, complication prevention, revision burden, and individualized surgical planning. Compliance with PRISMA was maintained throughout study identification, selection, extraction, synthesis, and reporting.

4 RESULTS

The database search identified 684 records across PubMed, Scopus, Web of Science, Cochrane Library, LILACS, ClinicalTrials.gov, and ICTRP. After removal of 176 duplicates, 508 records underwent title and abstract screening. A total of 438 records were excluded because they addressed non-nasal reconstruction, benign lesions only, trauma, congenital defects, cosmetic rhinoplasty, non-oncologic surgery, or lacked reconstructive outcomes. Seventy full-text articles were assessed for eligibility, and 50 were excluded because they did not meet the time-window, population, intervention, or outcome criteria. Twenty studies met the inclusion criteria and were included in the final qualitative synthesis.

Tabela 1

Characteristics and main conclusions of the included studies.

Reference	Population / Intervention / Comparison	Outcomes	Main conclusions
Veldhuizen <i>et al.</i> , 2021	The study systematically reviewed flap reconstructive options for nasal skin defects, including defects after oncologic excision and Mohs micrographic surgery.	The outcomes assessed included complication rates, flap-specific applicability, nasal subunit suitability, and reconstructive decision-making.	The study concluded that multiple flap options are available for nasal skin defects and that technique selection should be guided by defect location, size, depth, and expected complication profile.
Núñez-Castañeda <i>et al.</i> , 2021	The study evaluated patients with nasal skin tumors treated surgically, with reconstruction selected according to nasal aesthetic subunit and defect characteristics.	The outcomes assessed included tumor distribution by nasal subunit, reconstruction type, complications, and practical use of reconstructive procedures.	The study concluded that nasal reconstruction after skin cancer excision should be individualized according to subunit involvement and that local flaps remain central for many defects.
Apaydin <i>et al.</i> , 2022	The study included patients who underwent paramedian forehead flap reconstruction for large nasal skin defects after basal cell carcinoma (BCC) or squamous cell carcinoma (SCC) excision.	The outcomes assessed included defect size, tumor type, flap viability, complications, revisions, and aesthetic restoration.	The study concluded that the paramedian forehead flap is a reliable option for large nasal defects caused by nonmelanoma skin cancer, particularly when substantial tissue replacement is required.

Mamsen <i>et al.</i> , 2022	The study compared local flaps and full-thickness skin grafts used for facial reconstruction after skin cancer surgery, including nasal and other facial defects.	The outcomes assessed included hematoma, necrosis, wound dehiscence, infection, major complications, patient risk factors, and tumor-related risk factors.	The study concluded that local flaps were associated with a lower complication profile than full-thickness skin grafts in selected facial reconstructions, especially among older and male patients.
Schwartzman <i>et al.</i> , 2022	The study reviewed assessment parameters for secondary intention healing after Mohs micrographic surgery, including anatomically relevant facial and nasal wounds.	The outcomes assessed included wound healing, cosmetic assessment, functional implications, patient selection, and outcome measurement.	The study concluded that secondary intention healing can be useful in selected defects but requires better standardized outcome assessment and careful anatomical selection.
Kim <i>et al.</i> , 2023	The study evaluated nasal defects managed by second-intention healing after Mohs micrographic surgery.	The outcomes assessed included defect location, defect size, cosmetic outcome, healing behavior, and factors associated with favorable or unfavorable results.	The study concluded that second-intention healing may be appropriate for selected nasal defects, particularly when size, depth, and contour predict acceptable contraction and epithelialization.
Desisto <i>et al.</i> , 2023	The study reviewed the available evidence for facial skin cancer reconstruction after Mohs micrographic surgery, including nasal reconstruction strategies.	The outcomes assessed included reconstructive technique selection, evidence quality, complications, patient-reported outcomes, and gaps in comparative research.	The study concluded that the evidence base for facial and nasal skin cancer reconstruction is limited by heterogeneity and that stronger comparative studies are needed.
Drake <i>et al.</i> , 2024	The study addressed decision-making in nasal reconstruction, focusing on when to use bilobed flaps, forehead flaps, skin grafts, and related reconstructive options after skin cancer surgery.	The outcomes assessed included technique indication, anatomical suitability, defect-based planning, and functional-aesthetic trade-offs.	The study concluded that nasal reconstruction should follow structured decision-making based on defect depth, location, subunit involvement, and functional risk rather than a rigid reconstructive ladder.
Song <i>et al.</i> , 2024	The study reviewed the implications of malignancy, radiation, and timing in major nasal reconstruction	The outcomes assessed included timing of reconstruction, oncologic context,	The study concluded that malignancy type, margin certainty, previous or planned radiation, and timing

	after skin cancer treatment.	radiation-related risk, delayed versus immediate reconstruction, and reconstructive planning.	strongly influence the safety and complexity of major nasal reconstruction.
Hifny <i>et al.</i> , 2024	The study evaluated keystone flaps for reconstruction after skin cancer excision, including use in nasal reconstruction.	The outcomes assessed included flap versatility, closure reliability, complication rate, and applicability to post-oncologic defects.	The study concluded that keystone flaps may be a useful option for selected skin cancer defects, although their role in nasal reconstruction remains more limited than established nasal local flaps.
Faenza <i>et al.</i> , 2024	The study compared grafts and local flaps for reconstruction after nonmelanoma skin cancer surgery of the face.	The outcomes assessed included aesthetic satisfaction, functional satisfaction, independent surgeon evaluation, complications, and patient-reported outcomes.	The study concluded that local flaps provided better overall aesthetic and functional results than grafts in facial post-oncologic reconstruction, although nasal-specific conclusions were limited by anatomical heterogeneity.
Caretto <i>et al.</i> , 2024	The study assessed three-dimensional photogrammetry as an objective tool for evaluating outcomes after post-oncologic nasal reconstructive surgery.	The outcomes assessed included volumetric change, surface contour, objective aesthetic measurement, and feasibility of three-dimensional imaging.	The study concluded that three-dimensional photogrammetry can be a valid method for objectively assessing contour and volumetric outcomes after nasal reconstruction.
Rashnoo <i>et al.</i> , 2024	The study compared nasolabial and forehead flaps for repair of nasal soft-tissue defects resulting from basal cell carcinoma.	The outcomes assessed included operative staging, functional outcome, aesthetic outcome, complication profile, and practicality of flap selection.	The study concluded that both nasolabial and forehead flaps are effective for nasal basal cell carcinoma defects, with nasolabial flaps offering a simpler one-stage approach in selected cases.
Dhaha <i>et al.</i> , 2024	The study evaluated forehead flap reconstruction of oncologic nasal defects after excision of basal cell carcinoma and	The outcomes assessed included flap type, tumor size, staging, aesthetic outcome, complications, and	The study concluded that forehead flap techniques remain reliable for oncologic nasal defects and provide good aesthetic outcomes

	squamous cell carcinoma.	reconstructive reliability.	with acceptable morbidity.
Hollier <i>et al.</i> , 2024	The study reviewed reconstruction of small nasal defects, including post-Mohs and post-excisional defects caused by skin cancer.	The outcomes assessed included primary closure, secondary intention healing, skin grafting, local flaps, biologic adjuncts, and subunit-based planning.	The study concluded that small nasal defects may be managed successfully with several techniques when defect depth, skin quality, subunit, and patient factors are appropriately considered.
D'Antonio <i>et al.</i> , 2025	The study reported a 12-year experience with paramedian forehead flap reconstruction for nasal defects after nonmelanoma skin cancer removal.	The outcomes assessed included flap safety, complication rate, patient comorbidity, smoking status, defect complexity, and aesthetic-functional outcome.	The study concluded that paramedian forehead flaps are dependable for large nasal defects after skin cancer excision, including in older patients and patients with comorbidities.
Veija <i>et al.</i> , 2025	The study compared immediate local flap, skin graft, and linear closure reconstruction after standard excision of basal cell carcinoma of the nose.	The outcomes assessed included reconstruction method, margin status, re-excision risk, defect location, tumor characteristics, and practical reconstructive patterns.	The study concluded that immediate reconstruction after standard excision of nasal basal cell carcinoma is commonly performed, but margin-related uncertainty must be considered when selecting flaps or grafts.
Dogan <i>et al.</i> , 2025	The study compared skin grafting and secondary intention healing for selected nasal defects.	The outcomes assessed included cosmetic outcome, healing time, patient satisfaction, scar quality, and suitability of conservative wound management.	The study concluded that both full-thickness skin grafting and secondary intention healing may be acceptable for selected nasal defects, with technique selection depending on wound size, depth, location, and patient preference.
Wu <i>et al.</i> , 2025	The study evaluated a defect-size-dependent strategy for nasal tip cutaneous wounds after tumor resection.	The outcomes assessed included flap choice by defect diameter, wound healing, infection, edema, aesthetic preservation, alar rim	The study concluded that a size-based algorithm using horn-shaped, bilobed, and frontonasal flaps can achieve satisfactory healing and contour

		distortion, and short-term recurrence.	preservation in nasal tip defects.
Ma <i>et al.</i> , 2025	The study evaluated early division of the paramedian forehead flap in nasal reconstruction.	The outcomes assessed included timing of flap division, flap viability, smoking status, cartilage graft use, defect thickness, and safety of accelerated staging.	The study concluded that early flap division may be feasible in carefully selected nonsmoking patients with partial-thickness defects and limited cartilage grafting.

5 RESULTS AND DISCUSSION

Veldhuizen *et al.* provided a structured synthesis of flap-based reconstruction for nasal skin defects and reinforced that flap choice should be determined by anatomical subunit, defect size, and expected distortion of free margins.¹⁵ The review was clinically useful because it organized flap options around practical reconstructive decisions rather than presenting the reconstructive ladder as a fixed sequence.¹⁵ However, the study also demonstrated that the evidence supporting many flap choices remains largely observational, with limited comparative outcome measurement and substantial heterogeneity in complication reporting.¹⁵ Núñez-Castañeda *et al.* complemented this approach by describing real-world reconstruction after excision of nasal skin tumors according to nasal aesthetic subunits.¹⁶ Their findings emphasized that BCC predominates among nasal malignancies and that local flaps are frequently used when defects involve complex convex surfaces or areas with limited laxity.¹⁶ The main limitation of that study was its modest sample size, which restricted subgroup analysis by tumor histology, defect depth, and reconstructive technique.¹⁶

Apaydin *et al.* focused on the paramedian forehead flap for large nasal defects and confirmed the continued relevance of this flap in oncologic reconstruction when local tissue is insufficient.¹⁷ The study supported the concept that large, deep, or multi-subunit nasal defects require tissue with reliable vascularity, adequate reach, and sufficient thickness for contour restoration.¹⁷ Its findings are consistent with classical reconstructive principles, but the retrospective design and long study period introduced potential variability in technique, staging, and postoperative assessment.¹⁷ Mamsen *et al.* contributed comparative evidence by evaluating local flaps and full-thickness skin grafts in facial reconstruction after skin cancer surgery.¹⁸ Their results suggested that local flaps may be associated with fewer major complications than grafts in selected patients, particularly when vascularized adjacent tissue can be recruited safely.¹⁸ Nevertheless, the inclusion of multiple facial regions limits direct extrapolation to the nose, where subunit-specific anatomy strongly modifies both graft and flap performance.¹⁸

Schwartzman *et al.* addressed secondary intention healing after Mohs micrographic surgery and highlighted the need for better outcome assessment in wounds allowed to heal without immediate surgical closure.¹⁹ This contribution is important because secondary intention healing may be overlooked in nasal reconstruction despite potential advantages in carefully selected concave or superficial defects.¹⁹ The main weakness of the available evidence is that cosmetic outcome, contraction, healing time, and functional consequences are inconsistently measured across studies.¹⁹ Kim *et al.* specifically evaluated factors affecting second-intention healing of nasal defects after Mohs micrographic surgery and provided more directly applicable evidence for nasal wounds.²⁰ Their findings support the view that defect size, depth, and location are critical determinants of final contour and scar quality.²⁰ Second-intention healing should therefore be considered a selective reconstructive strategy rather than a default approach for patients considered poor candidates for operative reconstruction.²⁰

Desisto *et al.* reviewed facial skin cancer reconstruction after Mohs micrographic surgery and underscored the broad methodological limitations of the field.²¹ Their synthesis showed that most evidence remains technique-centered, retrospective, and insufficiently standardized in patient-reported outcomes.²¹ This limitation is particularly relevant for nasal reconstruction, because technically successful closure may still result in dissatisfaction if contour, symmetry, or airway function is compromised.²¹ Drake *et al.* emphasized defect-based decision-making and clarified the practical indications for bilobed flaps, forehead flaps, skin grafts, and other reconstructive options.²² This perspective is valuable because nasal reconstruction often requires moving beyond a simple ladder toward an algorithm that integrates subunit, depth, cartilage exposure, skin thickness, and patient expectations.²² The study's limitation is that algorithmic recommendations, although clinically coherent, are not equivalent to high-certainty comparative evidence.²²

Song *et al.* examined the influence of malignancy, radiation, and timing on major nasal reconstruction and highlighted that reconstruction should not be planned independently from oncologic risk.²³ Their analysis supports delayed or staged decision-making when margin status, aggressive histology, recurrence, or radiation exposure may affect flap survival and surveillance.²³ This is especially relevant for SCC and melanoma, where tumor biology may require wider excision, nodal evaluation, adjuvant therapy, or more cautious reconstruction than typical low-risk BCC.²³ Hifny *et al.* evaluated keystone flaps after skin cancer excision and suggested that this flap family may be useful for selected post-oncologic defects.²⁴ In the nasal region, however, keystone flap utility appears more constrained because convexity, limited laxity, and free-margin distortion reduce its versatility compared with established nasal

flaps.²⁴ Its role should therefore be considered complementary rather than central in nasal reconstruction after malignant tumor excision.²⁴

Faenza *et al.* compared grafts and local flaps after nonmelanoma skin cancer surgery of the face and reported better aesthetic and functional satisfaction with local flaps.²⁵ This finding supports the common surgical preference for vascularized adjacent tissue when the goal is to match nasal color, thickness, and contour.²⁵ Yet the study should be interpreted cautiously for nasal decision-making because facial regions differ markedly in mobility, contour, sebaceous quality, and risk of functional distortion.²⁵ Caretto *et al.* introduced three-dimensional photogrammetry as an objective method for evaluating post-oncologic nasal reconstruction.²⁶ This is a meaningful methodological advance because conventional photographs and subjective ratings may miss subtle contour asymmetries, volume deficits, and subunit distortion.²⁶ Wider adoption of three-dimensional assessment could improve comparability among reconstructive studies and reduce reliance on non-standardized aesthetic judgments.²⁶

Rashnoo *et al.* compared nasolabial and forehead flaps for nasal soft-tissue defects after BCC excision and found both options effective in selected patients.²⁷ Nasolabial flaps may offer a simpler and potentially single-stage solution for alar and sidewall defects when adequate cheek laxity and vascular reliability are present.²⁷ Forehead flaps remain preferable when defects are larger, deeper, multi-subunit, or require more substantial tissue replacement.²⁷ Dhaha *et al.* further supported the reliability of forehead flap reconstruction for oncologic nasal defects after excision of BCC and SCC.²⁸ The study reinforced that staged forehead flap reconstruction remains highly relevant despite increasing interest in simpler one-stage approaches.²⁸ Its main limitations were the observational design, limited comparative control, and incomplete standardization of aesthetic and functional endpoints.²⁸

Hollier *et al.* reviewed reconstruction of small nasal defects and showed that limited defects may be managed with primary closure, secondary intention healing, skin grafting, local flaps, or biologic adjuncts depending on location and depth.²⁹ This study is clinically important because small nasal defects are common after skin cancer surgery but can still produce disproportionate cosmetic or functional consequences if poorly treated.²⁹ The review supports a tailored approach in which minimal intervention is appropriate only when it does not compromise contour, free margins, or future revision options.²⁹ D'Antonio *et al.* provided a large institutional experience with paramedian forehead flap reconstruction after nonmelanoma skin cancer removal.³⁰ Their data support the dependability of this flap in older patients and in patients with comorbidities when careful planning and staging are performed.³⁰ However, retrospective case series cannot determine whether equivalent

outcomes could have been achieved with less complex local or regional alternatives in selected defects.³⁰

Veija *et al.* directly compared immediate local flap, skin graft, and linear closure after standard excision of nasal BCC.³¹ Their findings are particularly relevant outside Mohs micrographic surgery settings because they address reconstruction when complete margin control may not be available intraoperatively.³¹ The study suggests that immediate reconstruction can be feasible, but margin uncertainty remains a major factor when choosing complex flaps that could complicate re-excision.³¹ Dogan *et al.* compared skin grafting and secondary intention healing for selected nasal defects and reinforced that both strategies may be appropriate when indications are carefully defined.³² Skin grafting may provide faster coverage and more predictable epithelial closure, whereas secondary intention healing may avoid donor-site morbidity and preserve options for later revision.³² The choice between these strategies should be based on wound depth, subunit contour, patient tolerance for wound care, cosmetic priorities, and functional risk.³²

Wu *et al.* proposed a defect-size-dependent reconstruction strategy for nasal tip cutaneous wounds after tumor resection.³³ Their algorithm using horn-shaped, bilobed, and frontonasal flaps is useful because the nasal tip has limited laxity, high aesthetic visibility, and a substantial risk of alar rim distortion.³³ The short follow-up and small sample, however, limit conclusions regarding long-term scar maturation, contour stability, and oncologic recurrence.³³ Ma *et al.* evaluated early division of the paramedian forehead flap and suggested that accelerated staging may be feasible in carefully selected patients.³⁴ This finding has practical implications because reducing the interval between stages may improve patient comfort, social reintegration, and treatment efficiency.³⁴ Early division should nevertheless be restricted to patients with favorable vascular risk, partial-thickness defects, limited cartilage grafting, and careful intraoperative assessment of flap perfusion.³⁴

Across the included studies, local flaps emerged as the most versatile option for small-to-moderate nasal defects when adjacent tissue could be mobilized without distorting the alar rim, nasal valve, or tip-defining points.³⁵ Full-thickness skin grafts remained useful for selected superficial defects, especially when flap morbidity, operative time, or patient comorbidity made local tissue transfer less attractive.³⁵ Secondary intention healing appeared most defensible for carefully selected shallow defects in anatomically favorable regions, but it requires patient adherence, prolonged wound care, and realistic counseling about contraction and scar maturation.³⁵ Regional and interpolated flaps, especially paramedian forehead flaps, were consistently favored for larger, deeper, multi-subunit, or structurally complex defects.³⁶ Cartilage grafting and lining reconstruction were decisive when tumor

excision compromised alar support, lower lateral cartilage, vestibular lining, or nasal valve competence.³⁶ These observations support an anatomy-driven reconstructive framework rather than a technique-driven hierarchy.³⁶

Comparison with contemporary reconstructive principles and guideline-oriented practice suggests that oncologic safety must precede aesthetic reconstruction, particularly for aggressive BCC, high-risk SCC, recurrent tumors, melanoma, and previously irradiated tissue.³⁷ Mohs micrographic surgery remains particularly advantageous for many nasal BCC and SCC lesions because it maximizes margin assessment while preserving tissue for reconstruction.³⁷ When standard excision is used, immediate reconstruction may be reasonable in selected low-risk cases, but complex flap transfer should be balanced against the possibility of positive margins and re-excision.³⁷ The certainty of evidence according to GRADE was low to very low for most comparisons because the available literature was dominated by retrospective studies, case series, technical reports, and heterogeneous outcome definitions.³⁸ Evidence was downgraded mainly for risk of bias, imprecision, indirectness, and inconsistency in outcome reporting.³⁸ No high-certainty evidence was identified to prove the superiority of a single reconstructive method across all nasal defects after malignant cutaneous tumor excision.³⁸

The most important implication for practice is that nasal reconstruction should be individualized through multidisciplinary planning that integrates tumor biology, margin certainty, defect anatomy, patient comorbidity, and patient preference.³⁹ Dermatologic surgeons, plastic surgeons, otolaryngologists, head and neck surgeons, pathologists, radiation oncologists, and ophthalmology-adjacent specialists may all contribute when defects approach the medial canthus, nasal valve, lacrimal drainage region, or periocular tissues.³⁹ Shared decision-making is essential because the balance between single-stage simplicity, staged refinement, donor-site morbidity, wound-care burden, and final appearance differs across patients.³⁹ Future research should prioritize prospective multicenter cohorts with standardized defect classification, validated aesthetic scales, nasal obstruction measures, patient-reported outcomes, recurrence surveillance, and revision tracking.⁴⁰ Comparative studies should avoid grouping all facial defects together when the clinical question is specifically nasal, because nasal subunits behave differently from cheek, forehead, lip, and periocular defects.⁴⁰ Until stronger evidence becomes available, the best-supported approach is a structured but flexible reconstructive algorithm that privileges oncologic clearance, nasal function, aesthetic subunit restoration, and individualized patient-centered care.⁴⁰

6 CONCLUSION

Nasal reconstruction after excision of malignant cutaneous tumors requires a structured but individualized approach that balances oncologic safety, nasal function, aesthetic subunit restoration, and patient-specific surgical risk. The included evidence suggests that local flaps are highly versatile for small-to-moderate defects, full-thickness skin grafts remain useful for selected superficial wounds, secondary intention healing may be appropriate in carefully chosen anatomical settings, and paramedian forehead flaps remain essential for large, deep, multi-subunit, or structurally complex defects. No single reconstructive strategy can be considered universally superior because outcomes depend strongly on tumor type, margin status, defect size, defect depth, nasal subunit involvement, cartilage support, lining integrity, and patient expectations.

The clinical relevance of this review lies in reinforcing that nasal reconstruction should not be planned as a purely cutaneous closure procedure. Successful reconstruction must preserve nasal airway function, avoid alar rim distortion, maintain external nasal valve competence, restore contour symmetry, and minimize visible scarring in a central facial structure. For clinicians treating nasal basal cell carcinoma, squamous cell carcinoma, melanoma, and other malignant cutaneous tumors, the evidence supports decision-making based on defect anatomy and oncologic context rather than routine application of a fixed reconstructive ladder.

The main limitations of the literature are the predominance of retrospective studies, small single-center series, inconsistent reporting of defect characteristics, heterogeneous outcome definitions, and limited use of validated aesthetic or functional instruments. Many studies combine different facial regions, tumor types, and reconstructive techniques, making nasal-specific conclusions less precise. The certainty of evidence is therefore low to very low for most direct comparisons, and current recommendations rely heavily on anatomical principles, expert surgical judgment, and observational outcome data.

Future research should prioritize prospective multicenter studies using standardized nasal defect classifications, validated scar and aesthetic assessment tools, nasal obstruction measures, patient-reported outcome instruments, and long-term oncologic surveillance. Comparative studies should stratify outcomes by nasal subunit, defect size, defect depth, tumor histology, margin-control method, cartilage or lining involvement, and reconstructive timing. Greater attention should also be given to revision burden, cost, quality of life, elderly patients, anticoagulated patients, immunosuppressed patients, and patients requiring adjuvant radiotherapy.



Evidence-based nasal reconstruction after malignant tumor excision requires collaboration among dermatologic surgeons, plastic surgeons, otolaryngologists, head and neck surgeons, pathologists, oncologists, and other specialists involved in complex facial reconstruction. The best reconstructive strategy is the one that achieves complete tumor management while restoring form and function with the least acceptable morbidity for the individual patient. A multidisciplinary, individualized, and patient-centered strategy remains the most appropriate framework for improving outcomes in oncologic nasal reconstruction.

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