

A Comprehensive Review of Mohs Micrographic Surgery in the Last Decade Innovations and Aesthetic Reconstruction in Oral and Maxillofacial Surgery, focused on Nasal Cutaneous Malignancies - Advanced Micrographic Control and Structural Metamorphosis

Short Title: Oral and Maxillofacial Mohs Micrographic Surgery - Innovations and Aesthetic Nasal

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A B S T R A C T

Introduction: Cutaneous malignancies of the nasal pyramid present unique therapeutic challenges due to its intricate embryonic fusion planes, high recurrence dynamics and the critical cosmetic value of the midface. Mohs Micrographic Surgery (MMS) provides the highest evidence-based cure rates by evaluating 100% of the peripheral and deep margins of biopsy samples.

Objective: This comprehensive review synthesizes this decade technological innovations in intraoperative margin detection and advanced aesthetic reconstruction strategies tailored specifically for complex nasal defects after MMS, presenting a few author's private clinic cases to illustrate this study.

Methods: A systematic screening of PubMed, Embase and the Cochrane Library was conducted for articles published up to 2026. The focus was restricted to randomized controlled trials, cohort studies and high-impact dermatosurgical reviews evaluating ex vivo imaging tools and advanced nasal flap designs.

Results: Emerging modalities such as Ex Vivo Confocal Microscopy (EVCN) and Optical Coherence Tomography (OCT) drastically compress intraoperative processing times while maintaining diagnostic concordance with traditional frozen sections. For post-ablative defects, algorithmic selection of specialized local flaps, such as the Zitelli-modified bilobed flap, the nasolabial

transposition flap, the classical paramedian forehead flap and the author's cutting-edge new flap techniques yields superior structural preservation of nose aesthetics and functional restoration of the nasal valve.

Conclusion: The integration of real-time digital margin assessment with customized biomechanical reconstructions represents the modern paradigm of oncological safety and cosmetic excellence in Oral and Maxillofacial Oncologic Surgery focused on nasal skin cancer management.

Keywords: Mohs micrographic surgery; Nasal skin cancer; Facial skin cancer; Ex vivo confocal microscopy; Optical coherence tomography; Nasolabial skin flap; Nasolabial propeller flap; Paramedian forehead flap; Nose aesthetic reconstruction; Oral and maxillofacial oncology surgery

Introduction

Cutaneous malignancies affecting the nasal pyramid, primarily Basal Cell Carcinoma (BCC) and Squamous Cell Carcinoma (SCC), account for a disproportionate burden of head and neck oncology cases¹, reaching around 30% of facial cancers. The unique anatomical framework of the nose, characterized by rigid sebaceous skin superiorly, tightly bound fibroelastic tissue inferiorly and underlying cartilaginous or bony scaffolding, facilitates the silent, subclinical extension of neoplastic nests along embryonic fusion planes and periosteal/perichondrial boundaries^{1,2}.

Historically, traditional Wide Local Excision (WLE) relied on arbitrary surgical margins (typically 4 to 6 mm) and postoperative histopathological assessment via standard vertical cross-sectioning, known as “bread-loafing”³. Because bread-loafing samples less than 1% to 2% of the actual surgical margin, it introduces a significant false-negative sampling error, culminating in recurrence rates as high as 10% to 15% for high-risk facial tumors^{2,3}.

Developed by Dr. Frederic Mohs in the 1930s and later modified into the fresh-frozen technique, Mohs Micrographic Surgery (MMS) revolutionized cutaneous oncology². By utilizing horizontal tissue sectioning and systematic mapping, the Mohs surgeon examines 100% of both the peripheral and deep margins^{3,4}. This dual capability maximizes oncological cure rates (reaching 99% for primary BCCs) while enforcing strict tissue-sparing behavior^{2,4}. This conservative footprint is vital on the nose, where even a single millimeter of wasted tissue can alter the nasal ala, cause vestibular collapse or induce severe asymmetric post-op scarring^{4,5}.

In recent years, the intersection of biomedical engineering and advanced Oral and Maxillofacial Oncologic Surgery (OMFOS) has driven major innovations in this field. This review examines these new advances, focusing on ex vivo imaging technologies that bypass traditional tissue freezing, as well as refined reconstructive surgical algorithms designed to restore the nose's complex subunits.

Adopted Literature Synthesis and its Methodological Framework

To guarantee a robust scientific baseline appropriate and specifically for the Medical Journal Sanamed, a narrative review of the literature was executed. Computerized databases, including MEDLINE (via PubMed), Scopus and the Web of Science, were queried using targeted Boolean strings as appears here: {“Mohs micrographic surgery” OR “MMS”} AND {“nasal

skin cancer” OR “nose carcinoma”} AND {“ex vivo confocal microscopy” OR “reconstruction” OR “local flap”}.

The screening criteria prioritized peer-reviewed clinical trials, prospective observational cohorts and consensus guidelines published within the last five years to reflect the latest evidence. Articles focusing exclusively on standard WLE without micrographic control or those lacking clear reconstructive endpoints for nasal subunits were excluded. Out of the compiled literature, data extraction concentrated on two specific key metrics: 1) The diagnostic accuracy and processing time of novel intraoperative margin-imaging techniques; 2) The functional longevity and complication rates (e.g., flap necrosis, pin-cushioning, alar distortion) of contemporary nasal reconstruction strategies.

Critical Role of Extended Margins (WLE) in Standard Local Excision Techniques

In cutaneous oncology, achieving complete margin control during the primary surgical excision of malignant tumors, such as Basal Cell Carcinoma (BCC), Squamous Cell Carcinoma (SCC) and Melanoma (MM), is paramount to minimizing the risk of local recurrence and optimizing long-term patient survival⁶. Traditional local excision techniques performed without appropriately extended margins frequently result in incomplete resections due to subclinical, microscopic tumor extensions that radiate beyond the clinically visible borders of the lesion. When an oncologic oral and maxillofacial surgeon fails to implement an adequate surgical margin tailored to specific tumor biology, post-operative histopathological evaluation often reveals positive margins containing atypical or malignant cells at the deep or lateral borders.

As illustrated in **(Figure 1)**, standard local excisions executed with narrow or inadequate margins risk transecting these microscopic pathways, leaving positive deep and lateral margins that house residual atypical aggregates directly within the wound bed. This technical deficit frequently requires secondary re-excision procedures, increases patient morbidity, increases overall costs, delays definitive reconstruction and significantly elevates the potential for local treatment failure^{6,7}.

Consequently, the precise clinical selection and execution of extended margin boundaries remain a critical determinant of successful skin cancer eradication⁷. To achieve histologically verified negative borders, scientific consensus parameters dictate that surgical execution must adapt to tumor risk stratification; this requires utilizing a 4 mm peripheral margin for well-demarcated, low-risk lesions, which must be scaled up to 1

cm or greater for high-risk variants or aggressive histological subtypes. By broadening the boundary parameters to encompass these subclinical fields, the surgeon effectively isolates the core malignancy along with its microscopic digitations.

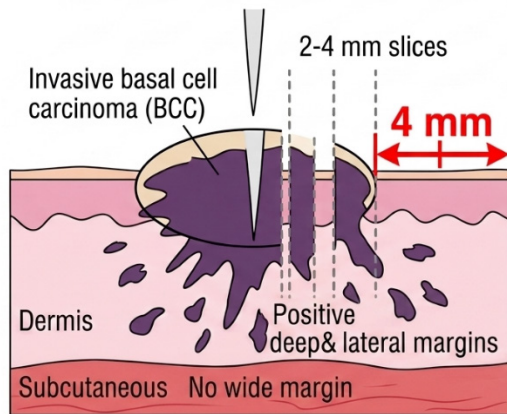


Figure 1: Standard local excision but with no wide margins. The diagram outlines the vertical cross-sections where subclinical tumor nests hide unexamined between 2-4 mm cuts, leading to positive deep and lateral margins.

As demonstrated in (Figure 2), implementing a local excision with appropriately extended margins successfully clears the peripheral and deep vectors of the operative field, rendering a specimen with clear, negative margins. Although this meticulous, mathematically and sound surgical approach should be the rule, it might but not always guarantee complete oncologic clearance prior to permanent wound closure, striking a vital balance between definitive cancer cure and functional cosmetic preservation^{6,7}. Because the uncertainty of all atypical cells removal, even with extended margins, MMS is always indicated for cutaneous cancer being now the golden standard.

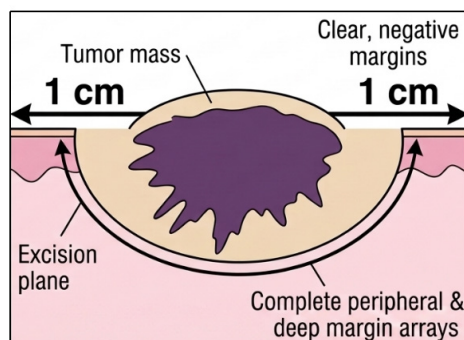


Figure 2: Local excision with extended margins. The diagram depicts how expanding the boundary parameters ensures the complete peripheral and deep margin arrays capture all subclinical fields, verifying clear margins under complete examination.

Histopathological Mechanism, Structural Subunits and Advanced Reconstructive Dynamics

To achieve maximum oncological safety and optimal cosmetic restoration, the clinician must integrate the microscopic precision of tissue processing with the macroscopic principles of facial biomechanics. This section provides a detailed analysis of the classic frozen section mechanics of Mohs Micrographic Surgery (MMS), followed by an extensive, subunit-by-subunit reconstructive surgical algorithm utilizing local and distant flaps for nasal defects.

The classic histopathological mechanism of MMS versus traditional pathology

The definitive superiority of MMS in cutaneous oncology relies entirely on its unique geometric tissue processing, which contrasts sharply with standard postoperative pathology.

A) The “Bread-Loafing” Flaw in Wide Local Excision (WLE): In traditional pathology, a surgical specimen is cut vertically at routine intervals (typically every 2 to 4 mm)³. This technique, known as “bread-loafing” or vertical cross-sectioning, samples less than 1% to 2% maximum of the actual surgical margin³. If a narrow strand of tumor passes between two vertical cuts, it remains undetected, leading to a false-negative report and subsequent clinical recurrence^{1,3}. This description can be appreciated in (Figure 3) represented below.

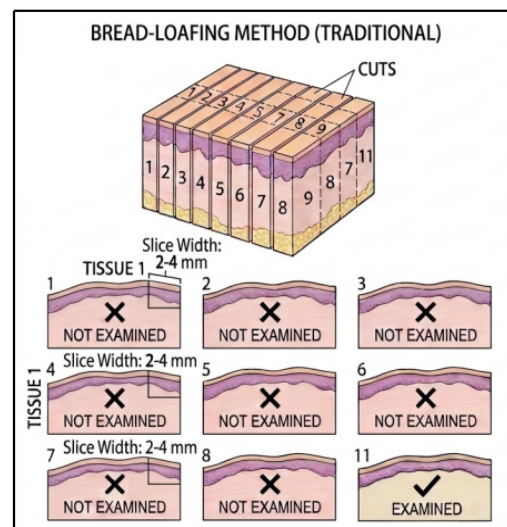


Figure 3: Bread-Loafing Method. Detailed view of traditional method called “Bread-Loafing” with cuts ranging from 2 to 4 mm.

B) The mechanics of 100% margin evaluation: MMS circumvents this sampling error through horizontal (tangential) sectioning. The surgical process follows a strict sequence of four steps as cited below.

Beveled excision: The Mohs surgeon excises the tumor tissue at a 45-degree angle (4). This beveling is critical because it flattens the lateral epidermal edges into the same horizontal plane as the deep surgical margin^{3,4}.

Tissue flattening and relaxing incisions: The specimen is relaxing-cut or sectioned so it can lie completely flat on the cryostat microtome stage⁴.

True margin sectioning: The microtome cuts the tissue horizontally from the deep surface up toward the epidermis. As a result, the very first complete slices contain the entire continuous peripheral and deep margins on a single glass slide^{3,4}.

Orientation and mapping: The specimen is divided into quadrants and color-coded using distinct tissue dyes (e.g., red, blue, green, black)⁴. This mapping corresponds exactly to a grid drawn on the patient’s surgical defect. If any malignant cells are spotted under the microscope, the surgeon can trace them back to the exact location on the patient, preventing unnecessary tissue loss during subsequent stages^{2,4}.

The entire description of this technique can be depicted in (Figure 4) shown below.

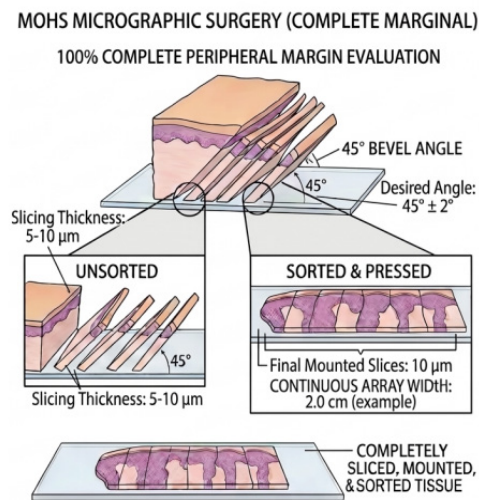


Figure 4: Mohs Micrographic Surgery (MMS). Detailed view of the MMS method showing a 45 degree-angle bevel when preparing the tissue for microscopic examination allowing a wide deep extension of tissue remaining in the same slide.

Advanced imaging innovations: Ex Vivo Confocal Microscopy (EVCN)

While frozen section pathology remains the gold standard, preparing slides intraoperatively takes considerable time, requiring freezing, embedding, microtome cutting and staining (Hematoxylin and Eosin - H&E or Toluidine Blue)⁸. This process typically takes 20 to 45 minutes per stage.

A) Ex Vivo Confocal Microscopy (EVCN): It has emerged as a major innovation that bypasses cryostat processing⁸.

- **Mechanism:** EVCN utilizes a low-power laser (often 830 nm for reflectance or 488 nm for fluorescence mode) to scan fresh, unfrozen tissue specimens immediately after excision⁸. By treating the tissue with a contrast agent like acridine orange, the laser generates high-resolution optical sections that mimic traditional histopathology.
- **Clinical impact:** The tissue requires no freezing or sectioning, reducing preparation time to less than 5

minutes per specimen. The digital images display cellular details, such as nuclear atypia, palisading and clefting artifacts, allowing the pathologist and surgeon to evaluate margins in real time⁸. Recent multicenter trials show a diagnostic concordance rate of over 95% between EVCN and traditional frozen sections for BCC, highlighting its potential to streamline MMS⁸⁻¹⁰.

Nasal subunits anatomy and biomechanical principles

The human nose is divided into nine distinct anatomical subunits based on skin thickness, sebaceous density, contour and light reflection: one root or radix, one bridge, one tip, one columella, two lateral walls, two paired alae and two soft triangles¹¹.

Below, (Figure 5A-5C) show a natural skin tones and lightning effect with a realistic sub-surface scattering profile and assigned generated mesh which will design and determine the subunits. The 3D topological wireframe shows the distribution edge loops, aligned along major structural stress lines which are important to determine areas of soft tissue contraction and possible distortion resulting in final aesthetic deformation. Notice that Catmull-Clark smooth subdivisions follow the light incidence throughout the nose structure which are important details for technical surgery.

The subunits are divided in six parts, numbered from 1 to 6. Even numbers follow a vertical straight line, from dorsum to columella and uneven numbers are horizontally spread away from the center. They are described as follows: 1. Nasal Root (Radix): The upper transition zone anchoring the model to the glabella. 2. Dorsum: The central bridge bridging the upper rigid bones and lower structures. 3. Lateral Walls (Right and Left): Symmetric flanks providing architectural transitions to the paranasal cheeks. 4. Nasal Tip: High-projection apex incorporating the supratip break and soft triangles. 5. Alae (Right and Left): Rounded, highly curved nostril wings isolated via transverse alar edge loops to prevent pinching artifact. 6. Columella: The lower structural column terminating at the subnasale point.

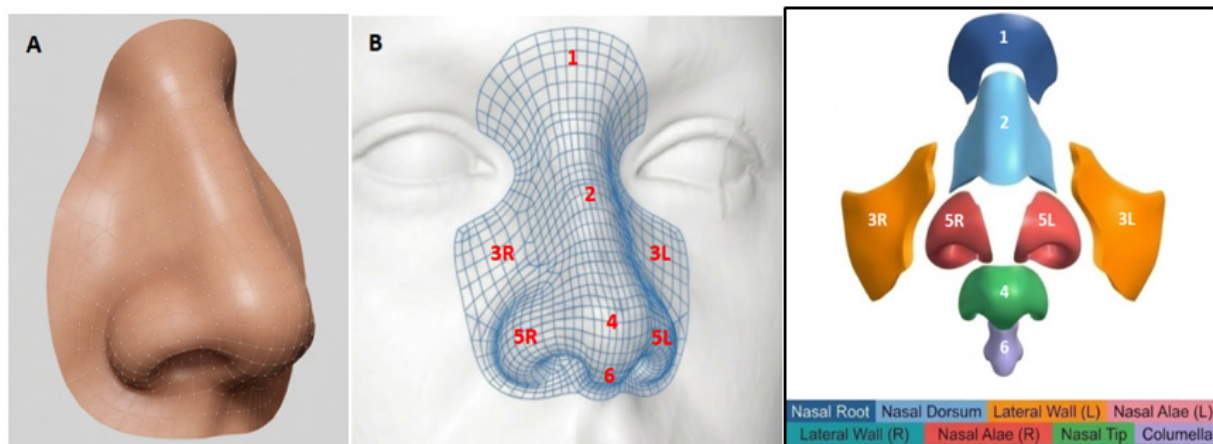


Figure 5A-5C: Comprehensive anatomical segmentation and digital subdivision mapping of the external nasal framework. (A) Integrated natural skin tones and lightning effect with a realistic sub-surface scattering profile and assigned generated mesh. (B) 3D low-poly topological wireframe demonstrating the distribution of quad-dominant edge loops aligned along major structural stress lines, where subunits are numbered from 1 to 6. (C) Comprehensive anatomical segmentation and digital subdivision mapping of the external nasal framework. Explosion view and smooth Catmull-Clark subdivision rendering illustrating the six distinct, self-contained functional subunits.

Reconstructive surgery on the nose must follow Burget and Menick's Subunit Principle: if a defect covers more than 50% of a specific subunit, the surgeon should excise the remainder of that subunit^{5,11}. This ensures that the scars fall along natural contour lines, rendering them less visible to the human eye^{5,11}.

Comprehensive subunit flap reconstruction algorithm

The selection of local versus distant flaps depends on tissue mobility, structural needs and defect size within each subunit. The subunits are divided in only four divisions, accordingly with the skin characteristics, as described below.

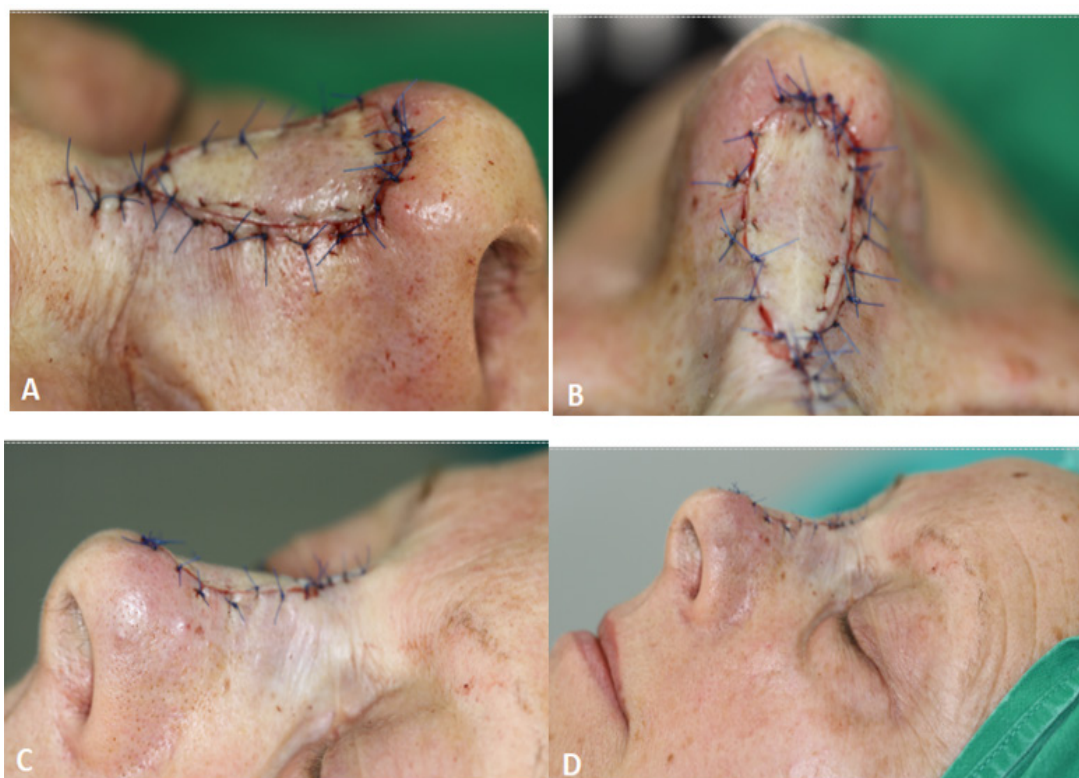
Division 1. Nasal Dorsum and Sidewall (Bridge and Lateral Wall)

A) Skin characteristics: Thin, mobile and relatively non-sebaceous.

B) Reconstructive options and types of Flaps:

Local Flap Choice (Rieger's Glabellar / Rotation Flap):

Ideal for defects sized 1.5 to 2.5 cm on the upper dorsum¹². This random-pattern rotation-advancement flap recruits loose skin from the glabella and moves it inferiorly¹² as shown in **(Figure 6A-6D)**. Care must taken to anchor the flap properly to avoid secondary distortion of the medial canthus^{12,13}.

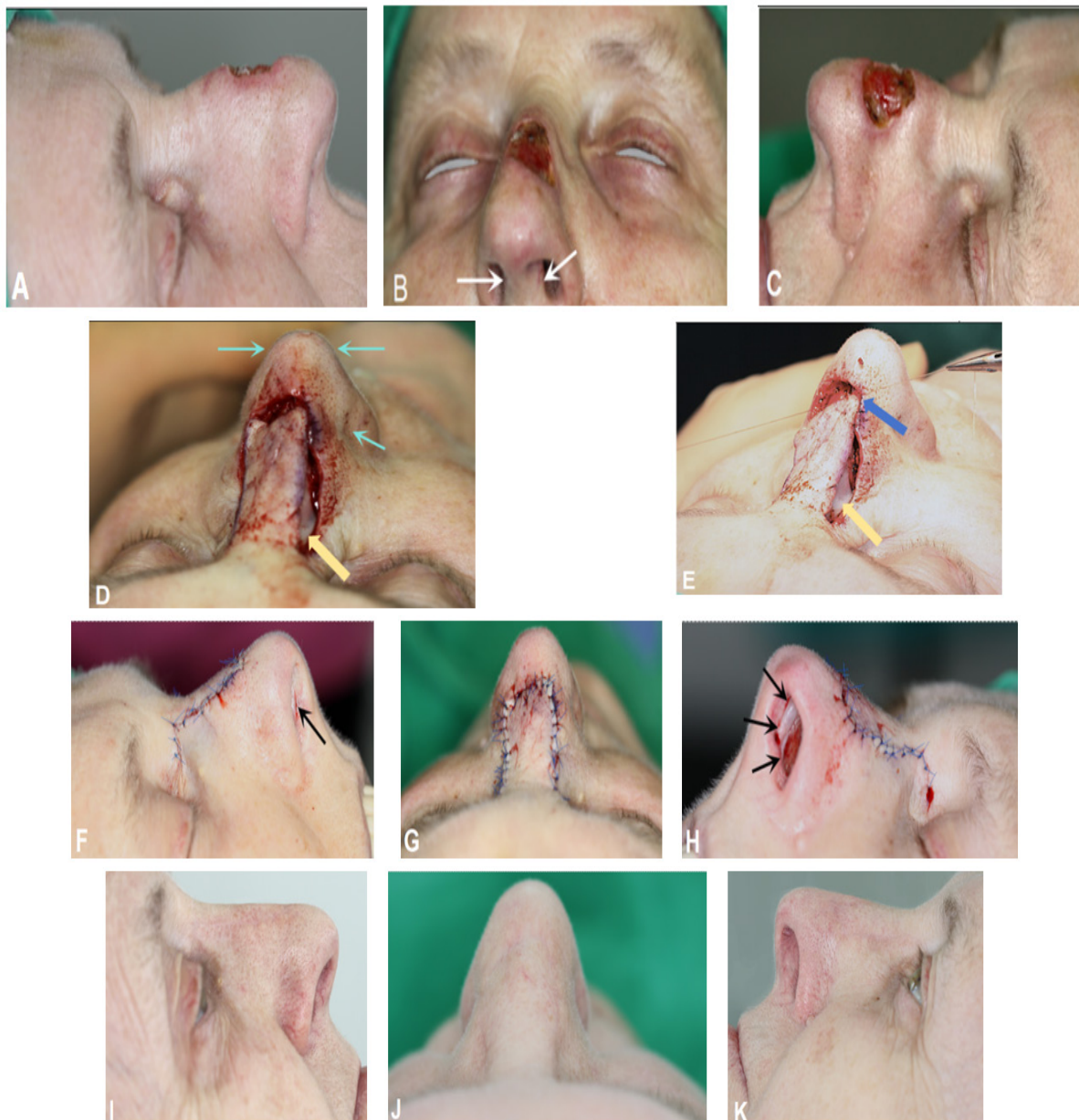


Figures 6A-6D: MMS resection of a nose dorsum BCC. Propeller flap for inferior advancement of glabella skin tissue to cover the nasal dorsum after its reduction of with piezosurgery (Wound Open Septo-Rhino-Piezosurgery - WOSRP), integrating a pure cosmetic rhinoplasty to reduce dorsum projection, diminishing the skin flap in its vertical dimension. Plasma Rich Fibrin (PRF), in two formats (liquid and membranes) were respectively inserted and injected underneath the skin flap.

- **Inverted-T modified glabellar flap (superior base pedicle without rotation):** This is a flap developed by the author which effectively covers the whole extension of nasal dorsum and/or radix, moving tissue from glabella and frontal area downward, maintaining a superior base pedicle. This technique along with WOSRP is presented in **(Figures 7A-7K)**. As per our surgical routine, for all facial skin cancer reconstruction, liquid Plasma Rich Fibrin (i-PRF) and 2-4 membranes in extended format (e-PRF - made by heating the plasma layer, which makes the membrane last for several months) are, respectively, injected at the end of the surgical procedure (and the 2-3 day post-operatively, as well) and inserted underneath the skin flap, building additional layers between subcutaneous and perichondrium-periosteum structures, as appreciated in **(Figures 7A-7K)**.

The following case is a nasal dorsum reconstruction following BCC resected in two stages. First evaluation also revealed left-sided septal deviation, resulting in columellar

enlargement and ipsilateral tip deviation. An inverted-T modified glabellar flap developed by the author was designed for nasal reconstruction. Soft tissues from the glabella and radix were mobilized inferiorly, supported by extended medial canthal incisions. Extensive dissection was performed beneath the lateral walls and frontal regions for complete surgical exposure of the nose for WOSRP. Extra attention should be devoted to not accidentally detach medial canthal ligaments during this dissection phase. The alar and nasal tip regions underwent delicate internal procedures to refine tip contour and tuck the alar crease for improved aesthetic outcomes. Extended Platelet Rich Fibrin (e-PRF) membranes were positioned underneath the flap to optimize healing. The flap was stabilized inferiorly using internal, resorbable Donatti sutures. Cephalo-caudal view and lateral aspects of the immediate post-operative outcomes. Sutures secure the medial canthal incision extensions. Additional stabilization points include columella reconstruction, anterior nasal spine and septum surgical correction.



Figures 7A-7K: Surgical reconstruction of a nasal dorsum defect following BCC surgical removal. (A-C) Nasal defect following two-stage excision. Left-sided septal deviation causes columellar enlargement and ipsilateral tip deviation showed by white arrows on B. (D) Inverted-T Modified Glabellar Flap reconstruction. External aspect of the internal tip refinement and alar crease tucking shown on cyan arrows. Yellow bold arrow depict Extended Platelet Rich Fibrin (e-PRF) membrane placed beneath the flap. (E) Inferior flap stabilization using internal resorbable Donatti sutures, marked by blue bold arrow. Yellow arrow depict the e-PRF membrane. (F) Immediate post-operative outcome from right lateral view. Black arrow indicate small incision for columella reconstruction. (G) Cephalo-caudal view of final sutures. (H) Final aspect of left lateral view of the nose. Black arrows indicate access incision for the anterior nasal spine and anterior aspect of nasal septum. (I-K) Post-operative photographic analysis at 4 months and 19 days, encompassing lateral and dorsal views of the nose, revealing good functional and cosmetic results.

- **Alternative Local Option (V-Y Advancement / Island Pedicle Flap):** Effective for lateral sidewall defects, moving adjacent cheek or superior sidewall tissue into the wound¹³.
- **Distant flap selection:** Rarely required for superficial wounds; however, full-thickness defects involving nasal bones require a Paramedian Forehead Flap (PMFF) or a free tissue transfer (e.g., radial forearm free flap) when medial cheek is also missing.

Division 2. Nasal Tip and Supratip

A) Skin characteristics: Thick, inelastic and highly sebaceous, with low mobility.

B) Reconstructive options and types of Flaps:

- **Local Flap Choice (Zitelli's Modified Bilobed Flap):** The primary choice for defects under 1.5 cm on the tip or supratip¹⁴. It utilizes two distinct tissue lobes rotated at a precise angle (typically 90 to 100 degrees total deviation from the defect axis) to distribute closing tension. This prevents alar elevation or asymmetry¹⁴.
- **Distant flap selection (Paramedian Forehead Flap - PMFF):** The gold standard for defects larger than 1.5 cm on the tip¹⁵. Based on the supratrochlear artery and its derivative vessels, this axial-pattern flap provides robust perfusion and matching tissue thickness. The PMFF can be

performed under two techniques. If a smaller in extension flap is needed, reconstruction can be aesthetically done in just one stage as shown in (Figures 8A-8D).



Figure 8A-8D: Aggressive infiltrative BCC on the lateral wall of the right side extending itself to the dorsum of the nose. (A) First consult showing a lesion with a crust-like type of tumor. Resection was performed in two stages not willingly but due to the histopathological result showing positive margins in all areas of the first sample. (B) The first surgical procedure had already involved a WLE tumor removal. (C) A second procedure was then performed using now MMS, resulting in a very large resection, involving almost all right lateral wall, radix and dorsum. (D) Right Paramedian Forehead Flap (R-PMFF) was the best option to adequately cover the large defect. An extended forehead dissection under the musculature is performed to provided enough tissue to close the donor site.

If a full and long PMFF is needed to cover large portions of the lateral walls and/or the entire tip but not the dorsum, then it might require a two- or three-stage procedure, with vascular pedicle divided (separated) 3 to 4 weeks after the initial transfer¹⁵.

A case of very infiltrative SCC of the tip of the nose is presented in (Figure 9A-9J). The tumor invaded nasal septum perichondrium, cartilaginous septum and bilateral lateral crura. The lesion was small and “apparently innocuous”. Resection was performed using MMS and histopathological results with positive margins in the nasal septum and bilateral lateral nose cartilages. A long PMFF was optioned to cover the distant and large defect. Nasal septum and lateral crura were reconstructed with free helix cartilage grafts. Special sutures called Anchoring Sutures were developed by the author and are always used in such cases to help holding lateral borders of the donor site margins to reduce tension and scar. The Clamp Test Procedure or Pedicle Occlusion Test can be performed even after a month postoperatively which is a clinical maneuver used to determine if a transposed or transferred flap has achieved autonomization. A verified autonomization means the flap is neovascularized now with an independent blood supply provided from the surrounding recipient bed. Therefore, the flap can be divided because it is ready for separation and this is the second stage of the treatment.



Figure 9A-9J: An infiltrative squamous cell carcinoma (SCC) on the nasal tip, invading perichondrium, cartilaginous septum and lateral crura. (A) Initial consultation showing a small, seemingly innocuous lesion on the nasal tip. (B) Close-up view of the tumor with lateral bulging and central crusting. (C) Photo reveals 7-day post-op after MMS. PMFF was selected for the large defect coverage. (D) Extra suture (developed by the author and called Anchoring Suture) is applied to the lateral borders of the donor site to reduce tissue tension and scarring. (E-F) Right and left views of the pedicled flap at 59 days post-operation. (G-H) The Clamp Test (Pedicle Occlusion Test) to confirm flap autonomization. A successful test confirms neovascularization and independent blood supply from the recipient bed, signaling

the flap is ready for the second-stage division. (I) Frontal view showing aesthetic results 80 days after flap separation. (J) Caudal-cephalic view at 80 days post-separation, demonstrating complete preservation of nostril patency and format. A third revision of the tip might still be necessary.

Division 3: Nasal Ala and Soft Triangle

A) Skin characteristics: Highly rigid, prone to collapsing inwards and missing an underlying cartilaginous framework at the lower alar rim (soft triangle).

B) Reconstructive options and types of flaps:

- Local Flap Choice (Nasolabial Transposition Flap):** Designed as a true myocutaneous flap pedicled on the facial artery, the Nasolabial Transpositional Flap (NTF) is a robust and versatile flap that is well suited to single-stage reconstruction of oral cavity defects or to staged reconstructions of facial defects¹⁶. Best for defects under 1.5 cm on the ala¹⁷. Based superiorly or inferiorly, it recruits tissue from the mobile cheek and nasolabial fold¹⁷. Due to its versatility, a modified NTF by then author, functioning as a bilobed flap with its rotation downward, is presented in Figure 10A-C to cover the entirety of right ala after resection of a BCC. The ala fibro-fatty connective tissue was first robustly reconstructed with the Free Helix Cartilage Graft Roll Technique (HCGRT)¹⁸ as presented below.



Figure 10A-10C: BCC clinically involving part of the right ala. (A) Removal with MMS condemned most of its structure due to its histopathological aspect. (B) Immediate result after using modified nasolabial flap with inferior-medial rotation. (C) Caudal-cephalic immediate postoperative perspective of the ala reconstruction, maintaining its integrity and patency.

- Combined Flap (Nasolabial Transposition Flap and Free Auricular Cartilage Graft):** A novel, effective and important reconstructive procedure following nose skin tumor removal, called Free Helix Cartilage Graft Roll Technique (HCGRT), was introduced by Steolo and Maurer in 2026¹⁸ envisioning to establish a foundation for the right ala, giving a strong structure, avoiding undesired collapse of the nostril and/or flap contraction closing/distorting it.
- Distant Flap Selection (PMFF with Cartilage Lining):** Mandatory for total alar defects. The flap must be lined with an autologous cartilage graft (sourced from the nasal septum or ear concha) is mandatory to prevent collapse of the external nasal valve during inspiration^{15,19}.

Division 4. Columella

A) Skin characteristics: Extremely scarce tissue with virtually no local mobility.

B) Reconstructive options: Small defects may heal via secondary intention or full-thickness skin grafts. Larger defects

require a turnover nasolabial flap or a specialized interpolation flap from the upper lip or forehead^{15,17}.

Summarized options for flap dynamics matrix is presented in (Figure 11).

Comparative Matrix of Flap Dynamics for Nasal Subunits.

Nasal Subunit	Defect Size	Recommended Flap Type	Primary Vascular Supply	Key Complication Risk
Dorsum / Sidewall	1.0 – 2.5 cm	Rieger Glabellar Flap	Angular/Angular perforators	Medial canthal distortion ⚠
Nasal Tip	< 1.5 cm	Zitelli Bilobed Flap	Angular artery branches	Pin-cushioning / Trapdoor effect
Nasal Tip / Complex	> 1.5 cm	Paramedian Forehead Flap	Supratrochlear artery	Pedicle necrosis (in smokers) ⚠
Nasal Ala	< 1.5 cm	Nasolabial Transposition	Facial / Infraorbital perforators	Alar asymmetry / Notch formation ⚠
Nasal Ala / Full Thick.	> 1.5 cm	PFF + Conchal Cartilage	Supratrochlear + Graft support	Nasal valve collapse ⚠

Figure 11: A matrix of flap dynamics for nasal subunits, specially designed for fast scannability.

Clinical Indications, Patient Selection and Oncological Efficacy in Low- to Intermediate-Risk Nasal Tumors

While MMS is traditionally recognized for managing highly aggressive cutaneous malignancies, its application in low- and intermediate-risk tumors on the nose is strongly supported by clinical evidence¹. The complex anatomy of the nasal pyramid makes even clinically routine or low-risk histological subtypes prone to deep subclinical extension²⁰.

This section examines the Appropriate Use Criteria (AUC) and updated long-term cure rates for low- to intermediate-risk nasal cutaneous malignancies treated with MMS.

Appropriate Use Criteria (AUC) and risk stratification

The American Academy of Dermatology (AAD), in collaboration with the American College of Mohs Surgery (ACMS), established the Appropriate Use Criteria to guide clinical decision-making²¹. Risk stratification is based on three main pillars: anatomical location, clinical characteristics (such as size and recurrence status) and histopathological features²¹.

On the nose, anatomical classification overrides small tumor size or non-aggressive histology^{2,21}. The entire nasal pyramid is designated as Area H (High Risk), as shown in (Figure 12), due to its critical cosmetic value and tendency for silent tumor extension along embryonic fusion planes²¹. Consequently, the AUC rates MMS as highly appropriate (score 7-9) for almost all epithelial tumors on the nose, including low-risk subtypes like superficial or nodular BCC²¹.

Low- to intermediate-risk tumor profile

For this review, low- to intermediate-risk nasal malignancies are defined by the absence of high-risk features, such as morpheaform or infiltrative patterns, perineural invasion or immunosuppression.

- Nodular basal cell carcinoma:** The most common variant on the nasal dorsum and sidewalls. It presents as a well-circumscribed, pearly papule with telangiectasias. Microscopically, it features nests of basaloid cells with peripheral palisading and clefting artifacts. While clinically cohesive, its deeper margins can silently track along the perichondrium of the nasal cartilages^{1,20}.
- Superficial basal cell carcinoma:** Frequently observed on the upper bridge and lateral aesthetic units. It appears as an erythematous, slightly scaly plaque. Histology shows

buds of atypical basaloid cells dropping down from the epidermis, often spreading out horizontally over a wide area rather than invading deeply²⁰.

- **Squamous cell carcinoma in situ (Bowen's Disease):** An intermediate-risk intraepidermal malignancy that often presents on the nose as a hyperkeratotic plaque. It displays full-thickness epidermal atypia but maintains an intact basement membrane. If left untreated, it can transition into an invasive carcinoma²².

Updated long-term oncological efficacy and cure rates

Recent large-scale cohort studies and multi-center tracking data demonstrate that MMS achieves superior long-term cure rates for low- and intermediate-risk nasal malignancies compared to traditional Wide Local Excision - WLE²⁰.

- **Primary nodular & superficial BCC:** Long-term 5-year follow-up data show a recurrence rate of 0.5% to 1.2% when treated with MMS, resulting in a 98.8% to 99.5% cure rate²⁰. In contrast, WLE for identical tumors on the nose carries a 5-year recurrence rate of 4.5% to 7.8%, primarily due to lateral margin sampling errors in standard vertical pathology^{3,20}.
- **Squamous cell carcinoma in situ:** MMS yields a 5-year cure rate exceeding 99.1%²². Because Bowen's disease can spread broadly along the epidermis without visible clinical signs, the 100% horizontal margin control of Mohs surgery reliably prevents the positive margins that frequently complicate traditional excisions²².

A matrix in (Figure 13) depicts the comparison between MMS versus WLE after 5-year follow-up.

STATISTICAL PERFORMANCE: MMS versus WLE				
TUMOR TYPE	MMS 5-YEAR CURE RATE	WLE 5-YEAR CURE RATE	MEAN SURGICAL STAGES	RECURRENT RISK REDUCTION
PRIMARY NODULAR BCC	99.2% MMS	95.5% WLE	1.3 stages	~82% Reduction
SUPERFICIAL BCC	99.5% MMS	94.2% WLE	1.1 stages	~91% Reduction
SQUAMOUS CELL CARCINOMA IN SITU	99.1% MMS	92.0% WLE	1.2 stages	~88% Reduction

Figure 13: Comparative 5-Year Cure Rates of Mohs Micrographic Surgery (MMS) versus Wide Local Excision (WLE) for Nasal Malignancies. Across all three clinical presentations, micrographic boundary control (MMS) demonstrates a higher 5-year clearance rate over standard wide margin surgical excision, with cure rates peaking at 99.5% for superficial basal cell carcinomas.

The high cure rates achieved in just 1.1 to 1.3 surgical stages underscore the efficiency of MMS for low- to intermediate-risk nasal tumors. This precise margin control ensures complete clearance while conserving maximum healthy tissue, creating smaller defects that simplify subsequent aesthetic flap reconstruction²⁰.

Physiological Integration, Biomechanical Dynamics and Complication Mitigation of Nasal Flaps

The success of aesthetic reconstruction following MMS

depends on microvascular physiology and soft-tissue biomechanics. Because the nose features distinct zones of skin thickness and a rigid underlying framework, successful reconstruction requires an understanding of how local and distant flaps heal. This section examines the physiological phases of flap integration, the biomechanical forces that shape outcomes and evidence-based techniques to prevent common surgical complications.

Microvascular physiology and stages of flap integration

When a tissue flap is incised and moved into a nasal defect, its survival shifts through three distinct physiological phases, as presented in (Figure 14).

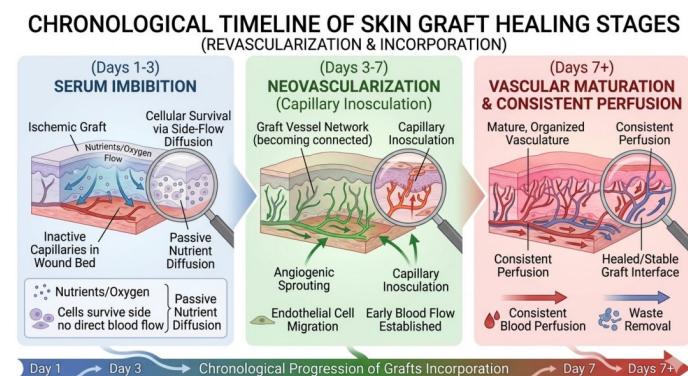


Figure 14: Chronological Timeline of Skin Graft Healing Stages. A schematic flowchart demonstrating the three primary phases of skin graft revascularization. The process progresses sequentially from initial Serum Imbibition (passive fluid absorption, Days 0–3), through Neovascularization (capillary sprouting, Days 3–7), to final Vascular Maturation (definitive direct circulatory communication, Days 7+).

Phase 1. Serum Imbibition (Days 0 to 3)

During the first 24 to 72 hours, the transposed tissue lacks direct connection to the recipient wound bed. It survives via passive absorption of nutrients and oxygen from the underlying fluid¹⁵, a process known as serum imbibition. The survival of the flap during this critical window depends entirely on its intrinsic vascular pedicle (random subdermal plexus or a defined axial artery).

Phase 2. Neovascularization and Inosculation (Days 3 to 7)

True physiological integration begins with inosculation, where endothelial buds from the recipient wound bed align and connect with existing vessels in the flap. Concurrently, angiogenesis drives the sprouting of new capillary networks across the fibrin interface. By day 5, microvascular blood flow is established across the wound margins¹⁷.

Phase 3. Vascular maturation and remodeling (Day 7 onward)

The chaotic network of newly formed capillaries undergoes pruning and maturation. Vessels realign along the primary vectors of physical stress and tissue tension, establishing definitive directional flow that secures the long-term viability of the flap^{15,17}.

Biomechanical dynamics: Tension vectors and structural deformation

Reconstructing nasal defects requires managing complex

biomechanical forces. The skin of the upper nose (dorsum and sidewalls) is relatively elastic, whereas the lower third (tip and alae) is highly rigid and unyielding.

Applying local flaps to these zones introduces specific mechanical stresses. These forces of contractions are discussed below.

Primary and secondary tension vectors: Every local flap creates a primary vector of tension along the line of closure, paired with a secondary tension vector at the donor site¹⁴. If the primary closure vector runs parallel to the alar rim, the resulting tension can pull the ala upward, causing asymmetry or external nasal valve collapse¹⁹.

The trapdoor effect (Pin-Cushioning): This common biomechanical complication occurs frequently with curved or circular flaps, such as the Zitelli bilobed flap or transposition flaps¹⁷. As the circumferential scar contracts over time, the tissue inside the loop is compressed upward, creating a bulging, dome-like deformity. This effect is worsened by lymphatic obstruction along the curved scar line and an excessively thick subcutaneous fat layer^{14,17}.

A trapdoor case is seen in (Figure 15A-15B), showing upward elevation (bulding) of the flap tissue already healed in position, but contracting ipsilateral nasal ala. A thick subcutaneous tissue layer (“cushion”) is trapped within a tight, healing arcuate incision. The scar tissue contracts deeply the right alar fibrofatty connective tissue forcing it upward.

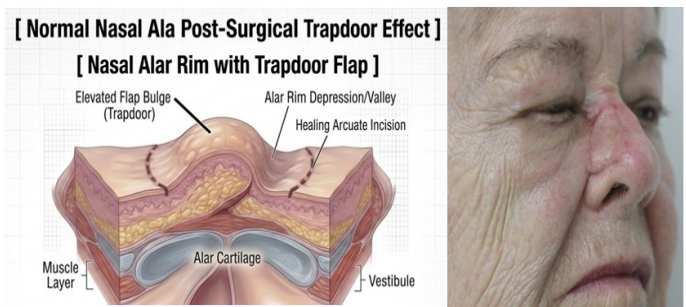


Figure 15A-15B: Cross-sectional schematic of the trapdoor (pin-cushioning) effect on the nasal ala after flap reconstruction. (A) The diagram illustrates the characteristic upward bulging of the central flap tissue, driven by a thick subcutaneous tissue layer (“cushion”) trapped within a tight, healed arcuate incision. (B) Patient presents a trapdoor deformity, where an adjacent structural valley is formed forcing the center of the flap upward, resulting in the visible contour deformity over the deep muscle layer, right lateral wall.

Strategies to mitigate complications

Preventing aesthetic and functional complications requires specific technical modifications during the initial surgery.

A) Prevention of alar distortion

- **Technique:** Align the primary closure lines parallel to the nasolabial fold or vertically along the dorsum to avoid pulling on the alar margin^{14,17}.
- **Structural grafting:** For defects located within 0.5 cm of the alar rim, place an autologous cartilage batten graft (sourced from the ear concha or septum) beneath the flap. This cartilage provides a rigid support that counteracts contractile scar forces, ensuring the nostril remains symmetrical and open¹⁹.

B. Minimizing the trapdoor effect

- **Wide Undermining:** Undermine extensively in the correct anatomical plane (subgaleal/supraperiosteal on the upper nose; subdermal/supraperichondrial on the tip) well beyond the wound margins to distribute contractile forces evenly¹⁷.
- **Geometric alteration:** Avoid perfectly circular flap contours. Incorporate straight lines or subtle zig-zag patterns into the design to break up the scar line and minimize concentric contracture¹⁷. For wounds near the nasofascial junction, deep suspension sutures must be anchored directly to the nasal bone periosteum to isolate the internal nasal valve from surface tension vectors¹³.
- **Peripheral Tapering:** Bevel the edges of the flap slightly outward and thin the subcutaneous fat along its margins to create a smooth transition to the surrounding tissue.

C) Managing venous congestion and flap ischemia

- **Pedicle design:** Maintain a wide, reliable base for random-pattern flaps, ensuring a length-to-width ratio of no more than 3:1.
- **Medical interventions:** If a flap shows signs of venous congestion intraoperatively (e.g., dark purple discoloration or brisk, dark bleeding), place a few nitroglycerin ointment strips to relieve localized pressure. Small incisions can help promoting alternative drainage paths¹⁵. Also, injection of heparin performed in the “Chemical Leech” technique can be used for venous congestion²³.

A synoptic matrix of possible complications when reconstructing a nose is proposed in (Figure 16).

SYNOPTIC MATRIX OF COMPLICATION PROFILES AND INTERVENTIONS				
Complication Profile	Primary Anatomical Sites	Biomechanical Root Cause	Preventive Surgical Maneuver	Postoperative Salvage Option
 Alar Retraction	Alar upward pull tension forces	Biomechanical bause and urot pot injections	Intralesional triamcinolone acetonide injections	Secondary V-Y advancement or composite graft
 Trapdoor Effect	Concentrically contracting scars	Bioconcentrital tensionorfone contracting and dravitations	Preventive surgical Intralesional surgical maneuver	Secondary V-Y advancement or composite graft
 Flap Tip Ischemia	Restricted blood flow arect flow	Blomocfield restricted unn restricted blood flow	Preventive surgical maneuver aronological alarrenaston	Secondary V-Y advancement or composite graft
 Medial Canthal Distortion	Distorted medial canthal slasting structure	Inarolosion structural contracting scar for trapoloping scars	Preventive surgical maneuver li propositir nirsical maneuver	Secondary V-Y advancement or composite graft

Figure 16: A clinical matrix detailing four key postoperative nasal reconstruction complications: Alar Retraction, Trapdoor Effect, Flap Tip Ischemia and Medial Canthal Distortion. Each clinical cohort is accompanied by an anatomical schematic illustrating the biomechanical root cause or site-specific vectors, moving horizontally to correlate the primary anatomical sites, underlying pathomechanics, preventive intraoperative maneuvers and secondary postoperative salvage options.

Critical Discussion and Synthesis of the Literature

The management of nasal cutaneous malignancies requires balancing oncological clearance with functional and aesthetic reconstruction. This section presents a critical evaluation of the recent literature, analyzing the practical utility of intraoperative imaging technologies alongside the predictability of long-term functional and cosmetic outcomes for nasal reconstructions.

Technological versus Histopathological Trade-Offs

The introduction of Ex Vivo Confocal Microscopy (EVCN) and Optical Coherence Tomography (OCT) into the

MMS workflow has created a new paradigm in dermatologic oncology^{8,10}. Recent comparative studies show a strong diagnostic concordance (95% to 97%) between EVCM and classic frozen sections for BCC with low- to intermediate-risk. A comparative matrix is detailed in **(Figure 17)**. However, a critical analysis of the literature reveals several operational and diagnostic challenges.

INTRAOPERATIVE MARGIN ASSESSMENT COMPARISON	
Traditional Frozen Sections	Ex Vivo Confocal Microscopy EVCM
+ Gold standard clarity	+ Rapid turnaround (~5 mins)
+ Familiar H&E morphology	+ No physical tissue consumption
- Time-intensive (30-45 mins)	- High initial equipment cost
- Tissue artifacts from freezing	- Steep learning curve for artifacts

Figure 17: A comparative side-by-side clinical matrix evaluating the procedural advantages and limitations of two intraoperative margin modalities. The left cohort highlights Traditional Frozen Sections, detailing its diagnostic familiarity balanced against freezing artifacts and a longer processing time (30–45 minutes). The right cohort presents EVCM, contrasting its rapid turnaround (~5 minutes) and non-destructive tissue profile against higher initial equipment investments and a specialized technical learning curve.

A) Diagnostic limitations and artifacts

Traditional frozen sections use Hematoxylin and Eosin (H&E) or Toluidine Blue staining, providing clear cytoplasmic and nuclear details familiar to pathologically trained Mohs surgeons (3,4). EVCM, which relies on fluorescent agents like acridine orange, produces a digital image that looks different from traditional slides.

The literature notes that inflammatory cells, dense solar elastosis and glandular structures on the nasal ala can mimic basaloid nests, leading to false positives⁸. Conversely, small micronodular or superficial strands can sometimes be missed if the laser plane is misaligned, introducing a risk of false negatives^{8,9}.

B) Operational efficiency versus financial realities

The primary advantage of EVCM is speed, reducing processing times from 30-45 minutes down to under 5 minutes per stage. This allows the surgeon to clear margins quickly and proceed directly to reconstruction.

However, the high cost of the equipment and the need for specialized training mean its adoption is currently limited to high-volume academic medical centers. The literature suggests that while EVCM is highly effective for routine nodular or superficial BCCs and traditional frozen sections remain necessary for complex or poorly differentiated SCC⁸. Traditional frozen sections remain necessary when encountering complex histopathological features or deep attachment to the nasal perichondrium^{3,8}.

Long-term aesthetic outcomes and predictability matrix

Aesthetic success on the nose relies on maintaining the distinct boundaries between facial subunits¹¹. When scars cross these boundaries or alter natural skin texture, the reconstruction becomes more noticeable.

A) Tissue matching dynamics: The upper two-thirds of the nose (dorsum and sidewalls) feature thin, smooth skin, making them

well-suited for full-thickness skin grafts or regional rotation flaps like Rieger’s Glabellar Flap¹².

Conversely, the lower third (tip and ala) consists of thick, sebaceous, non-mobile skin¹¹. Reviewing the literature shows that using thin skin grafts on the tip often causes a depressed, pale scar that matches poorly with the surrounding tissue (5). For this zone, local flaps like the Zitelli’s Bilobed Flap or interpolation flaps like the PMFF offer a much better match in thickness and texture^{14,15}.

B) Dynamic changes over time: Scars continue to remodel for up to a year after surgery. The literature emphasizes that circular local flaps are prone to late-stage contracture, which can lead to the trapdoor effect or pin-cushioning.

To ensure predictable long-term results, surgeons must emphasize wide subcutaneous undermining and careful dermal anchoring during the initial procedure. This helps minimize late-stage scar contraction and prevents the need for subsequent revision surgeries¹⁷.

Long-term functional outcomes and airway preservation

The structural integrity of the nose is vital for maintaining a patent airway. The external and internal nasal valves regulate nasal airflow resistance and are easily compromised by poorly planned surgical procedures resulting in unsuccessful results as illustrated in **(Figure 18A-18D)**.

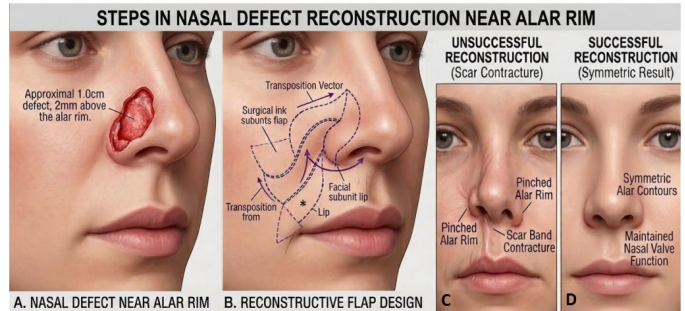


Figure 18A-18D: (A) Pre-operative view of a defined surgical defect (approx. 1 cm) in close proximity to the critical alar rim tissue. (B) Intra-operative design of a multi-lobed transposition flap to recruit skin from the nasolabial and cheek subunits, minimizing tension and tissue sacrifice. The vector if transposition is crucial. (C) An unsuccessful outcome demonstrating secondary-intention healing or simple closure leading to alar collapse, nostril stenosis and profound asymmetry due to scar contracture. (D) A successful reconstruction result employing the designed flap, which has maintained alar support, symmetry and function.

A) External nasal valve dynamics: The external nasal valve is formed by the alar rim, the caudal border of the lateral cartilage and the nasal septum. Wounds on the ala or soft triangle that heal under vertical tension can pull the alar margin upward.

Long-term follow-up studies demonstrate that without structural support, tissue contracture often leads to dynamic alar collapse during inspiration¹⁹. Incorporating an autologous auricular cartilage batten graft beneath the flap provides the structural support needed to resist these contractile forces, ensuring long-term airway patency.

B) Internal Nasal Valve Integrity: The internal nasal valve which is the narrowest segment of the airway, is bounded by

the caudal end of the upper lateral cartilage and the septum. Large defects on the nasal sidewall or dorsum can alter this relationship.

The literature highlights that aggressive flap advancement across the nasofacial junction can flatten the upper lateral cartilage inward, causing chronic nasal airway obstruction¹³. Preserving this airway space requires anchoring deep suspension sutures directly to the nasal bone periosteum, isolating the internal valve from the tension of the overlying skin closure¹³.

Synthesis of evidence-based literature outcomes

The current literature reveals a clear consensus on managing low- to intermediate-risk nasal malignancies on three aspects as exhibited in (Figure 19) as characterized below.

- **Oncological safety:** MMS remains the most reliable method for achieving complete margin clearance while preserving the maximum amount of healthy tissue. This minimized surgical defect simplifies the subsequent reconstruction^{4,20}.
- **Imaging integration:** Digital imaging tools like EVCM speed up intraoperative processing times for routine cases but require traditional frozen section validation for complex or atypical pathology^{8,9}.
- **Reconstructive strategy:** Long-term aesthetic and functional success depends on structural cartilage support and selecting the right procedure based on the proper and specific anatomical subunit boundaries^{5,19}. Smaller wounds (<1.5 cm) on the tip or ala are effectively managed with precise local flaps (bilobed or nasolabial), while larger, more complex defects require the structural support and tissue volume provided by a paramedian forehead flap combined with cartilage grafting^{14,15,19}.

Comprehensive Synthesis of Technology, Esthetics and Function

Evaluated Dimension	Modality / Flap Strategy	Oncological & Tech Performance	Long-Term Aesthetic Predictability	Long-Term Functional Patentability
Intraoperative Margin Control	Classic Cryostat Frozen Section	Gold standard; 100% margin evaluation; captures complex margins.	N/A (Diagnostic)	N/A (Diagnostic)
Intraoperative Margin Control	Ex Vivo Confocal Microscopy	Rapid (~5 mins); high concordance for low-to-mid risk tumors.	N/A (Diagnostic)	N/A (Diagnostic)
Anatomical Reconstruction	Zitelli Bilobed Flap (<1.5cm Tip)	Tissue-sparing, single-stage procedure.	Good color match; risk of late trapdoor effect.	Maintains tip projection; low risk to nasal valve.
Anatomical Reconstruction	Nasolabial Flap (<1.5cm Ala)	Reliable vascularity; efficient tissue recruitment.	Good color match; risk of minor alar asymmetry.	Risk of alar retraction unless supported by cartilage.

Figure 19: Operational Matrix Synthesizing Margin Control Modalities and Reconstructive Flap Strategies. A comparative chart correlating Intraoperative Margin Control (Frozen Sections vs. Ex Vivo Confocal Microscopy) and Anatomical Reconstruction (Zitelli’s Bilobed Flap versus Nasolabial Flap). The horizontal rows categorize interventions by oncological performance, long-term aesthetic predictability and functional outcomes, highlighting the trade-offs between processing speed, tissue preservation and structural risks like trapdoor deformity or alar retraction.

Conclusion and Future Perspectives

The treatment of cutaneous malignancies within the nasal pyramid represents a complex intersection of dermatologic oncology, optical physics and facial plastic surgery. Because the nose serves as both a prominent central aesthetic feature and a vital airway valve, selecting the right surgical approach

is essential. This comprehensive review highlights that combining MMS with subunit-specific reconstructions provides an exceptionally reliable framework for achieving complete oncological clearance while preserving natural facial form and function.

The author recommends utilization of second-generation Platelet Rich Fibrin (PRF), including advanced (A-PRF), extended (e-PRF) in liquid and membrane variants, for all head, face and neck cutaneous cancer treatment to optimize tissue regeneration, attenuate adverse secondary effects of the acute postoperative inflammatory response and minimize cicatricial tissue formation.

It is the author concept that while reconstructive surgery of the head, face and neck primarily focuses on covering exposed areas, the concomitant execution of pure aesthetic procedures such as rhinoplasty, otoplasty, rhytidoplasty, forehead lift, among others, should be always discussed with patients to enhance both functional and cosmetic results.

Clinical summary and recommendations

- **Oncological management:** MMS remains the definitive gold standard for low-to-intermediate risk nasal malignancies, yielding 5-year cure rates between 98.8% and 99.5%. Its horizontal sectioning technique eliminates the false-negative sampling errors common to standard vertical cross-sectioning pathology^{3,20}.
- **Technological innovation:** Ex Vivo Confocal Microscopy (EVCM) represents a major shift in margin analysis. By bypassing traditional frozen section preparation, it compresses intraoperative processing times from over 30 minutes to under 5 minutes per stage, optimizing clinical workflows without compromising diagnostic accuracy⁸.
- **Structural preservation:** Long-term aesthetic and functional success relies on strict adherence to Burget and Menick’s subunit principles. Smaller defects (<1.5 cm) on the tip or ala are effectively restored using local transposition or bilobed flaps. Larger or deeper defects (>1.5 cm) require the robust, axial blood supply of a paramedian forehead flap, paired with autologous cartilage grafts to prevent structural collapse and maintain airway patency^{15,19}.

Future horizons

The future of nasal cutaneous cancer surgery lies in the integration of three factors: a) Digital imaging (EVCM), b) Automated analysis by Artificial Imaging (AI) and c) Biomechanical modeling from patient’s own cells. This optimistic view of Oral and Maxillofacial Oncologic Surgery is detailed in (Figure 20).

A) Artificial intelligence and automated margin assessment: Deep learning algorithms and convolutional neural networks (CNNs) are currently being trained to analyze digital EVCM and optical coherence tomography (OCT) scans. In the future, these AI systems could assist the surgeon by automatically highlighting suspicious basaloid clusters or cellular atypia in real time^{9,10}. This automated assistance would further standardize margin interpretation, reduce human error and accelerate the intraoperative workflow.

B) Three-D biomechanical modeling and customized cartilage scaffolding: While autologous ear or septal cartilage

grafts remain the standard for preventing alar collapse, harvesting these tissues adds surgical time and introduces donor-site morbidity¹⁹. Emerging research in tissue engineering and 3D bioprinting points toward a future where synthetic or biocompatible, patient-specific scaffolds can be printed intraoperatively^{9,19}. These custom inserts will match the exact contours of the surgical defect, ensuring reliable, long-term structural support for the nasal valve.

C) Molecular-targeted therapies and hybrid regimens: For tumors that intimately track along the periosteum or cartilage, combining micrographic surgery with localized, molecularly targeted therapies, such as topical hedgehog pathway inhibitors, may offer a way to further minimize surgical defects. This hybrid approach would preserve even more healthy tissue, simplifying the subsequent reconstructive plan²⁰.

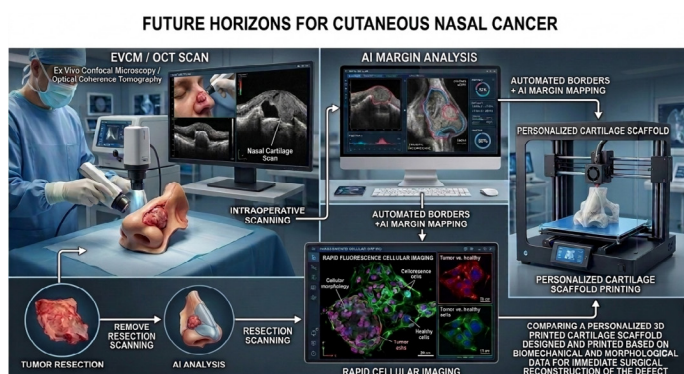


Figure 20: Integrated intraoperative workflow for cutaneous nasal cancer reconstruction. Schematic showing real-time EVCM/OCT scanning of the nasal defect, automated AI margin analysis and border mapping, rapid cellular imaging for morphological evaluation and immediate 3D biomechanical printing of a patient-specific cartilage scaffold tailored to the surgical defect.

Future perspectives on managing nasal skin cancer will require a careful balance between oncology, precise extension of resection and excellent final aesthetics. By combining microscopic precision of modern micrographic surgery with structural, subunit-focused reconstruction, oncologic surgeons will reliably eliminate cutaneous nose cancers, while maintaining the intricate contour and essential function of the nasal airway.

Conflict of interest

The author declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Data availability statement

Data Availability Statement: All data analyzed and synthesized during this study are included within this published review article and its cited primary sources.

Ethical statement

The cases reported were conducted in a private office,

therefore adhering national counselling and the Declaration of Helsinki guidelines, prioritizing and ensuring patient privacy, confidentiality and anonymity.

Informed consent statement

Informed consent was taken for this publication with all patients providing their written consent for their photographs be published particularly and only for this scientific cases report. All signed documents are legally being kept in author's private office under specific patients' chart. All other images/drawings are original and were specially AI created/developed for this article and author, therefore are not found anywhere in the World Wide Web (www).

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