Portuguese Journal of Dermatology and Venereology

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REVIEW ARTICLE

Nasal dorsum reconstruction in the cutaneous oncology setting

Reconstrução do dorso do nariz em cirurgia oncológica cutânea

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Abstract

The nose is one of the most frequent anatomic locations of skin cancer. The purpose of surgery is not only fully eliminating the tumor but also preserving nose function and aesthetics. Reconstruction of defects involving the nasal dorsum usually presents a substantial challenge. A wide range of reconstructive options have been developed for reconstructing this area, all of which can result in excellent outcomes. The choice of a reconstructive technique is influenced by tumor type, by the defect, by patient individual skin characteristics, and by surgeon preferences. Defects on the nasal dorsum frequently cross to adjacent cosmetic subunits, such as the nasal tip, the sidewall, the medial canthus, and the glabella. These complex defects usually require challenging reconstructive technique and carry a higher risk of local complications. In this article, the main reconstructive techniques for nasal dorsum reconstruction are reviewed.

Keywords: Nose/surgery. Skin neoplasms/surgery. Surgical flaps.

Resumo

O nariz é uma das localizações anatómicas mais frequentes do cancro de pele. O objetivo da cirurgia é não apenas a exérese completa do tumor, mas também preservar a função e estética do nariz. A reconstrução de defeitos que envolvem o dorso do nariz são frequentemente desafiantes. Um vasto leque de opções reconstrutivas foi desenvolvido para esta subunidade nasal, com bons resultados. A escolha da técnica reconstrutiva é influenciada pelo tipo de tumor, pelo defeito, pelas características da pele do doente e pela preferência do cirurgião. Os defeitos do dorso do nariz invariavelmente afetam também outras subunidades adjacentes, como a ponta do nariz, as paredes laterais, os cantos internos dos olhos e a glabela. Estes defeitos complexos requerem técnicas reconstrutivas desafiantes e têm um maior risco de complicações locais. Neste artigo são revistas as principais opções reconstrutivas do dorso do nariz.

Palavras chave: Nariz/cirurgia. Neoplasias da pele/cirurgia. Retalhos cirúrgicos.

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Received: 09-10-2021
Accepted: 01-11-2021
DOI: 10.24875/PJD.M22000004

Available online: 16-05-2022
Port J Dermatol and Venereol. 2022;80(1):15-24
www.portuguesejournalofdermatology.com

Introduction

The nose is one of the most frequent anatomic locations of skin cancer, including non-melanoma skin cancer, lentigo maligna, and adnexal tumors. The purpose of surgery is not only fully eliminating the tumor but also preserving nose aesthetics and function. Given its central position in the face, even small defects may carry significant social impact.

Reconstruction of defects involving the nose frequently presents a substantial challenge. Selecting the appropriate reconstructive technique often allows for inconspicuous scars and overall nondeforming surgical results. Key considerations to achieve a satisfying cosmetic result include maintenance of the alar rim and crease, alar symmetry, color, and texture of the nasal skin.

The principle of nasal subunits assumes paramount importance for the success of nasal reconstruction. Burget and Menick divided the nose into nine aesthetic subunits, five of whom convex (tip, dorsum, columella, and paired alar base-nostril sills) and four concaves (paired sidewalls and soft triangles)[1]. According to this principle, when a defect of the nose covers > 50% of a subunit, the remaining subunit should be excised and the entire subunit repaired. This approach places incisions at boundaries between subunits, maintaining the native contour, and providing camouflage for surgical scars[2].

A wide range of reconstructive options have been developed for reconstructing the nasal dorsum. The choice of a reconstructive technique is influenced by tumor type, by the defect, by patient individual skin characteristics, and by surgeon preferences. Most defects in the nasal dorsum can be reconstructed with multiple different techniques, all of which can result in excellent outcomes.

Choice of reconstructive technique

Tumor type and defect analysis

The size, depth, location (distal vs. proximal), and position (midline vs. off-center) of the defect are the main elements which impact on the reconstructive choice. Defects on the nasal dorsum are not often restricted to this subunit, crossing to adjacent cosmetic subunits, such as the nasal tip, the sidewall, the medial canthus, and the glabella. These complex defects usually require challenging reconstructive techniques and carry a higher risk of local complications.

The tumor type also impacts on the choice of the reconstructive technique. For example, in the case of melanoma the performance of flaps should be avoided as far as possible.

Patient characteristics

Concerning patient characteristics, the technique should be adapted according to nasal shape and length, as well as skin laxity and sebaceous composition. In particular, thick sebaceous skin is usually stiffer and has a higher risk of closure with greater wound tension.

A history of prior skin cancer, nasal surgery or local irradiation should be elicited before surgery. Meticulous evaluation of the scars of patients who had a prior surgery to a skin tumor usually allow the deduction of the type of reconstructive technique used and the diagnosis of local recurrences, which might have a significant impact on the planning of the surgical approach and on the prognosis. Moreover, both head and neck irradiation and intervening scars can have a significant negative impact on skin-flap vascularity.

Reconstructive ladder

The reconstructive ladder is the spectrum of closure options available for surgical defects. In the mind of the surgeon, closure should be achieved by the most straightforward and least invasive method. The simplest and usually better reconstruction option is primary closure. Although easier to perform, second intention healing is not ideal as the convex form of the nasal dorsum predisposes to obvious scaring. For medium to large defects, local skin flaps or full-thickness skin grafts are required. In complex and extensive defects, partial primary closure can be combined with different flaps together or with full-thickness skin graft.

Primary closure

Primary closure is a simple and useful technique for the reconstruction of small defects of the midline nasal dorsum. Elderly patients who generally have significant skin laxity are particularly suitable for this approach.

For better cosmetic outcomes, primary wound closure should follow skin tension lines. Depending on the size and location of the defect, wound closure can be oriented horizontally (Figure 1 A-C) or vertically

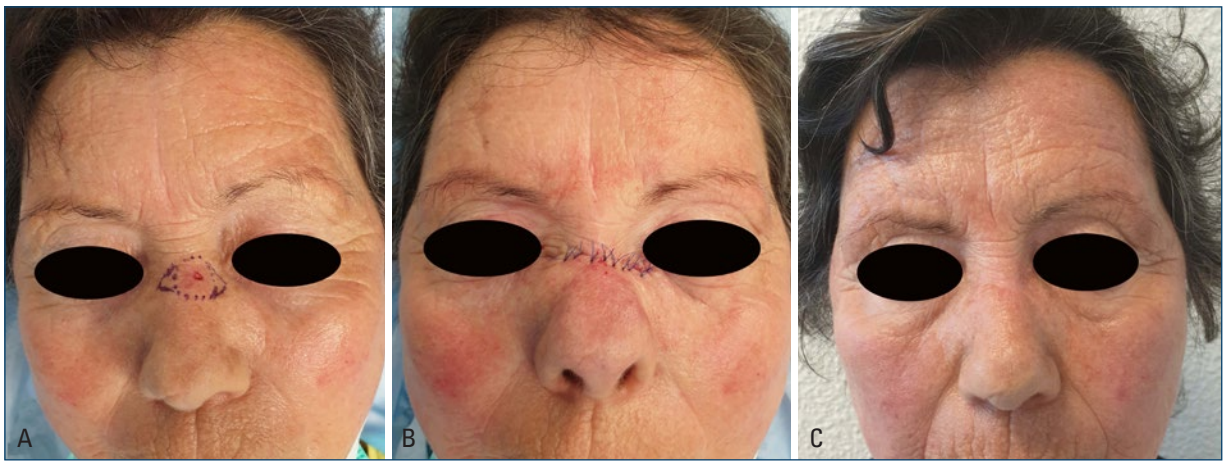

Figure 1. A and B: primary closure of a small midline defect of the nasal dorsum with a horizontal orientation after excision of a histologically confirmed basal cell carcinoma. **C:** cosmetic result after 6 months of surgery.

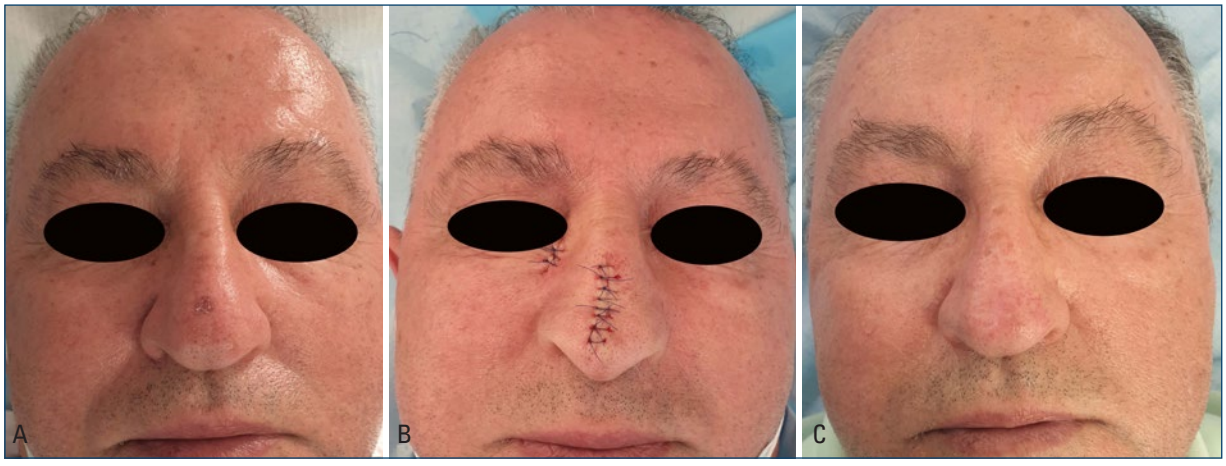

Figure 2. A and B: primary closure of a small distal midline defect of the nasal dorsum with a vertical orientation after excision of a histologically confirmed basal cell carcinoma. **C:** cosmetic result after 6 months of surgery.

(Figure 2 A-C). The ideal defect for a vertical linear nasal repair is a midline wound < 1.2 cm in width. In vertically oriented ellipses, wound tension closure can be reduced by elongating the ellipse to a 5:1 or greater length to width ratio (Figure 2 A-C). Shorter ellipses carry the risk of resulting in a distortion similar to a saddleback deformity. Vertical surgical defects which end in the mid dorsum or near the tip are more prone to poorer cosmetic results that may be apparent on profile views[3].

Surgical defects not centered in the nasal dorsum, located adjacent to the sidewall, is less suitable for primary wound closure, and is more ideally reconstructed with alternative techniques[4].

Primary closure may result in nasal tip rotation and cause changes on ala-columella relationship. These effects should be anticipated and discussed with the patient before surgery.

Second intention healing

Although second intention healing is a straightforward technique that eliminates the need for reconstructive procedures, it requires a long period of post-operative care and the cosmetic outcome can only be assessed after complete wound healing[5]. Second intention healing is more suitable for small defects in concave areas, such as the alar groove. As a convex subunit, second intention healing is uncommonly advocated for the management of surgical defects in the nasal dorsum, as it usually results in a depressed scar and introduces potential distortion of the lower nose because of wound contracture.

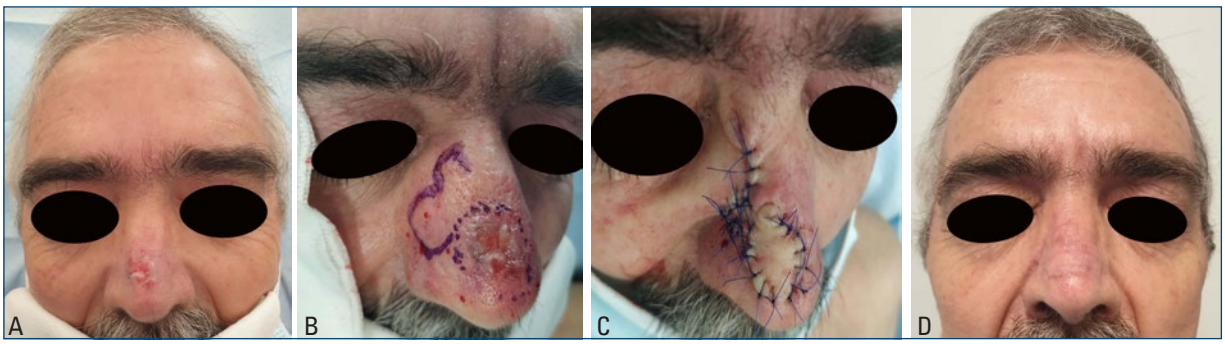

Figure 3. A-C: bilobed flap for reconstruction of a distal midline defect of the nasal dorsum after excision of a histologically confirmed basal cell carcinoma. **D:** cosmetic result after 6 months of surgery.

Flaps

Flaps are tissue transferred from its bed to an adjacent area while retaining its vascular attachment. The design of the flap should consider the length and width of the defect, the laxity and thickness of the skin and the relation of the defect to the anatomic subunits. Numerous local random pattern flaps may be considered for defects on the nasal dorsum, including transposition flaps, advancement flaps, rotation flaps, or interpolated flaps. Local tissue flaps recruit adjacent tissue and therefore reliably match the color, degree of photodamage, and sebaceous qualities of an individual's nose.

Transposition flaps

Transposition flaps are suitable for reconstruction of small to medium defects in the sidewall and nasal dorsum, where skin is thinner and easier to mobilize.

Rhombic flaps are single-lobed transposition flaps that recruit from a tissue reservoir that is immediately adjacent to the primary defect. Small distal nasal dorsum defects (< 10 mm) are usually suitable for reconstruction with an upper based rhombic flap.

As most defects on the nasal dorsum have a circular shape, a modified rhombic flap is usually performed, avoiding conversion of the defect into a rhombus. The sides of the flap are equal in length and have approximately 75% of the diameter of the primary defect. The first side of the flap is designed as an extension of the diameter of the defect. The second side is designed by plotting a line from the apex of the flap, back toward the primary defect, at an angle of 45° to the first side, thus creating two sides of an equilateral triangle. After transposition, minimal trimming may be required for the flap to fit the circular defect. The secondary defect is closed by side-to-side apposition with a key suture at the point of maximum tension in the base of the defect[6,7].

Rhombic flaps are mainly used to repair defects in the midline or just off-center. Putting the secondary defect in the nasofacial line usually results in a satisfying cosmetic result. Nevertheless, rhombic flaps create a secondary defect that can be as hard to repair as the primary and therefore should only be used in carefully chosen defects[4].

If a rhombic flap generates too much tension on the skin immediately adjacent to the primary defect or causes significant anatomic distortion, the bilobed flap is a good alternative. The bilobed flap is a versatile double transposition flap mainly used to reconstruct cutaneous defects of the lower third of the nose, especially at the lateral nasal tip and sidewall[8]. The bilobed flap may also be used to repair small to medium defects (between 10 and 20 mm in size) at the nasal dorsum with excellent cosmetic results (Figure 3 A-D). The flap can be designed from a laterally or medially based pedicle. A primary lobe originates at a 45° angle from the defect along the midline that bisects the defect perpendicular to the long axis of the standing cone. The secondary lobe is designed 45° to a line bisecting the primary lobe allowing for a total arc of rotation of approximately 90°. The length of each lobe should be shortened to avoid significant tethering of that base of tissue. Ideally, the diameter of the primary lobe should be equal to the diameter of the defect and the diameter of the secondary lobe can usually be undersized by 10-15% to avoid secondary motion. The suture of the flap can be initiated by closing the tertiary defect, which pushes the flap toward the primary defect. The primary lobe can then be sutured into the defect. Not invariably, the secondary lobe has excess length, requiring trimming to match the secondary defect[6,9].

Figure 4. A and B: trilobed flap for reconstruction of a distal midline defect of the nasal dorsum after excision of a histologically confirmed basal cell carcinoma. **C:** cosmetic result after 6 months of surgery.

Figure 5. A and B: superiorly based bilobed flap for reconstruction of a distal off-center defect of the nasal dorsum after excision of a histologically confirmed basal cell carcinoma. **C:** cosmetic result after 6 months of surgery.

For the reconstruction of dorsum defects, the flap should be designed to place the second lobe vertically in the glabella. When this cannot be achieved, using a trilobed flap to place the third lobe in the glabella is usually a good option (Figure 4 A-C)[10]. The same principles considered in the design and execution of a bilobed flap are applicable in the design and execution of a trilobed flap, with the additional consideration of placement of the third lobe. The three lobes of the trilobed flap are designed with a 45° angle of rotation. While the size of the first two lobes is similar to the bilobed flap, the diameter of the third lobe should be undersized by 15-20%. The tertiary defect may be closed first in a side-to-side fashion, allowing the three lobes to fall into their respective defects with minimal tension[11]. The third lobe allows the flap to reach tissue reservoirs increasingly remote from the primary defect. Moreover, the third lobe increases the width of the flap pedicle[6].

A superiorly based bilobed flap may be applied to reconstruct defects of the nasal dorsum, instead of the classically described which has a lateral base (Figure 5 A-C). In this case, the vascular base is oriented superiorly toward the mid glabella. The primary lobe is designed on the part of the nose abutting the surgical defect without extending into the nasofacial sulcus. The secondary lobe originates at on the paranasal cheek adjacent to the melolabial fold and is accompanied by a Burow triangle extending caudally. The size of the lobes should be nearly equivalent to the size of the defect. The superiorly based bilobed flap is particularly interesting to repair surgical defects in patients with tight nasal skin, by moving the terminal donor site to the medial cheek[12].

The main complications of the bilobed and trilobed flap are pincushioning, which presents as domed elevation of the transposed flap relative to the native skin, and trapdoor deformity, which generates a noticeable

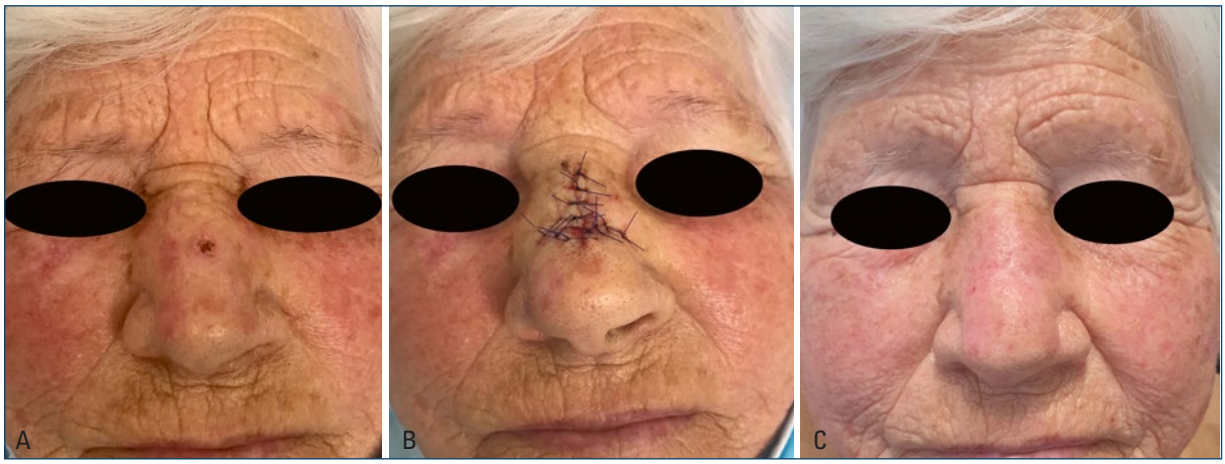

Figure 6. A and B: bilateral advancement flap for reconstruction of a midline defect of the nasal dorsum after excision of a histologically confirmed basal cell carcinoma. **C:** cosmetic result after 6 months of surgery.

scar along the inferior margins of the flap. Both complications are potentiated by oversized lobules and can therefore be prevented using lobules that are nearly equivalent in size to the surgical defect and using meticulous suture technique which includes the proper removal of subcutaneous cellular tissue and, in some cases, fixation to the underlying cartilage[8].

The bilateral rhomboid flap is a suitable reconstruction solution for medium (10-20 mm) to large (> 20 mm) defects on the midline of the nasal dorsum. This flap is particularly useful for the reconstruction of large defects of the mid-nose dorsum with a large horizontal dimension. This flap consists of two superiorly-based rhombic flaps designed with approximately 45° angles from the midpoint of the lateral margins of the surgical defect. The two mirror image flaps are designed to each reconstruct approximately 50% of the surgical defect. In addition, a midline common standing cone is removed superiorly along the nasal bridge. To avoid alar distortion, patients should have enough skin laxity on the nasal sidewall and paranasal cheek to accommodate flap movement[13,14].

Advancement Flaps

Advancement flaps are an effective reconstructive option for small to medium size (up to 15 mm) defects of the nasal dorsum. These flaps are particularly useful for midline defects and can be designed unilaterally or bilaterally. Advancement flaps benefit from the laxity of the nasal sidewall, therefore avoiding unnecessary sacrifice of the skin of the tip or nasal bridge.

The “anchor flap” is a superiorly based bilateral advancement flap with an inverted T-plasty design (Figure 6 A-C). This technique should be considered when sufficient skin laxity for primary closure or unidirectional tissue rearrangement is lacking. The first step after tumor excision is performing an incision perpendicular to the long axis of the defect. The incision starts in the extremity of the defect and has two arcs on each side of it. A central standing cone is removed. Undermining widely deep to the nasalis muscle allows tissue movement. The first suture is usually performed ate the two medial corners of the two sides of the flap. As with other flaps, incisions should be carefully placed at boundaries, such as the nasal creases, nasofacial sulcus, or nasal midline[15]. The bilateral advancement flap can also be used to reconstruct lateral dorsum defects by placing the incision on the nasofacial line.

The Peng flap is a modification of bilateral linear advancement flaps mainly used to reconstruct medium to large size (10-30 mm) defects of the tip and distal nasal dorsum. The original Peng flap has some limitations in defects proximal to tip and is usually associated with increased tension on the pedicle and webbing of the medial canthi resultant from pulling the glabellar skin distally[16]. Rowe et al. developed a modified version of the original Peng flap in which the incision of the arms of the flap starts as far down the wound as possible to minimize the advancement component (Figure 7 A and B). Two rotating arms are incised at the distal tangent to the surgical defect extending along the nasofacial sulcus to the nasal root. The tips of rotating arms are then moved medially to fill the defect[17]. This technique allows the flap to be inserted with less tension on the pedicle and is associated with less anatomic distortion by minimizing glabellar

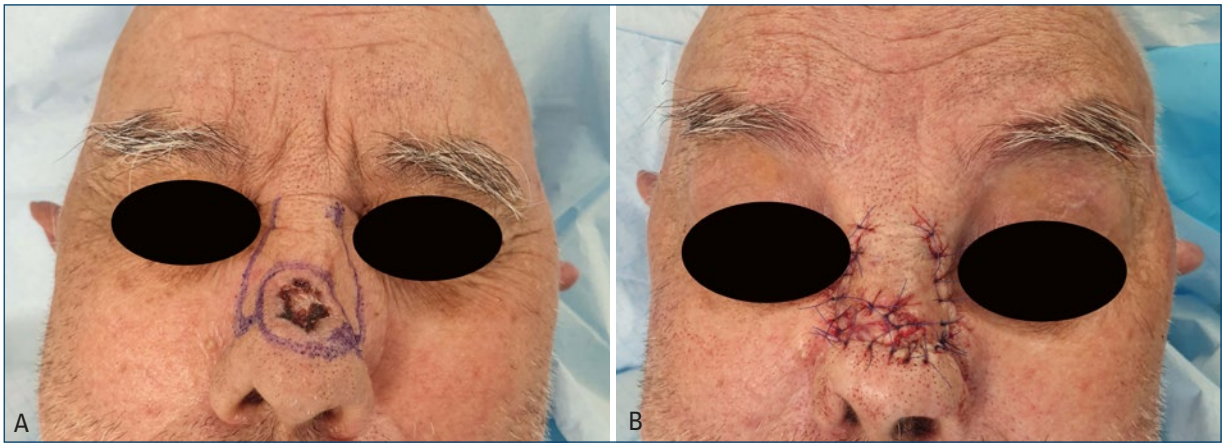

Figure 7. A and B: peng flap for reconstruction of a medium sized midline defect of the nasal dorsum and nose tip after excision of a histologically confirmed basal cell carcinoma.

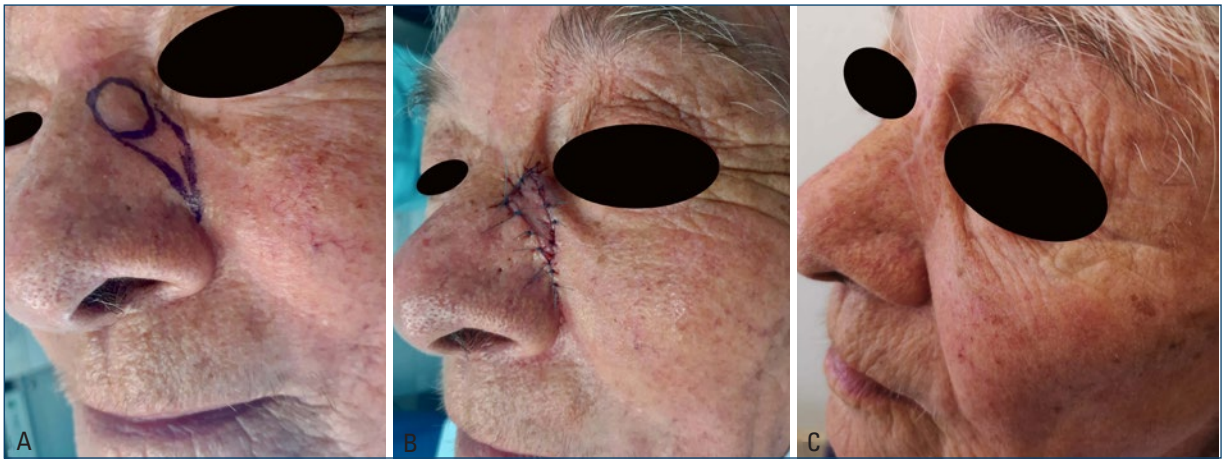

Figure 8. A-C: island pedicle flap for reconstruction of a lateral dorsum defect after excision of a histologically confirmed basal cell carcinoma. **C:** cosmetic result after 6 months of surgery.

advancement and gaining length from the rotation component. Nevertheless, the Peng flap does at times cause alar and nasal tip elevation and can unevenly distort the shape of the nostrils[16].

The island pedicle flap, also known as the V-to-Y advancement flap, is a versatile reconstruction option for small to medium-sized (up to 15 mm) off-center nasal defects (Figure 8 A-C). Although being more frequently used for the repair of alar and tip defects, this flap can be adapted to repair defects on the nasal dorsum near the sidewall or the tip[18]. This flap is a skin island, detached from all sides, with vascular supply from an underlying pedicle. The first step is an incision of the epidermis and dermis that is continued through the subcutaneous tissue up to the muscle. The flap is then trimmed and undermined for at least 50% of its total length, first in the proximal and then in the distal part. The flap is moved into the defect, without need of an incision or a blunt spreading of the underlying muscle. The possible movements of the flap are defined by the shape and length of the flap and the overlapping of the trimmed parts. The longer the chosen length and the more the trimmings overlap each other, the more the flap can execute a pivoting movement[19]. To repair dorsal defects, the island pedicle flap is often laterally to inferiorly based to use the surrounding tissue reservoirs of the nasal sidewalls, and medial cheeks. However, the use of this technique on the nose can be difficulted by limited tissue movement. To enhance the degree of mobility several strategies can be used, including additional dissecting beneath the nasalis muscle or flipping the flap in a rotational movement of up to 180°. Although flipping movement can result in commensurate twisting of the pedicle, this usually does not compromise

Figure 9. A and B: hatchet flap for reconstruction of a medium sized midline defect of the nasal dorsum after excision of a histologically confirmed basal cell carcinoma. **C:** cosmetic result after 12 weeks of surgery.

vascular supply[4]. In these cases, it is especially important to avoid pedicle tension and damage to underlying structures during dissection. The island pedicle flap is a well-tolerated procedure, associated with a good match with regard to skin color, texture, and sebaceous character. The rate of complications is low, with a minority of patients reporting trapdoor effect.

Rotation flaps

The dorsal nasal (Rieger) flap is a versatile rotation flap that can be used to reconstruct a wide range of defect sizes, affecting distal areas of the nose. This flap involves rotational advancement of dorsal nasal skin from the proximal two thirds of the nose and glabella to cover a distal defect. The flap incision usually begins in the medial part of the defect and then sweeps widely into the nasal sidewall parallel or coinciding with the nasofacial line and is then curved upward onto the nasal bridge. For dorsal nasal defects, the incision should be kept as low on the tip as possible. To allow inferior rotation, the proximal segment of the flap can follow the horizontal tension lines of the nasal bridge or alternatively extend into the vertical lines of the glabella. After undermining, the flap is elevated in the submuscular aponeurotic plane and rotated into position. In the proximal segment closure is performed in a V-Y or crescent manner. Sometimes the rotation movement generates a secondary defect in the nasofacial groove area that is best closed using a cheek advancement procedure. After suture into position, dog ear created by rotation at the lateral side should be excised[20,21].

Classically, the dorsal nasal flap has been described to repair small-sized defects of the lower-third of the nose[20]. However, with slight modifications, it can be used to repair even large defects in a single-stage procedure, with good aesthetic and functional results. For example, the leading edge of flap rotation can be lengthened to provide tissue from the adjacent nasal skin, the cheek, or the nasolabial groove to close the defect. This approach is particularly useful for large lateral defects[21]. Avoiding excessive tension closure is essential to prevent significant tip elevation and alar retraction or alar asymmetry. In most patients, this flap yields a slight elevation of the nasal tip which is commonly felt as a cosmetically acceptable result that tends to resolve with time[20].

The hatchet flap is a rotation advancement flap mainly used to reconstruct small midline defects of the nasal dorsum. This flap has similar principles to nasal dorsal flap but contrasts by its more vertical upper segment (Figure 9 A-C). Excising a small Burow's triangle in the inferior midpoint of the defect may be useful to reduce the size of the defect and allow the insertion of the midpoint of the flap[4].

Interpolated flaps

The paramedian forehead flap is a well-established technique for reconstruction of deep and large nasal defects. Reconstruction with a paramedian forehead flap begins by making a template of the cutaneous defect of the nose to outline the flap. The template is inverted (in contralateral designs), providing mirror-image symmetry, and then turned 180° to account for the pivotal movement to the nasal defect. The design of the paramedian forehead flap must take into account the details of the primary nasal defect skin and the secondary defect skin (the forehead), particularly around the base of the flap at the glabella[22]. The forehead flap is based on the supratrochlear vessels that typically emerge from the orbit between 1.7 and 2.2 cm lateral to the midline. Preoperative localizing the axial vessel by Doppler before flap design may decrease the risk of

Figure 10. A and B: full-thickness skin graft for the reconstruction of a complex medium sized off-center defect of the nasal dorsum and left sidewall after excision of a histologically confirmed basal cell carcinoma. **C:** cosmetic result after 12 weeks of surgery.

flap failure[23]. A narrower pedicle stalk minimizes torsion when the flap rotates toward the nose, therefore diminishing the risk of kinking arteries in the pedicle base. The flap is designed vertically with its long axis centered in the ipsi- or contralateral supratrochlear vessels. Ipsilateral flaps require less flap length than contralateral designs as they have greater pivotal movement about its axis. However, greater pivotal movement may increase the risk of vessel kinking and flap ischemia[22]. After incisions are made, elevation of the flap is then undertaken with extensive undermining in the subfascial plane. Corrugator muscle can be dissected from the underlying periosteum to allow greater mobility of the pedicle. The flap is then rotated into position over the nasal defect. The secondary defect in the frontal area can be closed by side-to-side apposition after undermining from the anterior margin of the temporalis muscles bilaterally, by second intention healing or, in large defects, by performing a full-thickness skin graft[24].

The paramedian forehead flap is usually performed as a two or three stage procedure, but in certain situations it can even be performed as a single-stage surgery. Most patients receiving forehead flaps will need at least one additional procedure to divide the vascular pedicle, and potentially more surgeries to refine the site of inset with debridement, dermabrasion, and other procedures.

Once the flap is deemed viable, the pedicle can be divided under local anesthesia, usually 3 weeks after the first procedure. Pedicle division is performed at the superior margin of the defect. Contiguous skin is trimmed and undermined to facilitate closure and at the base of the pedicle any scar tissue is removed to allow the base of the pedicle to be returned to its initial position[24].

With careful attention to the rebuilding of all aspects of the nasal defect, a paramedian forehead flap can restore virtually any large nasal defect with satisfying functional and cosmetic results. Nevertheless, this is a complex procedure and other alternative reconstructions may be considered[25]. Patient's ability to endure the procedure as well as the post-operative period should be carefully considered and discussed with them.

Full-thickness skin graft

Full-thickness skin graft is an important and useful reconstruction technique for coverage of medium to large surgical defects of the nasal dorsum when primary closure and skin flaps are not suitable options (Figure 10 A-C).

Unlike flaps, grafts depend on the ingrowth of capillaries from the recipient site for their ultimate survival. Wound infection and small vessel compromise by smoking limit full-thickness skin graft survival and must, therefore, be prevented[26].

Donor sites for full-thickness skin graft should be carefully chosen to match the texture, thickness, color, and actinic damage of the recipient skin, without creating an unsuitable secondary defect. Commonly used donor sites for dorsal nasal defects include pre- and post-auricular areas and supraclavicular skin. For extensive defects, the skin of the medial upper arm may also be considered[4]. For all donor sites, it is important to avoid any hair-bearing areas.

Skin flaps match the surrounding skin color and texture better than grafts but often have longer scars and can have some complications such as trapdoor deformity and nose anatomy distortion. By comparison, grafts do not usually distort nasal anatomy and are a suitable reconstruction technique in medically fragile patients. However, regardless of the thickness of recipient site skin, full-thickness skin grafts often initially appear scalloped and depressed following dressing removal. Although they

may thicken over the ensuing weeks, the skin graft usually presents a smooth character that can contrast dramatically in color and texture with native nasal skin.

Combination techniques

Large and complex defects involving the nasal dorsum can be repaired by combining different surgical techniques. Primary closure can be used to reduce the size of the defect and allow complete closure with flaps or a full-thickness skin graft. When complete closure cannot be achieved or generates too much tension, second intention healing of small defects can be combined with satisfying results.

Acknowledgments

We thank all the patients for providing oral informed consent to publication of their case details and images.

Author's contributions

PMG, CSQ and RM-M: Substantial contributions to the conception/design of the work; acquisition, analysis, and interpretation of data. PE-L: Drafting the work and revising it critically. JMS: Substantial contributions to the conception/design of the work, acquisition, analysis, and data interpretation, drafting the work, revising it critically and approval of the final version. PF: Drafting the work, revising it critically and approval of the final version.

Funding

This work has not received any contribution, grant, or scholarship.

Conflicts of interest

The authors have no conflicts of interest to declare.

Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

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