Reconstruction of Alar Defects

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KEYWORDS

• Nasal reconstruction • Nasal ala • Flap reconstruction

ANATOMY

Successful reconstruction of the nose depends on a thorough understanding of the anatomic and functional components of the ala. The crescentic alar groove serves as a topographic landmark that frames the ala and separates this convex structure from the surrounding cosmetic subunits. The ala abuts the nasal tip anteriorly and the nasal sidewall superiorly. The alar groove deepens as it extends posteriorly. This posterior portion of the alar groove is often called the alar-facial sulcus and separates the ala from the cheek and hairless apical triangle of the lip.

The ala is a critical cosmetic and functional landmark. The distal free margin of the alar lobule and the transition from the shadows of the alar groove to the reflection of the convex surface of the ala are important visual landmarks. The ala also frames the lateral aspect of the external nasal valve, a critical path for airflow during inspiration. Altered position of the ala during reconstructive surgery can compromise function of the external nasal valve. Relative to the nasal tip and sidewall, the alar tissue is more compliant, because it does not contain cartilage.[1] The alar lobule consists of skeletal muscle and fat enveloped by dermis and epithelium on both the vestibular and external aspects.[2] The lower lateral cartilage does not cross the alar groove and it is not part of the alar lobule.[2] The lack of an intrinsic osseous-cartilaginous skeleton and the complete absence of support at its distal free margin make this delicate structure particularly susceptible to distortion during reconstructive surgery.

Although the alar lobule does not contain cartilage, the ala gains dynamic and static support from the close relationship of its muscles with the osseous-cartilaginous framework of the nose.[1] A brief description of the osseous-cartilaginous framework is helpful. The nasal bone and maxilla frame the pyriform aperture. The paired upper lateral cartilages are firmly stabilized as they flare laterally from cartilaginous septum and fix to the deep aspect of the nasal bone. The intercartilaginous ligament stabilizes the cephalic margin of the lateral crura of the lower lateral cartilages to the caudal aspect of the upper lateral cartilages.[3] The lower lateral cartilages gain additional stability from loose connective tissue that links the domes of the lower lateral cartilages and possibly from direct connection of the medial crura with the caudal septum.[3] A fascial system, called the pyriform ligament, stabilizes the entire cartilaginous framework by connecting the lateral cartilages with the pyriform rim.[4]

The alar lobule essentially suspends from this osseous-cartilaginous framework as a network of skin and skeletal muscles. The actions of skeletal muscles on the position of the nasal ala remain poorly understood.[1,4,5] The dilatator naris muscle is the main muscular component of the alar lobule. The dilatator naris muscle originates from the lateral crus of the lower lateral cartilage and inserts

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directly onto the alar skin.[1] Contraction of this dilator naris muscle opens the nostril and may indirectly, via the intercartilaginous ligament, affect the caudal margin of the upper lateral cartilage and internal nasal valve.[1] The alar portion of the nasalis muscle originates from the fossa incisiva of the maxilla and inserts on the alar skin and accessory cartilages near the pyriform aperture. Contraction of this muscle may dilate the nasal valve area by drawing the accessory cartilages, and by extension, the lateral crura, laterally.[1] By contrast, the transverse portion of the nasalis muscle does not insert on the nasal cartilages and it mainly stabilizes the valve area by moving nasal skin. Additional dynamic support to the ala may come from the levator labii superioris alaeque nasi, which pulls the ala superiomedially,[5] and from the levator labii superioris muscle, which partially inserts on the vestibular skin of the nasal vestibule and widens the nostril by pulling it superolaterally.[4]

In addition to the structural and supporting tissue of the ala, the sensory and motor innervation, vascular supply, and lining all play intricate parts in the nasal alar anatomy. The dilator naris anterior, levator labii superioris alaeque nasi, and alar nasalis muscles are innervated by the buccal branch of the facial nerve (CN VII). The sensory innervation to the caudal and lateral portions of the nose are supplied by the external branch of the anterior ethmoidal nerve (branch of V1) and branches of the infraorbital nerve (V2).[6] The vascular supply to the nasal ala is derived from multiple branches of both the external and internal carotid artery systems. The facial artery gives off the superior labial and angular arteries, both of which contribute blood supply to the ala. Branches of the infraorbital artery, lateral nasal artery, and the external nasal branch of the anterior ethmoid artery also supply blood to the ala.[6,7]

In addition, because the nasal ala borders a free margin, the undersurface of the ala incorporates a combination of nasal vestibular skin and mucosal lining, going further into the nose. The importance of an intact nasal lining should not be underestimated, because if it is not replaced during a nasal reconstructive procedure, the nasal ala can become distorted from the contraction of this intranasal tissue void.

The structure and support of the nasal valves are linked to the anatomy and function of this area of the nose. The external nasal valve has been described as the area bounded by the caudal edge of the upper lateral cartilage superolaterally, the nasal ala and attachment of the lateral crus laterally, the caudal septum and columella medially, and the nasal sill inferiorly.[8] This area is variable and dependent on the shape, size, and strength of the lower lateral cartilage. Located just superior to the external nasal valve is the site of greatest resistance in the entire human airway, the internal nasal valve. Anatomically, the internal nasal valve is the cross-sectional area bounded superiorly by the upper lateral cartilage, cartilaginous nasal septum medially, anterior head of the inferior turbinate laterally, and nasal floor inferiorly. This valve angle is normally between 10 and 15 degrees in whites, but tends to be more obtuse in ethnic African Americans and Asians. The cross-sectional area of the internal nasal valve is about 0.73 cm.[2,9]

ANALYSIS OF THE ALAR DEFECT

The reconstructive surgeon must carefully analyze the defect to determine precisely what is missing. Originally described by Manson and colleagues,[10] nasal reconstruction should be viewed as a 3-part approach. The overlying skin, structural framework, and internal lining should be evaluated individually before developing an operative plan. Furthermore, the nostril free margin, contour, and relationship of the external nasal valve are vital to both a functional and aesthetic alar reconstruction. Preoperative recognition of whether reconstruction of the defect needs skin coverage, nonanatomic cartilage support, internal lining, or a combination of these allows for optimum results.

The skin of the nasal ala is thick and sebaceous. The skin in the region of the ala is also tightly adherent to the underlying muscles of facial expression. Consequently, the skin of the ala affords considerably less mobility or laxity compared with the skin of the nasal sidewalls and dorsum. To achieve aesthetic reconstructions of alar tissue, the surgeon strives to recruit skin with a similar thick texture and sebaceous character, such as the skin immediately adjacent to the defect or from the more distant melolabial fold and forehead.

Other factors that may influence reconstructive options of soft tissue defects include the quality of the wound bed and patient history. Patients who have prior nasal scars in the vicinity, current smokers, or those with a history of radiation to the area of the defect require an especially judicious choice of reconstruction. In such patients, the surgeon may limit the risk of necrosis by avoiding skin grafts, by delaying a flap before transfer, or by lengthening the amount of time between the flap transfer and pedicle division and insetting.[11]

In addition to the soft tissue defect, the surgeon must assess the status of theosseous-cartilagenous

skeleton, which provides critical support to the ala. If portions of the lower lateral cartilage are missing or if the defect is sufficiently close to the alar margin, there is an increased risk of distortion and alar retraction or notching. Loss of structural support at the alar rim can lead to distortion of the position of the free alar margin and functional problems, such as external nasal valve collapse. To prevent these issues, the use of cartilaginous grafting to repair a deficient lateral crus or nonanatomic alar batten grafts placed at the time of primary reconstruction help to prevent external valve collapse and alar retraction.[12,13] Nonanatomic free cartilage grafts both add structural support and provide a scaffold over which the skin can mold for an aesthetic contour.

The third and final aspect of alar defect analysis pertains to the nasal lining. If the nasal mucosal lining is missing and not replaced, contraction and distortion of the alar reconstruction is likely. Besides the obvious scar contracture that can occur, lining tissue is vital to providing a vascular supply to free cartilage grafts that are used in the reconstruction of full-thickness alar defects. If the cartilage does not have an adequate blood supply on either side of the graft, the cartilage has a high risk for necrosis.[13] Small holes in the mucosal lining can sometimes be closed primarily, if the lining is able to be freed up and advanced. However, larger defects often require other tissue and various flaps for repair. Multiple techniques can fill lining defects with intranasal mucosa, such as bipedicled, septal mucoperichondrial, and turbinate flaps.[13,14] In addition, skin grafts, turn-in flaps, and local tissue flaps can replace missing lining, but often require delayed cartilage grafting or subsequent contouring procedures.[14]

The size of the defect relative to the remaining portions of the subunit may also influence reconstruction options. Burget and Menick[15] introduced multiple principles for reconstruction of the cosmetic subunits of the nose, including the idea that if a defect involved more than 50% of the surface area of any subunit, the entire subunit should be resected. These investigators and others have demonstrated that strict adherence to this principle of complete cosmetic subunit repair is not always necessary.[11,16] The reconstruction must preserve and restore normal contour. In some instances, the surgeon can best preserve the subtle shadows and reflections of the ala by leaving intact skin. For example, it is often better to leave a millimeter or 2 of the alar-facial groove than to resect it and try to recreate it during the reconstruction.

RECONSTRUCTIVE OPTIONS

After methodically evaluating the characteristics of the patient and defect, the surgeon must then choose the most aesthetic reconstruction. For the sake of simplicity, we use a reconstructive ladder to organize reconstruction options from the most basic to the most complex.

Healing by Secondary Intension

Even small defects of the ala often demand considerable time and attention to achieve an excellent cosmetic result. When a simpler option is desirable, the surgeon may consider second intention healing (**Fig. 1**). Studies have shown that, in certain circumstances, healing by secondary intension can produce functional and even cosmetic results equal to or better than those achieved with a flap or graft repair.[17,18] Healing by secondary intention can result in acceptable scars for defects in concavities and subtle indentions of the face and nose.[19] Accordingly, Zitelli[17,18] has described the regions of the alar crease as a suitable location for healing by secondary intention. Other investigators have used second intention healing for small defects (<5 mm) in the area of the nasofacial sulcus or in the alar-facial crease.[18,20,21]

Because all scars contract, the surgeon must always account for the possibility that second intention healing will result in alar retraction or obstruction and compromise of the internal or external nasal valves.[22] Larger and deeper defects and a location near the alar rim portend a higher risk for such complications. Second intention healing should be avoided in these instances. As a crude physical test, the surgeon should push the alar rim superiorly. If the rim contracts easily, second intention healing will likely lead to a poor outcome. In most cases, the free margin of the ala will resist the force of scar contraction only for wounds that are shallow (ie, defect involved only epidermis and dermis) and at least 3 mm superior to the alar margin.

Concave surfaces do not always lend themselves to second intention healing. The surgeon must take caution when allowing wounds to heal in the concavities that frame the ala. Webbing that can result from scar contraction can ablate concavities and distort contour. Deep defects at the alar-facial crease are especially susceptible to this type of webbing.

The scars that result from second intention healing are predictably smooth and shiny. The light that reflects from these scars is predictably more harsh, compared with the more subtle reflections as light scatters from the normally

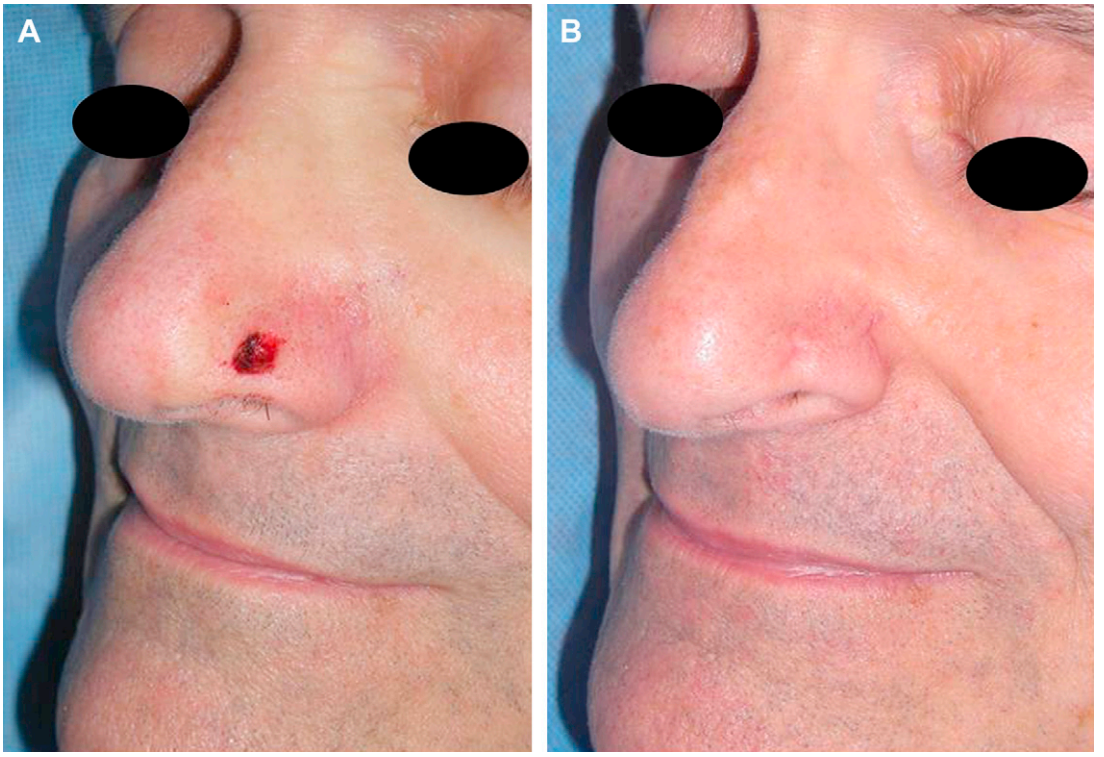

Fig. 1. (*A*) Small shallow defect involving the anterior aspect of the alar groove. (*B*) 4-month postoperative result after secondary intention healing.

textured and sebaceous skin of the ala. Larger, pale, and shiny scars from second intention healing can attract undue attention. The surgeon must prepare the patient for these predictable qualities of the scar.

Full-thickness Skin Graft

Another conservative reconstructive option would be to consider a full-thickness skin graft (FTSG) for an alar defect (**Fig. 2**). Although FTSGs may provide adequate coverage for an alar defect,

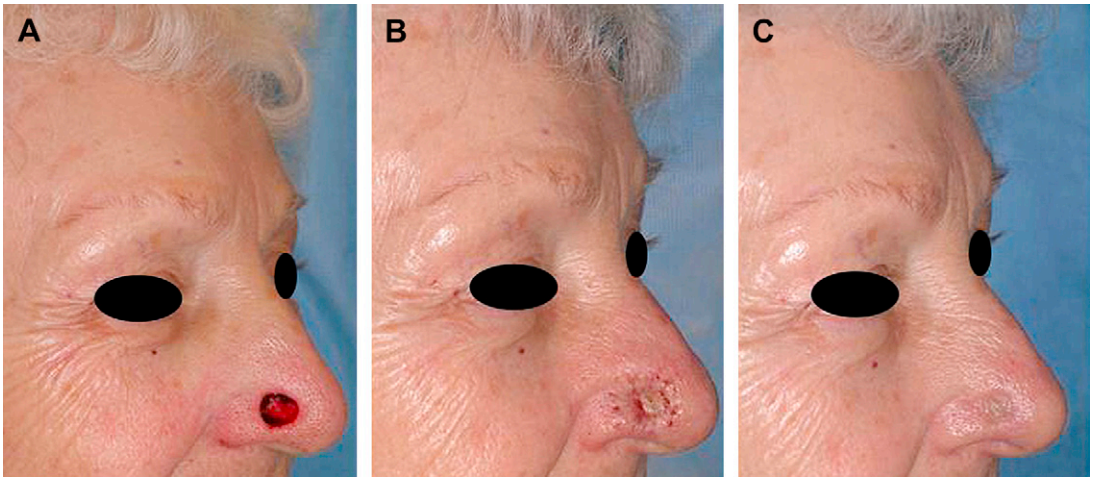

Fig. 2. (*A*) Surgical defect and (*B*) immediate postoperative result after an FTSG repair from the skin of the concha cavum. (*C*) 2-month postoperative result showing the graft with reasonable texture and contour, but a color discrepancy that is typical of skin graft reconstructions.

especially in a patient who may not be medically suitable for a long procedure, it is often difficult to match the texture, color, and thickness of the alar skin. With these difficulties of FTSGs noted, there have been data to support the use of these grafts for shallow nasal tip and alar defects.[23]

With time, FTSGs may frequently develop a depressed, shiny, or patchlike appearance. With this in mind, the surgeon must go back to the functional and cosmetic goals of the patient to produce the optimal result. FTSGs do work well, however, for small, partial-thickness defects of the alar rim with the underlying skeletal muscles still intact.[24] Possible FTSG donor sites include, pre- and postauricular skin, the supraclavicular area and even the melolabial fold. Other excellent donor sites for an FTSG to the nasal ala are the conchal bowl of the ear or the skin of the forehead, given their thicker skin texture, high density of sebaceous glands, and actinic damage similar to the nasal ala, in the case of the forehead skin.[24,25] For an FTSG to have the best aesthetic outcome, it is suggested that a template of the defect be created with the foil from suture packaging or a nonadherent dressing (Telfa). This template allows for the graft to be fashioned exactly according to size, so that it is not too large, causing a pincushion effect or too small, leading to necrosis from tension in securing it to the defect edges. FTSGs are harvested and raised in the subdermal plane and contain the epidermis, dermis, and a very minimal amount of subcutaneous fat, which can be trimmed extensively to reduce the flap bulk. Sufficient contact between the dermis of the FTSG and the recipient defect bed is critical to the processes of imbibition, inosculation, and neovascularization. Therefore, careful defatting of the FTSG helps to improve its survival.

Once transferred into the defect, these grafts are secured to the wound bed with absorbable suture. The donor sites are then closed primarily without tension after minimal undermining. After the graft has been secured in place, it is usually bolstered in place with Xeroform gauze for 5 to 7 days to prevent any shearing forces that may dislodge the graft from the underlying bed and to apply gentle compression to the graft site. This technique assists in optimizing graft adherence and eliminates any dead space under the graft.

Primary Closure

Although primary closure may be a viable option for defects of the loose skin over the nasal dorsum and supratip, few defects of the nasal ala allow this option. Three factors usually preclude this option. First, because the dermis intermingles with the underlying skeletal muscle of the ala, the skin is relatively stiff and immobile. Second, primary closure almost always threatens the position of the free margin. Primary closures oriented parallel to the alar margin elevate the rim. When primary closures are oriented perpendicular to the rim, the free margin exposes the standing cone and causes a slight downward push at the free margin. Third, primary closures, especially when oriented perpendicular to the free margin, can cause buckling of the soft tissue toward the vestibule, effectively decreasing the size of the external nasal valve. For primary closure in the alar subunit, these problems can cause both cosmetic distortion of the alar free margin and even compromise of the nasal valve from distortion of the nasal cartilages.[21] The lower lateral cartilages usually have enough intrinsic support to overcome wound contracture, but the distortion created from a primary closure could have ill effects on the alar-columellar relationship and nasal tip rotation.[26]

One-stage Flap Reconstructions

Alar advancement-rotation flap

There are few flaps derived entirely from within the alar subunit, and these must be reserved for small defects (eg, approximately 3–4 mm in width). An advancement-rotation flap with the arc based along the alar groove is one such flap. The ideal defect for this flap is located in the anterior half of the ala and is no wider than 3 to 4 mm (**Figs. 3** and **4**). To decide whether this flap will provide a good result, first draw a standing cone from the inferior aspect of the defect extending perpendicularly to the alar rim. If the angle of the standing cone at the alar rim exceeds 20 to 30°, then the flap is likely to distort the contour at the alar margin, and the advancement-rotation flap is a poor reconstructive option.

Next, extend the defect in a narrow column superiorly until it meets the alar groove. From the point where this extension of the defect intersects with the alar groove, the arc of the rotation flap can be cut laterally toward the alar-facial sulcus. The flap should then be undermined immediately superficial to the vestibular mucosa, so that the flap contains epidermis, dermis, and the muscles of facial expression. The flap is then rotated to close the defect. A secondary defect will form in the alar groove. The larger the arc of rotation, the larger the secondary defect will become. To close the secondary defect, the cheek is advanced medially. Care should be taken to keep the tension vectors of these sutures parallel to the alar rim.

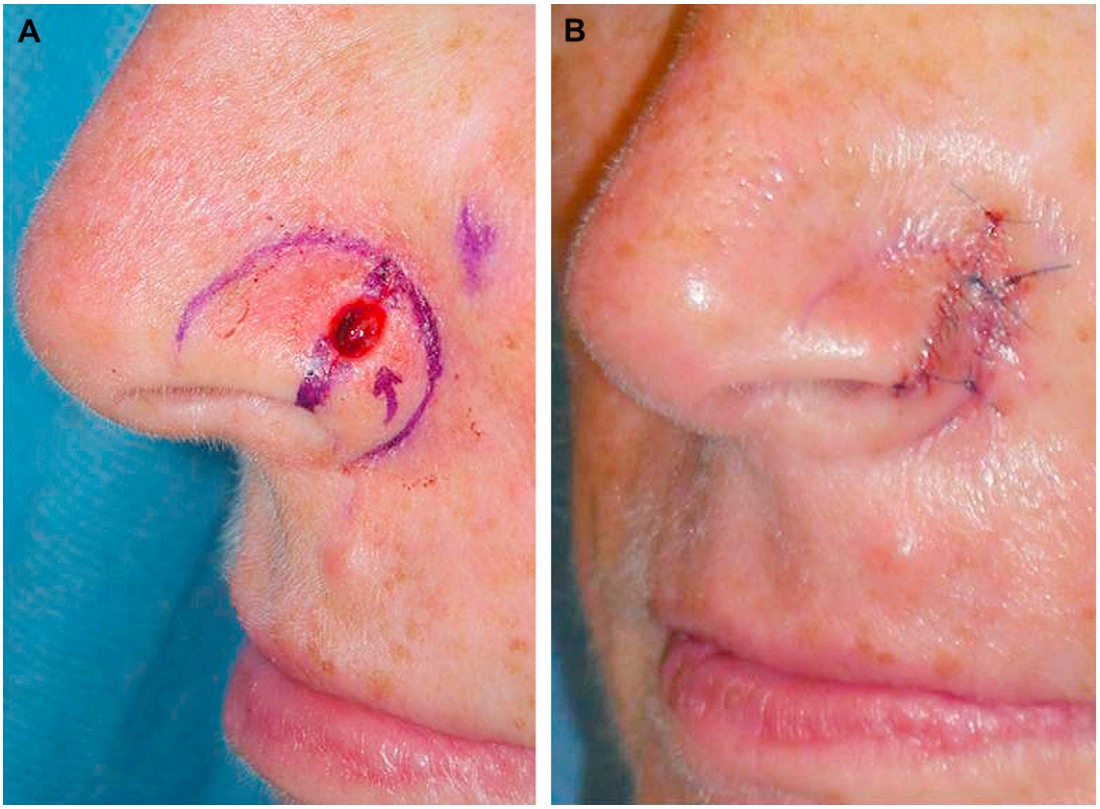

Fig. 3. (*A*) Small alar defect with the proposed alar rotation flap design. (*B*) Immediate postoperative result.

The main advantages of using this local flap are that it is a 1-stage flap with excellent color, thickness, and texture skin match.[27] Also, the arc of the rotation flap is nicely disguised by the natural concavity of the alar groove. However, the flap has some distinct disadvantages. The vertically oriented arm to close the defect and the standing cone can cause a slight downward push at the free margin. If the defect is too large (>1 cm) or the nasal tip cartilages are flimsy, this may lead to buckling of the alar rim and subsequent distortion of that lower lateral cartilage and nasal tip, when the local tissue is advanced for reconstruction.[27] Buckling of the soft tissue or lower lateral

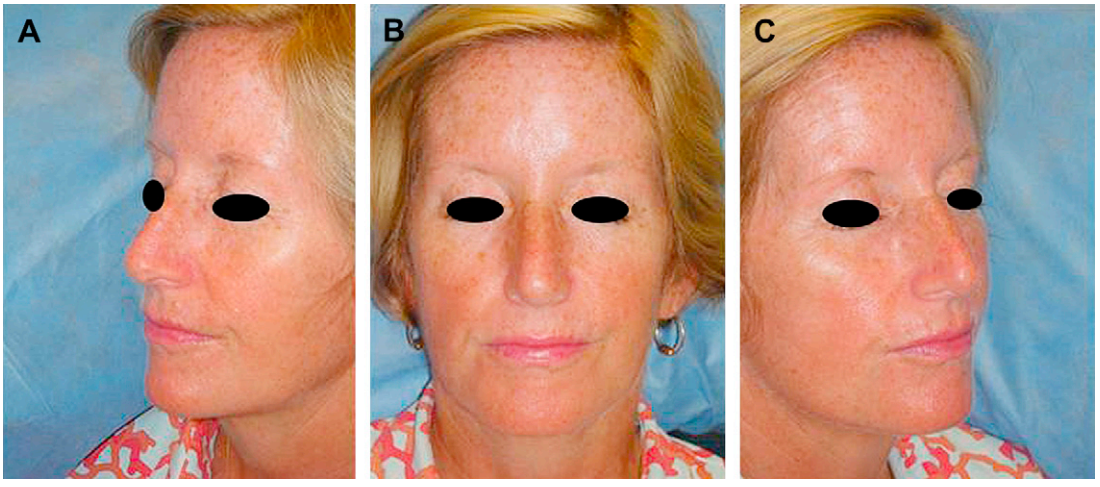

Fig. 4. (*A–C*) Three views of the 3-month postoperative result after an alar rotation flap repair.

cartilage toward the vestibule effectively decreases the size of the external nasal valve. The flap predictably causes a postoperative flattening of the alar rim, which may improve by 2 weeks after surgery and completely resolve by 6 months.[27]

V to Y island pedicle advancement flap

The V to Y island pedicle advancement flap is another option for 1-stage reconstruction of small (<0.5 cm) alar defects that are confined entirely to the alar cosmetic subunit. The ideal defect for this flap is located in the anterior half of the ala and is no wider than 0.5 cm. The greatest advantages of this flap are the superb color and textural skin match from the adjacent skin within the same subunit.[28] Anatomically, this myocutaneous flap maintains the transverse portion of the nasalis muscle pedicle that is supplied by the rich vasculature from the lateral nasal artery, fed by branches of both the angular and infraorbital arteries.

The basic design of this flap involves sliding a muscle-based skin paddle from laterally on the nasal ala to reconstruct a small defect that is more medially located. The secondary defect that is then created by transferring this tissue is closed in a linear fashion. The reconstructive surgeon must remember that the movement of this flap is in a direction that parallels the free nostril margin so that the nostril is not pulled up or retracted when attempting to close the defect. In addition, if there is an insufficient amount of tissue that is able to be recruited laterally, a second medially based flap can also be used to create a bipedicled modification of this technique. When performing this flap reconstruction, the triangular flap is tapered to a 30° point and it is sharply dissected with a knife, down to the muscle layer, providing significant flap mobility. Once the underlying nasalis muscle has been identified, the flap is lifted in a submuscular plane, maintaining the skin-muscle attachment to the triangular flap and its blood supply.[28] The surrounding alar subunit may be undermined to allow for adequate tissue movement and closure.

Using this flap to repair certain alar defects needs to be chosen wisely. It is best used for medial alar defects not involving the free alar margin. This is because as the flap gets closer to the nostril margin, the circulation is increasingly compromised and there is a dense adherence of the tissues, limiting the flap movement. Some investigators recommend designing these flaps at least 3 to 5 mm away from the alar margin to prevent retraction of the alar rim.[28] This flap prevents many of the functional problems that can exist with other flaps involving the compromise of the nasal valves and especially in dilating the nostril. It seems that even though the nasalis muscle is involved in nostril dilation, the redundancy of the muscle fibers that contribute to this act help to maintain this function.[28]

Rhombic flap

By transposing skin from the surrounding cosmetic subunits, the surgeon can avoid distortion of the alar rim and preserve the volume of the ala. The rhombic flap is a single-lobed transposition flap that can rarely be used for alar reconstruction. Although this flap can present the advantage of transposing like tissue to the area for reconstruction, it has multiple disadvantages for defects of the ala. First, the donor site for the rhombic flap usually needs to be the skin of the nasal sidewall, immediately superior to the alar groove. The tension to close the secondary defect at the donor site can compromise the nasal valve by causing medial deviation of the lower lateral cartilage on that side.[21] Second, it is difficult to avoid blunting of the alar groove when using the rhombic flap.

Bilobe flap

In contrast to the rhombic flap, the second lobe of the bilobe flap places the tertiary defect further from the alar groove and rim, thereby allowing closure with less risk of nasal valve compromise. Tension to close the tertiary defect on the loose skin of the proximal nose carries less risk of nasal valve collapse, because the underlying nasal bone affords more stability compared with the lower lateral cartilage on the distal nose. Rather than transposing the flap along a 180° axis of rotation, as originally described, the bilobe flap should be designed to rotate along a 90° or 100° axis (**Figs. 5** and **6**).[15,29] With this design improvement, each of the lobes of the bilobe flap transposes approximately 45°. In addition to decreasing the size of the standing cone, the decreased arc of transposition results in less secondary motion at the primary defect and less risk of elevating the alar rim.

The bilobe flap for alar reconstruction is best suited for defects of the anterior and middle aspects of the ala. Defects that are too far lateral on the ala often demand that the bilobe flap cross directly over the alar crease, a penalty that is best avoided. The bilobe flap can be based off either a medial or lateral blood supply, depending on the needs of the defect site. For most alar defects, a medially based pedicle is preferable (**Figs. 7** and **8**). The medially based pedicle allows a flap design that does not cross over the alar crease and helps avoid nasal valve

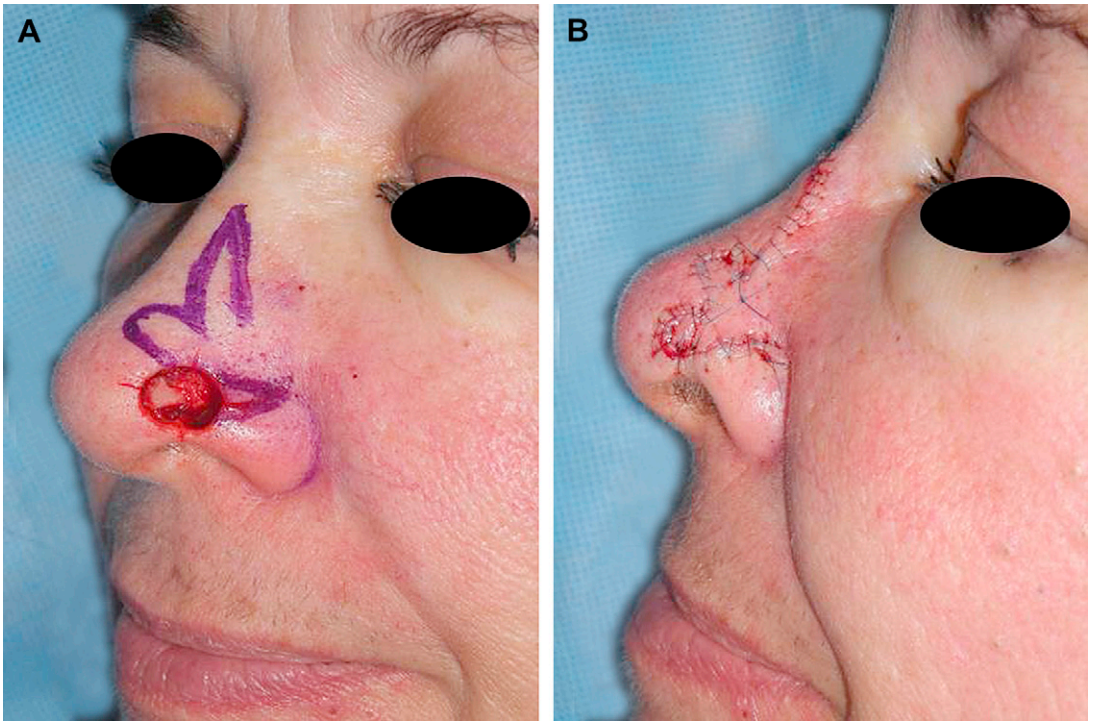

Fig. 5. (*A*) Surgical defect and laterally based bilobe flap design. (*B*) Immediate postoperative result after bilobe flap repair.

problems. Robinson and Burget[30] have written that in reconstruction of the lower third of the nose or the nasal sidewall, any flaps that cross or come within 1 mm of the alar crease are at risk for postoperative nasal valve obstruction. After transposition of the flap, the alar crease should be located right between the first and second lobe of the bilobe flap, diminishing the possibility of blunting the contour of the alar groove. With even with the most careful flap design, the surgeon must take pains to avoid distortion and elevation of the free margin of the ala.

Nasolabial groove transposition flap (single-stage melolabial fold flap)

The melolabial fold flap can be used as a single-stage flap to reconstruct alar defects as large as

Fig. 6. (*A–C*) Three views of the 6-month postoperative result from the laterally based bilobe flap.

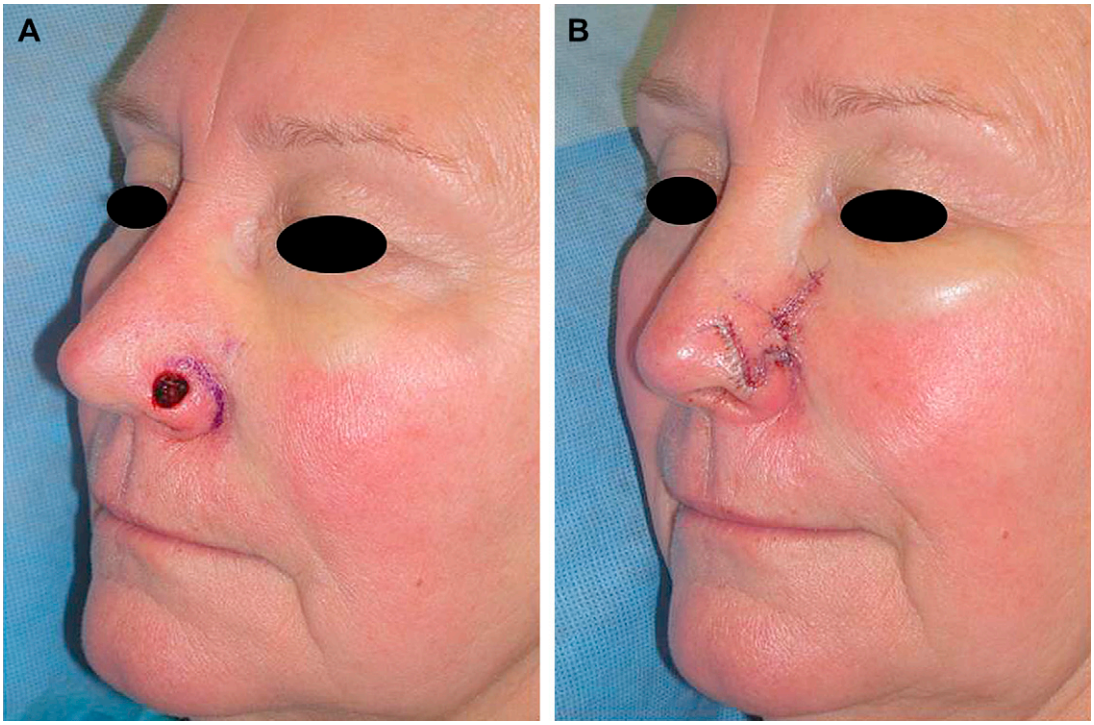

Fig. 7. (*A*) Surgical defect before a medially based bilobe flap. (*B*) Immediate postoperative result after bilobe flap repair.

2.5 cm.[31] This 1-stage, superiorly based, transposition-advancement flap receives its random pattern, but robust blood supply from the distal branches of the angular and facial arteries, as they perforate through the levator labii superioris alaeque nasi muscle.[32] The skin of the melolabial fold serves as an ample donor site flap that has a great tissue match for skin of the nasal ala.[32,33]

The ideal defect for the single-stage melobial transposition flap involves the alar groove. A small island of lateral ala must be present to anchor the advancing cheek skin and close the donor site, so defects that extend all the way to the lateral aspect of the ala and alar groove may best be reconstructed with another flap option. The medial aspect of the flap is designed to correspond to the melolabial crease, and the flap should taper down to a 30° point inferiorly. The horizontal width of the flap on the cheek should exactly match the width of the alar defect and should be extended no further than where the defect and the nasojugal fold intersect. The nasal sidewall skin is also excised up to the nasojugal sulcus, at a 30° angle maximum, to facilitate the medial transfer of the flap into the defect site.[32] Once these cuts have been made, the flap is elevated in the standard subcutaneous plane and advanced medially over a small island of native ala (**Figs. 9** and **10**).

To ensure this flap is well contoured, some basic techniques must be used. To ensure a tension-free closure, a tacking suture should be placed from the dermis of the underside of the advancing flap to the thick fascia and muscle along the rim of the pyriform aperture. As the suture is gently tightened, this will take the tension off of the flap and also recreate the contour and concavity of the nasofacial sulcus. Even a mild over-correction in this area can be tolerated, as the tissues tend to relax with time. Next, the donor site defect is closed and the distal flap is thinned aggressively to allow tissue match of that aspect of the flap into the alar defect. In addition, the skin of the nasal tip, ala, and sidewall is undermined and the flap is trimmed to fit the defect exactly, although it can be important to leave this area of the flap slightly redundant to push back the ala and accentuate the alar crease.[32]

Compared with other flap choices, this is a great reconstructive option, given the excellent tissue match, ability to hide the donor scar in the melolabial fold, and because it is a 1-stage procedure. Disadvantages include the possibility of blunting the alar groove and a high risk for pincushioning if the flap is not sized appropriately. Moreover, without meticulous suturing technique, the rounded scar where the flap insets at the ala tends to invert.

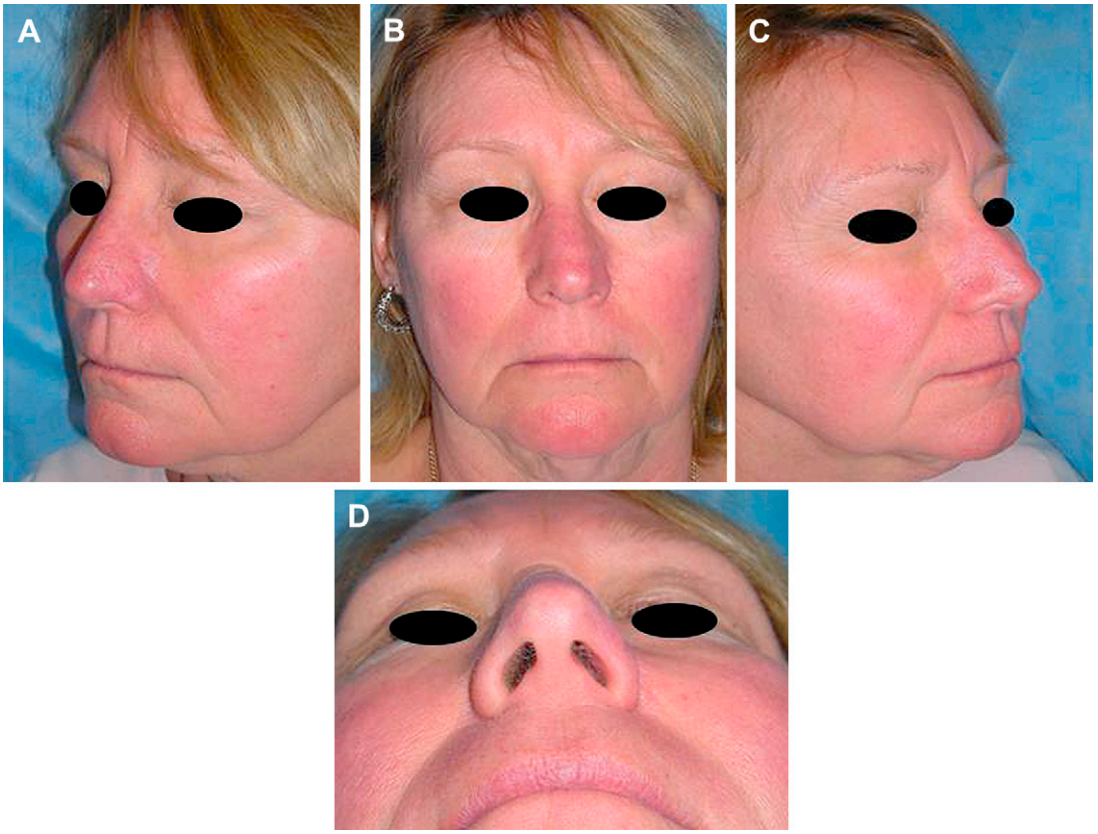

Fig. 8. (*A*–*D*) Four views of the 3-month postoperative result from the medially based bilobe flap.

Two-stage Flap Reconstructions

Interpolated paranasal flap

When the surface area and depth of the alar defect are great or when the preservation of the contour is not possible with a single-stage flap, a 2-stage interpolation flap may be necessary. The interpolated paranasal flap is a random pattern skin flap with an inferior pedicle based on the rich blood supply of the angular artery. The donor skin for this flap is located in the nasofacial sulcus, where the nasal sidewall and cheek facial subunits meet.

When deciding whether to reconstruct the alar defect with the interpolated paranasal flap through a spot-filling approach or by resurfacing the entire subunit, Cook[34] has described his extensive experience with the favorable cosmetic results achieved solely by replacing the tissue to fill the defect. It has also been suggested that this flap be mapped exactly according to the template or even slightly smaller. This technique of under sizing the flap has reduced the instances of pincushioning that have been seen.[35] If the defect involves more than 50% of the surface area of the ala, the surgeon may consider removing the remaining portions of the alar subunit. A template of the contralateral nasal ala may be used to design a flap that is symmetric in size. Whether reconstructing the entire alar subunit or spot-filling the defect, always ensure that the template is sized appropriately by placing it over the alar defect.

With the template resting over the alar defect, it should then be rotated approximately 90° superiorly and laterally and transferred to the nasofacial sulcus on the affected side. After doing so, the portion of the template corresponding to the alar rim faces medially and the portion of the template corresponding the anterior portion of the alar defect is closer to the medial canthal angle. The horizontal width of the flap design should equal the vertical height of the defect on the ala. A surgical marking pen can be used to trace the outside edge of the template onto the skin of the nasofacial sulcus. The template must be placed superiorly enough to ensure that the distal portion of the flap reaches the most anterior aspect of the alar defect when it is rotated counterclockwise into the defect.

The medial incision for the flap begins just lateral to the alar groove and is carried superiorly in the nasofacial sulcus toward the medial canthus. The

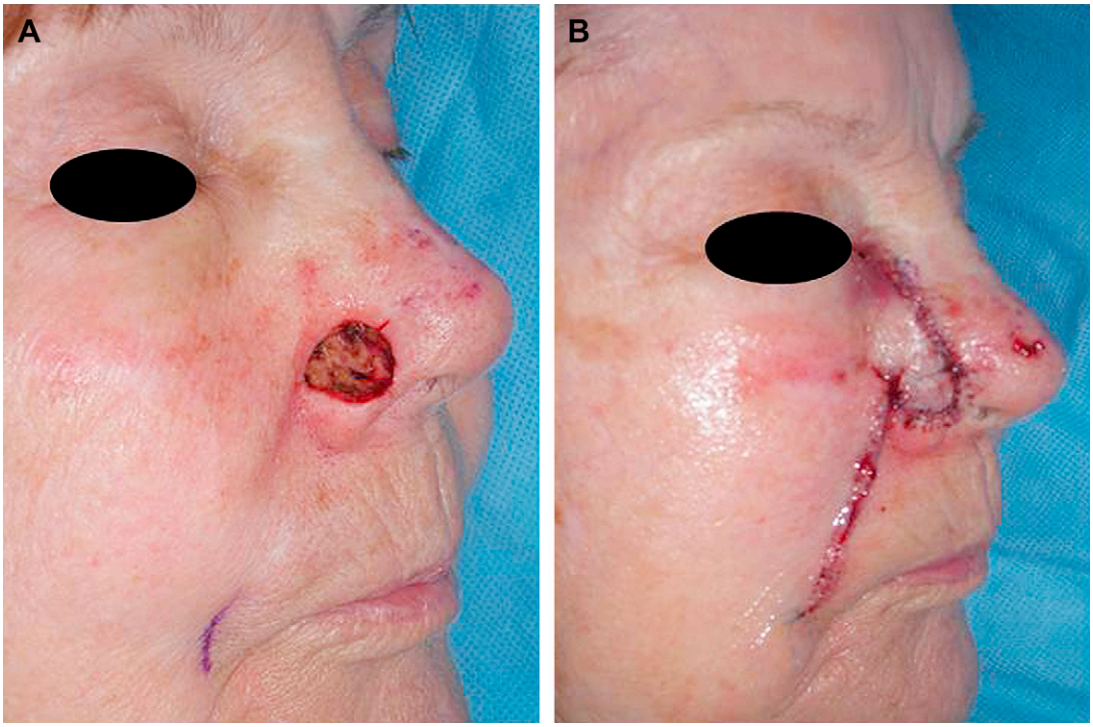

Fig. 9. (*A*) Right alar defect following Mohs surgery. (*B*) Immediate postoperative result after a 1-stage nasolabial transposition flap reconstruction.

standing cone superior to the template should have a maximum angle of 30° at its apex. To preserve the blood supply to this flap, it is elevated in the deep subcutaneous plane, immediately over the levator labii superioris alaeque nasi and the nasalis muscles. The flap should be thinned judiciously, but the distal aspect of the flap may be thinned down to the dermis. Once the medial cheek and nasofacial sulcus have been undermined so that the donor site may be closed, a tacking stitch may be placed on the underside of the advancing cheek flap to secure it medially. The flap is then swung inferiorly and medially into the alar defect, trimmed as necessary, and then secured with a layered suture closure.

The pedicle is usually left intact for about 3 weeks and the patient then returns for division and insetting. For the second stage of the reconstruction, the proximal flap is divided, thinned, and inset to cover the lateral aspect of the defect. As a general rule, it is best to deepen the defect site if possible, rather than thinning the flap pedicle too aggressively and compromising its blood supply. The flap is next inset in a layered fashion from laterally to medially. The pedicle is then removed with a fusiform excision and closed with the incision in the melolabial fold.

There are multiple advantages to using this flap versus other reconstructive options. Because the blood supply to this flap comes from an inferiorly based pedicle, and not from above, like the interpolated melolabial flap, non–hair-bearing tissue can be swung into the defect from the nasofacial sulcus and lateral nasal sidewall. Additional benefits of this flap are that it has a rich vascular supply from branches of the facial and angular artery and that the axis of rotation is less than 90°, allowing for less torsion and constriction of the pedicle.[35] The medial cheek pad is also spared with this approach, decreasing some of the asymmetry of the melobial fold, which is common after a melolabial interpolation flap.[35]

Interpolated melolabial flap (superiorly based nasolabial flap)

Although the paranasal interpolated flap uses the skin from the nasofacial sulcus as its donor site, the melolabial interpolation flap uses the skin from the melolabial fold as its donor site. In contrast to the paranasal interpolated flap, which has an inferiorly based pedicle, the melolabial interpolation flap has a superiorly based pedicle. The skin of the melolabial fold is an excellent color and texture match for the ala, and the flap preserves the alar-facial

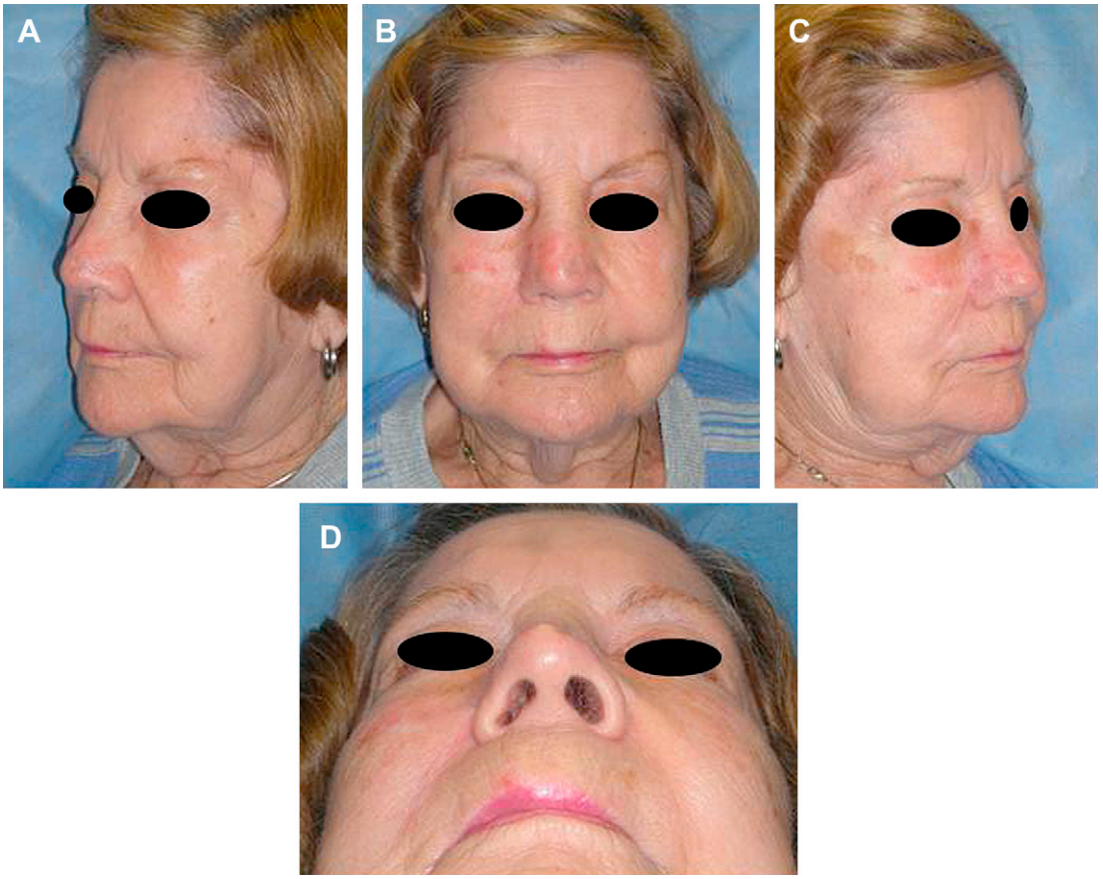

Fig. 10. (*A*–*D*) Four views of the 6-month postoperative result from the 1-stage nasolabial transposition flap.

sulcus.[20] The interpolated melolabial flap remains the workhorse flap for replacement of the alar subunit.[35] This flap has often been referred to as the first choice option when reconstructing cutaneous defects of the entire nasal ala, largely because of its generous donor site tissue availability.[35] The flap is a random pattern flap that has its vascular source based on the abundant blood supply coming from the perforating branches of the facial and angular arteries, as they come through the levator labii muscle.

This is a 2-stage procedure. The first stage involves transferring the flap into the defect site, usually along with the placement of a cartilage batten graft for support. When considering the flap design, the base is created with an incision that extends superiorly to just above the nasolabial crease on the side of the defect and about 5 mm lateral to the alar-facial sulcus, with the medial border of the donor flap lying in the melolabial fold.[36] It is recommended that a template is created from the contralateral ala and that this template is centered directly over the midportion of the nasolabial fold at approximately the level of the oral commissure (**Figs. 11** and **12**). The flap width should be equal to the vertical height of the nasal alar defect to ensure a good size match, and the lateral incision should parallel the nasolabial fold. This melolabial flap has been described both as a peninsula of skin or as a true island, based solely on the subcutaneous pedicle.[37] Alternatively, epidermis and dermis can be left on the superiorly based pedicle at the time of initial transfer.[20,38] This pedicle can be interpolated, as is the case of the flap described, or it can even be tunneled subcutaneously in some cases. In addition, in cases of full-thickness alar defects, this flap may also be used for both internal lining and external skin cover by turning over the most distal aspect of the flap for the internal lining and then using the mid or more proximal portion of the flap to cover the external defect.[39]

When replacing the entire alar subunit, a nonanatomic cartilage batten graft is usually necessary to brace the alar rim against the forces of flap contraction. Excellent donor sites include the conchal bowl or the antihelix. Cartilage from these

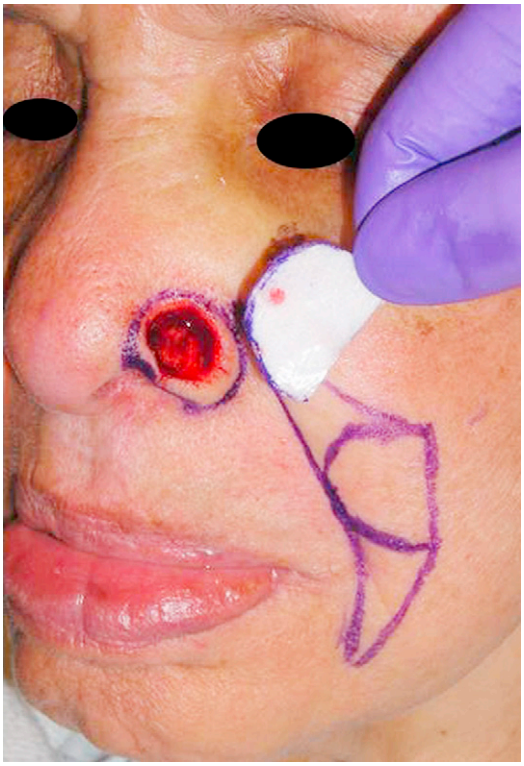

Fig. 11. Views of a partial surgical defect, delineation of the nasal alar subunit, and template for the entire alar subunit. A 2-stage nasolabial interpolation flap reconstruction planned and design transposed on the patient's cheek.

sites can be trimmed and shaped to preserve and restore the contour of the alar rim, then secured to the vestibular mucosa with interrupted sutures. Cartilage batten grafts may not be necessary if a substantial portion of the ala remains intact and a spot-filling flap is used.

The flap is elevated in a subcutaneous plane and thinned distally to a millimeter or two of subcutaneous fat to create the appropriate thickness match for the defect site. Next, the flap is rotated superiorly and medially to cover the alar defect. This flap has a wide angle of rotation, and it can be rotated about 150°.[20] A standing cone is removed inferiorly at the donor site, and the secondary defect is then undermined to allow closure in a layered fashion at the melolabial fold.[40]

The pedicle of the flap usually remains in place for 3 weeks. The second stage involves the division of the pedicle, thinning of the proximal flap, and insetting to the alar-facial sulcus. The base of the flap is divided and the skin of the flap base can be used to reconstruct the curvature of the lateral ala and alar base, if that was part of the original defect. Excess skin at the base of the flap must be trimmed to fit exactly in the defect. The more proximal aspect of the flap can be thinned at this second stage. The base of the pedicle is excised and closed primarily along the melolabial fold or nasofacial sulcus.

Advantages of this flap include the excellent color and skin match of the local tissue, as well as the rich vascular supply that traverses this area. However, there are reasons why some reconstructive surgeons may tend to use other flaps for alar reconstruction. One disadvantage to using this flap is that in men, the flap may transfer hair-bearing skin from the donor site to the ala. Although laser hair removal is possible after the reconstruction, light or gray hair is difficult to remove with the laser. Another possible downside to using this flap is the postoperative facial asymmetry that results in the nasolabial folds.[41]

Paramedian forehead flap

The paramedian forehead flap can give excellent results for alar reconstruction.

Compared with the paranasal and melolabial interpolation flaps, which both have a random blood supply in their pedicles, the paramedian forehead flap is an axially based flap. The flap pedicle contains the supratrochlear artery and has a robust and reliable blood supply. If Doppler sonography is not available, the artery reliably originates at the medial brow, in the transverse crease formed with contraction of the corrugator muscle.[36] The pedicle is then constructed with a 1.1- to 1.5-cm base that is centered on the artery.

After making a template of the alar defect, the template design is transferred just below the hairline and centered on the pedicle of the supratrochlear artery. A nonanatomic, free, cartilage batten graft should be sutured to the alar margin, as necessary. The conchal bowl and antihelix are convenient donor sites. Incisions are then made around the flap pedicle and its distal margin before the flap is lifted. The most distal aspect of the flap is dissected in the subdermal or subcutaneous plane. Variable amounts of subcutaneous fat are left, according to the desired thickness. The dissection then deepens to a subgaleal or subfrontalis plane to avoid transaction of the supratrochlear artery and its branches, which lie superficial to the frontalis muscle and galea at the level of the mid and superior forehead. As the dissection continues toward the orbital rim, blunt dissection lifts the corrugator off the frontal bone and leaves the artery intact. The flap is then rotated medially and inferiorly almost 180° and inset onto the nasal defect. The donor site on the

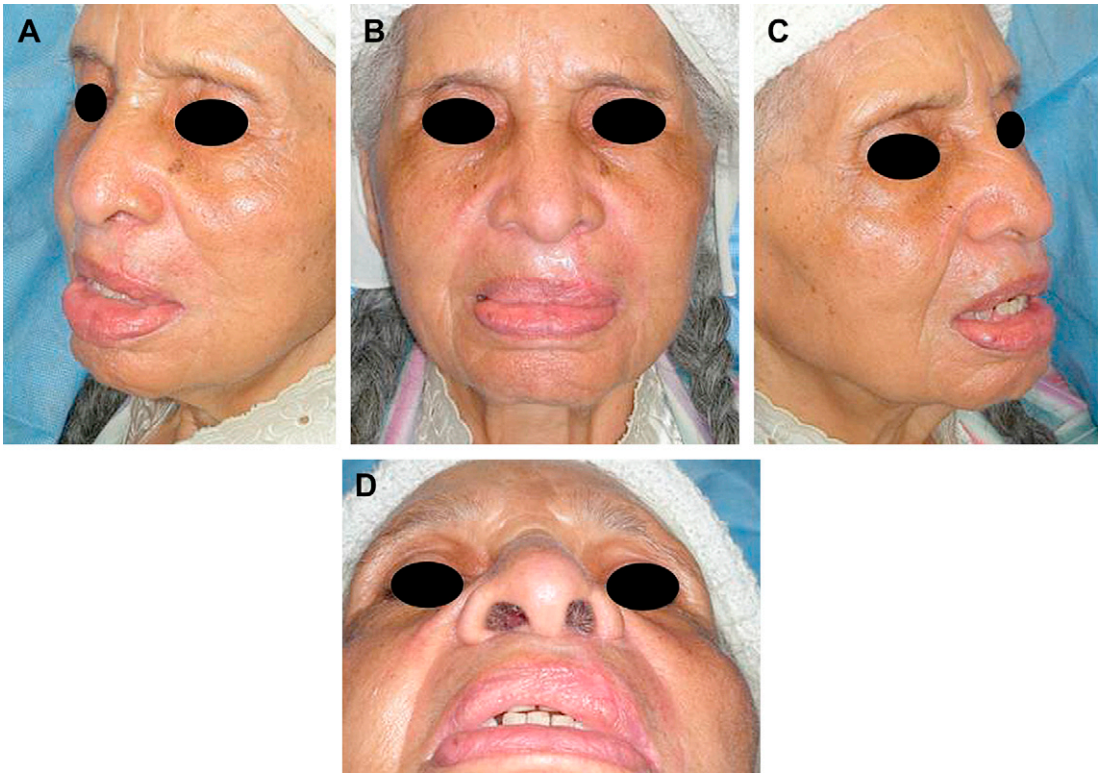

Fig. 12. (*A*–*D*) Four views of the 6-month postoperative result after a 2-stage nasolabial interpolation flap and free conchal cartilage graft reconstruction.

forehead is closed primarily, as tension allows. A standing cutaneous deformity can be excised superiorly to close the forehead donor site. If the surgeon is unable to close the forehead donor site, this may be left open to granulate by secondary intention with good results.[14]

This pedicle is left connected for about 3 to 4 weeks before division and inset. At that point, the pedicle is divided, and the flap is trimmed and inset at both the proximal aspect of the nasal defect and at the donor site at the medial brow.

The paramedian forehead flap is a dependable and robust flap to resurface large alar defects and those encompassing multiple distal nasal subunits. Compared with the interpolated flaps discussed earlier, there are some benefits and disadvantages. The axial blood supply of the paramedian forehead flap has been suggested for situations where a reliable blood supply is necessary, such as defect sites that have been irradiated or in patients who are diabetics or smokers.[42] One disadvantage with this flap, however, is the long forehead scar that may leave some patients unhappy. Many prefer the donor site incision to be hidden in the melolabial fold. In a series reported by Arden and colleagues,[42] they compared the paramedian forehead flap with the melolabial interpolation flap. They found the melolabial donor site scar to be objectively superior to the paramedian forehead flap donor site, in terms of scar length and width. Also, 1 out of 3 patients in this study was dissatisfied with the result of the forehead scar.

SPECIAL RECONSTRUCTIVE CONSIDERATIONS AND COMPLICATIONS

Composite Grafts

Reconstruction of full-thickness defects demands replacement of the external skin envelope, the internal mucosal lining, and structural support.[7] Auricular composite grafts provide a 1-stage option to reconstruct small, full-thickness alar defects. Composite grafts are commonly taken from the helical crus, conchal bowl, or antitragus, and include the skin and underlying cartilage.[19] The donor site is chosen based on the geometry of the nasal defect and whether the cutaneous portion of the composite graft is used to reconstruct the external nasal skin or the internal lining. Composite grafts have a high metabolic demand and a high risk for necrosis. Therefore, it is generally recommended that auricular composite grafts

do not exceed 1 cm in size to minimize the risk of necrosis.[7,43]

Obtaining the composite graft requires careful measurements and planning, with selection of the appropriate donor site based on contour match and tissue availability. It is generally appropriate to take a graft that is slightly larger than the defect (approximately 2 mm in all dimensions), to account for the expected wound contracture and to decrease the likelihood of notching during the healing process.[6] After transferring a template of the alar defect to the desired donor site on the ear, the skin and/or cartilage is excised. It is frequently desirable to harvest a cartilage graft that is larger than the overlying skin paddle. The excess cartilage on either side of the skin can be inserted into pockets on either side of the defect in the fashion of a tongue-and-groove joint. These pockets help to stabilize the graft and also increase the surface area of contact with vascularized tissue. Inset of the graft requires meticulous closure in layers, including the internal lining and external skin. For very small cartilage grafts, sutures through the cartilage itself are usually unnecessary, although larger grafts may benefit from fixation to the native nasal framework (eg, lower lateral cartilage).

Reconstruction of the donor site defect depends on its size. Smaller defects may be closed primarily, whereas larger defects may require skin grafts (eg, thin full-thickness graft) or a postauricular advancement flap.[19] Auricular composite grafts larger than 1 cm are infrequently needed, but may be taken from the conchal bowl. In such cases, the donor site requires a more advanced repair; for posterior defects, a local advancement flap of postauricular skin, and for anterior defects, a thin FTSG. To limit donor site deformity, however, larger cartilage grafts are generally harvested as free cartilage alone.

Composite grafts have also been used with great success for repair of nostril or nasal vestibule stenosis.[44,45] This procedure is rarely required in primary repair, but is an extremely useful technique for secondary reconstruction in patients with unacceptable cosmesis as a result of scar contracture or previously operated congenital defects. Graft harvest is performed as described earlier, although the graft size and donor site may differ somewhat. Placement of composite auricular grafts for nostril stenosis involves dissection and elevation of the alar-facial groove and alar base. The cutaneous component of the composite graft is used to augment the nasal vestibule. In combination with local flaps and V to Y advancements, satisfactory results have been shown for a wide range of deformities.[46]

Stabilization of free composite grafts is required to avoid shearing forces and to ensure survival. Methods to stabilize the graft include intranasal and external bolsters and even intranasal packing with a standard dental roll or a piece of emollient-impregnated gauze that is rolled to an appropriate size.[6] External bolsters are also useful, in particular for the recreation of the alar-facial sulcus and the depression that separates the superior ala from the nasal sidewall.[47] These may be secured with a fine-gauge, unbraided, synthetic suture, and should be left in place for approximately 1 week.

For reconstruction of large defects that include the nasal ala and portions of neighboring subunits, such as the columella, tip, or sidewall, composite auricular cartilage grafts may also be used in combination with local or regional flaps. In cases where a combination of reconstruction techniques are used, the composite graft is typically used for alar replacement, with the cutaneous portion of the graft used as an internal lining and the local/regional flap tissue used for external lining (eg, paramedian forehead flap for resurfacing of the tip and alar rim, with a composite graft for alar replacement and lining). In such cases, general adherence to the subunit principle ensures adequate cosmesis.[12,19] As these composite grafts are at increased risk for failure, meticulous technique is necessary.[11,16] Necrosis of a composite graft used for internal lining can sabotage the reconstructive efforts.

Free Cartilage Grafts

Free cartilage grafts are used much more frequently than composite grafts. When external skin is provided by a local flap and adequate mucosa exists for internal lining, nonanatomic free cartilage grafts are frequently necessary to preserve the position of the alar margin and to brace it against contraction. Free grafts for alar reconstruction are most commonly taken from the contralateral ear, either from the antihelix or the conchal bowl (**Fig. 13**). These grafts may be harvested using either an anterior or posterior incision through the skin of the ear. Hydrodissection of both the anterior and posterior auricular skin with local anesthetic facilitates harvest of the cartilage. Once the skin is carefully elevated, sharp dissection is used to excise the free cartilage graft. The free cartilage can then be sutured to the vascularized lining of the nose and covered with a vascularized flap for external cover. To ensure survival, vascularized tissue should nourish both sides of the cartilage.

Attention can then be turned to the donor site on the ear. After obtaining careful hemostasis, the

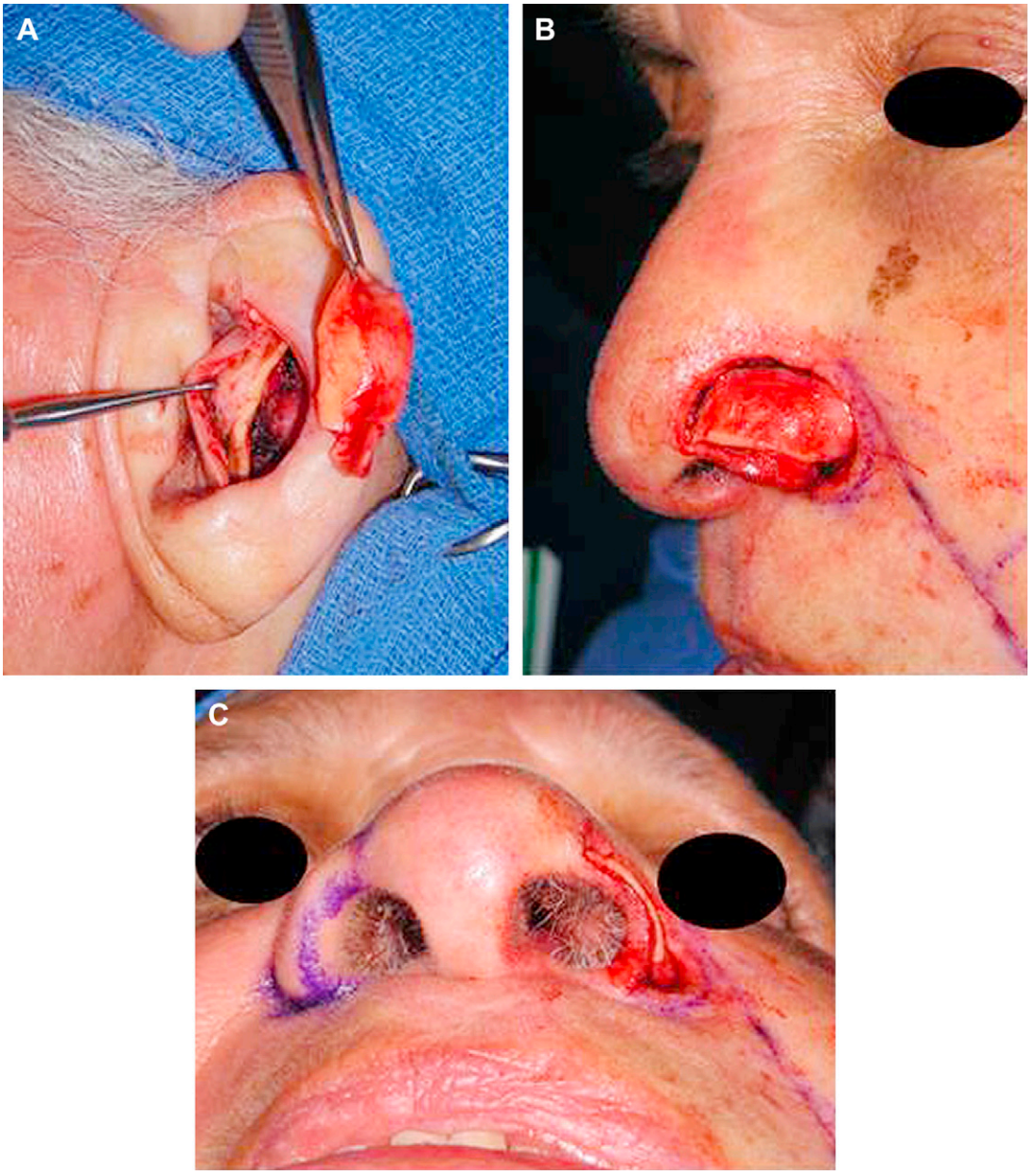

Fig. 13. (*A*) Conchal cartilage graft is harvested from the left ear donor site. (*B*) Free cartilage graft inset and sutured to the nasal lining mucosa. (*C*) Swimmer's view of cartilage graft displaying the appropriate thickness for restoration of the alar rim contour.

incision in the auricular skin can be closed with a simple layer of cutaneous sutures. Quilting sutures and a bolster dressing may be prudent to avoid hematoma, depending on the size of the cartilage graft.

Internal Lining Reconstruction

The nasal mucosa is essential for maintaining adequate nasal function and provides crucial blood supply to all types grafts and flaps. The function of the nasal airway is to warm and humidify inspired air, a mechanism that depends on adequate airflow and a healthy, large mucosal surface area.[7,9] Failure to adequately repair or reconstruct the internal nasal lining may lead to chronic crusting, infection, and poor healing.[13] These complications may eventually lead to graft necrosis. Because a significant contribution of the vascular supply to cartilage grafts is derived

from the nasal mucosa, formally reconstructing this layer is essential. There is a high risk for contraction of the reconstruction used for external cover if there is a defect of the underlying mucosa.

A variety of donor sites and techniques exist for reconstruction of the internal nasal lining. The simplest option is a free septal mucosal graft, although these grafts must be small to ensure quick healing and survival. Free grafts are less desirable in situations where any doubt exists about the vascular supply of the remaining layers. Vestibular skin may be rotated as a bipedicled advancement flap for smaller alar reconstructions.[36] This flap is elevated roughly in an oval shape, beginning with an intercartilaginous incision (proximal to the alar defect) with the medial end roughly at the nasal septum and the lateral end at the floor of the vestibule. The wider middle portion of the mucosal flap is then rotated inferiorly into the reconstructed alar subunit, and the donor site is repaired with a thin FTSG.

When alar or distal nasal reconstruction demands a larger internal lining flap, as in the case of full-thickness defects, an excellent option is a hinge flap based on the ipsilateral septal mucosa.[7,36] This flap is based on a single wide pedicle at the anterior septal angle, and is raised by standard hydrodissection followed by submucoperichondrial dissection and mucosal cuts. The posterior cut defines the length of the flap, then the superior and inferior cuts determine its distal width. Once the flap is raised, it is folded (like a hinge) and sutured into the internal aspect of the defect. Ideally, this procedure is performed before reconstruction of the cartilaginous framework and external skin envelope, as the exposure and dissection is significantly easier at this point. A second step is generally required to divide and inset the flap, because the hinged portion can cause substantial nasal airway obstruction. This can be undertaken at the same time as pedicle division in cases where 2-stage local flaps (eg, paramedian forehead or melolabial) have been used.

The inferior turbinate is an alternative intranasal donor site for internal lining reconstruction.[43] The mucoperiosteum of the bony inferior turbinate is abundant, well vascularized, and may be harvested as a pedicled flap based at its head. This procedure begins with generous infiltration of local anesthetic followed by medialization (in-fracture) of the turbinate with a blunt elevator or knife handle. Incision is made along the superior aspect of the turbinate and the mucoperiosteum is elevated along the free edge. Subsequently, the bony turbinate is disarticulated from the lateral nasal wall using sharp osteotome dissection or cutting sinus instruments, taking care to avoid transecting the flap and leaving a small amount of bone and soft tissue at the head of the turbinate. Once the bone is removed posteriorly, the remaining mucoperiosteum is mobilized and the flap is turned toward the alar defect. This is sutured in place and allowed to heal, although a second stage with pedicle division is necessary for large flaps causing significant nasal airflow obstruction.

When there is insufficient or inadequate intranasal graft materials, local flaps have also been used for internal lining reconstruction. In such cases, the donor tissue is not of the typical mucosal type. Two common examples are so-called turnover flaps, where a portion of a local skin flap is rotated into the defect and flipped 180° so that the skin surface faces the nasal passage. Although this can be an excellent option in cases where much internal lining is missing, the surgeon must ensure that the skin used for nasal lining is free of cutaneous neoplasms. It is unwise to place skin with similar actinic damage inside the nose where surveillance is difficult.[48] In addition, Menick[49] has written extensively about the 3-stage, turnover forehead flap as a source of both external cover and internal lining. In this situation, the distal end of the flap is folded over to form the ala, free margin, and the lining inside of the nostrils. Another option when a paramedian forehead flap is planned for the external layer reconstruction is to extend the local flap dissection to include the galea aponeurotica.[50] This layer can be raised with the overlying cutaneous tissue and then separated as its own pedicled layer when the skin flap is thinned. The galea is then used as an internal lining flap, with cartilage grafts placed in between this layer and the forehead skin. This reconstruction eventually becomes mucosalized, as the native nasal mucosa grows across the galea graft.[50] The galea-including paramedian forehead flap is most useful for larger distal reconstructions including portions of the ala and tip subunits, as the geometry of rotation and inset can be difficult in other areas, and ensuring the stability of cartilage grafts may be difficult. Other local pedicled flaps and even a second paramedian forehead flap from the other side of the forehead have been used alone or in combination to reconstruct large defects of the nasal lining.

Free microvascular reconstruction

In large, distal nasal reconstructions, some investigators have used radial forearm free flaps for internal nasal lining.[51] This flap is a free fasciocutaneous graft based on the radial artery and venae commitantes, and has been combined with local flaps and cartilage grafts to reconstruct complete

defects of the distal third of the nose.[51] In addition, some interesting work has been done using free microvascular transfer of composite grafts from the helical root and preauricular skin.[52] This flap is based on the superficial temporal artery and vein, and may be harvested in a variety of configurations, including variable quantities of cartilage, skin, and even bone. Although beyond the scope of this article, these options at the top of the reconstructive ladder are mentioned as a last resort for massive defects or in cases where local graft tissues are not available or such reconstructions are contraindicated.

Structural Cartilage Grafts for Alar Reconstruction

Full-thickness alar reconstructions are exposed to significant contractile forces during the healing process. Without proper consideration and structural support, this may lead to significant alar retraction, alar notching, columellar show, and a poor cosmetic result. As with any surgery, the best treatment of a complication is prevention. This philosophy dictates that cartilage grafting be performed at the primary reconstruction to support the nose as it heals. In the case of alar retraction, prevention is best performed by placement of an alar rim graft (unless an auricular composite graft has already been used at the alar rim). These grafts are nonanatomic in the sense that they do not replace or reconstruct a specific piece of native cartilage.[53] Alar rim grafts are generally carved from free conchal cartilage, and when shaped to the appropriate size and contour, add significantly to the final cosmetic result.[43] These grafts should be thin (1–2 mm), and shaped using the contralateral ala as a template to determine length and curvature. Grafts should be placed at the reconstructed alar margin and secured with suture to the surrounding tissues to prevent migration during healing.

External nasal valve collapse may also accompany reconstruction of the nasal ala, especially when soft tissue flaps are large or poorly supported.[22] Reconstructions that involve the entire alar subunit or a portion of the lateral nasal wall are predisposed to this complication, and preventative techniques resemble those used for functional rhinoplasty. Alar batten grafts are linear, free cartilage grafts that may be carved from septal cartilage, or less commonly, conchal cartilage. The graft should be made long enough to span the distance between the lateral crus of the lower lateral cartilage and the bony edge of the pyriform aperture.[8] Depending on the size of the defect and the extent of the nasal dissection, batten grafts may be placed via a precise pocket (closed technique) or directly onto the exposed framework (open technique).

The internal nasal valve (INV) is the narrowest portion of the airway and contributes about half of all airway resistance. Thus, any compromise of this area during the reconstructive process (including soft tissue bulk or internal lining flaps) results in significant functional loss.[22] The INV is actually a three-dimensional space bounded by the head of the middle turbinate, the floor of the nose, the cartilaginous septum, and the articulation of the upper lateral cartilage (ULC) with the septum. The angle formed by the ULC and the septum is typically 9° to 15°.[8] Narrowing of this angle results in significant increases in nasal airway resistance, corresponding to Poiseuille's law, which states that resistance to flow is proportional to the radius to the fourth power. Maintenance or augmentation of the INV is key to a satisfactory functional result of any nasal surgery. Thus, larger distal nasal reconstructions involving replacement or manipulation of the ULC must consider spreader graft placement as an adjuvant treatment. Again, depending on the size of the defect and the extent of the nasal dissection, spreader grafts may be placed endonasally (closed technique) or directly between the exposed quadrangular cartilage and ULC (open technique).

With larger defects that involve the nasal tip or columella, in addition to the ala, consideration must be given to the structural support of the distal third of the nose. This is particularly true when the resection margins have included a significant portion of the lower lateral cartilages, violating important tip support mechanisms (eg, the scroll region or the medial crural footplates). To avoid tip ptosis, the reconstructive surgeon must consider the tip support mechanisms disrupted by the surgical defect and the relative weight of the grafted tissues. In these cases, a columellar strut graft may be useful in providing strength to the reconstructed tip.[54] This simple cartilage graft may be carved from septal, conchal, or costal cartilage. The graft should be 2 to 3 mm wide, with the length determined by the preoperative or desired postoperative projection. The graft is placed in a precise pocket that is dissected between the medial crura of the lower lateral cartilage and rests on the maxillary crest. It should be secured with fine-gauge, synthetic, nonabsorbing suture.

Timing of Flap Takedown and Insetting

For any interpolated or 2-stage flap that is performed, the surgeon must decide the optimal

time to perform the pedicle take down and flap inset. Most of the literature suggests that the 3 weeks after surgery is a safe time to take down the flap, but specific patient comorbidities, such as smoking, prior radiation, or diabetes, may warrant leaving an intact pedicle for a longer period of time. Also, less aggressive thinning of the flap during the initial procedure may be judicious in patients with a history of some of the comorbid issues. Despite variability in the time of take down and inset among surgeons, most of the vascular in-growth from the wound bed is adequate to divide the flap pedicle between 2 and 4 weeks after the initial procedure.[43] A quick test can be performed in the clinic to determine if the flap has engrafted itself to the defect wound bed. The surgeon can assess the color of the flap by constricting the pedicle at its base with a hemostat. If the color of the flap does not change, the flap has taken to the defect site and it is safe to severe the pedicle at that time. In addition, during the procedure of pedicle division, most surgeons lift up the proximal flap, thin it out aggressively, add contour and shape to the alar reconstruction with tacking and fixation sutures, and then inset the remainder of the flap. The flap should be adequately debulked at this point, using a scalpel blade to remove any excess fat and subcutaneous tissue, as well as granulation tissue, from the wound bed.[26] The flap can then be precisely trimmed to exactly fit the defect size, after the wound edges are freshened, and inset with interrupted cutaneous sutures.

Complications

In performing nasal reconstructive surgery, there are many issues that can lead to poor functional and cosmetic results. Although some complications such as infection, flap necrosis, and unsatisfactory cosmetic appearance can occur with many different flaps, this section address some of the complications or problems that can occur more specifically with alar reconstruction. Thorough preoperative assessment of the defect and reconstruction options, as well as proper surgical technique can limit the risk for most of these complications.

Decreased nostril or alar size

This problem can become an issue especially in cases where the surgeon is set to repair small defects that are confined to the alar subunit itself. As discussed earlier, primary closures, rotation-advancement flaps, and V to Y nasalis muscle island pedicle flaps all predictably shorten the size of the ala. Consequently, the alae can be asymmetric and the aperture of the external nasal valve is decreased. When considering defect reconstruction with tissue that is entirely within and limited to the ala, these flaps, as well as those using just alar tissue, should be reserved for reconstructing defects with a horizontal dimension less than or equal to 0.5 cm.

Impairment of alar contour

The contour of the nasal ala is particularly difficult to replicate. The delicate convex ala is framed by the concave alar groove. The inferior free margin is particularly susceptible to distortion. If care is not taken, flaps for which donor tissue is taken from the nasal sidewall or cheek can blunt or ablate the alar groove superiorly or the nasofacial sulcus laterally. The surgeon must exercise caution when using 1-stage flaps with donor sites located outside the alar skin, such as a medially based bilobe flap or nasolabial transposition flap. If the chosen flap is likely going to blunt the alar contour, another flap that incorporates multiple stages or one that reconstructs the entire alar subunit should be considered.

Buckling of the lateral crus of the lower lateral cartilage into the nasal vestibule

Reconstruction options that decrease the volume of the ala in the anterior-posterior dimension often cause buckling of the lateral crus of the lower lateral cartilage into the nasal vestibule because of the strain put on the underlying cartilage with this type of closure. The problems associated with this can range from being asymptomatic to causing significant nasal obstruction. The reconstructive surgeon must be aware of this possibility and take steps to try and prevent or repair this issue. Free cartilage grafts can help to stabilize the position of the lateral crus. In many cases, either an alar strut graft can be placed between the vestibular mucosa and the undersurface of the lateral crus or an alar batten graft can be placed in a precise pocket, over top of the lower lateral cartilage, in the region of the INV. Horizontal mattress sutures securing the cartilage graft to the intrinsic lower lateral cartilage will help to bring the tail of the lateral crus out of the nasal cavity and relieve that aspect of the patient's nasal obstruction. In general, the surgeon can prevent buckling of the lateral crus by reconstructing with flaps that have volume equal to the size of the defect.

Distortion or retraction of the free alar margin

The complication of alar retraction usually occurs from either a weakened lateral crura of the lower lateral cartilage, from undersized flaps, from flap designs with secondary motion that pulls the alar rim superiorly, or from postoperative scar contracture.[54] Alar retraction can usually be prevented

though careful planning during the reconstructive procedure. A cartilage graft, most often auricular concha, is usually placed along the alar rim or slightly superior to this, to brace the free alar margin and prevent a retraction of the ala, which can lead to a poor cosmetic outcome.

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