3 Reconstruction of the Nasal Unit

Ian Maher, Jamie L. Hanson, and Gabriel Amon

Summary
The nose has important functional and aesthetic purposes. As an anatomic landmark in the center of the face, the nose serves an integral role in the perception of appearance.[1] With a complex architecture comprising convex and concave surfaces, the nose poses a significant challenge to dermatologic surgeons attempting to preserve the aesthetics of this facial unit. To do so successfully, understanding its key structural and anatomic features is fundamental.

Keywords: nasal reconstruction, bilobed flaps, trilobed flap, paramedian flap, crescenteric advancement flap, dorsal rotation flap

3.1 Structure and Function

The structural support system of the nose consists of the nasal bone proximally, which transitions to a distal cartilaginous skeleton. The cartilaginous portion of the nose can be further subdivided into three parts: the nasal septum and the paired upper and the lower lateral cartilages.[2] Above this structural support system lies the nasalis muscle, which is overlaid by skin. With regard to the nasal airway, there are two key anatomic structures of functional importance: the internal and external nasal valves. The external nasal valve serves as the gateway to the nasal passage and is formed by the nasal septum, the nasal floor, the caudal edge of the upper lateral cartilage, and the nasal ala.[3] The internal nasal valve is a narrow passage found at the level of the pyriform aperture and is the site of maximum air resistance; its boundaries are formed by the upper lateral cartilage, the nasal septum, the nasal floor, and the inferior turbinate.[4] Because collapse of these valves can obstruct inspiratory airflow, their preservation is vital to all nasal reconstruction.

3.2 Skin Characteristics

The characteristics of the skin overlying the nose vary markedly by location. There are three primary zones, each with unique features.[5] Zone I (proximal) involves the nasal dorsum and proximal nasal sidewalls; the overlying skin in this region is thin, mobile, and elastic. Zone II (distal) corresponds to the distal half of the nose and contains thick, sebaceous skin that is stiff and less mobile. Zone III extends to the infratip lobule and consists of thinner skin, but it is tightly affixed to underlying tissue and therefore less mobile.[5]

3.3 Nasal Subunits

The concept of facial aesthetic units described by Gonzalez-Ulloa[6] in 1954 introduced the concept of restoring regions of skin to achieve optimal aesthetic results. Burget and Menick[7] subsequently introduced the nasal subunit theory, applying similar principles on a smaller scale again in an attempt to achieve improved aesthetic outcomes. Using this approach, incisions and scars are designed to fall between subunits where natural shadows and transitions help disguise their appearance. These concepts have remained a common approach to facial reconstructive surgery in today's practice. There are nine nasal subunits in total, which include the tip, columella, right and left alar lobules, right and left soft triangles, nasal dorsum, and right and left dorsal sidewalls. The nasal dorsum and dorsal sidewalls are mobile subunits in the majority of patients, as they are composed of elastic, nonsebaceous skin, are largely planar, and overlie the bony nasal skeleton. In contrast, the remaining subunits are considered immobile. The nasal tip and alar lobules are highly sebaceous and located on convex surfaces; in these locations, volume replenishment is key in preventing indent deformities. The columella and soft triangles are nonsebaceous and flat.

3.4 Keys to Success

When planning an operative repair of the nose, preserving proper function and cosmetic structure are important components that often go hand in hand. There are a few key principles that will assist in achieving these goals. In general, maintaining horizontal tension vectors when planning operative closures on the nose is best; this schematic prevents vertical forces that can distort the free margin at the alar rim. Additionally, repairs should be planned so as to minimize horizontal tension over the compressible cartilaginous nasal skeleton, as this can lead to saddle nose deformity. The next key point when executing a repair is to undermine within the correct tissue plane. In general, undermining should be performed within the subnasalis tissue plane, which is a relatively bloodless plane, since the nasalis provides relative structural stability for the sebaceous and fragile distal nasal skin.[8] Meticulous attention to suture placement and technique will also ensure ideal cosmetic outcomes. By placing emphasis on precise deep sutures that incorporate the nasalis muscle, the overall integrity of the closure will be optimized, thus preventing scar spreading, scar depression, as well as other contour deformities such as trapdoor deformity. When planning a flap repair on the nose, it is advisable to always deepen the primary defect

to the subnasalis plane to avoid "overfilling" of the defect, which is another cause of trapdoor deformity. Finally, gentle handling of the tissue throughout the repair will serve well in achieving even closures with well-disguised surgical scars.

3.5 Local Reconstruction of Subunits

The unique characteristics of each subunit with regard to skin characteristics and tissue mobility will guide the reconstructive choices in each location. Many approaches can be employed successfully; herein we will review our "go-to" choices. Notably, the size of the operative defect relative to the total nasal surface area and the corresponding tissue mobility is the most important determinant regarding the feasibility of a closure as opposed to a hard and fast rule. This section discusses closure options for defects in the 8- to 15-mm range. Our algorithm for reconstruction of nasal defects can be found in this figure.

3.5.1 Mobile Subunits

Nasal Dorsum/Bridge

Primary Closure

In this location with a largely planar surface and thin mobile tissue, small defects can often be closed primarily with a direct linear closure, particularly if the wound is smaller and in the horizontal rather than vertical dimension. Some surgeons believe a primary closure is best used for midline nasal defects, as the tension is then spread symmetrically across both sides of the nose.[9] Closures in this area should generally be vertically oriented and widely undermined to insure a tension-free closure. Excess tension across the dorsum will result in a saddle nose deformity, which can be appreciated on the lateral view. Other tips to prevent these deformities from a primary closure include designing an ellipse with a ratio of greater than 3:1 in the vertical domain and planning elongated standing cones.[9,10] These strategies will result in a longer surgical scar, but the overall profile of the nose will be preserved without tenting at the edges of the incision.

Full-Thickness Skin Grafts

The most important consideration when using a full-thickness skin graft (FTSG) is selecting an appropriate color and texture match of the graft to the donor site. The skin of the nasal dorsum is thin, nonsebaceous, and on a sun-exposed area. Previously reported donor sites with similar texture and color qualities include preauricular, postauricular, lateral forehead, and melolabial skin.[11,12,13,14] There are inherent risks with use of an FTSG leading to poor cosmetic outcomes; these include wound contraction and graft ischemia.[4,10] Precise sizing of the graft will minimize contour deformity that results from wound contraction.[4] Limiting the size of the graft to smaller defects will reduce vascular demands and subsequent risk of tissue ischemia and potential necrosis; however, 90% of grafts with a good vascular bed should survive.[10] Finally, although there is no substitute for meticulous suturing of the graft to the recipient base with good apposition to achieve an even closure, the texture match between donor and graft site can still be improved with postoperative dermabrasion or laser resurfacing.[14]

Transposition Flaps

The thin, mobile tissue of the nasal dorsum allows for closure with a single-lobed transposition flap such as the rhombic or banner flap (▶ Fig. 3.1).[15,16,17] Again, in order to maintain an ideal tension vector, the flap should be designed vertically.[18] A vertically designed flap will also ensure that you are drawing from the most generous tissue reservoir located cephalad to the defect.

Nasal Sidewalls

Proximal

Transposition Flap

The nasal sidewall contains skin from zone I, similar to the nasal dorsum. Again, the thin and elastic nature of the skin from this region allows for adequate closure with a single-lobed transposition flap such as the rhombic or banner flap. The glabellar tissue reservoir is ideal for tissue defects on the nasal sidewall, as it allows for a vertical tension vector, and the donor site scar can easily be disguised into preexisting glabellar frown lines. One drawback to the glabellar donor site is that closure of the secondary defect may lead to narrowing of the interbrow distance.[19] Careful planning of the flap and avoiding a broad base can mitigate this undesired outcome.

Rotation Flap

A rotation-based flap, again using the proximally based glabellar tissue reservoir, can also be utilized for closure of defects involving the proximal nasal sidewall.

Burow's Graft

A Burow's graft is another option that can be utilized for nasal sidewall repair. The schematic of a Burow's graft is to harvest an FTSG from an excess tissue "dog-ear," which would have been removed in a traditional linear repair, to aid in closing the remainder of the defect.[20,21,22] This technique is particularly useful if the defect also involves the medial cheek. In these cases, a cheek advancement flap combined with a melolabial Burow's graft to close the nasal sidewall defect can be employed.[11]

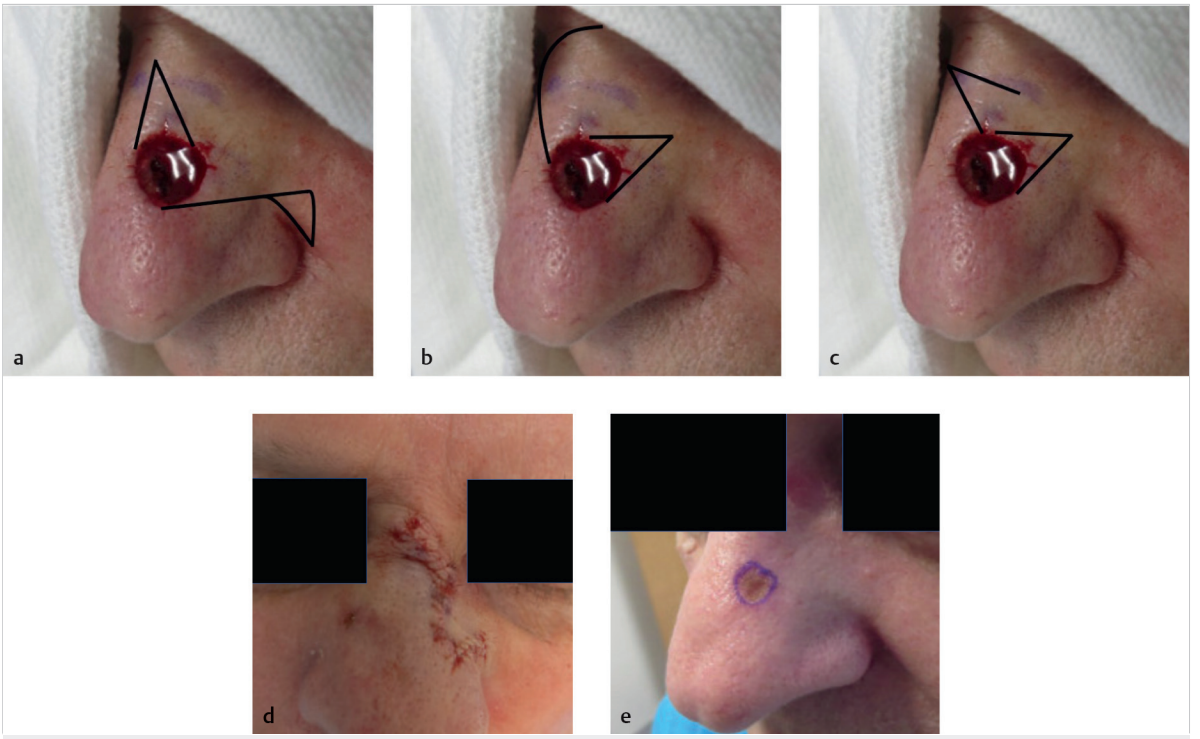

Fig. 3.1 **(a)** Dorsum option 1. Crescentic cheek flap illustrated to repair the defect of the left lateral nasal sidewall. Flap is designed with a standing cutaneous defect (SCD) superior to the primary defect sulcus and a second SCD in the left nasolabial fold extended laterally from the defect. Undermining must transition from the subnasalis plane on the nose to the subcutaneous plane on the cheek. This option allows for horizontal tension vectors and for scars to be hidden partially in the nasolabial fold. **(b)** Dorsum option 2. Rotation flap illustrated to repair the defect of the left lateral nasal sidewall. Flap is designed to provide a good tissue match by using similar skin superior to the defect via a curved incision extending along the nasal ridge and back to the left lateral sidewall to recruit proximal nasal and glabellar laxity. **(c)** Dorsum option 3. This is the option we chose. Rhombic flap illustrated to repair the defect of the left lateral nasal sidewall. Flap is designed to incorporate tissue from an SCD in the nasal root and another SCD in the sidewall. When incising the flap overlying the procerus complex, the flap is elevated in the subcutaneous plane with transition of undermining to the subnasalis plane at the nasion. **(d)** Sutured. **(e)** Follow-up at 12 weeks.

Distal

In general, advancement flaps are favored for closure of nasal sidewall defects, particularly when the skin is sebaceous. Sebaceous skin tends to be more rigid, less mobile, and poorly vascularized, which predisposes it to poorer healing.[23] The lines of advancement flaps on the distal nasal sidewall conform more readily to natural boundaries and this favorable placement is advantageous when optimal healing may not occur even with the most fastidious surgical technique.

Crescentic Cheek Advancement Flap

The crescentic cheek advancement flap was introduced by Webster[24] and has subsequently been modified as an excellent repair option for surgical defects involving the lateral nasal sidewall.[25,26] The crescentic cheek advancement flap allows for the donor site scar to be hidden within the nasolabial fold and the scar from the primary defect can then be disguised within the shadows of the nasofacial sulcus. This technique can be thought of as a modification of Burow's advancement flap with a crescent-shaped standing cone along the nasolabial fold as opposed to the traditional triangular design used in other locations.[27] The redundant tissue superior to the primary defect along the nasofacial sulcus can be removed as a traditional triangular standing cone. To ensure adequate tissue mobility and to minimize tension upon closure, the flap along the nasolabial sulcus should be designed so that the curvilinear outer edge of the flap is made to be as long as the shorter inner edge plus the length of the primary defect.[27] Minimizing horizontal tension of the primary defect is particularly important in the region of the internal nasal valve so as not to impair function with inspiratory airflow.

3.5.2 Immobile Subunits

Sebaceous and Convex

The skin in these locations will have zone II characteristics, meaning it will be thicker, more sebaceous, and less

mobile. In general, volume replenishment will be key in achieving optimal cosmetic results with minimal contour deformity.

Nasal Tip

For small (< 4 mm) midline defects involving the nasal tip, a vertically oriented primary closure can be utilized. If the defect is small but slightly displaced from midline, then an east–west advancement flap may be considered. This closure technique is best used in patients with relatively flexible skin with a broad nasal tip.

East–West Advancement Flap

Traditionally the east–west advancement flap has been advocated for patients with particularly sebaceous skin.[23] Ideally, this closure should be reserved for defects that are taller than they are wide. The overall design is a linear closure with a larger standing cone taken superior to the defect and displacement of the inferior standing cone medially over the columella.[28] Key design concepts include elongation of the superior standing cone to avoid a saddle nose deformity with closure, wide undermining in the subnasalis plane, and careful attention to tension vectors when advancing the skin horizontally to avoid any upward pull on the alar free margin.[29] Particular attention should be placed on meticulous deep sutures to reduce tension on the overlying sebaceous epidermis.

Bilobed and Trilobed Transposition Flaps

Our favored repair in this location is a bilobed or trilobed transposition flap (▶ Fig. 3.2, ▶ Fig. 3.3), both of which have been extensively described in the literature.[30,31,32,33,34,35,36] These flaps recruit from tissue reservoirs located more proximally in zone I, reducing tension and anatomic distortion, which would result from a single-lobed flap in this location. Some authors believe that transposition flaps (including bilobed and trilobed flaps) also induce *Z*-plasty-like lengthening—although this is debated by others.[34] The bilobed flap is designed with a total arc of rotation of approximately 90 degrees,[30] which allows for redirection of the terminal tension bearing defect vertically over the bony nasal skeleton and away from the alar free margin. In general, it is recommended to remove the standing cutaneous defect (SCD) first.[31,32] The standing cone should be oriented so as to avoid encroachment on any neighboring cosmetic subunits. In most cases, the length of the SCD should approach, if not exceed, one primary defect diameter in order to minimize tissue redundancy at its apex, which may result in inward push on the nasal aperture or downward push of the ipsilateral alar rim.[18,31,37] As originally described by Zitelli,[30] the lobes would be of equal size with equal rotational angles, although this can be modified based on local tissue characteristics. Lobes situated in mobile skin can be expected to stretch and rotate more; thus, undersizing of the secondary lobe would be possible. If interlobe angles are unequal, it is crucial that more acute

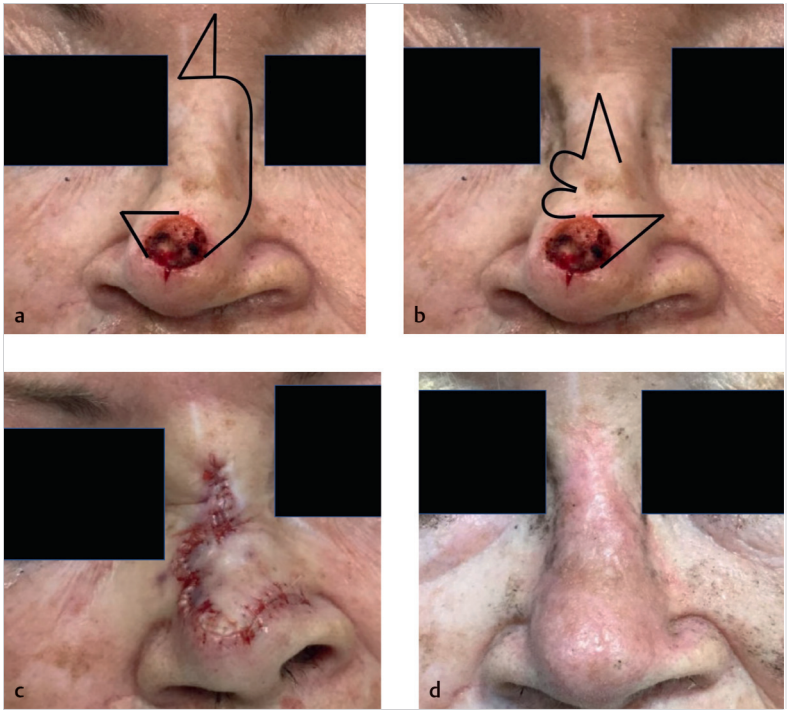

Fig. 3.2 **(a)** Nasal tip option 1. Dorsal nasal rotation flap illustrated to repair the defect of the nasal tip. Flap is designed to provide a good tissue match by using similar skin lateral to the defect, whereas a second standing cone defect with extension to the glabella is required due to the amount of repair tissue required. **(b)** Nasal tip option 2. This is the option we chose. Trilobed flap illustrated to repair the defect of the nasal tip. Flap recruits zone 1 tissue and with vertical orientation of the tertiary lobe allows horizontal tension vectors to maintain alar symmetry. **(c)** Sutured. **(d)** Follow-up at 8 weeks.

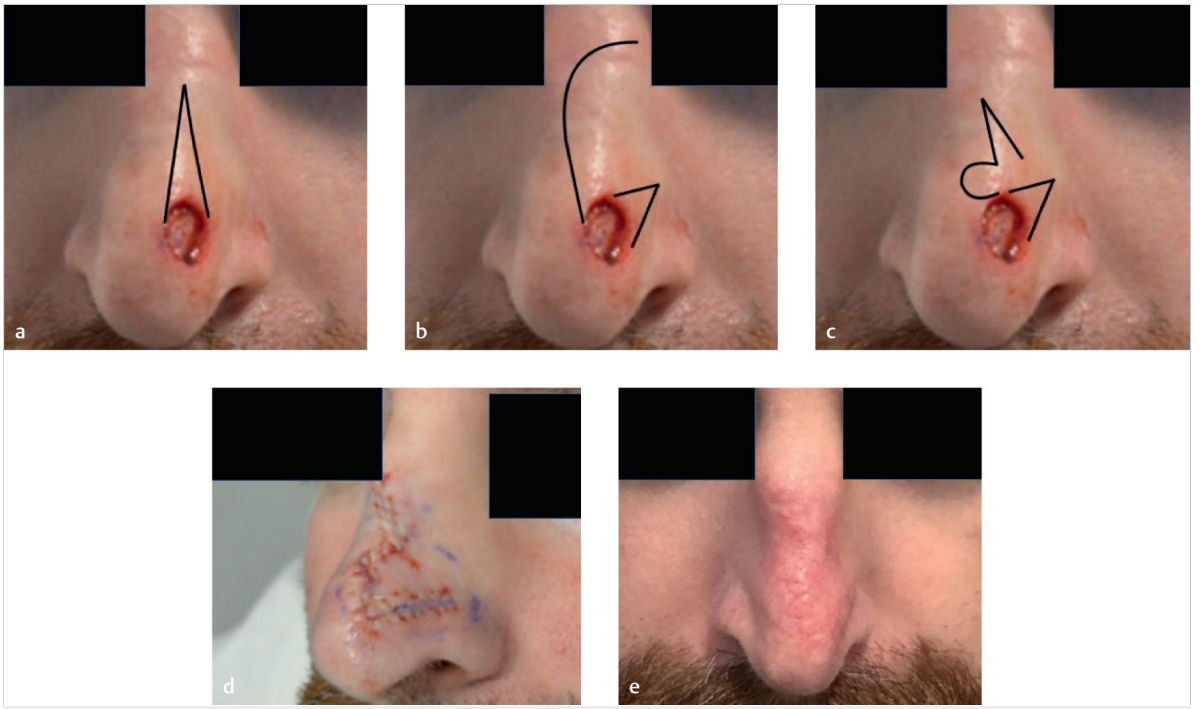

Fig. 3.3 **(a)** Supratip option 1. Nasalis sling island pedicle flap illustrated to repair the defect of the nasal dorsum and tip. This flap uses biplanar undermining to create a laterally based muscle-only pedicle. This is a wonderful repair option for "wider than tall" defects on the nasal tip. **(b)** Supratip option 2. Rotation flap illustrated to repair the defect of the nasal dorsum and tip. Flap is designed to provide a good tissue match and mobility via a curved incision extending superiorly from the defect along the dorsum to the left lateral sidewall. **(c)** Supratip option 3. This is the option we chose. Bilobed flap illustrated to repair the defect of the nasal dorsum and tip. Flap is designed so that the standing cone does not encroach on the alar crease and the tension bearing tertiary defect is oriented vertically or perpendicular to the ipsilateral alar margin. **(d)** Sutured. **(e)** Follow-up at 2 weeks.

angles be seated in stiffer skin proximate to the primary defect and more obtuse angles be located in more mobile skin nearer the tension bearing defect.[18]

Some authors have advocated for oversized primary lobes to overcome rotational shortening, but this only seems to occur in patients with particularly stiff, sebaceous skin.[38,39] As always, meticulous suturing in combination with wide undermining will limit contour defects such as pin cushioning or trapdoor deformities. Additionally, as with all nongraft nasal closures, defects should always be deepened to the subnasalis plane as opposed to thinning of the flap.

The trilobed flap follows similar tissue mechanics, but allows for even greater movement with the ability to recruit more distant tissue reservoirs and further reduce tension of the closure.[18,33,40] The arc of rotation in a trilobed flap is increased to 120 to 150 degrees,[33] which provides additional advantages. The wider rotational arc creates a wider flap pedicle, which provides more flexibility for design and placement of the SCD.[40] Additionally, it optimizes the ability to create a crucial horizontal tension vector over the bony nasal skeleton.[41] These authors have found that this can be achieved more readily with a slight modification of the traditional trilobed flap in which the external angle is made more acute between the primary defect and the primary lobe with increasingly more obtuse external angles for each subsequent lobe.[42] This technique reduces rotational shortening of the primary lobe and pushes the tension vector proximally into zone I skin where there is greater tissue laxity.

The dorsal nasal rotation flap, also known as the Rieger flap, is another closure technique that can be utilized for distal nasal defects. In its original design, the dorsal nasal flap is a random pattern flap that recruits mobile tissue from the glabella and nasal dorsum and rotates this tissue down into the more distal surgical defect. Traditionally, this closure technique is best for defects less than 2 cm in size and at least 5 mm from the alar rim.[43] Attempting to use this flap to cover larger defects or pulling the flap too inferior can result in undesirable tip elevation or alar retraction. Notably, various design modifications have been proposed to broaden the scope of this flap,[44] particularly in patients who desire a one-stage surgery that might otherwise be better suited by an interpolation flap.

Ala

The ala is a functionally critical structure to the nasal airway via the external nasal valve, and extra attention

should be placed on repairs in this location.[45,46,47] In general, if there is any concern for compromise of the alar free margin or patency of the external nasal valve, there should be a low threshold to select a cheek interpolation flap for repair. Although these are two-stage procedures, the long-term structural and functional consequences of under-repair in this location can be severe; thus, it is worthwhile to spend the necessary time and attention in planning the repair upfront.

The nasal ala is anatomically unique among the nasal subunits in that there is no bony or cartilaginous component.[48] The ala maintains its patency due to the structural integrity of the stiff curved sebaceous alar skin—much like an arch bridge. Therefore, cartilage grafting is typically not necessary unless there is compromise of the nasal valves after tumor excision. Prior to planning repair, we close the contralateral nostril and have the patient inhale and exhale to monitor for valvular collapse. When collapse occurs and structural grafting is deemed necessary, a free cartilage batten graft can be utilized. These are most often harvested from the antihelix or conchal bowl, because they are comprised of elastic cartilage, which provides desired strength and shaping properties. Grafts may also be harvested from the nasal septum or rib; however, these sites are comprised of hyaline cartilage, which is weaker and less moldable.[49,50,51,52]

For defects involving the ala with or without involvement of the nasal sidewall, a single-stage cheek transposition flap, such as the nasolabial transposition flap, may be considered. However, this type of closure can lead to blunting of the alar crease and the nasofacial sulcus. Although tacking sutures can help preserve the natural concavities, we tend to eschew this option as more reliable closure techniques are available.

Small Defects (< 7 mm in width) on the Superior Alar Crease

For flaps that rely on rearrangement of alar skin, the horizontal width of the primary defect is the key determinate. If excess horizontal tension is placed on the ala, it will result in inward collapse of the ala and obstruction of the nasal valves.

Alar rotation flap: This flap uses the nasal ala lateral to the surgical defect as a tissue donor, providing an excellent skin texture match and allowing for scars to be easily disguised in the shadow of the alar groove. However, its use should be limited to small defects (< 6–7 mm) on the anterior two-thirds of the ala in proximity to the alar groove.[45,53] These limitations are intended primarily to avoid distortion of the alar free rim and to ensure availability of an adequate tissue reservoir lateral to the defect. There are a few key design steps to ensure a successful repair with the alar rotation flap. First, the SCD should be taken from the inferior aspect of the defect and perpendicular to the alar-free margin. The SCD should be removed first, to allow for easier transfer of the flap into the defect. Next, any intervening skin between the defect and the alar groove should be excised. The incision can then be extended in an arcuate fashion along the alar groove to the alar base. The secondary defect can then be closed in a layered fashion. In general, a second standing cone is not necessary if the defect is closed carefully using the "rule of halves."[4]

Spiral flap: The spiral flap is alternative local rotation flap that allows for recreation of the alar groove while maintaining the convex structure of the ala when the primary defect spans the alar crease to involve both the nasal sidewall and the ala. The design of the spiral flap as outlined by Mahlberg et al is a rotation flap with a tip extension.[54] The origination point for the spiral flap is at the inferomedial portion of the defect and should then extend superiorly in an arcuate fashion. Next, the width of the flap's tip extension should be equal to the vertical height of the alar portion of the primary defect. The length of the tip extension should be equal to the horizontal dimension of the primary defect. The key suture connects the distal portion of the tip extension to the lateral portion of the alar primary defect, hinging the tip extension 90 degrees laterally, and beginning the spiral design of the flap. The second deep suture is then used to bring the body of the rotation flap down to the desired height of the alar crease. The remainder of the flap can then be sutured in place.

Island pedicle flap: Also known as a V-Y advancement flap, this is a myocutaneous flap that maintains a superior nasalis muscle pedicle providing a rich vascular supply.[45,55] Similar to the alar rotation flap, the island pedicle flap is ideal for small defects on the anterior aspect of the ala and maintains an excellent tissue match.[4,45] The overall design involves transfer of a laterally based triangular flap into the primary defect, followed by linear closure of the secondary defect. However, there are limitations to the island pedicle flap and precautions should be taken to avoid cosmetic distortion. The zone II alar tissue is stiff and less mobile; therefore, overall movement of the flap is limited. Additionally, closure of the horizontal secondary defect inherently causes some vertically oriented tension with risk of distorting the alar free margin. Proper selection of a small defect (< 7 mm in width), located relatively near the alar crease and at least 5 mm from the alar margin, will mitigate these risks.[55] Design of an elongated tapered triangular flap will also limit the vertically oriented tension vector created upon closure of the secondary defect.[4] It is inevitable that some elevation of the lateral ala will occur with closure of this secondary defect, and we advise counseling the patient to this fact preoperatively.

Defects of the Anterior Ala

Medially based multilobed transposition flaps: Medially based multilobed transposition flaps allow for recruitment of tissue reservoirs remote from the alar margins—thus

preserving alar symmetry—and allow the primary lobe to transpose over the deeper, more lateral portions of the alar crease, avoiding disturbance of a key aesthetic landmark. Our choice between bilobed and trilobed flaps depends on the ability to place the tension-bearing terminal defect in an area of relative tissue mobility.

The principles of a bilobed flap have previously been discussed; herein, we will address the key aspects to success when executing this repair on the nasal ala. In general, medially based transposition flaps are preferable on the ala as they allow the lobes to be transposed over the alar groove, preserving this anatomic structure. Additionally, the standing cone should be designed horizontally to the defect. This ensures that the tension vector of the tertiary defect is oriented vertically and also aligns the long axis of the primary lobe to run parallel with the alar free margin.[4] Both of these design features minimize distortion of the alar rim (▶ Fig. 3.4).

In many patients, a medially based trilobed may be more effective in recruiting the more forgiving zone I nasal skin reservoir.[42] The addition of a third lobe adds approximately one primary defect diameter to the height of the flap. The superior movement of the flap's terminal defect reduces the tension of closure and allows for more effortless preservation of alar symmetry.

Defects of the Middle to Posterior Ala: Large or Involving the Alar Rim

Large defects (>1.5 cm) in this location are often best repaired with interpolation flaps. There are a few different flap choices in such a case, each with a particular niche for which it is best suited. The melolabial interpolation flap

Fig. 3.4 **(a)** Ala option 1. Medially based trilobed flap illustrated to repair the defect of the left anterior alar. Flap is designed to incorporate the tension bearing quaternary defect in zone 1 where tissue is more easily mobile, and allow for horizontal tension vectors. **(b)** Ala option 2. Melolabial interpolation flap illustrated to repair the defect of the left anterior alar crease. Flap is designed to be a good tissue match while concealing the donor scar in the melolabial fold. This is a reliable option, but does require a secondary procedure and ~4 weeks of wound care. **(c)** Ala option 3. This is the option we chose. Spiral flap illustrated to repair the defect of the left anterior nasal alar crease. The body of the flap repairs the nasal sidewall portion of the defect, whereas the tip extension hinges 90 degrees laterally to resurface the alar portion of the defect. A small area was allowed to granulate to reform the alar crease. Incision extends from the primary defect to the superior aspect of the nasofacial sulcus. **(d)** Sutured. **(e)** Follow-up at 8 weeks.

(MLIF) is our preferred option and the most widely used repair option for the ala.[4,45,56,57,58]

Melolabial interpolation flap: By definition, the MLIF is a two-stage repair that is more labor intensive for the patient, requiring more wound care and multiple office visits. However, there are several notable advantages. Drawing from tissue residing along the melolabial fold, the MLIF provides an excellent tissue match for the nasal ala. Additionally, the melolabial fold provides a convenient location to disguise a surgical scar. The MLIF is a random pattern flap drawing its vascular supply from perforators of the angular artery.[59] The flap can be designed with either a myocutaneous (including skin in the pedicle) or myosubcutaneous pedicle (an "islanded" pedicle), each with different caveats.[56] Although the myocutaneous flap is easier to harvest in the first stage of the repair, it has greater metabolic demands[56] and may cause rotational shortening due to the stiffer pedicle base.[4] When designing the flap, the contralateral nasal ala can be used as a template if the surgeon is attempting subunit repair. Overall the flap should be precisely sized to the primary defect.[56,60] The medial border of the flap should align just lateral to the ipsilateral melolabial fold, and the alar template located at or above the level of the oral commissure.[56,61] Once mobilized, the flap is generally advanced medially and should overlie the defect without tension. The pedicle is typically divided after 3 weeks. The residual alar subunit is then excised, with the exception of 1 to 2 mm of alar base lateral to the defect. This remaining alar base will serve as the attachment point for the flap, allowing preservation of the native alar groove.[4] The donor site can then be closed primarily.

Although the MLIF is the preferred repair for this location, it is not plausible in all patients. For example, male patients often have terminal beard hair within the melolabial donor region. Although laser hair removal can be considered, this option is not permanent and has limitations—especially in those with gray or white hair. For these patients, it may be preferable to select a different repair such as the paranasal interpolation flap (PIF) or the paramedian forehead flap (PMFF).

Paranasal interpolation flap: The PIF is an inferiorly based random pattern flap that draws from a tissue reservoir along the nasofacial sulcus. Apart from the advantage of providing a hairless donor site, the PIF has an axis of rotation less than 90 degrees, which also allows for a shorter flap design.[62] Careful consideration should be paid to the mobility of the medial cheek as well as the position and laxity of the lower eyelid to ensure adequate closure of the donor site.[62] Key design principles include ensuring the flap width is equal to the height of the primary defect and tapering the end of the flap to 30 degrees to achieve ideal linear closure of the donor site.[62] The medial border of the flap is typically kept just lateral to the nasofacial sulcus, but if a wider flap is deemed necessary, the flap should instead straddle the nasofacial sulcus.[62] Once complete, the flap is again left in place for 3 weeks prior to takedown.

Nonsebaceous and Flat

Soft Triangle

For repair of the soft triangles that are composed of zone III skin and adherent to underlying structures, recruiting tissue from more distant donor sites is often necessary. In this location, there is a low threshold for interpolation flaps, the details of which have been reviewed in previous sections. We favor the use of the paranasal flap or MLIF for repairs in this location, as opposed to the PMFF. If a two-staged repair is declined by the patient, there are a few preferred options for local repair of the soft triangles. The first option is the trilobed flap, as discussed in more detail in previous sections. The third lobe allows for recruitment of more remote and mobile tissue from zone I. The second option for local repair is the nasalis sling flap (NSF).

The NSF has been described in the literature as an excellent option for repair of full-thickness defects of the nasal tip[63] and more recently has been described for repair of defects involving the soft triangles.[64] The NSF is a myocutaneous island pedicle flap from the nasal dorsum. This repair option has several advantages. Drawing from a nearby tissue donor site in zone II, the NSF provides an excellent color and texture match to the nasal tip and avoids distortion of the alar free margin by maintaining a horizontal tension vector.[64] The key to soft triangle repair lies within the rotational reach of the NSF, which is attributed to the flexible nasalis pedicle. The intrinsic movement and reach of the NSF allow for the excess skin from the leading edge of the flap to be in-folded onto itself, thus recreating the lining and structure of the soft triangles.[64]

Columella

Surgical defects of the columella are rare.[65] Fortunately, this region of the nose is not highly visible and therefore defects not involving the alar free margin are often amenable to a more simple repair. Allowing small defects of the columella to heal by secondary intention is a reasonable option but does require significant wound care on behalf of the patient. If patients desire a formal closure of the wound, the split-thickness skin graft (STSG) from the postauricular skin is another practical repair option.

3.5.3 Large or Multisubunit Defects

Paramedian Forehead Flap

The PMFF has been extensively described in the literature and is well established as the gold standard closure technique for large defects involving multiple subunits of the nose (▶ Fig. 3.5).[60,66,67,68] The PMFF is an axial pattern flap

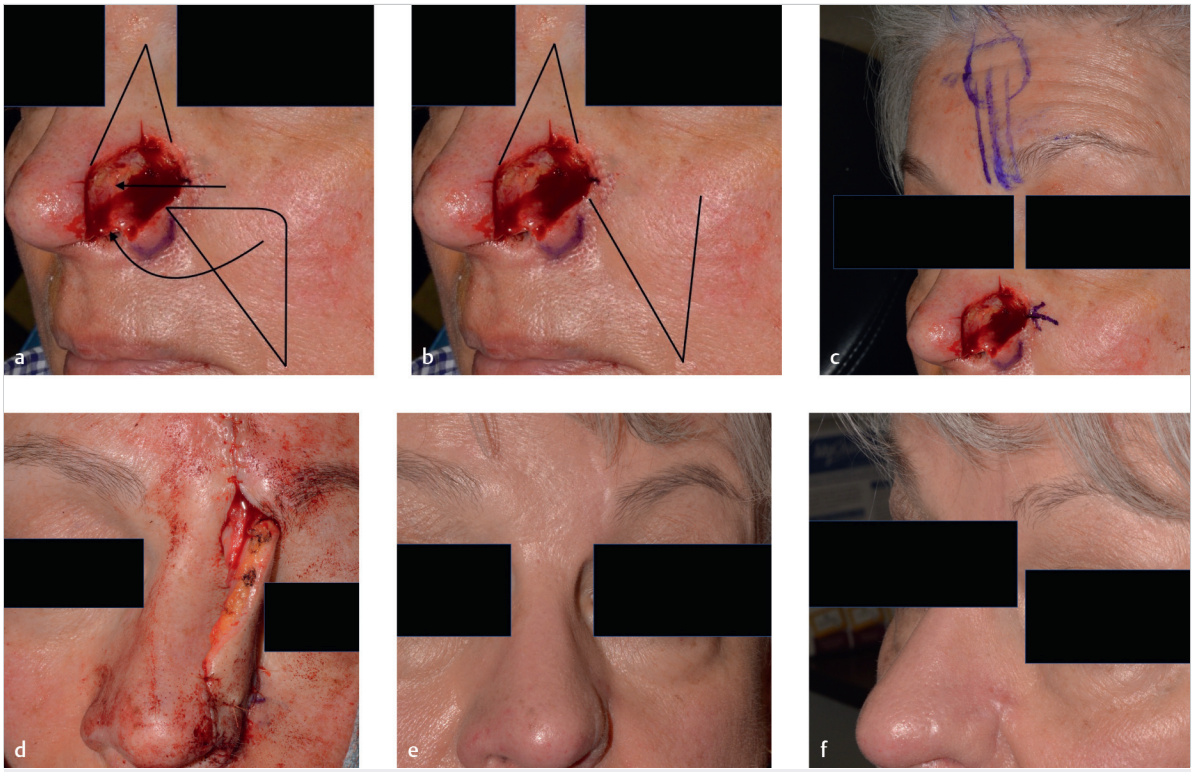

Fig. 3.5 **(a)** Full-thickness ala option 1. Combination of the melolabial interpolation flap (MLIF) with the crescentic cheek advancement flap illustrated to repair the defect of the left nasal ala. The melolabial standing cutaneous defect (SCD) is islanded and used as an MLIF to repair the ala, whereas the cheek is advanced to resurface the nasal sidewall. This option is preferred for patients with good cheek laxity, which was not present in our patient. **(b)** Full-thickness ala option 2. Single-stage cheek transposition flap illustrated to repair the defect of the left nasal ala. Flap is designed to use the medial cheek skin to resurface the nasal sidewall and the ala. Tacking sutures are used to recreate the alar crease and the nasofacial sulcus. Due to the involvement of the alar rim and lining as well as the cheek in this case, this option was not chosen. **(c)** Full-thickness ala option 3. This is the option we chose. The paramedian forehead flap (PMFF) illustrated to repair the defect of the left nasal ala. Flap is optimal for large, full-thickness defects affecting multiple nasal subunits. **(d)** Sutured. **(e)** Front view of the PMFF at 2 months of follow-up. **(f)** A 2-month follow-up L ¾ view.

drawing its blood supply from the supratrochlear artery; it can be performed in two or three stages depending on the extent of the defect. Skin-only defects or those involving fewer nasal subunits are often amenable to the two-stage PMFF. However, more extensive defects requiring fold over flaps for nasal lining repair or recreation of multiple subunit transitions may benefit from the three-stage repair, which allows for establishment of a more robust vascular supply.[66,69]

Successful execution of the PMFF requires meticulous planning with careful design of the template in order to ensure adequate reach. Doppler can be used to identify the supratrochlear artery and define the pedicle base. Alternatively, the glabellar frown line and 6 mm of skin immediately lateral to it serves as a reliable landmark for the supratrochlear artery.[70] Therefore, a thinner 1-cm pedicle base can be safely planned to incorporate this region.

In a two-stage repair, the distal "paddle" of the flap will be elevated in the subcutaneous tissue plane until the juncture with the "stalk," where the dissection should move into the subfrontalis/supraperiosteal plane in order to preserve the neurovascular bundle. Alternatively, in a three-stage repair, the flap will be elevated entirely from the subfrontalis plane. Each stage of the repair is separated by a period of 3 weeks. In the three-stage repair, the intermediate operation allows for thinning of the flap, removal of excess subcutis/muscle, and placement of any cartilage grafts. The flap is then sewn into what will be the final configuration. The final stage is the same for both approaches and involves division of the pedicle and inset and closure of the flap and donor site.

Although the PMFF serves as an excellent repair option for large, full-thickness defects, there are several drawbacks. Overall, the number of operations and necessary wound care is labor and time intensive for the patient. Additionally, patients with vascular compromise due to extremely heavy smoking, underlying medical comorbidities, or previous forehead surgeries may not be ideal candidates due to risk of flap necrosis. Generally, the PMFFs,

particularly the three-stage PMFFs, are quite safe even in smokers and flap loss is incredibly rare. Finally, some patients find that the resultant forehead scar is unappealing; however, in most cases, the forehead heals well—even with granulation—and emphasis should be placed on restoration of the aesthetically and functionally critical nose.

Combination of MLIF and Local Flaps

Although the PMFF has historically been the repair of choice for large multisubunit nasal repairs, there are several drawbacks that may deter patients. The bandaging required for the PMFF is bulky, which is more noticeable and socially stigmatizing for patients; it also interferes with activities of daily living such as driving or wearing eyeglasses. These disadvantages have been shown to impair quality of life for many patients[71] and may lead many to prefer other repair options. In these cases, the combination of an MLIF with an additional local flap provides an excellent alternative.[72] The overall approach utilizes the MLIF to reconstruct the nasal tip or alar portion of the defect, whereas a local flap such as the crescentic cheek advancement or a V-Y advancement flap will repair the nasal sidewall. In general, it is recommended to perform the local flap for nasal sidewall repair first, followed by inset of the MLIF into the distal portion of the defect.[72]

MLIF + V-Y advancement

This repair option is ideal for defects of the nasal sidewall that are wider than tall or in patients with sufficient vertical laxity. The V-Y advancement in this setting is designed as a myocutaneous flap from the vertical side of the defect, drawing its blood supply from a laterally based nasalis pedicle. In order to achieve this design, a bilevel undermining technique is used—undermining the subnasalis medially and above the nasalis laterally.[72] Once the V-Y advancement is sewn into place, the MLIF can be designed in a standard manner to close the distal defect, the details of which have been reviewed in previous sections. Advantages of the V-Y advancement in combination with the MLIF include two separate robust blood supplies for each flap. Additionally, the V-Y flap on is muscular pedicle is able to move independently from the MLIF, without creating undue restraint from the overlying skin.[72]

MLIF + Crescentic Cheek Advancement

This combination is ideal for defects whose sidewall components are taller than wide, or in patients with significant horizontal laxity. Again, the local flap—the crescentic advancement flap—will be performed first. The SCD will be taken superior to the primary defect and should be excised to the subnasalis plane. The cheek advancement flap should also be undermined in the subnasalis plane until the juncture with the nasofacial sulcus, at which point undermining should move to the superficial subcutaneous plane in order to preserve the pedicle of the MLIF.[72] The MLIF can once again be designed and inset to the distal defect in a standard manner as described in previous sections.

3.6 Conclusion

The nose is a complex anatomic and functional structure. Successful reconstruction of the nose requires precise planning and individualization of the repair to the characteristics of the defect, the local anatomy, and the patient (▶ Fig. 3.6).

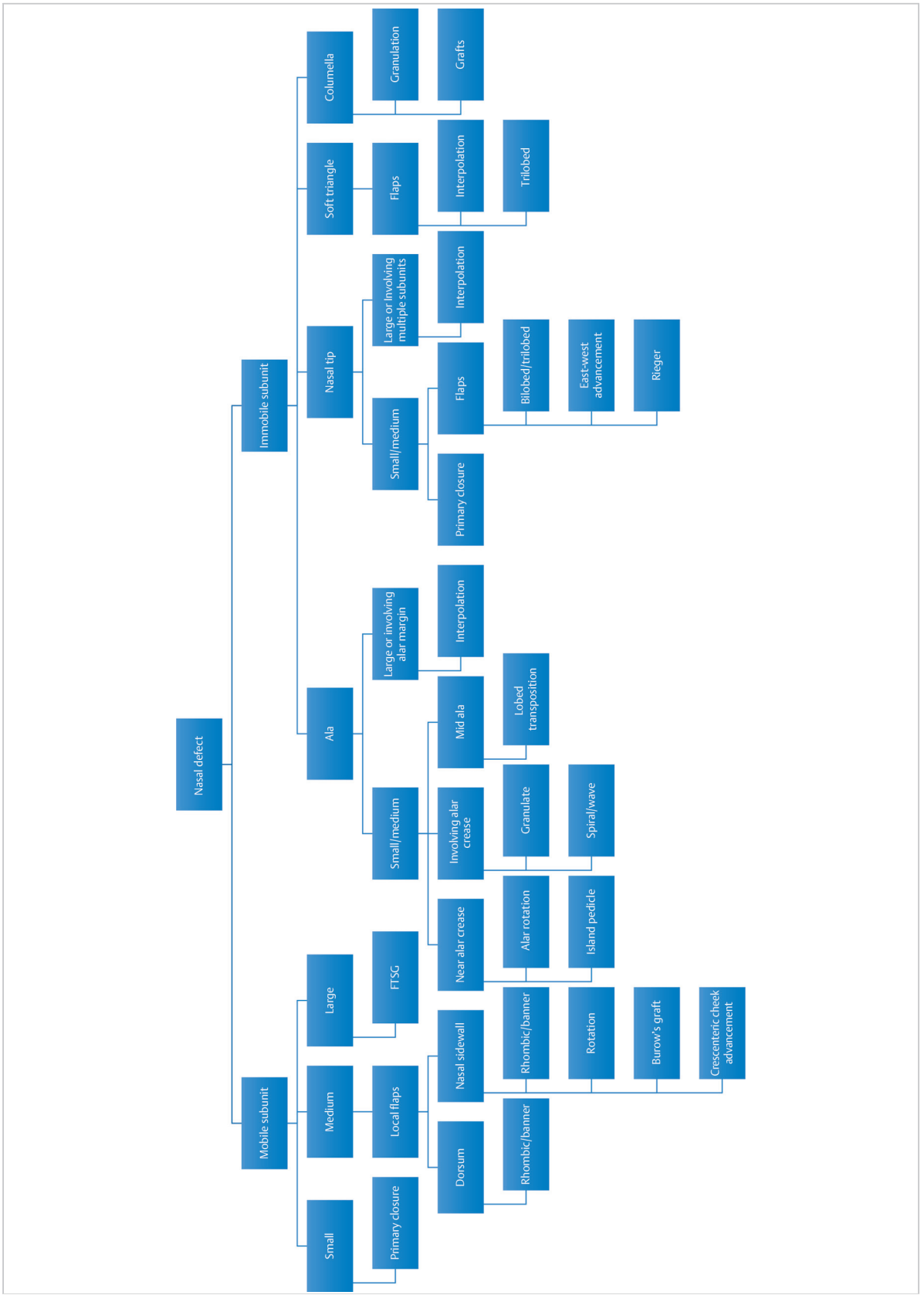

Fig. 3.6 Reconstructive algorithm for cutaneous nasal defects.

References

[1] Heppt WJ, Vent J. The facial profile in the context of facial aesthetics. Facial Plast Surg. 2015; 31(5):421–430

[2] Bruintjes TD, van Olphen AF, Hillen B, Huizing EH. A functional anatomic study of the relationship of the nasal cartilages and muscles to the nasal valve area. Laryngoscope. 1998; 108(7):1025–1032

[3] Hamilton GS, III. The external nasal valve. Facial Plast Surg Clin North Am. 2017; 25(2):179–194

[4] Maher I, Bordeaux J. Post-skin cancer alar reconstruction. Facial Plast Surg. 2013; 29(5):351–364

[5] Menick F. Nasal Reconstruction: Art and Practice. 1st ed. New York, NY: Saunders; 2008

[6] Gonzalez-Ulloa M, Castillo A, Stevens E, Alvarez Fuertes G, Leonelli F, Ubaldo F. Preliminary study of the total restoration of the facial skin. Plast Reconstr Surg (1946). 1954; 13(3):151–161

[7] Burget GC, Menick FJ. The subunit principle in nasal reconstruction. Plast Reconstr Surg. 1985; 76(2):239–247

[8] Oneal RM, Beil RJ. Surgical anatomy of the nose. Clin Plast Surg. 2010; 37(2):191–211

[9] Cook J, Zitelli JA. Primary closure for midline defects of the nose: a simple approach for reconstruction. J Am Acad Dermatol. 2000; 43 (3):508–510

[10] Wolfswinkel EM, Weathers WM, Cheng D, Thornton JF. Reconstruction of small soft tissue nasal defects. Semin Plast Surg. 2013; 27(2):110–116

[11] Kim KH, Gross VL, Jaffe AT, Herbst AM. The use of the melolabial Burow's graft in the reconstruction of combination nasal sidewall-cheek defects. Dermatol Surg. 2004; 30(2, Pt 1):205–207

[12] McCluskey PD, Constantine FC, Thornton JF. Lower third nasal reconstruction: when is skin grafting an appropriate option? Plast Reconstr Surg. 2009; 124(3):826–835

[13] Gloster HM, Jr. The use of full-thickness skin grafts to repair nonperforating nasal defects. J Am Acad Dermatol. 2000; 42(6): 1041–1050

[14] Rohrich RJ, Griffin JR, Ansari M, Beran SJ, Potter JK. Nasal reconstruction: beyond aesthetic subunits: a 15-year review of 1334 cases. Plast Reconstr Surg. 2004; 114(6):1405–1416, discussion 1417–1419

[15] Elliott RA, Jr. Rotation flaps of the nose. Plast Reconstr Surg. 1969; 44 (2):147–149

[16] Zitelli JA, Fazio MJ. Reconstruction of the nose with local flaps. J Dermatol Surg Oncol. 1991; 17(2):184–189

[17] Field LM. The glabellar transposition "banner" flap. J Dermatol Surg Oncol. 1988; 14(4):376–379

[18] Blake BP, Simonetta CJ, Maher IA. Transposition flaps: principles and locations. Dermatol Surg. 2015; 41 Suppl 10:S255–S264

[19] Turgut G, Ozcan A, Yeşiloğlu N, Baş L. A new glabellar flap modification for the reconstruction of medial canthal and nasal dorsal defects: "flap in flap" technique. J Craniofac Surg. 2009; 20(1):198–200

[20] Chester EC, Jr. Surgical gem. The use of dog-ears as grafts. J Dermatol Surg Oncol. 1981; 7(12):956–959

[21] Zitelli JA. Burow's grafts. J Am Acad Dermatol. 1987; 17(2, Pt 1): 271–279

[22] Eliezri YD. Variations on Burow's grafts. J Am Acad Dermatol. 1988; 18(5, Pt 1):1143–1145. United States

[23] Dzubow LM. Repair of defects on nasal sebaceous skin. Dermatol Surg. 2005; 31(8, Pt 2):1053–1054

[24] Webster JP. Crescentic peri-alar cheek excision for upper lip flap advancement with a short history of upper lip repair. Plast Reconstr Surg (1946). 1955; 16(6):434–464

[25] Mellette JR, Jr, Harrington AC. Applications of the crescentic advancement flap. J Dermatol Surg Oncol. 1991; 17(5):447–454

[26] Jackson I. Local Flaps in Head and Neck Reconstruction. St. Louis, MO: Mosby; 1985:245–249

[27] Yoo SS, Miller SJ. The crescentic advancement flap revisited. Dermatol Surg. 2003; 29(8):856–858

[28] Lambert RW, Dzubow LM. A dorsal nasal advancement flap for off-midline defects. J Am Acad Dermatol. 2004; 50(3):380–383

[29] Geist DE, Maloney ME. The "east-west" advancement flap for nasal defects: reexamined and extended. Dermatol Surg. 2012; 38(9): 1529–1534

[30] Zitelli JA. The bilobed flap for nasal reconstruction. Arch Dermatol. 1989; 125(7):957–959

[31] Cook JL. A review of the bilobed flap's design with particular emphasis on the minimization of alar displacement. Dermatol Surg. 2000; 26(4):354–362

[32] Cook JL. Reconstructive utility of the bilobed flap: lessons from flap successes and failures. Dermatol Surg. 2005; 31(8, Pt 2):1024–1033

[33] Albertini JG, Hansen JP. Trilobed flap reconstruction for distal nasal skin defects. Dermatol Surg. 2010; 36(11):1726–1735

[34] Steiger JD. Bilobed flaps in nasal reconstruction. Facial Plast Surg Clin North Am. 2011; 19(1):107–111

[35] Mobley S. Bilobed flap design in nasal reconstruction. Ear Nose Throat J. 2004; 83(1):26–27

[36] Zitelli JA. Design aspect of the bilobed flap. Arch Facial Plast Surg. 2008; 10(3):186

[37] Zitelli J. Commentary on the trilobed flap for inferior-medial alar defect. Dermatol Surg. 2014; 40(7):799–800

[38] Xue CY, Li L, Guo LL, Li JH, Xing X. The bilobed flap for reconstruction of distal nasal defect in Asians. Aesthetic Plast Surg. 2009; 33(4):600–604

[39] Zoumalan RA, Hazan C, Levine VJ, Shah AR. Analysis of vector alignment with the Zitelli bilobed flap for nasal defect repair: a comparison of flap dynamics in human cadavers. Arch Facial Plast Surg. 2008; 10(3):181–185

[40] Miller CJ. Design principles for transposition flaps: the rhombic (single-lobed), bilobed, and trilobed flaps. Dermatol Surg. 2014; 40 Suppl 9:S43–S52

[41] Zitelli JA. Comments on a modified bilobed flap. Arch Facial Plast Surg. 2018; 8(6):410

[42] Wang CY, Armbrecht ES, Burkemper NM, Glaser DA, Maher IA. Bending the arc of the trilobed flap through external interlobe angle inequality. Dermatol Surg. 2018; 44(5):621–629

[43] Rieger RA. A local flap for repair of the nasal tip. Plast Reconstr Surg. 1967; 40(2):147–149

[44] Redondo P, Bernad I, Moreno E, Ivars M. Elongated dorsal nasal flap to reconstruct large defects of the nose. Dermatol Surg. 2017; 43(8): 1036–1041

[45] Bloom JD, Ransom ER, Miller CJ. Reconstruction of alar defects. Facial Plast Surg Clin North Am. 2011; 19(1):63–83

[46] Gruber RP, Melkun ET, Strawn JB. External valve deformity: correction by composite flap elevation and mattress sutures. Aesthetic Plast Surg. 2011; 35(6):960–964

[47] Weber SM, Baker SR. Management of cutaneous nasal defects. Facial Plast Surg Clin North Am. 2009; 17(3):395–417

[48] Ali-Salaam P, Kashgarian M, Davila J, Persing J. Anatomy of the Caucasian alar groove. Plast Reconstr Surg. 2002; 110(1):261–266, discussion 267–271

[49] Immerman S, White WM, Constantinides M. Cartilage grafting in nasal reconstruction. Facial Plast Surg Clin North Am. 2011; 19(1): 175–182

[50] Campbell T, Eisen DB. Free cartilage grafts for alar defects coupled with secondary-intention healing. Dermatol Surg. 2011; 37(4):510–513

[51] van der Eerden PA, Verdam FJ, Dennis SCR, Vuyk H. Free cartilage grafts and healing by secondary intention: a viable reconstructive combination after excision of nonmelanoma skin cancer in the nasal alar region. Arch Facial Plast Surg. 2009; 11(1):18–23

[52] Cervelli V, Spallone D, Bottini JD, et al. Alar batten cartilage graft: treatment of internal and external nasal valve collapse. Aesthetic Plast Surg. 2009; 33(4):625–634

[53] Neltner SA, Papa CA, Ramsey ML, Marks VJ. Alar rotation flap for small defects of the ala. Dermatol Surg. 2000; 26(6):543–546

[54] Mahlberg MJ, Leach BC, Cook J. The spiral flap for nasal alar reconstruction: our experience with 63 patients. Dermatol Surg. 2012; 38(3):373–380

[55] Asgari M, Odland P. Nasalis island pedicle flap in nasal ala reconstruction. Dermatol Surg. 2005; 31(4):448–452
[56] Nguyen TH. Staged cheek-to-nose and auricular interpolation flaps. Dermatol Surg. 2005; 31(8, Pt 2):1034–1045
[57] Smith H, Elliot T, Vinciullo C. Repair of nasal tip and alar defects using cheek-based 2-stage flaps: an alternative to the median forehead flap. Arch Dermatol. 2003; 139(8):1033–1036
[58] Barlow RJ, Swanson NA. The nasofacial interpolated flap in reconstruction of the nasal ala. J Am Acad Dermatol. 1997; 36(6, Pt 1):965–969
[59] Oneal RM, Beil RJ, Jr, Schlesinger J. Surgical anatomy of the nose. Clin Plast Surg. 1996; 23(2):195–222
[60] Mellette JR, Ho DQ. Interpolation flaps. Dermatol Clin. 2005; 23(1): 87–112, vi
[61] Jewett BS. Interpolated forehead and melolabial flaps. Facial Plast Surg Clin North Am. 2009; 17(3):361–377
[62] Fisher GH, Cook JW. The interpolated paranasal flap: a novel and advantageous option for nasal-alar reconstruction. Dermatol Surg. 2009; 35(4):656–661
[63] Willey A, Papadopoulos DJ, Swanson NA, Lee KK. Modified single-sling myocutaneous island pedicle flap: series of 61 reconstructions. Dermatol Surg. 2008; 34(11):1527–1535
[64] Piontek JE, Mattox AR, Maher IA. Reconstruction of a defect of the infratip and soft triangle. Dermatol Surg. 2018; 44(12):1603–1606
[65] Goldman GD. Reconstruction of the nasal infratip, columella, and soft triangle. Dermatol Surg. 2014; 40 Suppl 9:S53–S61
[66] Menick FJ. A 10-year experience in nasal reconstruction with the three-stage forehead flap. Plast Reconstr Surg. 2002; 109(6):1839–1855, discussion 1856–1861
[67] Menick FJ. Nasal reconstruction with a forehead flap. Clin Plast Surg. 2009; 36(3):443–459
[68] Brodland DG. Paramedian forehead flap reconstruction for nasal defects. Dermatol Surg. 2005; 31(8, Pt 2):1046–1052
[69] Jellinek NJ, Nguyen TH, Albertini JG. Paramedian forehead flap: advances, procedural nuances, and variations in technique. Dermatol Surg. 2014; 40 Suppl 9:S30–S42
[70] Vural E, Batay F, Key JM. Glabellar frown lines as a reliable landmark for the supratrochlear artery. Otolaryngol Head Neck Surg. 2000; 123 (5):543–546
[71] Somoano B, Kampp J, Gladstone HB. Accelerated takedown of the paramedian forehead flap at 1 week: indications, technique, and improving patient quality of life. J Am Acad Dermatol. 2011; 65(1): 97–105
[72] Patel PM, Greenberg JN, Kreicher KL, Burkemper NM, Bordeaux JS, Maher IA. Combination of melolabial interpolation flap and nasal sidewall and cheek advancement flaps allows for repair of complex compound defects. Dermatol Surg. 2018; 44(6):785–795