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Reconstruction of Nasal Tip and Columella

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TIP RECONSTRUCTION

Tip defects are common, bearing a potential for considerable aesthetic and functional deformity. Of the 850 nasal defects treated in the authors’ department, 325 involved the nasal tip, of which 70 were through-and-through defects. Because of its unique individual characteristics, reconstruction of the nasal tip is a challenging endeavor. The range of reconstructive options varies in complexity from simple grafting to 3- or 4-stage reconstruction with regional flaps. To sculpture a structure that simulates the nasal tip while allowing normal nasal function, the reconstructive surgeon is impelled to turn to current rhinoplasty knowledge and expertise. This expertise involves the application of both functional and aesthetic nasal analysis and modern rhinoplasty techniques to the reconstructive problem. Indeed, nowhere is the line between nasal reconstruction and rhinoplasty so blurred than in rehabilitation of defects of the nasal tip.

Tip Anatomy

The nasal tip is a biconvex structure. It is unique in that it is the only nasal subunit that shares a common border with all remaining subunits of the nose (columella, dorsum, ala, soft triangle, sidewall) (Fig. 1). The shape and position of the nasal tip is determined both by the structure and position of the alar cartilages and by its skin, soft-tissue covering. Differences in skin characteristics, even within the nasal tip, can be appreciated. The majority of the nasal tip lies within a thicker skin zone, richly populated with sebaceous glands. The lower portion of the infratip lobule and soft triangle (separate subunit but juxtaposition to the tip subunit) lie within a zone with skin that is thinner, smooth, nonsebaceous, and adherent to the underlying cartilage.1 Obviously, as the replaced alar cartilage must mimic normalcy, the choice of skin covering must fit the preexisting state. In frontal view, the nasal tip unit consists of 2 halves or subunits. In profile, one may discern the supratip and infratip lobule. The lower lateral cartilage (LLC) largely determines these transitions from one area to another and thus contributes to the development of the double break, tip defining point, and supratip break point (Fig. 2). The transition of the medial crus to the intermediate crus forms an angle, which translates as a double break. This point is the most anterior point of the columella in profile and determines the transition from columella to infratip region. The highest point of the domal segment corresponds to the tip-defining point on each side. This pair of tip defining points is usually manifested externally by light reflexes. The supratip lobule ranges from the tip-defining point to the supratip break point. As the cephalic edge of the lateral crus slopes posterior it meets the dorsal septum producing the supratip breakpoint. This landmark defines the junction of the nasal dorsal and tip subunit. The transition from ala to nasal tip may best be assessed in basal view and is marked as the deepest point in this concave area (Fig. 3).

It may be clear that the shape of the cartilages translate as surface characteristics with, in
general, gently flowing hills and valleys. The transition in shape from convex to concave does represent the borders of the nasal tip subunit. The delineation of the boundaries on the nose between concave and convex surfaces, which results in differences in light reflection and shadowing, may be clear or sometimes less defined. However, they present opportunities to hide the reconstructive scars in areas where a transition is expected, making them less readily apparent to the eye.

Placing the scar in the previously mentioned areas might imply enlargement of the defect. Indeed, given the advantage of scar camouflaging one may go so far that if 25% to 50% or more of the nasal subunit is involved, the excision of the remaining subunit is considered.\(^2,3\) For example, smaller defects limited to one-half of the nasal tip may be converted to a hemi-tip unit defect. The unaffected other half remains, and can be used as a template to mirror exactly the reconstruction. The vertical midline scar naturally divides the tip into an equal left and right half. For more extended tip defects, the whole nasal tip may be resurfaced. It must be stressed that if the transitions of the subunit are not clear, the aesthetic sense helps to delineate a further resection so that the size of the tip remains in harmony with the remaining nasal dimensions. Defects of the nasal (hemi or total) tip unit dictate more extensive reconstruction with the forehead flap. This point is subsequently discussed in more detail.

**Tip Dynamics**

In reconstruction of the nasal tip, a basic understanding of tip dynamics is helpful to appreciate the changes that occur by resections and of the steps one should follow in reconstructing the changes in nasal tip shape, position, and function. For example, skin-only resection may lead to loss of tip projection. Similar to external rhinoplasty, the skin has been lifted off the alar cartilages and thus one of the minor tip support mechanisms (skin-cartilage attachment) is damaged. Specifically in large resections, when part or all of the alar cartilage is missing, the reconstructed LLC must bear the weight of the whole reconstruction and withstand the retractive forces that will inevitably...
accompany healing and scar formation. It follows that, similar to reprojecting the nasal tip in rhinoplasty, the reconstructed cartilage tip complex must have a strong base and lateral components that ensure adequate nasal function. An overview of cartilage reconstruction follows.

**Reconstructive Options**

In reconstruction of the nasal tip, the authors aim for optimal aesthetic outcome (shape, position, scar, contour) with preservation of the nasal airway. The reconstructive plan will have to take...

Fig. 4. (A) 5 or 6/0 PDS transdomal sutures help to recreate the curvature of the alar cartilage. (B) Graft aims to mirror the contralateral crus. (C) Shaped ear cartilage graft shown. (D) Transdomal sutures from rhinoplasty. (E) Example of added tip support with strut either free floating in between the remaining medial crura or fixed to septum or butt hole sutured to the spine.
into account tumor characteristics and patients’ wishes.

**Cartilaginous framework for tip reconstruction**

The review of the anatomy and tip dynamics aims to help the reader appreciate the importance of the interaction between the reconstructed cartilaginous framework and external appearance of the nose. The authors have come to appreciate how even small changes in the reconstructed cartilaginous framework impact the tip shape and position. The small loss of tip projection after skin-only excision, even with an intact underlying alar cartilage, can be compensated for by small tip grafting. As in rhinoplasty, grafts that contact the skin must be made to blend in to the remaining cartilage structure smoothly. Covering of tip grafts with perichondrium is considered. If the alar cartilage is damaged or missing it must be reconstituted. Ear cartilage harvested from the cymba concha is well suited because it has a preformed curvature. The Mustarde principle of suture shaping ear

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**Fig. 5.** (A) Preoperative view of basal cell carcinoma of left tip, side wall, and nasal dorsum. (B) Delineation of defect and nasal sub units. (C) Defect encompassing left hemi-tip and encroaching slightly on the right tip and left ala as well as lateral nasal wall and dorsum. (D) Excision of nasal dorsum continued to include the whole of the subunit and ear cymba cartilage before shaping. (E) On left and right side, cartilage grafts taken from the cymba concha. In the middle, the resected cartilaginous hump seen is from below. (F) The scored and sutured shaped curvature of the conchal cartilage mimics the contour required.
cartilage in combination with scoring is applicable to bend or straighten the neo-alar cartilage (Fig. 4A–C). This principle uses suture techniques from rhinoplasty, such as transdomal suturing, to mold the cartilaginous free grafts (see Fig. 4D). Septal cartilage is ideal to extend the length of these ear cartilages more laterally, which gives support even onto the piriform aperture to preserve nasal valve function. Septal cartilage can be used to support the nasal tip in the columella region as a strut (see Fig. 4E) or even septal extension graft, the latter offering maximum support.

To reposition and gain further support, the neo-alar is also fixed to the contralateral alar cartilage with interdomal sutures, which controls the width of the nasal tip. Essentially any of the tools used in rhinoplasty can be used depending on the experience of the surgeon.

At this stage it is important to make an assessment of the contractile forces on the lower two-thirds that will be exerted during the healing phase. To further support the free alar rim, alar rim grafts may come into play. Similarly, the soft triangle may need cartilaginous support. Spreader grafts or butterfly grafts are added so as to maintain nasal airway. For example, a butterfly graft beautifully repositions the recreated alar cartilages more laterally and opens up the external nasal valve. Grafts in the alar-sill region that extend laterally from the neo-alar to the septal spine may be the final link in recreating a cartilage ringlike structure from the columella, tip, lateral wall, and sill, which may offer maximum control over position, shape, and function. One may also appreciate that apparent tip position is also related to the height and shape of the nasal dorsum.
To get an aesthetically balanced outcome, an overprotected nasal dorsum may be lowered to compensate for loss of tip projection while harmonizing with the recreated nasal tip. When the cartilaginous dorsum is lowered and the upper laterals become detached from the dorsal septal edge, spreader grafts may be needed.

Apart from aesthetic goals, the authors work hard to maintain function or even correct it at the time of reconstruction. Any septal deviation or preexistent valve abnormality may become a potential problem, even after a well-executed reconstruction, if not corrected or compensated for. Moreover, the authors have come to realize that functional problems after nasal reconstruction are not easy to deal with. Because of the different anatomy and scarring, the rhinoplasty techniques applied are less effective.

The application of the reconstruction options presented here must be based on a clear appreciation of the preoperative situation. This appreciation includes evaluation of the patients’ airway and possibly pre-excision, 4-view photograph documentation. Preoperative aesthetic analysis may suggest the reconstructive possibilities and needs. For example, nasal-tip rotation or nasal-dorsal reduction create a relative excess of the skin soft-tissue envelope and help to diminish the size of the defect, which may then allow for a simpler reconstruction. The precise reconstitution of the cartilaginous framework cannot be overstated because this directly relates to the final results.

Fig. 5. (M) The reconstructed nasal skeleton in place. Skin coverage with forehead flap. (N–Q) Patient 13 months following surgery. Patient happy with result, function is impeccable. Profile improved, not perfect but harmonious. Maybe a slight tilt of the nasal tip has occurred because of the strong reconstruction on the left side.
An example is given of a reconstructed alar cartilage, including tip grafting and dorsal reduction, with the application of spreader grafts (Fig. 5), and another case with cartilage butterfly-type reconstruction (Fig. 6).

**Nasal lining reconstruction**

In through-and-through defects, 3 different layers are missing. The 3 components include lining, cartilage framework, and skin covering. If the different layers are reconstructed separately, each can be manipulated, shaped, and placed to contribute to the best possible outcome. Nasal-tip defects with inner lining defects often result from inferior and lateral extensions of the tumor onto the infratip lobule and the adjacent soft triangle, thereby reaching and growing over the nostril margin into the nose. Alternatively, lateral impingent of the tumor deep into the alar subunit may also result in nasal cavity involvement. Direct

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**Fig. 6.** (A, B) Defect involving tip, nasal dorsal subunit, and side-wall subunit. Inner lining intact but there is partial deficiency in upper lateral and lower lateral cartilages. (C) Alar margin, soft triangle not involved. Note the deviation of the anterior septum putting the nasal valve at risk after reconstruction. (D, E) Remainder of right hemi-tip excised. (F) Butterfly graft fashioned from concha cartilage to reconstruct the cephalic portion of the alar cartilage in proper position. This maneuver aims to maintain nasal valve function.
deep extension into the vestibule of isolated nasal-tip lesions is unusual because of the barrier afforded by the lower lateral cartilages and their perichondrium.

The considered lining options follow a logical reconstructive ladder from simple to more intricate. Small defects can be left to heal by secondary intention. Primary closure may, although infrequently, be an option. Caution must be exercised not to significantly diminish the internal diameter of the nasal airway.

Skin grafts can be applied onto the defect wound edges, which in a subsequent stage will serve as lining. After 2 or 3 months, when the wound edges have been skin covered and healed, the previous graft can be developed from superior to inferior and hinged into the lining deficit. Skin grafts can also be applied to the undersurface of skin flaps used for skin covering in the first stage of the reconstruction. There is a slight risk of graft failure. A second, intermediate stage is used for placement of cartilage grafts. The simplicity of this is alluring, but one has to be exact with the cartilage shape and position because at the third stage pedicle division is performed precluding further cartilage reshaping.

Fig. 6. (G) Butterfly graft fashioned from concha cartilage to reconstruct the cephalic portion of the alar cartilage in proper position. This maneuver aims to maintain nasal valve function. (H–K) Postoperative result. Good nasal function. Slight widening of the external nasal valve can be discerned. No middle nasal vault collapse. Contour of tip and function excellent. Scars well hidden in aesthetic subunit borders.
Skin-cartilage composite grafts offer 2 layers for reconstruction, but they are difficult to shape while placing the skin part of the graft exactly in the lining defect. However, in defects of less then 1 cm that involve the free border of the columella, soft triangle, and tip, they have an outstanding record. Ideally, some remaining lining will enhance vascular growth and increase the chance of survival.

Flaps have the advantage of carrying blood supply to support primary cartilage grafting. However, these flaps must be thin and supple to follow the desired contour and not impinge on the nasal airway. For clarity, the authors conceptualize flaps for lining by categorizing them according to donor site rather than flap type or tissue movement. Thus the possible donor sites include:

- Septum (ipsilateral or contralateral)
- Lateral nasal wall (inside or outside)
- Adjacent facial units (melolabial fold, forehead)

Of the septal flaps, only the ipsilateral anterior-based septal flap offers enough tissue and reach to be of value for tip reconstruction (Fig. 7). The inside of the lateral nasal wall may yield tissue

![Fig. 7](image_url)

(A, B) Full thickness defect of alar columella and nasal tip defect. (C) Anteriorly based septal flap based on the branches of the superior labial artery. (D) Septal flap used to reconstruct the inner lining sutured in place. Ear cartilage sculpted to reconstruct the missing part of the alar cartilage and soft triangle. Note part of the cartilage placed in the soft triangle is nonanatomic. (E) Cartilage in situ. (F) Forehead flap inset into defect.
often moved caudally as bipedicled mucosal flaps or more rarely as an anteriorly pedicled inferior turbinate flap. The outside of the lateral nasal wall offers ample tissue to be developed from superior to inferior and hinged into the lining defect. A major advantage is that the inside of the nose is not taken apart. These thicker flaps are sturdy and thin spontaneously over time.\(^7\)

For tip defects, the forehead flap may be folded inward as lining. In an intermediate stage, the bulky flap is incised caudally, divided, and thinned aggressively.\(^8\) Cartilage can be added at that stage. The pedicle is divided at the final stage (Fig. 8).

The authors suggest that tip-cartilage reconstruction is so demanding that a 3-layer, 3-stage reconstruction yields the best possibilities for an aesthetic shape. The precise cartilage grafting done at the first stage can be improved upon at 3 weeks during the intermediate stage. The forehead flap left pedicled superiorly can be lifted completely out of the wound bed and thinned as necessary. Cartilage can be shaped, refined, and added if needed.

Of course, the exact choice of reconstruction of the defect depends upon patient and defect factors. Patient factors, such as diabetes or smoking, make the fragile vestibular and septal flaps more prone to fail. Sometimes multiple lining options are used to compliment each other.

**Skin resurfacing** Nasal-tip defects may be classified according to the location, size, and depth of the defect. As cartilage framework and lining reconstruction have already been discussed, the focus turns specifically to skin covering. Again, adherence to a general reconstructive ladder listing the multiple options available from simple to more intricate is suggested (second intention healing, primary closure, skin grafts and local/regional flaps).

The choice and application of these techniques logically parallels the defect size. Thus, defects are subdivided into small (1 cm or less), moderate (1.0 to 1.5 cm), and large defects (greater than 1.5 cm). Again, there are no distinct cutoffs between the 3 categories, but these distinctions are not arbitrary. The authors’ preferred options in reconstruction of the nasal tip are free skin/composite grafting and regional flaps (the forehead flap). For smaller defects (<1 cm), skin grafting (including composite skin-fat and skin-cartilage grafts) as well as local flaps are commonly used. Full-thickness skin grafts are taken from the melolabial fold or forehead region. These areas provide the best match in color, texture, thickness, and sebaceous glands. Local flaps are developed in the middle and upper nasal vault, if the defect is slightly larger (1.0 to 1.5 cm) or when patients present with recipient sites that are not ideal (patients with diabetes or who smoke), indeed

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**Fig. 7.** (G–I) 1-year postoperative result.
local or regional flaps are good alternatives to skin grafts. In larger defects (>1.5 cm), the subunit principle is often applied and a forehead-flap reconstruction is executed.

**Small skin defects (≤1 cm)**

*Secondary intention healing* Because of its simplicity and the possible excellent results, secondary intention healing has to be considered in any defect. Secondary intention wounds heal by the process of filling in the defect with granulation tissue, re-epithelialization, and scar maturation. The best possible results are related to shape, depth, and size of the defect. Small superficial wounds in concave areas in fair patients with thin skin can do extremely well.9 The nasal tip, however, is mostly convex, largely covered with a thicker often sebaceous quality of the skin, which

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**Fig. 8.** (A, B) combined tip/soft triangle/columella defect, inner lining is deficient. (C) Following first stage. Folded forehead flap has been used to reproduce inner lining. No cartilage is placed in the defect yet. (D) At second stage, the idea site for the alar margin is marked and then incised elevating the remaining forehead flap. (E) After elevation of the proximal forehead flap one can appreciate the reconstructed inner lining. This neolining is then thinned and sculptured with a cartilage graft to prevent retraction. (F) The distal portions of the residual forehead flap is then thinned to improve the contour match and replaced over the cartilage graft. The pedicle will then be divided at the third stage (not shown).
does not favor secondary intention healing. However, to demonstrate the possibilities of second intention healing, a rare case is presented (Fig. 9).

**Primary closure** Primary linear closure is a rare possibility only in lax abundant skin. If the skin covering is thick and sebaceous it is also immobile and unaesthetic scars must be anticipated. In the supratip-dorsum junction a horizontal closure may be acceptable. Lateral dog-ear excision and tip rotation are logical sequelae. This scar will come to lie in relaxed skin tension lines (RSTLs) and in the aesthetic subunit boundaries. A vertical midline with dog-ears projected superior and inferior is a variation. On any other part of the tip a linear closure, even if following the RSTL, must be discouraged. Closure tension will flatten and even indent the natural convex surface of the nasal tip. The scar will be perceived readily as an interruption of the smooth, convex contour of the nasal tip. If simplicity is sought rather than aesthetics, the defect may be partly closed by superior and inferior dog-ear excision and horizontal skin advancement. A skin graft may cover the remainder of the defect. Alternatively, the excised dog-ears can be applied.10

**Skin grafts** When secondary intention healing or primary closure is not suitable, skin/composite grafts are the next option, having distinct advantages over local flaps in most cases. Skin/composite grafts are quick to perform and multiple donor sites are available. The aim is to reproduce the color/texture match with maximal contour. Full-thickness skin grafts (FTSGs) have been used but may unfortunately lack volume, which can produce quite obvious contour defects on the convex nasal tip. Alternatives include skin/perichondrial, skin/fat, and skin/cartilage composite grafts. The ideal donor site will depend on what portion of the nasal tip is deficient.

*Fig. 8. (G) 1-year postoperative appearance. (H) No asymmetry of alar margins. (I) No alar retraction. (J) Profile demonstrates good columella-alar relationship.*
prophylaxis; careful handling of the graft; strict hemostasis while avoiding too much cautery; antibiotic/saline irrigation of graft and recipient site before placement; sutures that eliminate shear between the graft and recipient site (but risk bleeding); and a soft, not overly pressured bolster (often with Steri-Strips only [3M, St Paul, Minnesota]), help reduce graft failure.

FTSGs involve a specific set of challenges. Typically, the skin of the convex nasal tip is thick and sebaceous. What then is the ideal donor site and graft type to reduce the often patchwork postoperative appearance caused by color mismatch and contour defects?

Various donor sites for FTSGs are available, such as the preauricular and postauricular regions, conchal bowl, melolabial, forehead, and supraclavicular region. The forehead and melolabial fold possibly represent the most closely matched site for nasal-tip reconstruction in terms of surface characteristics and sebaceous gland population.12,15,16 The donor-site scar can be well hidden in the melolabial crease or forehead rhytids with minimal aesthetic compromise.

Fig. 9. (A–C) Defect after basal cell carcinoma excision. The patient was awaiting a second renal transplantation. Because of the possible delay, he did not want a multiple-stage forehead flap reconstruction. (D–F) Approximation of wound edges with some tip rotation sets the stage for second intention healing over a period of 4 weeks. Note that cartilages were exposed. Moist environment is essential to prevent desiccation and filling in with granulation tissue.
Composite skin grafts are of the following 3 types:

Skin-fat composites grafts: Classical teaching suggests that skin grafts must be defatted to enhance blood vessel growth and survival. But thinner skin grafts are associated with contour deficits. The question arises whether it is possible to retain subcutaneous fat while aiming for an enhanced contoured reconstruction.\textsuperscript{17,18} In Fig. 10, the authors present a case of tip reconstruction using a composite skin-fat graft to effect optimal tip contour.

The complete survival rate of these skin/fat composite grafts are in the range of approximately 80\%.\textsuperscript{17} But even if the superficial parts do not seem to survive completely, the overall postoperative result show good contour. A degree of hypopigmentation and some loss of sebaceous glands may accompany these grafts. Dermabrasion may reduce some of the color mismatch or contour discrepancy.\textsuperscript{15} Given the possibilities

Fig. 9. (G–I) Patient received a new kidney. This 3-month postoperative view testifies to nature's healing capacity.
Fig. 10. (A) A young woman with high aesthetic expectations and a 1.5-cm skin and subcutaneous fat defect of the nasal tip. Alar cartilages are intact. (B) Interdomal suturing is performed to diminish the size of the defect to 1 cm. (C) Interdomal sutures used to narrow width of alar domes. (D) Donor site marked, centered over forehead rhytid, lateral burrows triangle excision marked. (E) Composite skin-fat graft. (F) Subcutaneous fat retained on the undersurface of the graft to improve contour. (G) The skin graft carefully manipulated and sutured in with 6-0 fat-absorbing sutures. Skin/fat composite graft is defatted incrementally until the contour exactly matches surrounding skin. (H) Tip projection and contour maintained. A small bolster is lightly applied with sterile strips for 4 days.
and minimal risks involved, skin-fat composite grafts are an excellent option for deep nasal-tip defects less than 1 cm in diameter.

**Perichondrial cutaneous composite grafts:** Perichondrial cutaneous composite grafts (PCCGs) are composite grafts (usually harvested from the conchal bowl) consisting of skin and a thin perichondrial layer. Its use is based on the theory that if one maintains the perichondrial plexus in a skin perichondrial composite it may allow for quicker revascularization of the graft, lower graft failure rates, and less retraction. Indeed, clinical studies suggest tendency of improved graft take. The conchal bowl donor site is easily managed by second intention healing.

**Skin/Cartilage composite grafts:** Composite chondrocutaneous grafts are an excellent alternative to other grafts in specific circumstances. They contain skin and cartilage usually harvested from the helical root. The benefit of including cartilage is the inherent shape and support. These characteristics can be used in reconstructing rims that otherwise are complex to reproduce. Skin/cartilage composite grafts do, however, have an increased metabolic demand and most authors agree that they have a somewhat higher failure rate than

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**Fig. 10.** (I) Primary closure of donor site in forehead rhytid. (J) The 10-month postoperative result A degree of hypopigmentation but excellent contour. (K) Tip projection is maintained. (L) Smooth contour and maintenance of tip convexity. (M) Minimal donor-site morbidity.
Fig. 11. (A) Soft-triangle defect abutting the free soft-triangle margin. (B) Auricular composite chondrocutaneous graft taken from root of helix. The cartilage dimensions extend laterally just beyond the skin to be inserted in the lateral wound edges. These extensions will provide support against scar contraction forces. (C) Donor site reconstructed with a small cartilage strip harvested from the scapha region and a cheek advancement flap. (D) Flap is seen in place in early 5-day postoperative picture. (E) Aesthetic outcome at 5 months. (F) No alar notching. (G) Symmetry of nares, no distortion of nasal tip. (H) Donor-site morbidity is minimal.
FTSG or PCCGs. However, much depends on patient selection. Skin/cartilage composite grafts are not used in patients who smoke or have diabetes, and the authors limit their size to a maximum of 1 cm. Ideally, some inner lining remains to increase the graft’s vascular support. Thus, for nasal reconstruction the indication for skin cartilage grafts are partial defects of the columella, soft triangle, andalar rim where one requires not only replacement of skin but also a definite shape. In Fig. 11, the authors present a case where a soft-triangle defect is reconstructed with a chondrocutaneous graft.

**Moderate-size defects (1.0–1.5 cm)**

**Local flaps** Local flaps attempt to transfer tissue from tissue reservoirs in the upper nasal vault or medial cheek where skin laxity exists to the lower third where the thick sebaceous skin of the nasal tip offers minimal mobility. Most local flaps for nasal reconstruction do not conform to the aesthetic unit borders or the RSTLs. As most flaps do pincushion to a degree, this will unmask the complex unaesthetic incisions. Most importantly, the nasal skin envelope may not tolerate reduction in the upper two-thirds to reconstruct the lower third. Indeed, local flaps may cause unaesthetic pushes and pulls, which can lead to alar retraction and tip deformity/asymmetry.

**Bilobed flaps:** Compared with uni-lobed transposition flaps, a double-lobed or even sometimes triple-lobed flap does extend the distance of tissue transfer. However, it must be recognized that although flaps are denominated as to their primary type of movement, these double-transposition flaps do move largely by a rotational component. In that sense, a double-transposition and a rotation flap are, apart from the garlanded type of incision of the former, quite similar. The geometric basis of the modern bilobed flap does demonstrate that clearly (Fig. 12). The rotational angles are limited to 50° for each flap (100° in total), which decreases the buckling around the pivotal point and the greater pull that occurs with the previous bilobed designs. Adherence to a precise geometric plan helps execution and sets the stage for optimal healing. The primary defect needs to be accurately measured in diameter and arcs of rotation for the transposition calculated and drawn. The plan further includes a total rotation between 90–110 degrees, and wide undermining into the surrounding tissues to prevent pin cushioning. The dog-ear is removed last. For laterally placed defects, the flap’s secondary defect should come to lie perpendicular to the alar margin. Careful planning and execution is asked for. Small inaccuracies in vector alignment and length of the primary and secondary flap can have dramatic effects and produce asymmetric retraction. Defects of 1.5 cm are the utmost limit for this flap or too much distortion and scarring is to be anticipated. Cases are presented in Figs. 13 and 14.

**Regional flap**

**Nasal-dorsal (glabellar) flap:** The nasal-dorsal (glabellar) flap is a rotation flap, which at least encompasses the nasal dorsum up to the naso-frontal angle. More extended rotation may yield tissue from the glabella to be moved into the nasal unit. The vascular pedicle is centered on the angular artery located at the upper part of the lateral nasal wall. It is typically based ipsilateral to the lesion to improve flap rotation. The flap and surrounding tissue of the nasal vault are undermined widely in the sub-superficial musculo-aponeurotic system (sub-SMAS) plane, similar to rhinoplasty. In the glabella region a transition in dissection plane is made to a more superficial subcutaneous plane. The thicker glabellar skin does come to lie opposite the thin skin of the medial canthal area. Generally, differences in

![Fig. 12. Bilobed orientation on nasal vault for reconstruction of nasal supratip defect. Note the relationship of the radius of defect (0.75 mm) to the arcs of rotation.](image-url)
skin thickness must be accounted for or corrected by thinning of the flap and additional soft-tissue grafts.\textsuperscript{23} Judicious excision of a standing cutaneous deformity is one of the last maneuvers to prevent alar retraction. The secondary defect in both lateral nasal wall regions is closed by cheek advancement. The nasal-dorsal rotation flap is only indicated in patients with lax skin over the dorsum and cheek regions. It is suggested that this flap should be limited to defects less than 1.5 cm in diameter located in the distal half of the nasal dorsum and nasal tip. The preferably centrally located defects, may extend to (but not beyond) the supratip lobule. Defects less than 1 cm from the alar rim do risk free alar border displacement.\textsuperscript{24} The wide dissection gives an unparalleled exposure to perform any rhinoplasty maneuver. More specifically, a large nasal skeleton with an under-rotated tip and an overprojected dorsum may be reduced. Secondary movement of the tip upwards, by means of a rotation control suture, facilitates defect closure and takes some tension off the closure. Similarly, dorsal reduction does reduce the size of the nasal skeleton relative to the skin soft-tissue envelope and also aids closure.

Because it is a dependent flap it may fill with lymphoid fluid, which takes a year to resolve. The scars are not in the RSTL, but the versatile blood supply and one stage of the procedure are a definite vote for this flap.\textsuperscript{22} Fig. 15 presents a typical case of the use of the nasal-dorsal (glabellar) flap (see Fig. 15).

Large skin defects ($\geq$1.5 cm) A defect that is greater than 1.5 cm signifies the movement above a threshold to a bigger reconstructive issue.

It is suggested that reconstruction is more reliably achieved in these instances with excision of

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**Fig. 13.** (A) Bilobed planned according to geometric design. Given the youth of the patient and the tight skin, the primary lobe of the flap in retrospect may need to be slightly oversized, rather then the exact dimensions of the defect. (B) Questionable skin laxity and possible undersizing of flap lead to suboptimal tension on closure. (C) 15-month postoperative result. Acceptable outcome, complex incisions slightly visible.
the hemi-tip on one or both sides and resurfacing with a forehead.\textsuperscript{25} The forehead flap offers ample tissue for reconstruction facilitating the application of the subunit principle where smaller defects are enlarged, aiming to place the final scars in the favorable boundaries of the tip subunit. This, however, may convert a possible 1-stage reconstruction to a more complex 2- or 3-stage reconstruction. As all flaps contract to a degree, it elevates the skin in a convex shape, which ideally

\begin{figure}
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\caption{(A) Central nasal tip lesion of 1.4 mm. A large bilobed flap chosen to accommodate the patient’s wish for a 1-stage closure. (B) Bilobed flap planned using geometric design, including dog-ear excision deferred to end of procedure. How much tissue can you move? (C–E) A 2-year postoperative result. Some distortion of the soft triangle. Unaesthetic complex incisions are made more obvious by some pin cushioning despite undermining around the defect.}
\end{figure}
mimics the natural contour of the subunit (tip and alar). Appropriate thinning, contouring of the flap with cartilage framework, matching flap edges to the recipient site, and bracing the flap’s marginal scars with thin platforms of cartilage are important techniques to master if any reconstruction is to succeed. When considering the subunit principle, multiple factors come into play. Skin with actinic damage may well camouflage skin grafts for similarly damaged skin or incisions associated with local flaps not adhering to the subunit borders and in these instances a more simple reconstruction may be a valid alternative. It is of note that, because of its insufficient reach and limited size, the melolabial flap is reserved for alar defects that encompass only some lateral part of the nasal tip.

**Forehead flap** For large defects of the nasal tip, the authors almost exclusively use the forehead flap for skin coverage. This flap is unrivaled in its robustness, skin color, and texture match for reconstruction of the nasal tip. As suggested, this provides the confidence to apply the subunit principle if indicated. The authors may indeed extend the defect to include the adjacent subunits.
(soft triangle, alar) even if minimally (only 25%) involved. Large skin tip defects frequently coexist with cartilaginous defects of the alar cartilages and occasional inner-lining defects. Synchronous repair of these accompanying defects is mandatory and will not be repeated.

In the authors’ practice, the current design of a forehead flap consists of a superior medial donor site and a vertically drawn pedicle, which at the level of the brow is less then 1.5 cm and as small as 1.2 cm in width and is placed just above the midline subsequently bending toward the lateral nasal sidewall half way between the medial canthus and the nasal dorsum. The flap pedicle is not extended more than 0.5 cm below the brow level. The pedicle is placed contralateral to the defect so that the flap does not impede vision. Anatomic studies have shown the rich dense vascular supply in the medial forehead from the supratrochlear and dorsal nasal arteries and angular artery. Of interest is the description of the central and para-central artery and vein, which may be key to the current design. The resulting vertical midline scar in the forehead is camouflaged by its position delineating a natural border between the 2 halves of the forehead. A small offset pedicle facilitates rotation while maintaining proper length. The purpose of extending the pedicle just below the brow level is to gain further length. Admittedly, the flap then has similarities to the older midforehead flap design (which also did not contain a supratrochlear artery) and still shares its unparallel survival rate. The authors have not seen vascular problems in any of their primary forehead flaps.

The forehead flap is raised in the suprapercranial plane. Incisions are beveled outward to increase the subcut vascular support and to facilitate closure. Sufficient length to reconstruct the nasal tip is achieved often without extending into the hair-bearing scalp. The distal part of the flap is thinned at the first stage. A total of 2 to 3 mm of subcutaneous fat, however, may enhance a more normal aspect of the reconstructed surface. When tip defects coexist with columella defects, the requirement of extension of the forehead flap into the hair-bearing scalp is to be expected.

Enough skin is available to reconstruct the entire nasal envelope based on 1 pedicle. When the width of the forehead flap is greater than 4.5 cm, primary closure of the forehead donor site is not possible. Intraoperative tissue expansion of the remaining lateral forehead regions and dissection...
into the temporal pockets help facilitate closure. At the second or third stage of the procedure, the forehead can be further closed and the forehead scar revised. Although the authors aim for complete closure of the donor site, a superior midline forehead defect left to heal by secondary intention, despite its convexity, may usually yield acceptable aesthetic results to the patients.32

Whether the flap is divided in the second or at a third stage is optional. It depends on the degree of thinning of the flap and sculpting cartilage framework that is required. In the authors’ practice, most nasal tip reconstruction requires a 3-stage approach for optimal aesthetic results. The intermediate stage may involve partial or total lifting of the flap off of the reconstructed nasal framework, which gives ample room for additional thinning and contouring of the flap, afforded by the enhanced blood supply resulting from the delay phenomenon. As suggested, the cartilage tip

Fig. 16. (A) Full-thickness defect of the nasal tip, alar, and soft triangle. This defect is approaching a hemi-nasal defect and requires a demanding reconstruction. (B) Profile view demonstrates degree of inner lining missing. (C) To bring in more tissue for lining reconstruction in a preliminary stage a FTSG is placed over the defect. (D) Following healing of FTSG. Note that some retraction of the remaining ala/sill has occurred. (E) Septal deviation, clinically significant, to be corrected in the same stage. (F) FTSG incised, elevated, and folded in to reconstruct inner lining defect.
Fig. 16. (G) Fold over flap adequately replaces inner lining defect. (H) The whole septum except the dorsal strut is taken out to be placed more caudally in the midline. (I) Cartilage septal graft to recreate the caudal strut. (J) Neo-septum in midline caudal position will provide additional support for the alar and sidewall reconstruction. (K, L) Neo-alar cartilage harvested from the cymba of the ear, reattached to neo-septum. (M) Butterfly graft added for lateralization of the reconstructed cartilaginous side wall. (N) Initial forehead flap is oversized so as not to deform the initially fragile cartilaginous reconstruction.
framework may also need more sculpturing or adding of cartilage. The timing of the second and third stage is 3 to 4 weeks and 6 to 8 weeks, respectively, after the initial operation. At the final stage the flap pedicle is divided and only a small portion of the pedicle base is worked into the interbrow/nasal area. The following two case studies (Fig. 16) sum up the extensive possibilities of current day nasal reconstruction a posttraumatic defect from the war zone in Iraq (Fig. 16) and a previous forehead flap reconstruction performed elsewhere (Fig. 17).

**COLUMELLA RECONSTRUCTION**

Columella defects may be congenital, infectious, traumatic, or surgical. The obvious aesthetic deformity may be compounded by loss of tip

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Fig. 16. (O) At second stage skin flap completely elevated. (P) Note the bulky soft-tissue component of the reconstruction after flap elevation. This component will need to be progressively thinned and further sculpted with cartilage to create ideal framework for the forehead flap, which will be replaced again. (Q) Further cartilage grafts taken from scapha for tip grafting. (R) Molding of the lateral cartilage grafts, tip graft added. (S) Basal view following decrease of lateral cartilage ring dimension to harmonize both sides, flap thinning, and inset. (T) Frontal view following flap thinning and inset.
support. Again, the whole range of reconstructive options may apply: primary closure, second intention healing, skin/composite grafts, skin flaps, and even microvascular techniques.33-35

Columella Anatomy

The columella extends from the infratip lobule to the nostril sill. The cartilaginous portion of the columella is composed of the medial crus demonstrating some flaring caudally to form the medial crural footplates (see Figs. 2 and 3). The width of the columella is largely determined by the distance between the medial crura and the flare of the crural footplates (see Fig. 3). The columella is crucial in tip support. Indeed, the medial crura do figure prominently in both the tripod and M-Arch concept.36,37

The skin of the columella is thin and adherent to the underlying cartilage. The columella skin is continuous with the membranous septum. The position and shape of the septum obviously has impact on the columella. The blood supply is derived from the superior labial arteries giving off the paired columella and anterior septal branches. In the lateral view a 2-mm columella show is ideal. From the anterior view a gull wing appearance is suggested by both ala and the columella.

Skin Resurfacing

When considering the various reconstructive options, including the application of the subunit principle, several variables can be taken into account. The skin of the columella, infratip lobule, the soft triangle and alar margin is thin. These areas are also non-sebaceous, giving the skin a more smooth quality.1 This skin lends itself well to reconstruction with full-thickness skin and composite grafts. Grafting of defects larger than 1 cm with composite grafts leads to suboptimal survival.38 Experience with open rhinoplasty has shown that scars in the columella region can be well hidden even when not conforming to subunit transition zones.39-41

Cartilaginous Framework and Tip Support

Defects of the columella often involve deficiencies of one or both medial crura, which are often essential in tip support. To avoid loss of tip position, reconstruction of the cartilaginous support is required. The actual amount of cartilage needed to reconstruct the support mechanism is minimal in small defects. A free cartilaginous strut from the septum or pinna (see Fig. 4E) and coverage with full-thickness skin grafts or skin flaps1 may be all that is needed. For small columella, vestibular,
and soft-triangle defects, an auricular composite graft is ideally suited. As the defect increases in size, the resultant demand on the cartilaginous framework increases. A more elaborate and stronger cartilaginous support must be strived for. Rhinoplasty techniques may be useful in these situations. Septal extension grafts, subtotal septal repositioning, or a rib cartilage neo-septal/spreader graft structure may be indicated. These grafts do find suture-fixated caudal support on the nasal spine.

**Common Types of Defects Classified by Reconstructive Need**

In attempt to rationalize reconstructive options to a manageable framework the authors categorize the defect depending on deficient structures that

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**Fig. 17.** (A) Post-traumatic defect from war zone in Iraq. Previous forehead flap reconstruction carried out elsewhere. There is scarring retraction and notching of alar margins presents a through and through defect on both sides. (B) Loss of tip projection, tip defining point, supratip break point, columella break point. (C) Unaesthetic appearance with significant scarring and asymmetry of alar margins and alar retraction. (D) Scarring has produced buckling of the alar cartilages. (E) Subunit excision of alar, soft triangle, tip is planned, which will be developed into hinge flaps that will be the inner lining on both sides. (F) Because of retraction, the nasal length is not adequate. The excess skin is folded over for inner lining.
Fig. 17. (G) Free cartilage grafts are placed to give supporting framework. (H) A second para medial forehead flap is planned. In those cases, Doppler studies are available to know if supratrochlear artery is viable. (I) Flap initially bulky following first stage. (J) Basal view following first stage. (K) At second stage, flap elevated, thinned, framework also sculpted. Flap is left attached distally at columella only. (L) End of second stage showing significant reduction in the thickness of the flap and improved contour. (M) Reduction in flap thickness shows acceptable profile view, however further thinning will be required for optimal aesthetic result. (N) Basal view at the end of second stage showing significant reduction in the thickness of the flap and improved contour that is required.
Fig. 17. (O) Left lateral view after intermediate (2nd) stage thinning, further thinning will be required at the final (3rd) stage (see fig. 17Q) for comparison. (P) Beginning of third stage again demonstrates the importance of thinning the flap at the second stage. Edema and flap retraction has again increased the bulkiness of the flap, which will now require further careful thinning. (Q) Third stage, the pedicle is divided and flap is thinned and set in to dorsal contour. The left alar flap is partly lifted again, thinned, soft tissues sculpted, and flap trimmed. (R, S) Note the distal attachment of the flap has not been elevated to allow thinning of the cephalic portion of the flap. (T) 17-month postoperative good alar symmetry without alar retraction or notching. Donor-site morbidity of second forehead flap minimal. (U, V) Aesthetic male profile view with maintenance of the supratip break point of tip defining point (transition from supratip to infratip lobule) and columella break point. (W, X) Oblique views showing good outcome of the reconstructed alar and soft triangle, using the subunit principle. (Y) Delighted patient in after operation with senior author.
Fig. 18. (A) Skin-only defect of the columella approximately 1 cm. (B) Composite graft from the melolabial crease to maximize contour and color match. (C) Excellent 12-month postoperative result. (D) Good contour match.

Fig. 19. (A, B) Skin cartilage defect of the left hemi-columella repaired with composite skin cartilage graft taken from the helical root. (C, D) 12-month postoperative result showing excellent outcome with minimal scaring.
Fig. 20. (A) Complete loss of columella subunit with limited extension onto philtrum and infratip lobule. Medial crus of alar cartilages have been resected. (B) Profile view shows the loss of tip support and degree of tissue loss from the columella. (C) Bilateral medial crus are reconstructed with conchal cartilage, note normal flaring of footplates is reproduced to achieve an anatomic reconstruction. (D) Correct alar/columella relationship. (E) Subcutaneous melolabial flap planned with aid of template of the columella defect. (F, G) Interpolated flap is inset. (H) At second (intermediate) stage excess soft tissue requires thinning.
will dictate optimal reconstructive choice. Of course some reconstructions will be suitable in more than 1 category.

**Skin defects**

Given a matching donor site, skin grafts are excellent substitutes for effectively replacing the thin, smooth skin of the columella. However, skin-graft contracture may produce a skeletonized, unnatural appearance to the reconstructed columella. A composite skin and subcutaneous fat graft may indeed provide a more natural outcome. Although a slightly higher population of sebaceous glands is found in the melolabial donor site, it does match

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**Fig. 20.** (I) Intermediate second stage, the interpolated subcutaneous-based melolabial flap is raised and cartilage strut is inset and the flap is thinned. (J) Third stage pedicle is divided and discarded. (K) Donor site closed primarily. (L) The 13-month postoperative result, complete reconstruction of columella subunit. (M) No columella retraction, ideal columella show (columella/alar relationship). (N) Good contour, minimal donor-site morbidity.
fairly well with the original columellar skin. Fig. 18 presents a composite skin-fat graft to the columella.

When the skin defect is larger than 1 cm, alternatives to skin grafts must be sought. Various local flaps, such as the subnasale, alar rim, and nostril sill flaps, transpose tissue from the columella base and peri-columella areas. They, however, provide limited amounts of skin, both in terms of width and lengths. Regional flaps (nasolabial, naso-facial, and forehead) offer abundant tissue to resurface the columella. A unilateral melolabial flap is sufficient to resurface the entire subunit, providing both contour and color match.

**Skin-cartilaginous defects**

For minor skin-cartilaginous columella defects, free auricular composite grafts are beneficial in view of their good color and skin-type match (Fig. 19). With the inclusion of the cartilage, the tip support is enhanced.

For larger skin-cartilaginous defects, the entire subunit skin/medial crus may require
reconstruction. Much attention must be given to robustly reconstructing the cartilage framework for support and contour purposes (Fig. 20).

Alternatively to the nasolabial flap, a naso-facial flap may be considered. This flap is harvested from the naso-facial sulcus with a subcutaneous inferior pedicle centered on the angular artery. The facial artery, vein, and investing muscular tissues are isolated as far inferiorly as the alar crease. The flap is then tunneled subcutaneously under the alar crease into the columella defect.\(^{49}\)

For skin coverage of larger defects, either bilateral nasolabial flaps\(^{50,51}\) or a forehead flap may be applied. If this coverage is not sufficient, it can be combined with bilateral septal mucoperichondrial flaps. A forehead flap, which is folded into the vestibular defect, will initially be too thick and may need thinning over time. A forehead flap does provide enough tissue to reconstruct a concomitant tip defect while reaching as far as the columellar base (Fig. 21).

When the columella defect is associated with significant upper-lip tissue loss, an Abbe flap

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Fig. 21. (G) Pedicle divided and discarded. (H) Tip grafts placed. (I) Previously split tip skin reapproximated. (J) The 17-month postoperative result. (K) Slightly bulky reconstruction caused by the fact that the patient also declined further thinning. (L) Some loss of tip projection, a hanging columella result from the inability to thin the columella in an intermediate procedure.
extended onto the chin region does provide enough tissue to reconstruct part of the columella with the same technique (Fig. 22). The vascular supply of the extended Abbe flap is based on a circumoral labial arcade made up of bilateral inferior and superior labial arteries. The vascular supply of the inferior cutaneous territory encompasses the skin of the entire lower lip, chin, and extending to the submental skin, which indeed can be pedicled on this flap.
SUMMARY

Reconstruction of the nasal tip and columella is a complex task. Patients have 2 aims: a tumor-free nasal tip and a reconstruction that does not draw attention away from the eyes. To attain this goal the surgeon must adapt what remains after complete tumor removal, replacing the skin, cartilaginous framework and inner lining. A purely anatomic reconstruction is often insufficient because healing forces must be accounted for. To avoid late contraction extra anatomical cartilage grafts to buttress the reconstruction are often required. Using rhinoplasty skills (cartilage grafting and suture techniques), the ability to replace kind with kind, understanding the contraction of the soft-tissue envelope with scarring, and placing scars in favorable locations are tools to create the best possible result.

REFERENCES


Fig. 22. (G–H) Lip pedicle severed and set in. Excess subcutaneous tissue of the flap excised and columella repositioned with oval membranous septal excisions. (I–L) The 3-month postoperative result, no significant columella retraction.