Nasal Reconstruction with a Forehead Flap

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``The tint of forehead skin so exactly matches that of the face and nose that a forehead flap must be the first choice for reconstruction of a nasal defect.``

—H.D. Gillies and D.R. Millard

The forehead makes by far the best nose. With some plastic surgery juggling, the forehead defect can be camouflaged effectively.

The use of a forehead flap, however, is not particularly indicated where only a new surface of the nose is required. Although its color is natural, the flap is liable to be a little too thick; if time and opportunity allow it to be thinned adequately, however, an acceptable contour can be achieved.

**PRINCIPLES**

The forehead and scalp are richly perfused by the supraorbital, supratrochlear, superficial temporal, postauricular, and occipital vessels. These axial vessels permit its safe and effective transfer on multiple individual vascular pedicles. The first “Indian” flap transferred forehead tissue on both the right and left supratrochlear vessels. The midline forehead was pivoted on a high, wide base, positioned above the eyebrow. This technique, however, limited the length of available skin, if hair-bearing scalp was to be avoided on its distal end.

Employing a modern design, Millard designed a “seagull”-shaped flap on a unilateral pedicle, centered on the medial canthus. A narrow, proximal, vertical stalk resurfaced the dorsum, and its distal wings covered the alae. Its low base brought the flap closer to the defect and effectively lengthened the flap’s reach. It harvested forehead tissue in both vertical and horizontal directions. The majority of the donor site was closed as a T-shaped scar. The flap could resurface the entire nose. This paramedian flap has vascularity, size, reach, reliability, efficiency, and relatively minimal morbidity. It can be elevated on a right or left supratrochlear pedicle.

The supratrochlear vessels exit the orbit over the periosteum and then pass through the corrugator muscles. About 2 cm above the superior orbital rim, the vessels pass through the frontalis muscle to run vertically upward, within the subcutaneous fat, almost adherent to skin at the hairline and into the scalp. The flap is perfused from three sources: randomly, through the frontalis muscle, and, most importantly, through its vertical axial vessels. Because of its axial blood supply, the width of the pedicle can be narrowed to 1.0 to 1.2 cm or less at its base.

The shortest distance between two points is a straight line. If skin harvest is not precluded by scar or pedicle injury, central nasal defects can be repaired, based on either the right or left brow. Lateral defects, however, are repaired with an ipsilateral rather than a contralateral pedicle. An ipsilateral pedicle places the base of the flap closer to a unilateral defect and shortens the distance from the donor site to the recipient site. The base of a contralateral pedicle is farther from the defect, making the recipient site harder to reach, so the flap must be longer.

Some suggest that a contralateral flap is easier to rotate, but the difference in “twist” is minimal,
perhaps 180° versus 160°. The most important maneuver in flap rotation is to incise the flap lower on its medial edge than on its lateral edge. It then is rotated, medially, toward the nose, regardless of flap’s base. The problem with a contralateral flap is the extra length required, not the ease or difficulty of transfer.

To increase the length, some elevate a forehead flap obliquely, to slant across the forehead, or raise a vertical flap, which then passes transversely under the hairline. Unfortunately, both designs cross the midline and transect the vertical axial vessels. The “working” paddle becomes random. Although it may survive, the distal aspect is at greater risk. It is less vascularized, is more vulnerable to tension, and is more likely to necrose.

Patients often need a second nasal repair. A new cancer may develop in sun-injured skin, or an old cancer may recur. Occasionally, the initial reconstruction is inadequate, and the old forehead flap must be discarded and a second one harvested to improve the result. In most instances, a second flap can be taken easily from the contralateral forehead after a prior vertical flap, but an initial oblique or angled design into the opposite forehead makes a second flap repair much more difficult. The pedicle is destroyed on one side, and the opposite hemi-forehead is scarred so that donor skin is unavailable. Pre-expansion or surgical delay may allow a second flap, but the repair will be delayed and more morbid. The potential need for a second flap may be the most important clinical reason to use a vertical flap.

The assumption, obvious in many discussions of nasal repair, is that most foreheads are short. Most foreheads, however, are 5 cm or more in height from eyebrow to hairline. A vertical paramedian flap can resurface the entire nasal unit easily without extending significantly into the hairline.

Most often, a template of the cover requirement is positioned just under the hairline, and the vascular pedicle is drawn downward and through the medial eyebrow. The distal flap is incised and elevated until it reaches the defect. The dissection is continued, little by little, incising skin, releasing fibrous restraints, and snipping corrugator muscles, while maintaining the visible vessels.

Fig. 1. (A–C) Skin over most of the right ala is missing after excision of a basal cell carcinoma by Mohs technique. This defect could be repaired with a nasolabial or forehead flap. Both will create linear scars, but a scar within the forehead will be less visible postoperatively than a distorted nasolabial fold. Because the defect is small, a forehead flap can be thinned at the time of transfer without risk to its vascularity and with the expectation that the final contour will be good.
Fig. 2. (A–D) The alar subunits are marked with ink. A foil template based on the contralateral normal left ala will determine the dimension and outline of a forehead flap and of the alar margin support graft.

Fig. 3. (A, B) Residual normal skin is excised within an alar subunit. A primary conchal cartilage graft is fixed to support, shape, and brace the soft tissues.
Fig. 4. (A–D) A pattern of the contralateral normal left ala is positioned just under the hairline. The pedicle base then is drawn over the ipsilateral supratrochlear vessels. The flap is elevated with 2 to 3 mm of subcutaneous tissue distally for 2 cm. The dissection is carried through the frontalis muscle, over the periosteum, to the orbital rim. The flap is sutured to the recipient site with a single layer of fine suture. The raw surface of the pedicle is covered with a full-thickness skin graft. The forehead is closed in layers primarily.

Fig. 5. (A, B) Four weeks later, the flap is well healed at the recipient site.
Fig. 6. (A–C) The pedicle is divided. The inferior forehead is reopened, and the proximal pedicle instead has a small inverted V replacing the medial brow. Distally, the skin is elevated superiorly with 2 mm of subcutaneous fat. The underlying soft tissue of fat, cartilage graft, and scar is sculpted to create a convex ala and the ala crease superiorly. It is trimmed and inset with quilting sutures and a single-layer skin closure.

Fig. 7. (A–D) Postoperatively, the quality, two-dimensional outline, and three-dimensional contour of the ala has been restored. The forehead scar is almost invisible. No revision was performed.
The lower the pivot, the more hairless skin is available superiorly to cover the defect and the less hairless skin is wasted as a vascular “carrier.” If the forehead seems short preoperatively, the pivot of a paramedian flap can be lowered. The pedicle design is carried through the eyebrow to move the pivot point toward the medial canthus and nearer the defect. The closer the base of the flap is to the recipient site, the shorter is the flap required to reach it.

Alternatively, the flap design can be placed distally within the hairline, accepting a small amount of hair on the end of the flap. Hair can be plucked, depilated, or lasered. It is better to have a normal nose with a little hair than one with a poor shape.

All agree that the paramedian flap is axial. The supratrochlear vessels are the primary blood supply. Anastomoses to the dorsal nasal, supraorbital, and angular arteries create a rich surplus but are secondary. These less important vessels, however, add to the flap’s superb blood supply and reassure the surgeon that prior injury to the supratrochlear vessels does not preclude its use.

Its axial nature also means that a vertical flap can be thinned distally without significantly diminishing its perfusion. The distal supratrochlear artery is bound tightly to the overlying skin and is not injured by the excision of frontalis and subcutaneous fat. Excessive tension—too short or too small a flap, too wide a pedicle or tight a twist, too complete an inset—or over-radical thinning

Fig. 8. (A–D) A Mohs defect lies within the distal nose, distorted by multiple previous skin grafts. The left nostril margin is retracted in an area of old composite graft.
can devascularize the flap and cause ischemia. If the repair is performed under general anesthesia without local epinephrine, worrisome blanching can be identified intraoperatively and can be avoided.

The resulting donor defect after a vertical flap is limited largely to the central/lateral forehead. The gap is closed by drawing the adjacent tissues together, vertically and horizontally. Any resultant defect is high in the forehead after closure and is left to heal secondarily. Although eyebrow distortion can occur, it usually can be avoided.

In contrast, oblique and transversely oriented flaps harvest skin within the opposite hemi-unit. The larger the nasal loss; the larger the flap, the bigger the resultant forehead defect, and the closer the defect lies to the brow. The risk of superior eyebrow malposition is significant when an oblique or horizontal oriented flap is used. As an alternative, any remaining forehead gap can be closed with a skin graft. Unfortunately, the skin graft always will look like a mismatched patch of shiny, irregularly pigmented skin within the remaining forehead and will not diminish with time.

**FLAP TRANSFER IN TWO OR THREE STAGES**

A forehead flap typically is transferred in two stages.\(^7\) Because the forehead skin is thicker than nasal skin, the subcutaneous flap and frontalis muscle are excised distally to thin the flap during the first stage. Axial vessels in the superficial subcutaneous fat are preserved easily. Although the frontalis muscle is excised, the supratrochlear vessels remain tightly adherent to the distal skin. The flap remains perfused by its axial supply. Its distal aspect is inset into the recipient defect, after restoring missing support or lining.

The pedicle is divided 3 or 4 weeks later during the second stage, once the inset has healed to the recipient bed. The skin over the superior aspect of the recipient site is elevated, and the underlying excess fat and frontalis is excised to debulk the more superior aspect of the repair. The proximal pedicle is trimmed and returned to the medial eyebrow, as a small, inverted V. Because the pedicle is narrow, it is returned easily to the donor site without drawing the eyebrows medially. Ideally, its scars blend into the normal frown lines.

Excellent results can be obtained with the two-stage transfer. Unfortunately, because the flap’s blood supply is entirely dependent on its distal inset at the time of pedicle division, the distal and most aesthetic aspects of the repair—the tip and ala—cannot be altered after the flap is transferred. Revisions can be made only months later, in stages, by elevating the flap from the recipient site.

More recently, Menick\(^8,9\) suggested that a forehead flap be transferred as a full-thickness flap in three stages, without initial thinning. This technique is especially useful when a large defect requires a large flap, complex contour restoration, or lining. It has become the primary approach used in major nasal repairs. The

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**Fig. 9.** (A–C) Rather than simply close the fresh defect, the distal nose will be resurfaced and the left nostril margin repositioned to restore the quality, outline, and contour of the nose. Skin within the dorsum tip and alae is discarded except for skin along the left nostril margin, which will be hinged over for lining.
two-stage method is used for smaller, and superficial defects that do not require thinning of the flap over a wide area or the re-establishment of complex three-dimensional (3D) contour with multiple cartilage support grafts or soft tissue shaping. A full-thickness flap, transferred in three stages, maintains maximal vascularity through the axial vessels, frontalis muscle, and a random skin blood supply. The flap is raised with all its layers, and thinning is avoided at the time of transfer. The technique is particularly useful if the patient is a smoker or has an old scar in the region of the flap.

After restoration of missing support and lining, a full-thickness flap is moved to resurface the defect. Four weeks later, the flap is physiologically delayed and has a robust blood supply. During the second intermediate stage, the skin of the flap is elevated with 2 to 3 mm of fat, creating an ideally thin and supple “skin only” flap to resurface the nose. Its elevation exposes the underlying excess fat and frontalis. This soft tissue is excised off the recipient site to sculpt a precise 3D contour. Previously placed cartilage support grafts are modified, if needed, and additional grafts are added, as appropriate. The flap then is replaced on the recipient site. Four weeks later (8 weeks after flap transfer), the pedicle is divided at a third stage.

In three stages, all anatomic components of a normal nose are integrated. During the intermediate operation, the repair is fine tuned, and the

Fig. 10. (A–D) External residual skin along with a left nostril margin is turned over for lining. Conchal cartilage grafts are placed as alar margin battens and to shape, support, and brace the reconstruction.
Fig. 11. (A, B) A full-thickness forehead flap without thinning is elevated.

Fig. 12. (A–C) Containing an axial, musculocutaneous, and random blood supply, a forehead flap is sutured in one layer to the recipient site. Its raw surface is covered temporarily with a full-thickness skin graft.

Fig. 12. (A–C) Containing an axial, musculocutaneous, and random blood supply, a forehead flap is sutured in one layer to the recipient site. Its raw surface is covered temporarily with a full-thickness skin graft.
hard and soft tissues of the nose are sculpted to create a 3D contour over the entire unit. This three-stage technique has permitted the development of a new method of lining. The traditional technique of folding a forehead flap for cover and lining is rarely effective because it precludes the placement of support and creates a thick nostril margin and collapsed airway. These limitations have been overcome with a three-stage modified technique.

To line a full-thickness defect, extra tissue is added distally as an extension of a full-thickness flap and is folded for lining. Within a few weeks, the distal folded lining incorporates into the adjacent residual lining and no longer depends on the forehead pedicle or its covering skin for blood supply.

In a three-stage full-thickness flap technique, regardless of how lining is reestablished, the skin of the full-thickness flap then is re-elevated completely off the recipient site with 2 to 3 mm of subcutaneous fat. The underlying exposed fat and frontalis now is adherent to the recipient site (and to any primary cartilage grafts that were placed initially over intact vascularized residual lining adjacent to the full-thickness lining defect during the initial flap transfer). The soft tissue excess and old cartilage grafts are sculpted to establish a contoured soft tissue and hard tissue recipient bed. Previously positioned support grafts are modified if insufficient, shifted, or poorly designed, and new delayed primary support grafts are placed to support the area of reconstructed lining. Delayed primary support is placed over the reconstructed folded lining to recreate a complete support framework. The thin cover flap then is returned to the donor site. Four weeks later (8 weeks after the initial operation), the flap’s pedicle is divided.

The advantages of the three-stage flap technique are vascular safety, the capacity to modify the soft tissues and cartilage support of the distal, most aesthetically important tip and ala before pedicle division, and the ability to fold the flap effectively to supply thin, supple lining. This three-stage method has become the usual technique for all large, deep defects and is invaluable in the repair of moderate full-thickness losses.

**TECHNIQUE**

A major nasal repair is best performed under general anesthesia. Local anesthesia balloons recipient and donor tissues and makes precise contour evaluation almost impossible. Epinephrine blanches the tissue, making it difficult to evaluate vascularity and tension, and this difficulty may cause tissue ischemia intraoperatively.

All important landmarks and reference points must be identified before the first incision. Once the operation is underway, intraoperative edema, gravity, and tension distort the soft tissues and make it impossible to identify facial landmarks. The hairline, frown lines, location of the supratrochlear vessels by Doppler, the outline of the defect, and nasal and lip subunits are marked with ink.

Exact templates then are made. The normal contralateral side of the missing nasal subunit is used to determine the dimension and outline of the required forehead flap and support grafts. A pattern of the contralateral upper lip is designed also, if the alar base is malpositioned and must be identified.

Quarter-inch adhesive strips are placed over the contralateral subunit, which has been outlined with ink. The strips are consolidated with an outer layer of collodion. Marking ink adheres to the deep surface of the pattern. The paper “mold” is removed and trimmed along the inked border. The paper pattern is used to create a foil pattern from a suture pack. It is flattened on the forehead to outline the exact tissue dimension required to resurface the nose. Later, the template can be used to design a cartilage graft with the correct size and outline of nostril margin needed to support and shape the alar margin.

**Fig. 13.** At 4 weeks, the flap has healed to the recipient site, and the donor defect is healing secondarily. The reconstruction is bulky and shapeless. The flap has been effectively physiologically delayed by its elevation and transfer.
Debris, granulation tissue, and irregular margins of the defect are trimmed. If the remaining tissues have been displaced by scar within a healed or previously repaired wound, normal landmarks are returned to their normal position. Extra residual tissue within the subunits is excised, if a subunit excision is planned to alter the size and outline of the defect that requires repair.

The lining must be intact or, if missing, restored before or simultaneously with the restoration of nasal cover with a forehead flap. Then, septal, ear, or rib cartilage is used to replace missing bone and cartilage support. Although the ala normally contains no cartilage, a cartilage graft must be placed to support and shape the nostril margin when significant skin is missing. The alar grafts also brace against wound contraction to avoid alar rim retraction postoperatively.

Usually, the cover template is positioned just under the hairline, and the vascular pedicle is drawn downward and through the medial eyebrow.

The pedicle is then drawn inferiorly, centered over the supratrochlear vessels. Because the flap is an axial flap, its base can be tapered to a pedicle 1.2 cm wide.

A vertical flap design maintains the vascularity of the axial vessels and permits the harvest of

![Image](image_url)

**Fig. 14. (A–D)** The skin of the forehead flap is elevated completely off the recipient site with 2 to 3 mm of subcutaneous fat. This elevation exposes the underlying excess subcutaneous fat and frontalis muscle, which now is adherent to the underlying cartilage grafts.
a second flap from the opposite forehead in the future, should another forehead flap be needed. Unless the donor site has been injured by prior trauma, scars, or flap harvest, prior expansion is not needed. Pre-expansion adds an additional stage, morbidity, and the risk of extrusion or infection. If the forehead is excessively short (4 cm), tight (usually because of a prior flap harvest), or scarred, pre-expansion is a useful tool.

THE TWO-STAGE FLAP

Traditionally, a forehead flap is transferred in two stages. A forehead flap is thicker than nasal skin. Frontalis muscle and some subcutaneous fat must be excised to thin the flap (Figs. 1–7).

The border of the flap is incised. It is elevated from distal to proximal. Distally, the flap is lifted off the frontalis for 1.5 to 2 cm. The dissection then passes through the muscle and over the periosteum to the superior orbital rim. Inelastic periosteum is not elevated because it will restrict flap rotation and reach.

As the dissection reaches the brow, the skin borders of the flap are incised, snipping fibrous bands and corrugator muscle while preserving visible vessels. The flap is released, little by little, until the flap reaches the defect without tension.

If support is absent and vascularized lining is intact or has been restored, primary cartilage support grafts with a subunit outline are placed.

The pedicle of a two-stage flap is divided 3 to 4 weeks later.

The donor site is closed after wide undermining under the frontalis muscle into the temples. The forehead is approximated with several 4–0 polypropylene tension sutures, placed just at the wound edges. Then the frontalis is repaired with 4–0 clear slowly absorbing sutures, followed by 5–0 subcuticular sutures and 6–0 sutures for the skin. Any gap under the hairline is allowed to heal secondarily. The wound fills with granulation, epithelializes, and contracts over several weeks. It heals well. Months later, any residual scar can be excised secondarily after the residual forehead has relaxed. A skin graft is not applied to avoid a visible permanently discolored patch.

THE THREE-STAGE FULL-THICKNESS FOREHEAD FLAP

A large defect requires a large flap. A large flap must be widely thinned. A large defect encompasses multiple subunits, each requiring individual complex contour restoration. Multiple cartilage grafts and extensive soft tissue shaping will be needed. The greater the size of the defect, the more likely it is to extend through the underlying lining. In such cases, the author prefers to transfer a full-thickness forehead flap in three stages, with an intermediate operation to provide thin cover and a shaped middle support layer and lining, if needed (Figs. 8–21).

The flap is elevated over the periosteum, containing skin, fat, and frontalis muscle with the thin deep areolar layer. It maintains its axial, musculocutaneous, and random blood supply. The flap is not thinned. Missing support is replaced with cartilage and bone grafts over intact vascularized lining. Then the flap, with all its layers, is sutured to resurface the nasal defect.

Three to 4 weeks later, the flap is physiologically delayed. Its vascularity is maximized. At an intermediate operation, the skin of the flap is elevated off the entire recipient site with 2 to 3 mm of subcutaneous fat. The underlying excess of soft tissue then is excised to sculpt the healed fat and frontalis from the surface of the recipient site. Additional cartilage grafts can be applied, or old grafts can be sculpted or repositioned, if necessary. The flap, now of ideal nasal thickness, is resutured to the recipient site. This three-stage approach ensures maximal blood supply, ideal contouring of the soft and hard tissue, and better results.

Its pedicle is divided at a later third stage.

During the first stage of either a two- or three-stage transfer, the flap is inset with one layer of fine suture. It is sutured at the columella and rim. It is not necessary to inset the flap completely. If blanching occurs, placement of the inset should stop, and any tight sutures should be removed.

Fig. 15. The thick and stiff forehead flap has been converted to thin, supple forehead skin that matches the normal nasal skin in quality and thickness.
Fig. 16. (A–D) The excess soft tissue, cartilage support, and lining now are rigidly healed together. The excess can be sculpted by excision to remove bulk and improve contour.

Fig. 17. (A, B) A rigid subsurface architecture with a correct contour and outline is created.
Fig. 18. (A–C) The thin forehead skin is returned to the contoured recipient site and fixed with quilting sutures and peripheral sutures.

Fig. 19. (A, B) Four weeks later (8 weeks after flap transfer), the contour of the distal, most aesthetic aspect of the nose has been established by the intermediate operation.
The flap is sutured to the columella and along the nostril margins. Any lateral gaps along the lateral aspects of the defect are allowed to heal spontaneously. A forehead flap is very vascular, but a too small, too short, too tightly inset, or a too aggressively thinned flap will die. Although not vital, the raw undersurface of the exposed pedicle is skin grafted. This procedure maintains a cleaner wound between each surgical stage.

The next day, the patient can wash and shampoo. Skin sutures are removed in 5 days.

An extension of a full-thickness flap also can be used to replace nasal lining, if lining also is missing. A template of the external skin loss is created. Then another template of the lining defect is added as a distal extension to the covering flap. At transfer, the distal skin is folded inward to line the wound, and the proximal covering skin is turned back on itself to resurface the nose. Four weeks later, the lining component has healed and revascularized to residual normal lining. It no longer depends on the proximal forehead flap for blood supply. At the intermediate operation, the flap is divided along the ideal nostril margin. The proximal covering skin is elevated completely from the nasal surface with 2 to 3 mm of subcutaneous flap. The folded frontalis and subcutaneous fat, which overlie the skin lining, are excised. Delayed primary support grafts are

Fig. 20. (A–E) The pedicle is divided and skin over the superior aspect of the defect is elevated. Distinct dorsal lines, a flat sidewall, and alar creases are created by soft tissue excision. The inset is completed with quilting sutures and peripheral sutures.
placed to shape and brace the reconstruction. Lining and a 3D cartilage support skeleton are restored.

This modified folded lining technique now is the author’s preferred method of repairing small and moderate full-thickness defects.

Pedicle division is similar for a two-stage or three-stage flap. Three to 4 weeks later (6–8 weeks after the initial transfer of a three-stage flap), old scars and units are marked with ink, under general anesthesia. No local anesthesia is used. The site of pedicle division is marked to

Fig. 21. (A–E) Postoperatively, the expected uniform quality of nasal skin and the two-dimensional outline and three-dimensional contour of the nose had been reestablished. The forehead healed uneventfully. No revision was performed.
ensure adequate tissue to resurface the recipient site and to replace the medial eyebrow in its correct position.

The proximal pedicle is untubed. The inferior forehead is reopened. Excess soft tissue at the base of the flap and under the medial brow is excised. The forehead is re-closed, in layers, to create a small, inverted V-shaped recipient site, inferiorly. The excess proximal flap skin is trimmed to fit the defect in the medial brow and returned to the donor site. This procedure replaces the eyebrow.

The distal flap is partially re-elevated over the superior inset with 2 to 3 mm of subcutaneous fat. The underlying soft tissue is sculpted to restore the expected contour of the recipient site. The flap is reapplied to the defect with quilting sutures and peripherally with a single layer of fine sutures. The quilting sutures are removed in 2 days, and the skin sutures are removed in 5 days.

Complex repairs of large or deep defects may require a later revision at 4 months to define the alar crease, thin a thick nostril margin, or revise the forehead, if a gap has been allowed to heal secondarily. Such revisions are not considered a failure but are a necessary part of the repair of difficult defects.

REFERENCES