A 10-Year Experience in Nasal Reconstruction with the Three-Stage Forehead Flap

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Because of its ideal color and texture, forehead skin is acknowledged as the best donor site with which to resurface the nose. However, all forehead flaps, regardless of their vascular pedicles, are thicker than normal nasal skin. Stiff and flat, they do not easily mold from a two-dimensional to a three-dimensional shape. Traditionally, the forehead is transferred in two stages. At the first stage, frontalis muscle and subcutaneous tissue are excised distally and the partially thinned flap is inset into the recipient site. At a second stage, 3 weeks later, the pedicle is divided. However, such soft-tissue “thinning” is limited, incomplete, and piecemeal. Flap necrosis and contour irregularities are especially common in smokers and in major nasal reconstructions. To overcome these problems, the technique of forehead flap transfer was modified. An extra operation was added between transfer and division.

At the first stage, a full-thickness forehead flap is elevated with all its layers and is transposed without thinning except for the columellar inset. Primary cartilage grafts are placed if vascularized intranasal lining is present or restored. Importantly, at the first stage, skin grafts or a folded forehead flap can be used effectively for lining. A full-thickness skin graft will reliably survive when placed on a highly vascular bed. A full-thickness forehead flap can be folded to replace missing cover skin, with a distal extension, in continuity, to supply lining. At the second stage, 3 weeks later during an intermediate operation, the full-thickness forehead flap, now healed to its recipient bed, is physiologically delayed. Forehead skin with 3 to 4 mm of subcutaneous fat (nasal skin thickness) is elevated in the unscarred subcutaneous plane over the entire nasal inset, except for the columella. Skin grafts or folded flaps integrate into adjacent normal lining and can be completely separated from the overlying cover from which they were initially vascularized. If used, a folded forehead flap is incised free along the rim, completely separating the proximal cover flap from the distal lining extension. The underlying subcutaneous tissue, frontalis muscle, and any previously positioned cartilage grafts are now widely exposed, and excess soft tissue can be excised to carve an ideal subunit, rigid subsurface architecture. Previous primary cartilage grafts can be repositioned, sculpted, or augmented, if required. Delayed primary cartilage grafts can be placed to support lining created from a skin graft or a folded flap. The forehead cover skin (thin, supple, and conforming) is then replaced on the underlying rigid, recontoured, three-dimensional recipient bed. The pedicle is not transected. At a third stage, 3 weeks later (6 weeks after the initial transfer), the pedicle is divided.

Over 10 years in 90 nasal reconstructions for partial and full-thickness defects, the three-stage forehead flap technique with an intermediate operation was used with primary and delayed primary grafts, and with intranasal lining flaps \((n = 15)\), skin grafts \((n = 11)\), folded forehead flaps \((n = 3)\), turnover flaps \((n = 5)\), prefabricated flaps \((n = 4)\), and free flaps for lining \((n = 2)\).

Necrosis of the forehead flap did not occur. Late revisions were not required or were minor in partial defects. In full-thickness defects, a major revision and more than two minor revisions were performed in less than 5 percent of patients. Overall, the aesthetic results approached normal.

The planned three-stage forehead flap technique of nasal repair with an intermediate operation (1) transfers subtle, conforming forehead skin of ideal thinness for cover, with little risk of necrosis; (2) uses primary and delayed primary grafts and permits modification of initial cartilage grafts to correct failures of design, malposition, or scar contraction before flap division; (3) creates an ideal, rigid subsurface framework of hard and soft tissue that is reflected through overlying skin and blends well into adjacent recipient tissues; (4) expands the application of lining techniques to include the use of skin grafts for lining at the first stage, or as a “salvage procedure” during the second stage, and also permits the aesthetic use of folded forehead flaps for lining; (5) ensures maximal blood supply and vascular safety to all nasal layers; (6) provides the surgeon with options to salvage reconstructive catastrophes; (7) improves the aesthetic result while decreasing the number and difficulty of revision operations and overall time for repair; and (8) emphasizes the interdependence of anatomy (cover, lining, and support) and provides insight into the nature of wound injury and repair in nasal reconstruction. (Plast. Reconstr. Surg. 109: 1839, 2002.)

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The tint of the forehead so exactly matches that of the face and nose that it must be the first choice. The forehead makes far and away the best nose.

—Sir Harold Gillies and D. Ralph Millard

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Essentially, all flaps are similar and consist of two parts—the part chiefly concerned with the traffic of circulatory fluids, and the part available for plastic use.

—Sir Harold Gillies

Plastic surgery is a perpetual battle of beauty versus blood supply.

—Sir Harold Gillies and D. Ralph Millard

Because of the ideal quality of its color and texture, forehead skin has been acknowledged as the best donor site with which to resurface the nose. However, the forehead is composed of skin, subcutaneous fat, frontalis muscle, and a thin layer of areolar tissue that overlies the periosteum and bone. Therefore, all forehead flaps, regardless of their vascular pedicle, are thicker than nasal skin when elevated. Stiff and flat, they do not easily mold from a two-dimensional to a three-dimensional shape. Standing above adjacent recipient tissue, a bulky flap blends poorly and does not readily conform to a nasal shape.

Traditionally, the forehead is transferred in two stages, incorporating later secondary revisions at intervals of 6 to 12 months. At the first stage, varying amounts of frontalis muscle and subcutaneous tissue are excised distally, and the partially thinned flap is inset into the recipient site. Such initial debulking is relatively safe, at least in nonsmokers, because of the flap’s rich blood supply. However, alar and columellar extensions may become necrotic. At a second stage, 3 weeks later, the pedicle is divided and its proximal aspect is re-elevated off the recipient site and debulked. Unfortunately, such soft-tissue “thinning” is limited, incomplete, and piecemeal.

Multiple late secondary revisions are often required once the soft tissues have matured and softened. At intervals of 6 to 12 months, the flap is partially re-elevated through the scarred, subdermal plane during separate operative stages. Additional soft-tissue excisions are performed and secondary cartilage grafts are placed. However, the skin is now stiff, contracted, and noncompliant because of subcutaneous fibrosis, and it is not readily molded. Flap necrosis and contour irregularities are especially common in smokers and in major nasal reconstructions because larger flaps require more extensive soft-tissue thinning, putting the blood supply at risk. To overcome these problems, Millard, in 1974, believing that flap thinning would be safer with the pedicle intact, described an intermediate operation between flap transfer and division to sculpt the ala and tip. Burget and Menick, in 1992, recommended that a forehead flap be initially transferred with no distal thinning in major reconstructions. All contouring could be performed at the second operation, creating a thin cover flap and a shaped underlying bed. The pedicle was sectioned at a third stage. Realizing that a skin graft would survive on such a highly vascular bed, he also proposed that a skin graft could be used for lining if late contraction could be prevented. In the past, Kazanjian and Converse voiced concern about graft “take” and postoperative shrinkage. Gillies, however, used grafts for lining with success in the syphilitic nose by permanently splinting the repair with an internal prosthesis. Burget and Menick found that burying a cartilage graft in the subcutaneous layer between skin and frontalis muscle initially or during the intermediate operation, before pedicle division, was effective.

These concepts have been applied in 90 forehead flap nasal reconstructions over the past 10 years. It has become apparent that the aesthetic results are improved and the time to completion of repair is shortened. Equally important, the implications of a full-thickness forehead flap transferred in three stages with an intermediate operation expanded the options for lining to include the aesthetic use of a folded forehead flap. It provided insight into the nature of wound injury and healing, permitted the use of both primary and delayed cartilage grafts, and increased the opportunities available for the salvage of complications (Figs. 1 through 15).

TECHNIQUE

Creating Ideal Nasal Cover and a Rigid Subsurface Architecture

The forehead is multilamellar, consisting of skin, subcutaneous tissue, frontalis muscle, and a thin, areolar layer. Elevated as a full-thickness flap based on a paramedian pedicle, its supratrochlear vessels pass deeply over the periorbital vessels at the supraorbital rim and travel vertically upward through the muscle to lie at an almost subdermal position under the skin at the hairline. It is both a myofascial and axial flap, and highly vascular. Excision of the frontalis muscle and subcutaneous fat at the time of initial transfer removes the myocutaneous component of its blood supply; exposes a
wounded, raw, bleeding subdermal surface prone to fibrosis and contraction; and creates a flap less able to tolerate the tension of closure. However, when it is transposed with all its layers, flap necrosis is unusual. Its soft tissue remains soft. The expected severe induration of wound healing does not occur.

**Stage 1.** A full-thickness, multilamellar, non-expanded forehead flap (skin, subcutaneous fat, and frontalis muscle) is elevated. Subcutaneous fat and frontalis are trimmed only at the columella and a few millimeters along the nostril rim. The cover defect is replaced exactly, using a template derived from the contralateral normal side or from an ideal. It is inset, without tension or blanching, with a single layer of fine silk suture. If altering and enlarging the defect will improve the final aesthetic result, adjacent normal tissue within nasal subunits is excised, and the entire subunit is resurfaced, rather than only the defect. Primary support cartilage grafts are a first choice, but they can be positioned in a delayed primary fashion at the second-stage intermediate operation. Primary cartilage grafts are placed if vascularized intranasal lining is present or has been restored. Cartilage grafts are precluded at the first stage if skin grafts or a folded forehead flap has been used for lining.

The forehead donor site is closed in layers after undermining widely in the subgaleal plane. Any gap that cannot be approximated is allowed to heal secondarily.

**Stage 2.** Three weeks later, the full-thickness forehead flap, now well healed to the recipient bed is, in effect, physiologically delayed. In the intermediate operation, forehead skin with 3 to 4 mm of subcutaneous fat (nasal skin thickness) is easily elevated in the unscarred subcutaneous tissue plane over the entire nasal inset, except for the columella. This creates a maximally vascularized bipedicle flap that extends from the intact supratrochlear brow pedicle to the columella. The extent of flap elevation can vary, depending on the exposure required for soft-tissue excision and additional delayed primary cartilage grafting. Most often, it is complete except for the columellar inset. Perhaps because of the period of delay or the accommodation of the flap pedicle to the initial twist at transfer, its blood supply is excellent. In fact, forehead skin (without frontalis muscle) can be completely re-elevated off the nose, maintaining no distal inset, without significant risk, if such exposure is needed to allow more complete subcutaneous excision or cartilage graft placement. Usually, the intermediate operation is performed under general anesthesia, avoiding the distortion created by local anesthesia or the chemical blanching of epinephrine. A combination of digital two-hand palpation and transillumination allows the elevation of a smooth, even, thin, supple, conforming skin cover of ideal quality. The skin retains excellent color and capillary refill. The slightly edematous and previously undissected subcutaneous plane separates easily from underlying tissues, with little bleeding from the deep surface of the skin flap. Axial subcutaneous vessels lying in the subdermal superficial fat under the skin become visible and are not injured. The underlying subcutaneous tissue, frontalis muscle, and previously positioned primary cartilage grafts are exposed. This excess soft tissue, a conglomerate of cartilage, fat, and scar, heals into a rigid living structure that bleeds readily and is excised to carve an ideal subunit subsurface architecture. Previously positioned primary cartilage grafts are visible and can be remodeled by...
sculpting, further augmentation, or repositioning, if required. Delayed primary cartilage grafts can also be placed over vascularized lining skin grafts or the forehead skin that had been folded for lining. If the lining is deficient because of an initial design error or necrosis, additional skin grafts for the lining can be used to expand the available lining. After creation of an ideal subsurface architecture by soft-tissue excision and cartilage grafting, the forehead skin (now of nasal skin thickness) is replaced on the underlying rigid, recontoured three-dimensional recipient bed with quilting sutures to close the dead space and re-approximate the flap to the recipient site.

Stage 3. Three weeks later (6 weeks after transfer), the pedicle is transected. The inferior forehead scar is reopened, and the proximal pedicle is unfurled, trimmed, and inset as a small inverted V at the medial brow to simulate a frown crease. The distal flap is elevated with 3 to 4 mm of subcutaneous fat, and the proximal recipient bed inset is sculpted, as needed, by further excision of excess subcutaneous fat, frontalis muscle, and scar to define the dorsal lines, alar creases, and sidewall junction. The flap inset is completed over a stable, sculptured rigid platform flap whose nasal shape shows through the thin, conforming forehead skin.

Expanding Lining Options

In a smaller unilateral lining defect, a full-thickness skin graft can be sutured to fill the deficiency and fixed to the undersurface of the forehead flap with quilting sutures. No primary cartilage grafts are placed. In the intermediate operation, the forehead is re-elevated, the soft tissue is sculpted, and a delayed primary alar margin cartilage graft is positioned over the skin-grafted lining (now integrated into adjacent residual normal skin).

In moderate defects in which residual normal vestibular skin remains intact above the defect, a bipedicle flap of remnant vestibular skin, based medially on the septum and laterally on the alar base, can be incised in the vicinity of the intracartilaginous line. This flap is advanced inferiorly to the level of the proposed alar margin. The defect, which remains above the vestibular flap and is filled with a
full-thickness skin graft, lines the superior ala and nasal sidewall region. A primary alar rim cartilage graft can be sutured to the raw surface of the vascularized bipedicle flap at this first stage, but it cannot be placed over the skin graft. The missing covering skin is supplied by

Fig. 3. (Above, left) At 3 weeks, the full-thickness flap appears bulky and the cartilage framework does not show through. (Above, right) The forehead flap is incised along its margin. Forehead skin with 3 mm of subcutaneous flap is elevated over the entire nasal inset, except for the columella. The covering skin is supple and highly vascular, and it now has the thinness of nasal skin. The underlying subcutaneous tissue and frontalis muscle are exposed. The proposed alar crease is marked with ink. (Below, left) Scar, frontalis muscle, and subcutaneous tissue are excised to create a rigid subsurface architecture that will be visible through the overlying thin conforming forehead cover skin and will have the shape of a nose. (Below, right) The forehead pedicle is not transected. The flap is re-approximated to the nasal inset with peripheral and quilting sutures.
a full-thickness forehead flap. The skin graft, raw surface outward, will revascularize from the overlying raw surface of the forehead flap. Contact between the skin graft and forehead flap is enhanced by the placement of loosely tied, absorbable quilting sutures that pass intranasally through the skin graft and into the soft tissues of the overlying cover flap, and by a soft sponge that is placed within the airway for 48 hours.

While the alar margin is supported by a primary septal or conchal cartilage alar rim graft, the superior aspect of the defect overlying the skin graft is unsupported. At 3 weeks, before wound contraction occurs, the forehead flap and skin graft are separated during the intermediate operation. Excessive subcutaneous tissue and scar are excised over the skin graft bed. The skin graft lining is well vascularized from the periphery, and becomes indistinguishable from the residual normal lining to which it was sewn. It is thin, supple, and bleeds readily. A shaped piece of septal cartilage and bone can then be inserted in a delayed primary fashion.
to support and shape the nasal sidewall and middle vault during this second stage. A complete nasal framework is restored. An unbroken sheet of hard tissue lies throughout the defect to brace the reconstruction against upward retraction or inward collapse.

In larger unilateral defects, when residual vestibular skin is absent, a full-thickness skin graft replaces the entire lining defect. It is sutured with the skin surface facing the nasal vestibule and its raw surface outward. Before forehead flap inset, a subcutaneous tunnel between the skin and the frontalis muscle can be created about 3 to 5 mm above the alar margin. A conchal cartilage alar margin batten, approximately 5 mm wide and of adequate length, is placed within the pocket to support and shape the alar rim. However, the defect superior to this alar margin cartilage graft remains unsupported. Later, at the intermediate operation, any unsupported skin graft lining above the alar margin batten is exposed and braced with a delayed primary sidewall cartilage graft, after elevation of the forehead flap and soft-tissue excision.

The Folded Forehead Flap for Cover and Lining in Moderate Nasal Defects

In the past, forehead flaps have been folded to provide both cover and lining for the alar rim. However, it is difficult to fold a thick flap into a nasal shape, and the technique precludes the accurate placement of primary columnellar, tip, and alar support grafts. The nose remains thick and shapeless, and the unsupported soft tissues along the alar margin may collapse, obstructing the airway. Kinking of the flap at the hinge between cover and lining may
decrease blood supply distally if a thick flap is thinned at the initial time of transfer.

To overcome these problems, a full-thickness forehead flap is outlined to replace missing cover skin at the initial operation. At the same time, the lining deficit is determined, and a second template is designed and positioned distally on the forehead (in continuity with the cover flap) after adding 2 to 3 mm extra length to allow for the rolling in of the lining hinge. Typically, this lining extension of the flap is the site of the dog-ear excision, performed on closure of the forehead donor site, and would be discarded. The flap, drawn to provide both cover and lining, is elevated with all layers. The distal extension is turned in to provide the lining and is sutured to the residual mucous membrane with absorbable suture. The more proximal flap, which will be used for cover, is folded back and inset with a single layer of fine suture, opposing the two raw, deep areolar surfaces of the folded flap. The flap is not thinned; no cartilage support grafts are placed.

Three weeks later, in the intermediate operation, the flap is incised along the proposed alar margin, completely separating the proximal cover flap from the distal lining extension along the alar rim. The proximal flap is then elevated off its inset with a few millimeters of subcutaneous fat, or as a full-thickness forehead flap in the areolar plane between the two folded frontalis layers. Frontalis and subcutaneous fat is excised to expose the skin grafts previously placed for lining. It is difficult to differentiate the full-thickness skin graft from the other nasal lining. The lining grafts are well vascularized and “integrated into the reconstruction.”

Three weeks later (6 weeks after initiating the reconstruction) the pedicle is divided.
by the normal fibrosis associated with wound healing. Once the lining has been thinned and cartilage grafts positioned, the cover flap can be thinned to a nasal thickness as described or replaced as a full-thickness flap and thinned at a second intermediate sculpting operation 3 weeks later.

**Salvage Opportunities: Cover, Lining, and Support**

**Cover.** Rarely, infection, usually associated with significant loss of lining, puts an entire reconstruction in jeopardy. The only choice is to discard all cartilage grafts, debride back to healthy lining, and reattempt repair in 6 to 12 months once the wound has settled. However, precious forehead skin must be preserved. Fortunately, a full-thickness forehead flap has maximal vascularity, and unlike a flap that is significantly thinned during the first stage of a two-stage forehead flap transfer, it suffers minimal physical injury during its initial transfer. Furthermore, it retains its ability to fight infection and has little tendency to contract. In one instance, a full-thickness forehead flap was returned to its forehead donor site when a complicated repair developed infection because of necrosis of hinge-over lining flaps. “Banked” on the forehead, it suffered no necrosis or contraction. Six months later when the edema subsided, the flap returned to its original suppleness and became available for re-transposition during a future nasal repair because it was not thinned initially.

**Lining.** The skin graft lining technique can be used in salvage cases. In one instance, a total nasal defect was reconstructed with a free radial forearm flap for lining, which was initially covered with a thin skin graft. Later, it was resurfaced with a forehead flap and supported with a cantilever dorsal rib graft. However, the dimensions of the free flap lining were inadequate. The nostril airway was stenotic and would be too small if not enlarged. The free flap lining was cut loose at each alar base, and the gaps were filled with 1.5 × 2-cm skin grafts. The forehead flap, transferred without thinning, revascularized the skin grafts. Three weeks later, during the intermediate operation, it was re-elevated, excess soft tissue was excised, and delayed primary cartilage alar margin batten grafts were placed over the combined free flap/skin graft lining at each alar base, where they provided support and braced the lining.

Although untested to date, if an intranasal lining flap developed limited necrosis, the dead lining could be debrided at a second operation before invasive infection began, and any primary cartilage grafts in the area could be removed. The lining defect could then be replaced with a full-thickness skin graft positioned against the full-thickness forehead flap. After the skin graft had vascularized, the fore-
head flap could be re-elevated, and delayed primary cartilage grafts could be replaced. Such a maneuver could theoretically prevent a reconstructive disaster, preserving the forehead flap, the remaining reconstructed lining, and primary cartilage grafts from progressive infection.

Support. As described, support grafts can be placed primarily or in a delayed primary fashion and repositioned, sculpted, or added during any stage to correct imperfections resulting from improper design or shift caused by tension, gravity, or edema. The rigid architecture of healed soft tissues and cartilage grafts can be carved into a nasal shape. Nasal reconstruction becomes an opportunity for repeated artistic, three-dimensional sculpting completed before pedicle division.
FIG. 9. *(Above, left)* The skin graft take was incomplete, so a second full-thickness skin graft was placed, which healed without further problems. Six weeks after the initial forehead flap procedure, the reconstruction was too bulky and the alar rim remained unsupported over the lining skin graft. Excessive bulk was marked for excision. *(Above, right)* The forehead flap is elevated with 3 mm of fat as a bipedicle, maintaining its proximal blood supply at the brow and its inset into the columella. Underlying subcutaneous tissue, frontalis, and scar tissue are exposed. *(Below, left)* Excessive bulk is excised, creating a normal nasal shape. The underlying skin graft is well vascularized and incorporated into the residual lining. The pedicle was not transected. A delayed primary cartilage graft is placed to support and shape the right soft triangle and left alar rim. *(Below, right)* Three weeks later, at the time of pedicle division, the delayed primary cartilage graft that supports the underlying skin graft is visible.
RESULTS

Over 10 years in 90 nasal reconstructions of partial and full-thickness defects, the three-stage forehead flap technique was used with primary and delayed primary grafts, and with intranasal lining flaps \((n = 15)\), skin grafts \((n = 11)\), folded forehead flaps \((n = 3)\), turnover flaps \((n = 5)\), prefabricated flaps \((n = 4)\), and free flaps for lining \((n = 2)\). Necrosis of the forehead flap did not occur during initial full-thickness transfer or the intermediate sculpting operation. One infection occurred because of lining loss.

Because the forehead flap is thinned in its entirety and an ideal subsurface architecture is completed before pedicle division, late revisions may not be required or will be minor in partial-thickness defects. In full-thickness defects, a major revision or more than two minor revisions were performed in less than 5 percent of patients. At 4 to 6 months, once wound maturation is complete, the alar crease can be defined by direct soft-tissue excision; the nostril margin trimmed by rim excision; or the nasal aperture enlarged by local excision, local lining redistribution, or a composite skin graft. The forehead donor scar can be revised by excision and re-advancement, disregarding any area of hypertrophy associated with secondary healing. Overall, the aesthetic results can approach normal.

DISCUSSION

Rhinoplasty surgeons have long emphasized the interrelationship of the skin envelope and its underlying skeleton.12 Ideally, an aesthetically structured framework is designed to positively influence the conformation of its overlying skin. Although modern augmentation techniques can modify nasal cartilages that are inadequate in size, shape, or position, little can be done to improve a skin sleeve that is too large or too thick in a cosmetic rhinoplasty. Fortunately, the reconstructive surgeon now has the ability to transfer a covering flap of the exact size and of correct nasal thickness while creating a supporting framework.

The three-stage forehead flap technique with an intermediate operation allows the surgeon to transfer forehead skin of nasal thickness over a rigid, three-dimensional, sculptured, subsurface architecture, formed by primary and delayed primary cartilage grafts and soft-tissue excision before pedicle division. Such staging has many advantages. The intermediate operation ensures maximal vascular safety. Initially transferred with all its vascular layers, the full-thickness forehead flap is debulked at the second stage, taking advantage of the delay phenomenon and its new bipedicle character. It is highly vascular, and in our experience, necrosis did not occur. A thin, supple flap of even thickness is created during this

Fig. 10. Postoperative results at 1 year. No revisions were performed.
single operative stage, avoiding irregularities caused by piecemeal debulkings. With the flap almost completely elevated off its nasal inset, the exposed subsurface framework of preliminary cartilage grafts and soft tissue—healed into a solid, three-dimensional, coalesced composite—can be modified by additional delayed suture-fixated cartilage grafts, if needed, and by soft-tissue excision to form a sculptured middle layer that will show through the covering skin. With an unobstructed view, the surgeon can visualize the entire construction and the subtle requirements of contour needed to create a proportionate and attractive nasal shape.

The reliable vascularity of a full-thickness forehead flap ensures the “take” of a skin graft applied to its raw areolar surface at the time of flap transfer, and it permits folding of the forehead flap to supply both cover and lining.
Once healed in place, the skin graft or folded skin, which is now vascularized by its incorporation into the adjacent normal nasal mucosa, can be separated from the overlying cover flap and survive. After excision of excessive subcutaneous fat and frontalis muscle, delayed primary cartilage grafts, initially precluded, can now be placed on newly replaced thin supple lining.

Cartilage support is applied in stages and is coordinated with the replacement of other anatomic layers. Primary cartilage grafts are a first choice, but they can be positioned in a delayed primary fashion at the second-stage intermediate operation. An ideal rigid subsurface architecture can be created from soft and hard tissues before pedicle division almost regardless of lining techniques. In fact, it seems that the fibrosis normally associated with wound healing does not occur significantly under a full-thickness forehead flap. One might hypothesize that the absence of early flap thinning, by
avoiding injury of the subdermal, subcutaneous plane at the initial transfer, limits the fibrotic reaction and the deleterious effects of contraction. When the intermediate operation was delayed even months after forehead flap transfer, significant subcutaneous scarring did not occur. The intermediate sculpting operation can be completed with reliably supple cover and lining layers, easily molded by delayed primary support grafts.

Although intranasal lining flaps are ideal and usually are the first choice, this staged, sequential method of nasal reconstruction using full-thickness skin grafts or a folded forehead flap for lining, and primary and delayed primary placement of cartilage support grafts, is relatively simple. The reconstructed lining retains most of its original dimensions and remains thin and conforming. It is a less complex method with a shortened operative time, and it requires less manipulation of intranasal anatomy. It is useful in the elderly or debilitated patient when the risk of temporary nasal obstruction caused by crusting, edema, or intranasal bleeding should be minimized. It is also applicable when previous injury or rhinoplasty has interfered with septal blood supply, making the use of intranasal lining flaps based on the superior labial artery septal branch or the anterior ethmoid vessels unreliable. Although contraction can occur, distortion is relatively minor. The aesthetic endpoint may be less precise, but the results can be quite satisfactory. This compromised technique is applicable when less aesthetic precision is acceptable. A slightly bulkier nose with less definition may occur.

The technique ensures a maximal blood supply, a thin covering flap, unimpeded surgical exposure, controlled shaping, and the maximal use of all lining options. The aesthetic results are improved, and the need for later revisions is minimized.

The three-stage forehead flap technique of nasal reconstruction with an intermediate operation should be applied to all nasal reconstructions that require a forehead flap for the resurfacing of partial-thickness or full-thickness nasal defects, regardless of defect size or depth. It is especially useful in smokers who are at risk for forehead flap necrosis and in the reconstruction of large nasal defects that require wide thinning of the covering flap, especially with alar and columellar extensions. An exception might be an isolated alar or tip defect requiring minimal support or lining repair when the surgeon thinks that adequate distal, and then proximal, thinning is possible in two stages, without the intermediate operation.

The planned three-stage forehead flap tech-
nique of nasal repair with an intermediate operation:

1. allows the creation of a thin, supple, conforming cover from a thick forehead flap, with little risk of necrosis;
2. uses primary and delayed primary grafts and permits modification of initial cartilage grafts to correct failures of design, malposition, or scar contracture before pedicle division;
3. creates an ideal rigid subsurface framework of hard and soft tissue by cartilage grafting and subcutaneous excision, which is reflected through overlying skin and blends well into the adjacent recipient tissues before pedicle division;
4. expands the applications of lining techniques to include the use of skin grafts for lining at the first stage, or as a “salvage” procedure during the second stage, and also permits the aesthetic use of a folded forehead flap for lining;
5. shows that a skin graft or skin folded as an extension of a forehead flap integrates into adjacent normal lining and can be separated from the overlying cover from which it was initially vascularized, permitting delayed primary cartilage grafting;
6. ensures maximal blood supply and vascular safety to all nasal layers;
7. provides the surgeon with options to salvage reconstructive catastrophes;

Fig. 15. Postoperative result at 8 months. No revisions were performed.
8. improves the aesthetic result while decreasing the number and difficulty of revision operations and overall time to repair; and
9. provides insight into the nature of wound injury/repair in nasal reconstruction.

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