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Esthetic Refinements in Forehead Flap Nasal Reconstruction

Vito C. Quatela, MD; David A. Sherris, MD; Mark F. Rand, MD

Original Article

Objectives: To identify refinements in forehead flap nasal reconstruction that consistently provide better esthetic and functional results.

Design: Case series of patients undergoing forehead flap reconstruction of the nose from July 1997 to May 31, 1999.

Setting: University hospital otolaryngology departments.

Patients: Thirty-two patients with various nasal defects requiring repair.

Interventions: Modifications of paramedian forehead flap techniques, including the use of flexor donor site, Webster's closure, and creation of soft-tissue triangles. The principles of primary forehead flap design and construction are incorporated into cartilage grafting.

Results: The defect reconstruction of the nasolabial graft site is reconstructed with cartilage placed at the nasolabial fold.

Main Outcome Measures: Esthetic and functional results of nasal reconstruction were subjectively graded by the patients.

Conclusion: The procedure may require revision, but the esthetic results are generally excellent.

See Materials and Methods on next page.
MATERIALS AND METHODS

During the study period from July 1, 1987, to May 31, 1994, 32 patients underwent forehead flap nasal reconstruction in the division of Otolaryngology—Head and Neck Surgery at the University of Rochester (NY) Medical Center. Informed consent was obtained before the patients underwent treatment. The medical charts of the patients were retrospectively reviewed periodically by us for subjective analysis of results and appropriate modification of techniques. The techniques described are the result of refining this procedure during the study period.

Table 1 gives the subunits involved and reconstructed. The most common subunits that were reconstructed were the ala, sidewall, dorsum, and tip of the nose. The soft-tissue triangles and the columella were rarely deficient. Table 2 gives the tissue layers involved. Most defects involved skin and cartilage with or without a lining defect, but some involved skin only.

INDICATIONS

Guidelines for the use of the midline forehead flap in nasal reconstruction are not absolute. This flap is typically used to reconstruct defects larger than 2 cm in diameter and down to the depth of nasal cartilage or deeper. Defects of this size usually involve more than 50% of one or more subunits.

FLAP HARVEST

Some authors have described harvest of the precise midline forehead flap based on supratrochlear vascular pedicles.13,14 We prefer the paramedian forehead flap based on one supratrochlear vascular pedicle. The anatomic basis for this flap design has been described.15 The supratrochlear vascular pedicle to the nasal defect is marked after it is identified by a Doppler scope and a suture placed near the superior medial orbital. Precise identification of the vascular pedicle allows maximal narrowing of the pedicle to 0.5 cm (Figure 1). The narrow pedicle harvested from the side contralateral to the defect provides maximal flap length and ease of rotation.

The shape of the flap to be harvested is planned using a face template made from the corresponding undisturbed subunits. The flap is marked as close to the midline as the location of the vascular pedicle and hairline allow (Figure 1). This ensures closure of the donor site in the midline. Midline scars of the face, and especially the forehead, are less perceptible when healed. Some authors advocate forehead tissue expansion for reconstruction of large nasal defects. We believe that tissue expansion is indicated only in patients with less than 5 cm between the eyebrow and the hairline. We have harvested flaps measuring up to 5 × 6 cm without tissue expansion.

LINING REPLACEMENT

In full-thickness defects, the nasal lining needs to be replaced to provide a deep layer to act as a bed for cartilage grafts. Local mucosal advancement flaps can be used in small defects. Some authors have described mucoperichondrial and mucocohondial flaps from the nasal septum.16 These flaps occasionally are useful for unilateral full-thickness defects. When used for bilateral nasal lining, they result in iatrogenic nasal septal perforations, which we consider excessive donor-site morbidity. In most unilateral nasal lining defects and all bilateral nasal lining defects, we recommend the use of local epidermal turnover flaps harvested from the local nasal subunit to be reconstructed or from the adjacent nasolabial crease (Figure 2). These flaps are deepithelialized in their subcutaneous portions and are sutured into place with absorbable sutures. Commonly, transnasal bolster sutures and packing are used to obliterate dead space between the lining and structural reconstruction.

CARTILAGINOUS RECONSTRUCTION

Cartilaginous and bony structural reconstruction is done at the time of primary flap placement. Soft-tissue contracture prevents optimal results if structural reconstruction is undertaken secondarily.17 The nasal septum is the primary donor site for material to reconstruct the cartilaginous defect of the nose. The long, thick cartilage along the premaxillary crest provides excellent material for the alar reconstruction or the columellar strut. The cartilage along the bony cartilaginous junction at the ethmoid plate provides good material for the structural nasal tip graft and lateral sidewall. If not enough septal cartilage is available, auricular cartilage harvested from the conchal bowl can be used. If auricular cartilage is unavailable, rib cartilage can be harvested, although the donor-site morbidity is higher than for the other two sites.

Applying the techniques of open structural rhinoplasty,18 the cartilaginous nose can be precisely reconstructed with more preexisting structure. Because the flap acts like the skin and soft-tissue envelope in rhinoplasty, the cartilaginous reconstruction must be sounder than the natural nose to oppose the deforming forces of flap contracture. The missing cartilaginous structure is sequentially reconstructed. In cases of loss of the nasal tip, a columellar strut is placed in a pocket between the medial crura of the lower lateral cartilages just superficial to the nasal spine and fixed with 4-0 plain gut horizontal mattress sutures (Figure 3). A structural shield nasal tip graft described by Johnson et al19 is then sutured to the reconstructed nasal tip with 5-0 or 6-0 nylon sutures. The caudal medial crura are sculpted to form a cephalic bed as necessary. Multilayered tip grafts can be used to change nasal tip rotation and projection (Figure 4).

Alar rim defects are reconstructed by fixing convex batten precisely at the level of the planned alar rim caudally, rather than at the more cephalad, natural position of the lower lateral cartilage (Figure 5). This nonanatomic placement of the alar reconstruction prevents retraction at the alar rim. Medially, the alar batten is typically sutured to the medial crural remnant, the columellar strut, or the opposite lower lateral cartilage, depending on the original defect.
fect. Laterally, thealar button is fixed to the peristomeum and soft tissue at the pyriform aperture. Permanent suture material is used to prevent graft migration during flap contraction. A horizontal mattress suture of 5-0 chronic gut is placed through the button and the inner nasal lining to prevent deadspace during initial healing.

**SKIN AND SOFT-TISSUE ENVELOPE RECONSTRUCTION**

The distal one third of the midline forehead flap is thinned to the subdermal layer at the time of harvest to give better esthetic results (Figure 6). In this region of the flap, the supratrochlear vessels run superficial to the frontalis muscle and can be directly visualized during flap thinning. If the pedicle is damaged in the distal one third of the flap, this region will survive as a random flap based on the subdermal plexus. Hair follicles harvested in the flap are cut to prevent hair growth at the recipient site. The flap is inset at the alar rim with subcutaneous absorbable sutures and monofilament skin sutures. The natural, thin, webed appearance of the soft-tissue triangles cannot be reconstructed immediately with the thicker forehead flap tissue. We have found that leaving these small areas open at the time of flap inset allows healing by secondary intention that better approximates the natural appearance (Figure 7). Sutures are placed within 5 mm of the soft-tissue triangle along the alar rim and columella, thereby eliminating a notched appearance.

Horizontal mattress stay sutures of 5-0 monofilament material are placed through the outer and inner lining at the cephalic margin of the newly formed ala and are tied over external cotton bolsters (Figure 8). This maneuver fixes the distal flap and cartilage grafts at the desired level and creates the super-alar hollow in the new skin and soft-tissue envelope. The distal flap has never been lost, even with aggressive bolstering. A standard rhinoplasty dressing of taping and Aquaplast (Zimmerli Surgical Instruments, Woodland Hills, Calif) cast are always used to avoid hematoma formation. Petroleum-impregnated gauze (Xerof orm) is placed under the unattached pedicle and proximal flap. Antibiotic ointment is applied to the fresh wound edges.

**DONOR-SITE CLOSURE**

As previously explained, the donor site lies as close to the midline as anatomic constraints allow. Some authors advocate direct midline closure, while leaving the cephalic most aspect of the harvest site open to close by contracture if it is under undue tension. We prefer to use a W-plasty closure at the hairline combined with bilateral forehead advancement flaps (Figure 9). The W-plasty is planned so that three to four limbs are placed at the donor site on the cephalic side. The W-plasty is then extended to either side of the donor site at the level of the hairline. The edges of each unit of the W-plasty measures about 1 cm, and the angles of the peaks are greater than 90°. The hairline incision is beveled opposite of the direction of the local hair follicles to allow hair growth through the scar.

Subgaleal advancement flaps are elevated along the entire length of the forehead and down to the level of the superior orbital rim. Care is taken to preserve the superior orbital nerves. The galea is then closed with 3-0 absorbable sutures. The lateral-most limbs of the W-plasty on the cephalic side are sutured together, creating Burrow's triangles, and thereby avoiding "dog-ears" laterally (Figure 10). The subcutaneous tissue is closed with 5-0 absorbable suture, and the skin is closed with 5-0 monofilament suture. This technique obviates the dressing changes and wound care necessary when this area is allowed to heal by secondary intention. In addition, our technique provides scar camouflage similar to that seen with trichophytic forehead lift procedures (Figure 11).

**SECONDARY FLAP INSET**

During the 3 weeks between the primary and secondary procedures, the patient is instructed to change the petroleum-impregnated gauze under the unattached flap each day. The rhinoplasty dressing, bolster sutures, and skin sutures are removed on postoperative day 5. The patient is brought back to the operating room on day 21 for pedicle division and final flap inset. The subunits to be completely replaced are marked on the nose. The pedicle is divided carefully to leave enough tissue attached to the distal defect for closure. The pedicle remnant is replaced in the midline incision site. Minimal tissue is inset at the forehead site because attempts to return maximal tissue to the forehead at this time have not provided optimal cosmetic results. Better results have been obtained by returning tissue no higher than the level of the glabellar Brown lines (Figure 12).

The edges of the unattached flap are sharply incised, and underlying granulation tissue, fat, and subcutaneous tissue is aggressively debulked to appropriate thickness. Care is taken not to disturb the subdermal plexus or the portion of the flap that is attached to the distal nasal defect, because these structures provide the new blood supply to the flap. The feeding vessel need not be preserved at this time. The skin and soft-tissue envelope to be replaced is then excised down to the level of underlying perichondrium and periosteum. Hemostasis is achieved, and the flap is cut to slightly less than the size of the newly created nasal defect. The subcutaneous tissue is closed with 5-0 polyglycolic (Vicryl) simple buried sutures, and the skin is closed with 5-0 and 6-0 nylon sutures (Figure 12).

The wounds are dressed with antibiotic ointment and nonadhering gauze. The nose is dressed with a rhinoplasty dressing of nasal taping and aquaplast cast. The dressing and sutures are removed 5 days later. Dermabrasion to the entire nasal unit and the forehead scar is routinely performed 4 to 6 weeks after the secondary procedure. The entire nasal subunit is dermabraded for better color blending between the forehead and nasal skin.

Authors performed esthetically superior reconstruction by removing the remaining portion of the subunit and reconstructing the entire subunit with a skin graft or flap. Burget and Menick later supported the principle of subunit nasal reconstruction and emphasized...
that like tissue should be replaced by like tissue. They
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Figure 1.Planning of paramedian forehead flap
and W-plasty donor site closure.

Figure 2. Epidermal turn-in flap.

Figure 3. Columellar strut.

Figure 4. Case 3. Multilayered nasal tip graft.

Figure 5. Nonanatomic alar rim structural
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Figure 6. Case 2. Thinned distal one third of
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### Table 3. Functional and Esthetic Ratings for Nasal Reconstruction*

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<tr>
<td>Skin only</td>
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* Ratings for function are 1 (much worse than before operation) to 5 (much better than before operation), judged subjectively by patients. Ratings for esthetics are 1 (poor) to 5 (excellent), judged by three surgeons.

### Table 4. Procedures in Addition to Forehead Flap Nasal Reconstruction in 32 Patients

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**Figure 14.** Case 2. Top left, Defect after Mohs’ surgery. Top right, Planned cheek rotation flap. Bottom left, Planned forehead flap. Bottom right, Three-quarters view 11 months postoperatively.
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Revision surgery and adjunctive procedures were rarely necessary (Table 4). Dermabrasion was routinely offered, but only half of the patients elected to undergo the procedure. Injection of triamcinolone for prolonged edema and tissue deaflating was necessary in five patients. Preoperative tissue expansion was necessary in three patients. Complications resulting from forehead flap nasal reconstruction were as follows: one combined alar retraction and flap thickening that required revision surgery, one seroma that resolved with drainage, and one hypertrophic scar in the nasofacial groove that required revision surgery. No cases of airway obstruction, flap loss, cartilage graft loss, or infection were seen in the study group. Case reports are included to illustrate important points.

REPORT OF CASES

CASE 1

A 75-year-old man presented after Mohs' surgery for a nodular basal cell carcinoma. The original defect included the skin and soft-tissue envelope and cartilage loss to the depth of the inner lining of portions of the dorsal and right sidewall subunits (Figure 13, left). The patient had a cartilage graft that was sewn in place for naso-oral mucosal reconstruction. After the patient underwent forehead flap reconstruction (Figure 13, right), he reported that his function improved (5 on a scale of 1 to 5). His esthetic result was judged good (4).

CASE 2

A 48-year-old man presented after Mohs' surgery for a basal cell carcinoma of the nasofacial groove that had recurred three times. The original defect included por-
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tions of the right cheek unit, the right lateral and alar nasal subunits to the depth of the inner nasal lining, and the right soft-tissue triangle (Figure 14, top left). The cheek defect was reconstructed with a cheek rotation advancement flap (Figure 14, top right). The cartilage was reconstructed with an alar batten. The forehead flap measured 4x5 cm. The donor site was closed primarily (Figure 14, bottom left). The nasolabial groove developed a hypertrophic scar and had to be revised 3 months later. The esthetic result was judged as excellent (5)(Figure 1, bottom right), and his function was much improved (5).

CASE 3

A 70-year-old woman presented after Mohs' surgery for a recurrent morphoeform basal cell carcinoma. She had undergone glabellar flap reconstruction of the primary lesion 3 years previously. Because of her low hairline, the patient underwent forehead tissue expansion before reconstruction. Tissue expansion was done for 5 weeks. The patient then underwent reconstruction of a defect that included the entire nasal tip (including cartilaginous structure), soft-tissue triangles, portions of the anterior alar subunits, and the dorsal subunit (Figure 15, top left). The inner lining was reconstructed with two epidermal turn-in flaps. Cartilaginous reconstruction included bilateral alar battens, a columellar strut, and a multilayered nasal tip graft (Figures 3 and 4). The soft-tissue triangles were allowed to heal by secondary intention (Figure 7). Preoperative and 18-month postoperative views are shown (Figure 15). This patient underwent postoperative dermabrasion. She was also rated excellent (5) in function and esthetic results.

The combination of a vascular lining, increased structural support, a properly contoured soft-tissue envelope, and minimal donor-site morbidity results in excellent nasal reconstruction. Revision procedures are rarely necessary after secondary flap inset. In some cases, the final nasal reconstruction is more esthetically pleasing than the appearance of the nose before surgery (Figure 15, lower left and lower right). The reconstructive surgeon must strive to improve available techniques until the results of reconstruction equal or surpass the function and esthetics of the anatomic structure that has been repaired. The techniques we describe are one small step toward these final goals in nasal reconstruction.

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REFERENCES


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