Single-Stage Forehead Flap in Nasal Reconstruction

Gary M. Fudem, MD, Richard D. Montilla, MD, and Carolyn J. Vaughn, BS

Abstract: The paramedian forehead flap has become the standard of care for major nasal reconstruction. The classic procedure involves a second-stage operation to divide and inset the external pedicle. We present our experience in a clinical series using single-stage forehead flap reconstruction. Our indications include elderly patients, pediatric patients treated during mission trips, and any patient in whom an external pedicle or two-stage procedure is problematic. From 2008 to 2009, 9 patients underwent a single-stage forehead flap. The majority had defects after excision of skin cancer. Our modification involves removal of radix and proximal nasal skin and fat and deepithelialization of the proximal pedicle to allow inset without excess compression or kinking. This modification avoids the sequelae of an external pedicle, which include bleeding, dressings, the inability to wear eyeglasses, and the patient’s reluctance to appear in public. It safely provides acceptable results and avoids a mandatory secondary procedure.

Key Words: nasal reconstruction, forehead flap, single-stage forehead flap, nasal defects, nasal lining

The median and paramedian forehead flaps and their variations are considered as the procedure of choice for extensive nasal defects caused by trauma or cancer resection. The skin of the forehead closely matches the tip and alar subunits of the nose in both color and texture. The forehead flap has been used in nasal reconstruction for centuries, beginning in India as early as 1000 B.C. The classic Indian forehead flap had a midline design with a wide pedicle based above the eyebrow, which received its blood supply from paired supratrochlear vessels and sometimes included the supraorbital artery. This flap had a limited arc of rotation and created significant tension on the vessels. Later, anatomic studies demonstrated that a paramedian forehead flap based on a narrow pedicle receiving rich blood supply from 1 supratrochlear artery and the angular artery could be used. The narrow pedicle allows for a greater arc of rotation and flap reach without compromising viability. The paramedian forehead flap is now the workhorse for nasal reconstruction and is most commonly used as an axial flap, requiring a second-stage procedure to divide the external pedicle. Disadvantages of the external pedicle include increased time off work, wound care, inability to wear eyeglasses, and creation of an unsightly “elephant trunk” that leads most people to remain out of the public eye during the 3 to 6 week interval between procedures.

Converse and Wood-Smith described the first single-stage forehead flap found in the literature, which was an island midline forehead flap based on a wide pedicle. The flap was tunneled under intact glabellar skin, which led to significant venous congestion and fullness in the glabellar region, thus limiting the use of this design. More recently in the literature, single-stage forehead flaps have been described mostly for reconstruction of small nasal defects with tunneling of the flap under intact glabellar skin. Park’s modification is a single-stage flap with a narrow pedicle based on the medial brow region. To reduce venous congestion, Park resected the procerus muscle and undermined in the glabellar region. Adigun et al published a case report of a single-stage forehead flap used for reconstruction in a man with complete loss of nasal cover and lining after facial trauma.

Our modification involves several maneuvers to allow easy transposition of the flap and minimize kinking and compression of the pedicle. Bilateral corrugator muscles are released to prevent tethering of the flap. Limited undermining in the medial canthal area is done to maintain perioveal attachments and the medial canthal concave contour. Tunneling under glabellar skin is avoided by removal of radix and proximal nasal skin and fat and deepithelialization of the proximal pedicle (Fig. 1A, B). For full-thickness nasal defects higher on the nose, the proximal nasal skin and fat can be used as a hinge-flap for nasal lining. This skin and fat can also be used as a deepithelialized flap to augment the dorsum of the nose. The donor site is closed primarily or the superior portion can be left to heal by secondary intention. A single-stage reconstruction may be preferable in any patient with a large nasal defect. Our indications include elderly patients, pediatric patients treated during a mission trip where a 3 to 6-week interval before a second procedure is not feasible, and any patient in whom an external pedicle is problematic.

METHODS

A retrospective analysis of our series of forehead flaps was performed. Nine patients underwent nasal reconstruction with a single-stage forehead flap between 2008 and 2009. The patients ranged in age from 8 to 88 years old with a mean age of 53.5 years. Four patients were female, and 5 patients were male. Eight patients had basal cell carcinoma (BCC). Four of these patients also had concurrent squamous cell carcinoma (SCC). One patient had BCC and melanoma in situ. Three pediatric patients had xeroderma pigmentosa. One patient had severe rhinophyma. Three patients had full-thickness defects requiring replacement of intranasal lining. Full-thickness skin grafts were used for 2 patients, and a hinge-flap of proximal nasal skin was used for nasal lining in the third patient. Two patients had placement of conchal cartilage grafts at the first procedure. One patient, who had a full-thickness skin graft for lining during the initial procedure, had conchal cartilage graft placement at a second procedure. Three patients had elective aesthetic contouring of the flap as a secondary procedure. Patient demographics are outlined in Table 1.

CASE REPORTS

Case 1 is a 71-year-old man with rhinophyma of the nose, who presented with a severe nasal deformity and collapse of bilateral nasal alae with respiratory obstruction (Fig. 2A). The patient had undergone a deep shave procedure in the 1980s and had recurrence within 5 years. He underwent radical excision to remove involved skin and subcutaneous tissue (Fig. 2B). He was reconstructed with a right paramedian forehead flap. Auricular cartilage grafts were harvested from the left conchal bowl and placed along...
bilateral rims to reinforce attenuated native cartilage. The inferior portion of the donor site was closed primarily, and the superior portion was allowed to heal by secondary intention. Postoperatively, the patient had purulent drainage at the junction of the flap and the vestibular lining, which responded to antibiotics. Persistent right external valve collapse after the initial procedure was corrected with additional cartilage grafting and debulking of the flap at 11 and 20 weeks (Fig. 2C). The patient was happy with the result both functionally and cosmetically.

Case 2 is a 65-year-old man with BCC of the dorsum of the right nose, who underwent excision leaving a full-thickness defect of the right nose extending to the right cheek. The majority of the right nasal bone and dorsal septal cartilage as well as the right upper lateral cartilage and the cephalic portion of the right lower lateral cartilage were resected to obtain clear margins (Fig. 3A). A left paramedian forehead flap was raised. A full-thickness skin graft was harvested from the right supraclavicular area and was used to replace nasal mucosa. The superior area of the forehead donor site was allowed to heal by secondary intention (Fig. 3B). On follow-up, there was slight retraction of the nasal ala and some internal and external valve collapse because of lack of cartilaginous support. Although the patient was content with his result, there was concern that this retraction and collapse may be progressive. Therefore, the patient was returned to the operating room 10 weeks later to reinforce the right alar rim and upper lateral cartilage using auricular cartilage (Fig. 3C).

Case 3 is a 10-year-old girl with xeroderma pigmentosa from Guatemala seen during a mission trip, who presented with invasive SCC of the nose and right cheek. She underwent excision of the lesions and reconstruction with a paramedian forehead flap that extended onto the cheek and a V-Y advancement flap for the remainder of the cheek defect. Three patients from Guatemala with xeroderma pigmentosa were reconstructed with a single-stage paramedian forehead flap. Follow-up with these patients showed they had healed well. Photos of these patients are not included due to difficulty obtaining photo consent.

**DISCUSSION**

The nose is the most prominent facial feature and therefore has significant aesthetic importance. The complexities of the nose

---

**TABLE 1. Patient Demographics**

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Risk Factors</th>
<th>Etiology</th>
<th>Procedure</th>
<th>Anesthesia</th>
<th>Complications and Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>71</td>
<td>M</td>
<td>Tobacco</td>
<td>Rhinophyma</td>
<td>Forehead flap + conchal cartilage graft</td>
<td>General</td>
<td>Infection, resolved with antibiotics and local treatment</td>
</tr>
<tr>
<td>67</td>
<td>M</td>
<td>Tobacco</td>
<td>SCC, recurrent BCC</td>
<td>Forehead flap + FTSG + transposition flap lower eyelid</td>
<td>Local</td>
<td>Necrosis of distal 2 mm of flap, healed secondarily</td>
</tr>
<tr>
<td>84</td>
<td>M</td>
<td>BCC</td>
<td></td>
<td>Forehead flap + hinge flap + conchal cartilage graft</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>M</td>
<td>BCC</td>
<td>BCC</td>
<td>Forehead flap + FTSG</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>F</td>
<td>Tobacco</td>
<td>Malignant melanoma in-situ, BCC</td>
<td>Forehead flap</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>88</td>
<td>M</td>
<td>BCC</td>
<td></td>
<td>Forehead flap</td>
<td>Local</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>XP</td>
<td>SCC, BCC</td>
<td>Forehead flap + V-Y flap on cheek for second cancer</td>
<td>General</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>XP</td>
<td>SCC, BCC</td>
<td>Forehead flap + hinge-flap to augment dorsum</td>
<td>General</td>
<td>Venous congestion, resolved within 24 h</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>XP</td>
<td>SCC, BCC</td>
<td>Forehead flap</td>
<td>General</td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 1.** A, Deepithelialization of proximal pedicle and limited undermining in medial canthal area; B, elevated paramedian forehead flap; and C, 1 day postoperatively.
with its irregular contours, differences in skin thickness and texture, and functional intricacies make its reconstruction a challenge to the surgeon. Several local tissue options are available for nasal reconstruction including the nose itself, forehead, cheek, and periauricular area. The choice of reconstruction depends on the size and location of the defect and the individual needs of the patient.

Local flaps can be used for reconstruction of small nasal defects. The nasolabial flap may be appropriate for reconstruction of the alar subunit or lateral nasal wall trying to avoid violation of the alar-cheek crease and has been described as a two-stage or single-stage repair. Full-thickness skin grafts can be used to resurface small defects of the bony upper portion of the nose. Skin grafts require a highly vascular bed, and vascularity of the exposed periosteum or perichondrium must be intact for overlying skin grafts to survive. Effective compression for engraftment is difficult over the cartilaginous lower portion of the nose.

The forehead flap has been reliably used for nasal reconstruction for centuries and has many advantages such as its position adjacent to the nose, the similarity of its complexion and texture to the nose, and the amount of tissue available for resurfacing. For full-thickness nasal defects, external tissue coverage alone is not sufficient for a good result. These reconstructions require attention to both nasal lining and structural framework. Without replacement of nasal lining and semirigid support, the area will eventually heal by secondary intention, but often with significant contraction and distortion of the aesthetic and functional form of the nose. Several options exist for reconstruction of the internal lining. Traditionally, the forehead flap was used to recreate nasal lining by folding the

FIGURE 2. A 71-yr-old man with severe rhinophyma. A, Preoperatively; B, nasal defect with planned reconstruction; and C, 10 months after initial surgery and 3 months after placement of auricular cartilage grafts to bilateral alar rims and debulking of the flap.

FIGURE 3. A 65-yr-old man with BCC of right nose. A, Full-thickness defect after excision; B, postoperatively; and C, 6 months after surgery.
distal edge, but this is often too bulky creating nasal obstruction. Local lining from the vestibule, septum, and middle vault provide thin vascularized tissue that does not distort overlying skin or cartilage grafts or obstruct breathing. A bipedicle chondromucosal flap or a transposition flap of vestibular skin based medially or laterally can be advanced inferiorly to line small defects of the ala and nostril margin. Most often local flaps are inadequate because of tenuous vascularity leading to ischemia and contraction. The lining requirements of the undulating contours of the nose are often underestimated.

When there is not sufficient local tissue to replace large defects in nasal lining, full-thickness or thick split-thickness skin grafts can be used. In this case series, full-thickness skin grafts were used in 2 patients. One patient had a large nasal defect that required a full-thickness skin graft from the supraclavicular area. A second patient had a full-thickness skin graft harvested from the intervening skin between the defect on the lower third of the nose and the glabellar region. A hinge-flap of external skin can be turned in and faced intranasally to reconstruct nasal lining. An advantage of this flap, when using our technique, is that it uses tissue from the proximal sidewall subunit that would otherwise be discarded. Because it is vascularized, it allows for simultaneous cartilage grafting during the initial reconstruction. A hinge-flap of proximal nasal skin was used in one patient in this series.

The soft tissue cover and lining will collapse and contract without proper skeletal support. The alar rim must be reinforced with cartilage grafts even though there is no native cartilage in this area. Conchal cartilage grafts are typically used for reinforcement of the alar tip and lobule, where as stiffer septal cartilage may be preferable to reinforce the sidewall and middle third. We have used conchal cartilage for all grafts rather than violating the septum. To resist the contraction of a forehead flap, cartilage grafts can be placed within the flap. The forehead flap is a bilaminar structure, and cartilage grafts can be placed within tunnels made between the 2 lamellae and a full-thickness skin graft can be simultaneously placed on the raw undersurface of frontalis muscle of the flap. Both cartilage grafts and the skin graft receive adequate vascular supply. When a large lining skin graft was required, we chose to place cartilage grafts secondarily after the skin graft had vascularized. Using a thick split-thickness skin graft for lining is adequate to avoid contraction as long as there is skeletal support. Graft take is easier than with a full-thickness graft. These grafts can be harvested with a dermatome or scalpel. The donor site can be closed primarily or left to heal secondarily in the case of split-thickness grafts.

CONCLUSIONS

A single-stage reconstruction has many advantages over a two-stage, or three-stage reconstruction. A single-stage repair avoids the disfiguring “elephant trunk” deformity of the external pedicle. This exposed external pedicle is unsightly causing many patients to remain out of work or the public during the interval between procedures, precludes the use of eyeglasses, and can be a source of bleeding and drainage. In the case of a full-thickness defect where a full-thickness skin graft is used to replace nasal lining, a second procedure may be necessary for cartilage grafting. These secondary procedures are minor procedures often done under local anesthesia. At the time of the second procedure, the flap can be debulked for improved aesthetic result. In this series, no patients had revisions to the glabellar region. This single-stage forehead flap safely provides acceptable results for a subset of patients in which a two-stage procedure is problematic or not feasible.

ACKNOWLEDGMENT

Informed patient consent has been obtained for publication of the figures in this article.

REFERENCES