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Double forehead flap reconstruction of composite nasal defects

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Summary *Background and aim:* Composite nasal defects require skin, framework, and lining reconstruction. The forehead flap is an ideal donor for skin coverage because of good color match and excellent donor-site healing. Intranasal flaps and grafts are reserved for lining reconstruction of small defects. Locoregional and free flaps are used for larger lining defects, but these may not be ideal or safe. The authors advocate the double forehead flap for large composite defects of the nose in a subset of patients.
Methods: Three men and three women aged 55–87 years (average 74.7 years) were treated for composite nasal defects that resulted from cancer ($n = 5$) and trauma ($n = 1$). Skin and lining defects were >2 cm in every dimension. Double forehead flaps were raised in stages ($n = 1$) or simultaneously ($n = 5$), and nasal reconstruction was performed in two ($n = 1$) or three stages ($n = 5$).
Results: Patients were followed for 19.3 months (range 13–24 months). Donor sites of flaps raised in stages healed after 3 months. When flaps were raised together, healing required 5–13 months (average 7.6 months). There were no partial or complete flap losses. None of the patients had infection, hematoma, or nerve injury. Satisfactory aesthetic results were achieved in every case.
Conclusion: The authors advocate the double forehead flap for large composite nasal defects in patients who are not suitable candidates for nasolabial flaps and those who may not tolerate free tissue transfer. The advantages of this method must be weighed against the drawbacks, which include prolonged donor-site healing and elimination of the contralateral forehead flap.

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Introduction

The nose is a psychologically significant central facial structure with intricate aesthetic and functional features. Unique shadows and contours of the nasal dorsum are found nowhere else on the body; full-thickness defects must be rebuilt from scratch. Three specialized layers, lining, skeleton, and skin, must be restored as thin as possible to maintain airway patency and achieve an acceptable aesthetic result.[1–3] Full-thickness nasal defects are challenging because the aesthetic demands of nasal skin resurfacing and the functional demands of lining replacement are stringent. When local flaps and grafts are inadequate, the forehead is a dependable option for dorsal resurfacing because of its reliability and anatomic likeness to nasal skin.[2,4]

The choice for lining replacement is not as straightforward. Traditional methods for lining reconstruction range from skin grafting to free flaps, with each option having its advantages and limitations.[5] The forehead flap is a well-known option for lining replacement because it is thin and pliable, and the donor site is tolerant to healing by secondary intention. However, for full-thickness injuries, the forehead is traditionally reserved for skin cover. In some cases, the flap can be folded to recreate the lining, sparing the contralateral forehead flap for recurrence in oncologic reconstruction, or salvage. When the lining defect is extensive, traditional options such as intranasal lining flaps will not suffice. Free tissue transfer is a good option,[1,3,6,7] but the contralateral forehead flap should not be overlooked.

Reconstruction of the nose is the priority of the authors. Although there are limitations, the authors endorse composite nasal reconstruction using paired forehead flaps[8] for sizeable full-thickness defects of the nose in patients who cannot tolerate or choose not to undergo nasolabial or free flap lining reconstruction. The authors present the indications, surgical technique, and rationale for paired forehead flap reconstruction of composite nasal defects.

Patients and methods

Three men and three women aged 55–87 years (average 74.7 years) presented with large composite nasal defects following trauma in one case and tumor extirpation in five (Table 1). Patients were of Taiwanese ethnicity. Their skin defects ranged from 2.5 × 3 to 7 × 6.5 cm, and their lining defects ranged from 2 × 2 to 3 × 3 cm. Informed consent was obtained before the patients underwent treatment. Five patients had medical comorbidities including hypertension (four cases), diabetes mellitus type II (one case), cirrhosis (one case), and Parkinson's disease (one case).

Indications (Table 2)

Patients included in this series had lining defects >2 cm in every dimension. Patients of advanced age and those with medical comorbidities who were not ideal candidates for free flap reconstruction were selected for this operation. Alternatively, patients who refused free flaps or other regional flaps because of donor-site functional or aesthetic

Table 1 Patient demographics and outcomes.

Age/sex	Comorbidities	Etiology	Subunit involvement	Skin defect, cm	Lining defect, cm	Flap harvest staging	Additional flap	Framework grafts	Donor defect, cm	Follow-up, months	Donor-site healing, months
57/M	ESLD	BCC	Left cheek, sidewall, dorsum, ala	7 × 6.5	3 × 3	Two stages	cheek advancement	costal	3 × 3 (lining) 3 × 3 (cover)	34	3
81/F	HTN	BCC	Right sidewall, dorsum, ala	2.5 × 3	2 × 3	Single stage	cheek advancement	septal and conchal	7 × 8	25	8
84/M	HTN	BCC	Left sidewall, dorsum, ala	3.5 × 2.5	2.5 × 3	Single stage	cheek advancement	conchal	8 × 10	20	6
87/M	HTN	BCC	Bilateral sidewall, ala, dorsum, tip	3.5 × 3	2 × 2	Single stage	—	conchal	7 × 10	24	13
55/F	—	Trauma	Left sidewall, ala, tip	4 × 3	2 × 3	Single stage	—	conchal	8 × 9	13	5
84/F	PD, HTN, and DM	BCC	Right lower eyelid, cheek, lip, sidewall, ala, dorsum, tip, columella	6 × 6	2.5 × 3	Single stage	cheek advancement	conchal	8 × 9	12	6

ESLD, end-stage liver disease; HTN, hypertension; PD, Parkinson's disease; DM, diabetes mellitus type II; BCC, basal cell carcinoma.

Table 2 Relative indications for double forehead flap reconstruction in this series.

Indication	Case example
Lining defect >1.5 cm in any dimension	1, 2, 3, 4, 5, 6
Lining defect extends beyond the reach of the nasolabial fold flap	1, 2, 3, 4, 5, 6
Elderly patient	2, 3, 4, 6
Significant medical comorbidity	5
Patient prefers single donor site	2

concerns were included. Finally, when the lining defect was too cephalad (i.e., at the proximal dorsum, tip, or sidewall) for locoregional options to reach, a second forehead flap was used for lining reconstruction.

Operative technique

Staging of reconstruction

Double forehead flaps were raised together in five cases and separately in one case. When the flaps were raised separately, the lining flap was raised first and then inset (Figure 1). Lining flaps were inset to existing nasal lining margins. In some cases where the existing lining was thin or fragile, holes were drilled to underlying bone to stabilize the interface.

The lining flap was covered with a skin graft or suitable dressing to minimize interval contracture. The framework was either prelaminated at that stage or placed during the second stage when the covering flap was raised. When flaps were raised together, the cartilage framework was placed at the same time as a composite "sandwich" between flaps (Figures 2–4).

Harvest of forehead flaps

Procedures were performed under general anesthesia. Conventional methods were followed in three stages[2] in patients who could safely tolerate several operations. Defects were recreated on a foil template. The supratrochlear artery was identified by Doppler examination. When flaps were raised simultaneously, the first reconstructive stage was flap elevation and transfer. Preservation of periosteum and areolar tissue was of greater focus than with traditional forehead flap reconstruction to facilitate secondary healing of a larger donor site. Efforts were made to identify the vascular pedicle and maximize dissection along the supraperiosteal plane toward the supraorbital rim.

Skin defects tended to be larger than lining defects and extended more distally. To accommodate the discrepancy, the authors used the ipsilateral forehead flap for skin replacement and the contralateral forehead flap for lining. In some cases where the skin and lining defects were similar in size and extent, the ipsilateral forehead flap was used for lining because the lining defect was deeper. This decision was made on a case-by-case basis.

Three-stage forehead flap reconstruction was performed in five cases, and a two-stage reconstruction was performed in one patient to reduce anesthesia risk from an additional operation. Defects were minimized with cheek advancement flaps in four cases. Autologous cartilage was used in every reconstruction, taken from the rib (one case), septum and concha (one case), and concha alone (four cases).

Donor-site management

The donor-site defect was closed primarily when possible; resultant defects healed secondarily. To facilitate secondary healing, petrolatum gauze was placed over the defects and bolstered with 4/0 nylon sutures for 1 week. After a week, pressure dressings were replaced by IntraSite hydrogel and covered with Allevyn (Smith & Nephew, Inc., Andover, MA, USA) daily for 1 week, and then every other day until healing was complete.

Pedicle division

In the intermediate stage, soft tissue thinning and sculpture of the lining flap was combined with cartilaginous reinforcement or modulation and division of the lining flap pedicle 3 weeks after inset. The forehead flap was elevated completely and the lining tissue was thinned at this stage. Three weeks later, pedicle division of the skin

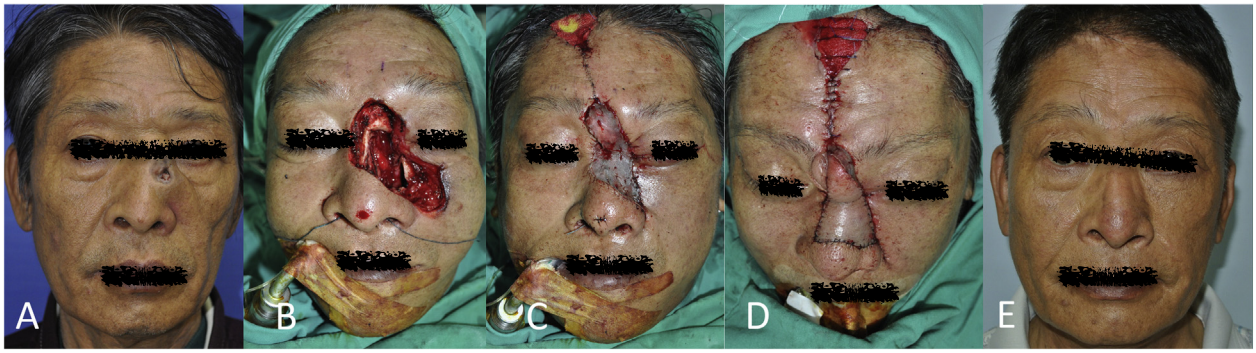

Figure 1 A. A 57-year-old man with end-stage liver disease was treated for basal cell carcinoma of his nose. A 7 cm × 6.5 cm skin defect and 3 cm × 3 cm lining defect involved the left cheek, nasal sidewall, dorsum, and ala. B. In a staged reconstruction, the cheek was advanced and a right forehead flap was used to cover the defect and lined with a skin graft. C. Four weeks later, the left paramedian forehead flap provided skin coverage and costal cartilage graft was used to provide framework. D. Photographs taken at 34 months demonstrate the appearance of the donor site that was healed at 3 months, and the reconstructed nose.

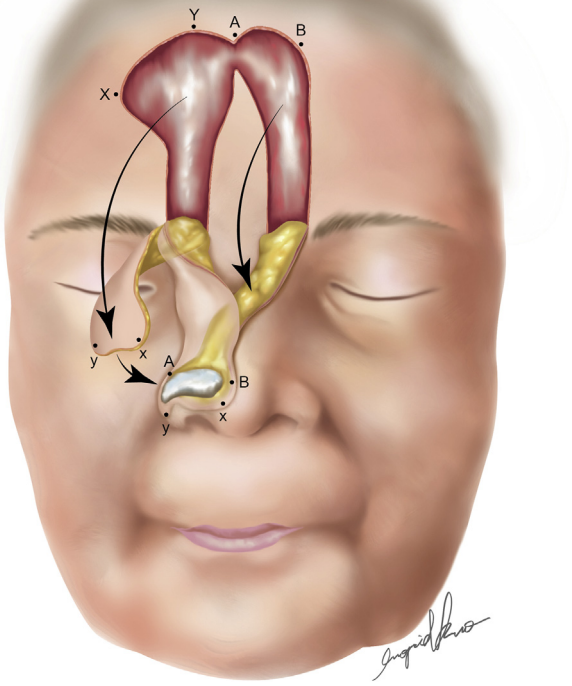

Figure 2 When double forehead flaps were raised together, the cartilage framework was placed at the same time as a composite "sandwich" between flaps.

cover flap was accomplished in the third stage. In the two-stage nasal reconstruction case, both pedicles were divided at 4 weeks.

Results

Patients were followed up for 19.3 months (range 12—34 months). Satisfactory aesthetic results were achieved in every case. After staged forehead flap harvest, each of the lining and cover flap defects was 3 × 3 cm. After simultaneous flap transfer, donor-site defects were 7—9 cm long by 8—10 cm wide. All donor sites healed uneventfully. When the flaps were raised separately, donor-site healing occurred at 3 months. When the flaps were harvested together, healing required 5—13 months (average 7.6 months). There were no partial or complete flap losses. None of the patients had infection, hematoma, or nerve injury. Our patients had no complaints of airway obstruction, and examination with a nasal speculum did not reveal obstructive nasal valvular collapse.

Discussion

The forehead flap is a mainstay of nasal reconstruction with numerous indications. Traditionally, it has been used for skin coverage, but it can be folded to provide lining. Alternatively, skin grafts can be used for lining, as well as intranasal mucosal flaps, locoregional flaps such as the nasolabial flap, composite grafts, or free flaps. Intranasal lining flaps provide thin, pliable, and dependable coverage. Although we did not formally study airflow with flowmetry or endoscopy, there were no complaints of airway obstruction, and the thinned forehead flap was thinner than any described free flap. Unfortunately, intranasal lining flaps may be limited in availability, unpredictable in smokers, may be friable, and can lead to heavy bleeding during harvest. A patchwork of smaller flaps may not support large cartilage grafts and late stenosis may be encountered.[8] These and composite grafts are most suitable for smaller defects.

For larger defects, the forehead flap used to cover the external defect should be paired with another flap. Nasolabial flaps are characteristically thick and both obstruct the airway and may bulge externally. In addition, the alar crease is effaced, a scar is generated on the central face, and the flap may not reach. Free flaps such as the radial and ulnar forehead flaps are robust, dependable, and time proven, but they confer important donor-site morbidity and scarring that may not be tolerated.[9,10] Abundant tissue may obstruct the airway and total flap loss may occur. More importantly, not all

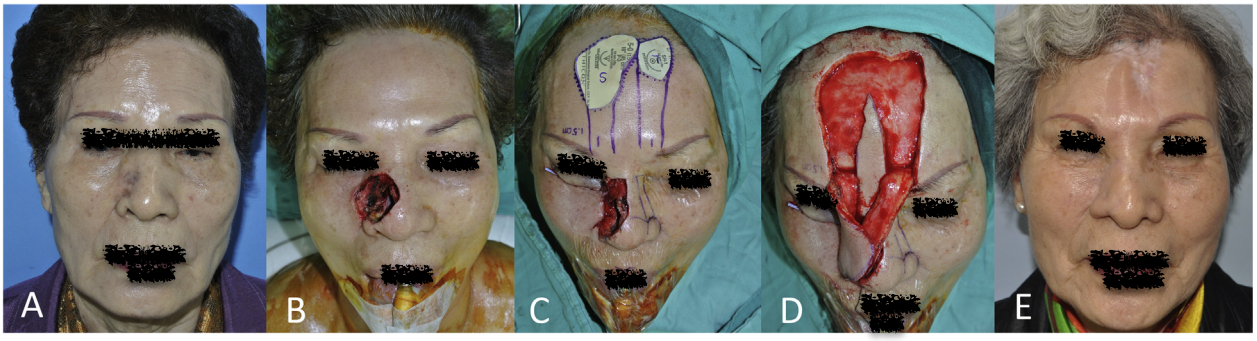

Figure 3 A. An 81-year-old woman with hypertension was treated for recurrent basal cell carcinoma of her nose. A 2.5 cm × 3 cm skin defect and 2 cm × 3 cm lining defect involved the right sidewall, dorsum, and ala. B, C. In a single reconstruction, the cheek was advanced and bilateral forehead flaps were raised to sandwich septal and conchal cartilage grafts. The donor-site defect was 7 cm × 8 cm. At 3 weeks, the skin flap was thinned and the lining flap pedicle was divided. Three weeks later, the pedicle for the covering flap was divided. D. Photographs taken at 25 months demonstrate the satisfactory donor-site appearance that took 8 months to heal, and the reconstructed nose.

Figure 4 A. An 87-year-old man was treated for huge basal cell carcinoma of his nose. A 3.5 cm × 3 cm skin defect and 2 cm × 2 cm lining defect involved bilateral sidewall, dorsum, tip, and ala. B, C. In a single reconstruction, bilateral forehead flaps were raised to sandwich conchal cartilage grafts. The donor-site defect was 7 cm × 10 cm. D. Photographs taken at 24 months.

patients are candidates for free tissue transfer. Elderly patients who require rhinectomy for advanced skin neoplasms tend to have medical comorbidities and may not tolerate a lengthy operation or have reliable vasculature. Finally, microsurgical resources and expertise may not be available.

A second forehead flap should therefore be considered in elderly or sick patients with large lining defects. Generally, flaps are raised simultaneously to avoid an additional operation and associated risks of anesthesia. However, staged harvest is amenable to rapid donor-site healing, as two smaller donor sites are addressed at separate stages. In our series, healing was complete at 3 months versus 7.6 months in patients whose flaps were raised together. Prolonged healing is inconvenient for both patient and provider, and may be costly with the rising cost of wound care supplies. In addition, should cancer recur, an important donor resource is no longer available. Of course, nasolabial flaps and free tissue may be transferred in such cases. Based on the significant drawbacks associated with prolonged healing and tumor recurrence, reconstructing the nose is the authors' first priority. The double forehead flap accomplishes that goal with excellent aesthetic and functional results.

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