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Aesthetic Refinements in Forehead Flap Reconstruction of the Asian Nose

Les améliorations de la reconstruction du nez asiatique par lambeau frontal

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Abstract

Background: Traditional paramedian forehead flap reconstruction exploits the aesthetic subunit principle. Refinements and outcomes of forehead flap nasal reconstruction largely reflect Western experience. Differences in ethnic Asian anatomy and wound healing may foster suboptimal outcomes. We modified methods to address Asian features by extending subunit and flap boundaries, minimizing flap thinning, and overbuilding the nasal framework to combat contraction and suboptimal scarring. **Methods:** Between November 2010 and September 2015, 40 Asians were treated for nasal reconstruction with a modified forehead flap technique. Average age of 26 men and 14 women was 50.2 years (range: 10-87 years). Oncologic, traumatic, congenital, and infectious defects involving 1 (37%) or more (63%) subunits were reconstructed. Modifications to the classic forehead flap were extension of involved subunits and flap, conservative flap thinning, and framework overbuilding. **Results:** Patients were followed for 20 months (range: 16 months to 4 years 8 months). Nasal lining was reconstructed with hinge-over lining flaps, forehead flaps, free flaps, or regional flaps. Cartilage was reconstructed in 44 (88%) patients with autologous septum or ear in 33 (75%) cases. Costal cartilage was needed in 11 (25%) cases. In 48 (96%) cases, the ipsilateral forehead was used. There were 5 (10%) wound infections, 2 (4%) dehisced wounds, and 2 (4%) occurrences of distal flap necrosis. Nasal aesthetic results were 72.6% good, 23.3% fair, and 4% poor. Donor site aesthetic results were 74% good and 26% fair. Three case reports are included. **Conclusion:** We report favourable results of forehead flap nasal reconstruction using refinements tailored to ethnic Asians.

Résumé

Historique : La reconstruction paramédiane classique par lambeau frontal fait appel au principe esthétique des sous-unités. Les améliorations et les résultats cliniques de la reconstruction nasale par lambeau frontal reflètent largement l'expérience occidentale. En raison des différences dans l'anatomie et la guérison des plaies des Asiatiques, les résultats peuvent être sous-optimaux. Les chercheurs ont modifié la méthodologie pour tenir compte des caractéristiques asiatiques. Ainsi, ils ont étendu les attaches des sous-unités ou du lambeau, réduit l'amincissement du lambeau et surconstruit la structure nasale pour éviter une contraction et une cicatrisation sous-optimale. **Méthodologie :** En novembre 2010 et en septembre 2015, 40 Asiatiques ont subi une reconstruction nasale au moyen d'une technique de lambeau frontal modifiée. Les 26 hommes et les 14 femmes avaient un âge moyen de 50,2 ans (plage de dix à 87 ans). Des anomalies oncologiques, traumatiques, congénitales et infectieuses touchant une (37 %) ou plusieurs (63 %) sous-unités ont été reconstruites. Le lambeau frontal classique a été modifié par l'extension des sous-unités et du lambeau, l'amincissement limité du lambeau et la surconstruction de la structure. **Résultats :** Les patients ont été suivis pendant 20 mois (plage de 16 mois à quatre ans et huit mois). La paroi nasale a été reconstruite au moyen de lambeaux qui se chevauchaient sur la paroi, de lambeaux frontaux, de lambeaux libres ou de lambeaux régionaux. Chez 44 patients (88 %), le cartilage a été reconstruit à l'aide d'une cloison autologue et dans 33 cas (75 %), à l'aide d'une oreille autologue. Il a fallu utiliser du

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cartilage costal dans 11 cas (25 %). Dans 48 cas (96 %), la partie ipsilatérale du front a été utilisée. Il y a eu cinq infections de la plaie (10 %), deux plaies déhiscentes (4 %) et deux occurrences de nécrose du lambeau distal (4 %). Les résultats esthétiques du nez étaient bons à 72,6 %, acceptables à 23,3 % et mauvais à 4 %. Les résultats esthétiques au site du donneur étaient bons à 74 % et acceptables à 26 %. Trois rapports de cas en faisaient partie. **Conclusion :** Les auteurs rendent compte des résultats favorables de la reconstruction du nez par lambeau frontal grâce à des améliorations adaptées à l'ethnie asiatique.

Keywords
nasal reconstruction, forehead flap, cartilage framework

Introduction

The nose is a psychologically significant central facial structure with intricate aesthetic and functional qualities that can be considerably challenging to reconstruct. 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. Lining and skeletal reconstruction is an intricate science that should be approached on a case-by-case basis. When local flaps and grafts are inadequate, the forehead is a superb option for dorsal resurfacing because of its reliability and likeness to dorsal skin. Judicious skin harvest is advocated, but unobtrusive scarring can be expected after secondary healing at this privileged site.

The science of nasal reconstruction has advanced significantly since its origins in ancient India.[1] In the modern day, refinements founded largely—if not entirely—in the Western world have the potential to indiscernibly reconstruct unsightly defects in 1 or more stages.[2-11] Unfortunately, these methods may not be appropriate for all populations as cultural, anatomic, and physiologic distinctions cannot be ignored. An emerging popularity in facial plastic surgery has uncovered new guidelines, nuances, and standards tailored to ethnic Asians.[12,13] The challenges we face in aesthetic rhytidectomy and rhinoplasty do not spare reconstruction. In addition to unfavourable scarring, a weak skeletal foundation and unforgiving skin envelope generate scarce donor tissue and imposing forces in Asian patients.

We follow a different set of guidelines in aesthetic surgery of the Asian nose; this is the topic of innumerable texts and scientific articles.[12-20] In the same way, methods established in the Western world can and should be refined to reflect the ethnic Asian nose.[21,22] Early experience at this centre revealed a need for enhanced structural support, a tendency for unfavourable scarring, and increased flap bulk in our patients compared to Caucasian counterparts. This retrospective series is the first to examine an ethnically sensitive approach to forehead flap nasal reconstruction aimed at guiding patient and physician expectations.

Patients and Methods

During the study period from November 2010 and September 2015, 40 ethnic Asian patients were treated at this centre for nasal reconstruction with the modified Asian forehead flap technique. Informed consent was obtained before the patients underwent treatment. Medical charts were reviewed retrospectively to obtain accurate patient history and procedures and to analyze outcomes. Patients with prior tissue expansion were excluded. The average age of patients was 50.2 years (range: 10-87 years). There were 26 men and 14 women. Twenty-five (62%) defects were the result of tumour extirpation. The remaining 15 reconstructions included 7 (17%) post-traumatic deformities, 6 (15%) congenital deformities, and 2 (5%) post-infectious deformities. Six patients were irradiated preoperatively. Table 1 includes the tissues and subunits that were reconstructed. In 15 (37%) patients, 1 subunit was involved; in 19 patients, multiple subunits were involved; and 6 (15%) patients had total nasal loss. The most common subunits reconstructed were the ala, tip, side wall, and dorsum.

Operative Technique

Paramedian forehead flap. There are no absolute guidelines indicating forehead flap reconstruction. In general, defects were larger than 1.5 cm and involved 2 or more layers. Procedures were performed under general anaesthesia. Conventional methods were followed in 3 stages—after appropriate wound, oncologic, and infectious control, nasal subunits and the defect were recreated on a foil template. The supratrochlear artery was precisely identified by Doppler examination. The first reconstructive stage included flap elevation and transfer with or without cartilaginous reconstruction. The donor site defect was closed primarily as possible; resultant defects healed secondarily. In a subsequent stage, soft tissue thinning and sculpture was combined with cartilaginous reconstruction or modulation. Pedicle division was accomplished in the final stage. Lining was reconstructed with hinge-over flaps, local flaps, or free tissue if forehead tissue was not used. When indicated, minor revisionary procedures to improve aesthetic and functional results were performed under local anaesthesia; major procedures were performed under general anaesthesia.

Refinements by stage

1. Defect extension (stage 1)

   The aesthetic units were marked per routine. The boundaries of involved units were extended beyond traditional margins on all sides. Conventional rules applied—When defects encompassed the majority of a traditional subunit, the whole of

Table 1. Patients' Information.

Defect	Sum	Etiology: Congenital	Etiology: Trauma	Etiology: Cancer	Etiology: Infection	Skin Defect: Subunit (S) Involved	Skin Defect: Subunit (S) Involved	Cartilage Donor Site: Ear	Cartilage Donor Site: Septum	Cartilage Donor Site: Ear + Septum	Cartilage Donor Site: Rib	Lining Reconstruction: Hinge-Over	Lining Reconstruction: Forehead Flap	Lining Reconstruction: Regional Flap	Lining Reconstruction: Free Flap	Complications: Infection	Complications: Dehiscence	Complications: Necrosis
Single subunit	15	2	3	10	0	T	3	5	2	0	0	6	8	0	0	0	0	0
						A	10											
						D	2											
Multiple subunits	19	4	4	10	1	A S	1	1	6	9	5	15	5	4	3	2	2	1
						A T	2											
						T C	2											
						D S	3											
						A D S	3											
						A T C	3											
						T D S	3											
						T D S C	2											
Total nose	6	0	0	5	1			0	0	0	6	2	0	0	6	3	0	1
Sum	40	6	7	25	2			6	8	9	11	23	13	4	9	5	2	2

Abbreviations: A, ala; C, columella; D, dorsum; S, side wall; T, tip.

Figure 1. Refinements in forehead flap reconstruction include (A) identification of subunits warranting reconstruction, (B) removing the subunit that was extended by 1 mm in all directions (dotted red line), (C) designing and extending (dotted purple line) over the supratrochlear axis and reinforcing cartilage framework (blue arrow), and (D) paramedian forehead flap to cover the extended defect.

the extended subunit was excised and replaced (Figure 1A).

2. Flap extension (stage 1)
   Templates were created using the contralateral nasal subunits when they were unaffected and vertically reflected and centred over the supratrochlear arterial axis. If both sides were affected, freehand template design was attempted. The pattern was traced on the forehead as a solid line and then extended in all directions to accompany the extended defect as a dotted line (Figure 1B).
3. Full-thickness flaps (stages 1-3)
   Forehead flaps were not thinned in the first stage. Thickness of forehead and recipient site skin was documented. In the intermediate stage, forehead flaps were thinned conservatively or not thinned completely to reflect donor and recipient thickness discrepancies.
4. Skeletal overbuilding (any stage)
   Inadequate septal and auricular cartilage supply and quality were anticipated for significant nasal skeletal reconstructions. Costal grafts were favoured

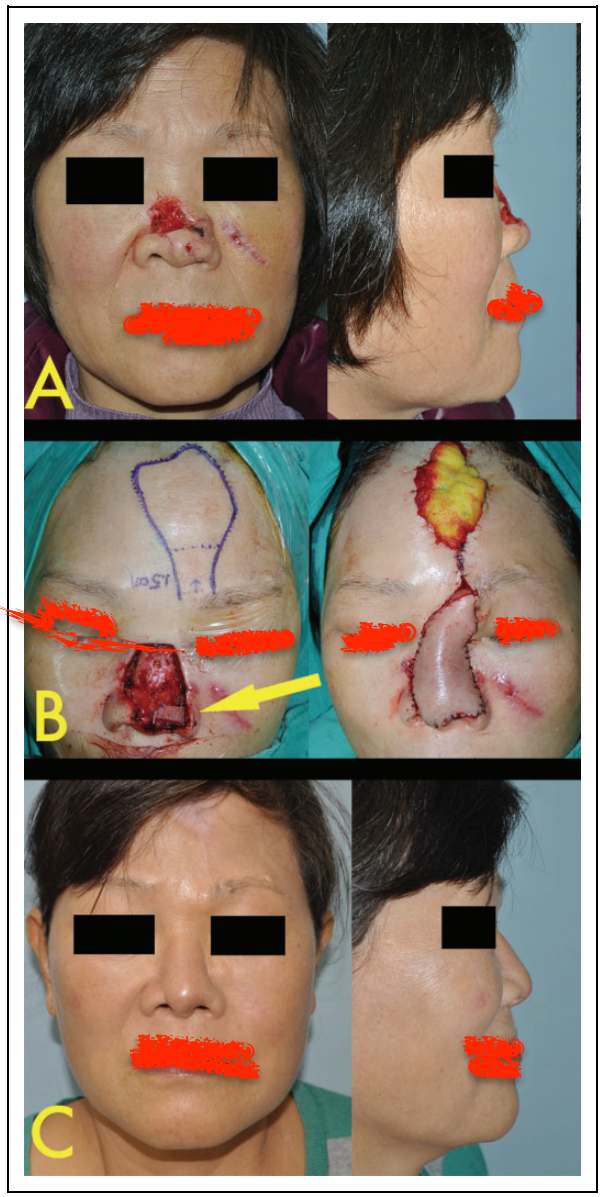

Figure 2. Case 1. A, Front and side views of defect. B, Intraoperative views including left alar reinforcement (yellow arrow) and skin grafting of donor site. C, Reasonable healing and maintenance of results at 15 months with scars along subunit boundaries. A 56-year-old woman was involved in traffic accident resulting in subtotal nasal amputation. The tip, dorsum, both side walls, columella, and left ala were involved. In the first of 4 stages, defects were extended beyond traditional subunit margins except for the ala, since less than half that subunit was affected. Skin thickness at the tip was documented, and there was no lining defect. Septal cartilage was sufficient for columellar and left alar reinforcement as a strut and onlay graft, respectively. A foil template was designed to mirror existing intact structures. The preliminary design was transferred to forehead and extended in all directions. Approximately half the wound was closed primarily, with the remainder left to heal secondarily. The left paramedian forehead flap was conservatively thinned 4 weeks later to match the recipient site. Subsequent division was performed 4 weeks after thinning, with further refinement 2 months after that.

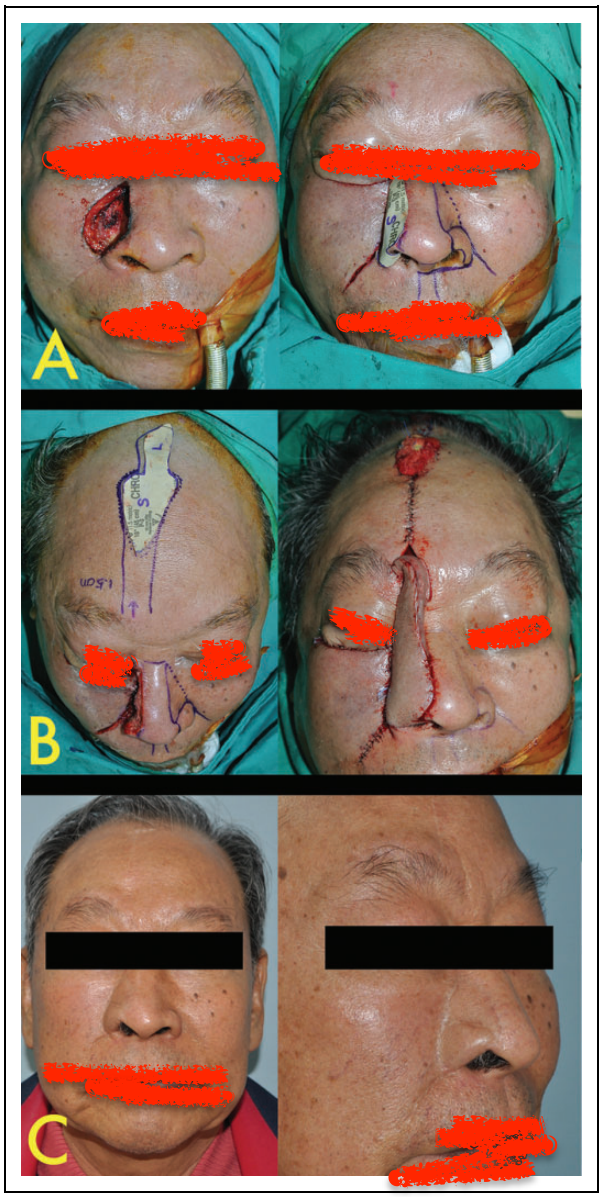

Figure 3. Case 2. A, Intraoperative view showing cheek and side wall involvement before (left) and after (right) cheek advancement. B, Intraoperative view showing template and extension (dotted line) of flap marking. C, Satisfactory result with minimal alar notching at 20 months. A 68-year-old man had a partial nasectomy for recurrent basal cell carcinoma. A full-thickness defect included 2 cm $\times$ 1.5 cm of lining and skin of the right side wall, ala, and cheek. A right-sided facial advancement flap addressed the cheek defect. Affected subunits were marked and extended beyond traditional side wall and alar margins. A folded right-sided paramedian forehead flap was designed to replace lining and skin. The majority of the wound was closed primarily, with the remainder left to heal secondarily. The cartilage framework at the right alar rim was overbuilt in the second stage. Subsequent flap division and additional refinement stages were performed at 2 and 4 months, respectively.

Figure 4. Case 3. A, Preoperative front and side view of woman with spindle cell tumour of nasal tip. B, Intraoperative view after extirpation that preserved all cartilages (left) still required cartilage reinforcement (right, yellow arrow). C, Post-operative view at 19 months shows reasonable scar position coincident with the aesthetic tip subunit. A 61-year-old woman was treated for a stage I spindle cell tumour of the nasal tip with wide resection. After margin control was confirmed, the skin defect encompassed the tip, part of the nasal dorsum, and side walls. A defect-based template was crafted, transferred to the right forehead, and extended per routine. In the first stage, septal cartilage was used to reinforce the upper and lower cartilages at the midline and a shield graft was used to enhance tip projection. The wound was closed primarily. Flap thinning and division were performed in 2 subsequent stages at 1 and 2 months, respectively. An excellent aesthetic result was obtained by 19 months with no need for additional refinement.

in total nasal reconstruction. Septal, auricular, or costal cartilage was used for patchwork and alar reconstruction. Regardless of donor medium, framework and contour-defining cartilages were overbuilt to be stronger than native cartilages (Figure 1C).

Results

Patients were followed up for 20 months (range: 16 months to 4 years 8 months) in outpatient clinic. Nasal lining was reconstructed with hinge-over lining flaps in 23 (57.5%) cases, folded forehead flaps in 13 (32.5%) cases, free flaps in 9 (22.5%) cases, and regional flaps in 4 (10%) cases (including 3 second-time forehead flaps and 1 nasolabial flap). Overbuilt cartilage frameworks were established in 34 (85%) patients. Six (15%) patients had isolated dorsal or dorsolateral defects that were not reconstructed. Cartilage was harvested from the septum in 8 (23%) cases, the ear in 6 (17%) cases, and both in 9 (26%) cases. Costal cartilage was used in 11 (32%) cases. In 38 (95%) cases, the ipsilateral forehead was used; in 2 patients, a previous ipsilateral flap failed and a contralateral flap was used. In 3 patients, 2 forehead flaps were used for simultaneous lining and skin replacement.

Five (10%) patients had wound infections 2 to 4 weeks post-operatively that were managed with antibiotics, debridement, and removal of diseased or threatened cartilage. There was wound dehiscence in 2 (4%) patients requiring repair under local anaesthesia. Two (4%) patients had distal flap necrosis; advancement of the forehead flap was a sufficient salvage method in both. Function was preserved in all patients (Figures 2–4).

Discussion

The paramedian forehead flap is a time-proven and hearty option for nasal reconstruction that offers excellent colour, texture, and volume match. Three stages are commonplace in forehead flap nasal reconstruction but more may be necessary to optimize results.[2-11] The nasal aesthetic subunit, as introduced by Burget and Menick, is 1 of 9 distinct territories of the nose that should be replaced in full when the majority of it is affected or missing. Subunit boundaries are points of inflection or concavities amenable to favourable scarring.[3,23] When the nasal aesthetic subunit principle of Burget and Menick is respected, superb cosmetic results can be achieved after flap reconstruction. Despite efforts to challenge and modify the subunit principle,[11,24-27] most surgeons honour its role in the reconstructive armamentarium.

We Recognize the Existence of Significant Intra-Racial Variation Among Ethnic Asians

However, a gross generalization identifies relatively small noses, broad and low-set radices, thick skin, abundant subcutaneous fibrofatty tissue, more sebaceous glands, increased pigmentation, midface retrusion, and reduced cartilage quantity and quality.[26,28,29] There may be a propensity for scar hypertrophy, hyperpigmentation, and contracture. Given these qualities, suboptimal aesthetic outcomes may result with traditional subunit reconstruction and a framework that does not withstand increased contracture forces.