



Forehead flap nasal reconstruction: oncologic and functional outcomes in a regional centre

Campbell Schmidt^{1,2}, James Nightingale^{2,3}, Curtis Ioannou³, Roger Grigg^{1,2}

¹School of Medicine, University of Queensland, Brisbane, Australia; ²Department of Otolaryngology, Head and Neck Surgery, Toowoomba Hospital, Toowoomba, Queensland, Australia; ³School of Medicine, Griffith University, Gold Coast, Australia

Contributions: (I) Conception and design: C Schmidt, R Grigg; (II) Administrative support: None; (III) Provision of study materials or patients: R Grigg; (IV) Collection and assembly of data: C Ioannou, J Nightingale, C Schmidt; (V) Data analysis and interpretation: C Schmidt; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Dr. Campbell Schmidt. ENT Registrar, Queensland Health, Brisbane, Australia. Email: campbell.schmidt@health.qld.gov.au.

Background: The forehead flap is a workhorse of nasal reconstruction for advanced cutaneous malignancy and is a useful tool for the ear, nose and throat (ENT) head and neck surgeon. Appropriate patient selection and meticulous surgical technique are imperative to optimise oncologic and functional outcomes.

Methods: A single centre retrospective review of 98 patients who underwent forehead flap nasal reconstruction by an ENT surgeon in Toowoomba (2008–2018).

Results: Forty-seven percent of cases were staged post-Mohs surgery, 31% were performed at the time of primary cancer excision, while 20% of operations were for residual or recurrent malignancy. Most cancers were located on the lower third of the nose, with the most common pathology basal cell carcinoma (70%) and squamous cell carcinoma (27%). Autologous cartilage graft was used in 57% of patients with 6% of patients also having internal nasal lining reconstructed. The median time to pedicle division was 23 days (range, 14–42 days), at which time four patients had involved margins cleared. Four patients had adjuvant radiotherapy. There were four cases of local recurrence, two of nodal failure and two of distant metastasis. Eight patients had a minor complication, while two patients underwent revision surgery for significant nasal obstruction. There were no cases of complete flap failure with only one case of partial flap necrosis.

Conclusions: Outcomes are comparable to those achieved at tertiary facial plastic surgery centres. Nasal obstruction is a potentially under-recognised complication of forehead flap reconstruction that may necessitate revision surgery. Appropriate utilisation of cartilage graft and internal lining reconstruction may mitigate this risk.

Keywords: Forehead flap; nasal neoplasm; nasal obstruction

Received: 07 March 2021; Accepted: 24 August 2021; Published: 31 August 2021.

doi: 10.21037/ajo-21-6

View this article at: <https://dx.doi.org/10.21037/ajo-21-6>

Introduction

Patients with advanced cutaneous malignancy of the nose require appropriate reconstruction to restore cosmesis and function. The high incidence of skin cancer in Australia is largely drawn from regional populations with significant occupational and recreational sun exposure. Travel to metropolitan centres with tertiary plastic surgery services places a significant financial, physical and emotional

burden on many patients and an increasing strain on the health budget. Facial plastic surgery is a core element of otolaryngology head and neck surgical (OHNS) training and practice in Australia. Where ear, nose and throat (ENT) surgeons can provide a robust reconstructive service for advanced cutaneous malignancy of the head and neck, particularly in regional centres, there are likely to be significant benefits both for the individual patient and health services.

The forehead flap is recognised as a workhorse of nasal reconstruction. The pedicled forehead flap was first described in the Sushruta Samhita circa 700 BC (1). The surgeons of the time sought to reconstruct the amputated nasal tip, an early form of punishment in ancient India. The procedure was revived in Italy in the 1400s and again in the 1800s in the United Kingdom (2). In the 1990s it was popularised as a reconstructive option for combat injuries, scrofula, syphilis and cancer. The supratrochlear artery supply was first characterised in the 1930s and over time the flap has evolved from a broad median to a narrower paramedian pedicle, granting greater effective length, arc of rotation and allowing multiple forehead flaps to be harvested (3).

The anatomic basis for the forehead flap and variations in design and surgical technique have been well studied (4-7). However, there is a paucity of oncologic and functional outcomes data, particularly in the Australian and otolaryngology literature. This study aims to evaluate outcomes from a regional ENT service to inform ongoing management of nasal cutaneous malignancy and approach to reconstruction within the specialty. We present the following article in accordance with the STROBE reporting checklist (available at <https://dx.doi.org/10.21037/ajo-21-6>).

Methods

A single centre retrospective review was performed. Over the defined ten-year period (2008–2018), 98 patients met inclusion criteria: forehead flap utilised to reconstruct a partial or full-thickness nasal defect, with or without cartilage graft(s), by a fellowship qualified OHNS surgeon in Toowoomba, Queensland. There were no exclusion criteria.

Demographic and clinicopathological data were extracted from existing medical records, including gender, age, smoking status and comorbidities (diabetes, vascular disease and immunosuppression). Patients were deemed to have vascular disease if any recorded diagnosis of ischaemic heart disease, cerebrovascular or peripheral vascular disease. Disease factors included pathology, tumour site, margin status, presence of perineural invasion and dates of diagnosis, treatment and recurrence. Treatment factors included pedicle design, cartilage graft, internal lining reconstruction, donor site closure, time to pedicle division, adjuvant treatment, complications and need for revision surgery. A complication was recognised if recorded in the medical record at any time post-operatively. Complete

flap loss, nasal obstruction requiring revision surgery, alar notching and return to theatre were deemed major complications. Partial flap necrosis, haematoma, bleeding, infection and mild-moderate nasal obstruction were classified as minor complications.

Statistical analysis

Data was collated and statistical analysis performed in Microsoft Excel (version 2015). A univariate descriptive analysis was undertaken.

Ethics

Low negligible risk research approval (LNR 19 QTDD 48702) was granted by the Darling Downs Human Research Ethics Committee. Adequate protection of patient privacy and confidentiality was ensured through deidentification and appropriate data storage. Consent was justifiably waived. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Results

Patient demographics

Of the 98 patients included in this study, 46 were men and 52 were women, with a median age at diagnosis of 69 years (range, 36–93 years). At the time of surgery, 12 patients were active smokers, 11 patients had vascular disease and seven patients had diabetes mellitus. Six patients were immunosuppressed: five with rheumatoid arthritis or systemic lupus erythematosus, and one with chronic lymphocytic leukaemia (CLL).

Indications for and outcomes of resection

Forty-six nasal forehead flaps were post-Mohs resection, performed by a dermatologist either the day of or day prior to the reconstructive surgery.

In 30 cases primary tumour resection and forehead flap reconstruction was performed synchronously by the treating ENT surgeon. The remaining 20 operations for malignancy were in the setting of residual or early recurrent disease. There were single cases of trauma and nasocutaneous fistula, where the forehead flap was utilised following initial debridement or failed conservative management, respectively.

Of the 96 patients with malignant pathology, 67 (70%) were basal cell carcinoma (BCC) and 26 (27%) were squamous cell carcinoma (SCC) with single cases of microcystic adnexal carcinoma, melanoma *in situ* and invasive melanoma. Most lesions were located on the nasal tip [34] or alar [35], while 19 primarily involved the nasal dorsum and 6 were lateralised to a nasal sidewall. The average maximum diameter was 32 mm (range, 15–50 mm). Microscopic perineural invasion was detected in 11 patients. Six patients had involved margins on the original resection with four having further margins resected at the time of pedicle division to confirm pathological clearance. One female with a solid BCC and predominantly dermal disease of the nasal tip declined further resection and proceeded to post-operative radiation therapy (PORT) after pedicle division. An elderly male with a large full-thickness nasal tip SCC with involved cutaneous and mucosal margins was also referred for PORT instead of further resection. Two other patients proceeded to adjuvant radiation therapy in the setting of adverse pathologic features.

Forehead flap reconstruction and complications

Forty-nine (50%) flaps were paramedian, 31 (32%) were median and in 18 (18%) cases pedicle design was not recorded in the operative notes. Autologous conchal cartilage, harvested by a posterior incision and subperichondrial dissection, was inset as an alar batten graft in 55 patients. One patient had bilateral conchal cartilage harvested while one case utilised nasal septal cartilage. Six patients with malignancy had full thickness defects necessitating internal lining reconstruction. This was achieved by folding the thinned distal component of the forehead flap around the alar rim with a 1 mm releasing incision sandwiching the cartilage graft, as described by Menick (8).

Primary closure of the forehead donor site was achieved in 81 patients after undermining in the subgaleal plane with blunt dissection, while 15 had partial closure with the residual defect healing by secondary intention. Two patients required a full thickness skin graft (FTSG).

Most reconstructions were performed under general anaesthesia although several comorbid patients had sedation and local anaesthetic for both resection and pedicle division. All patients were admitted for overnight observation and routinely administered low flow nasal oxygen, nursed head up to minimise venous congestion and prescribed aspirin 100 mg daily from the night of surgery if no pre-existing antiplatelet/anticoagulation therapy,

which was not routinely withheld. No patients returned to theatre for bleeding, haematoma or flap failure during the initial admission or were re-admitted with post-operative complications. One patient required transfusion with two units of platelets post-operatively for persistent ooze in the setting of platelet dysfunction.

The average time to pedicle division was 23 days (range, 14–42 days). No patient with active smoking history or significant vascular disease had division before 19 days. At this second stage, one patient had a minor forehead donor site dehiscence debrided while another patient had a small haematoma at the cranial aspect of the inset evacuated.

A further five patients had minor complications for a total minor complication rate of 8%. One patient reported troublesome hair transposition requiring regular depilation and three patients reported partial nasal obstruction that did not require further surgical intervention. One patient required a revision surgical procedure beyond routine planned second stage pedicle division. This was a 54-year-old active smoker with partial flap necrosis at the nasal tip. Pedicle division was delayed to 6 weeks to allow demarcation and an attempt at smoking cessation prior to a FTSG.

There were no instances of complete flap loss or alar notching in this series, however two patients had significant nasal obstruction requiring revision surgery, amounting to a 2% major complication rate. One patient with morphoeic BCC crossing nasal tip and alar subunits who required a conchal cartilage graft, had revision surgery at 25 months to address a stenosed alar rim via a marginal incision and thinning of the caudal aspect of the flap. The sole trauma patient in this series, who suffered a full thickness angle grinder injury, also required revision surgery with a FTSG for nasal stenosis. There were no recorded patient complications with forehead, cartilage graft or skin graft donor sites or scar revision procedures performed.

Oncologic outcomes

Patients were followed with three monthly reviews for the first two years then seen at increasing intervals under shared care with the referring dermatologist/general practitioner. There were four cases of local recurrence detected during routine follow-up. One patient had a presumed recurrent nasal tip SCC after Mohs surgery and paramedian forehead flap reconstruction and proceeded to wide local excision and contralateral forehead flap repair. Two patients had smaller BCC recurrences at the nasal tip/

ala amenable to primary closure while one patient with recurrent BCC required a FTSG.

There were two cases of cervical nodal metastasis treated with selective neck dissection within two years of surgery. One patient had a basosquamous carcinoma of the nasal tip excised with clear margins, then presented with delayed cervical nodal metastatic SCC requiring a level I–IV neck dissection. Another patient with a background of CLL required bilateral level I–III neck dissections after presumed recurrence of a primary nasal SCC.

There were two cases of distant metastasis in this series. A 69-year-old female with a neglected nasal tip BCC underwent a partial rhinectomy with a 36 mm defect requiring bilateral conchal cartilage graft reconstruction. Despite clear margins and PORT, the patient was found to have an iliac bone metastasis eight months post-operative with histology confirming a basaloid carcinoma with squamous differentiation. Ultimately, the patient died 26 months after her initial resection. A 54-year-old male with a nasal tip melanoma excised with clear margins, who presented with seizures 33 months post-operative, was found to have an isolated parietal lobe metastasis requiring craniotomy, adjuvant radiation and immunotherapy.

Discussion

This is a large series from a single regional unit over a ten-year period that demonstrates the utility of the forehead flap in the ENT surgeon's reconstructive arsenal. Oncologic outcomes were good for this high-risk mid facial zone, especially given 20% of patients were being treated for residual or early recurrent disease after incomplete excision by the primary physician. In the 53% of patients who did not have Mohs surgery, there was a low rate of positive pathologic margins, which in almost all cases was addressed at the second stage pedicle division, with no requirement for additional ablative or reconstructive procedures. The two patients with residual disease had PORT and no documented evidence of recurrence at last follow-up.

Of the four cases with local recurrence within two years of initial surgery, only one case required additional reconstruction where a second forehead flap was able to be harvested, illustrating the benefit of a paramedian flap design that preserves the contralateral pedicle for future use. Nodal recurrence was a rare event that occurred in the setting of adverse primary pathology or immunosuppression, while the two cases of distant metastasis were instances of malignant melanoma and neglected advanced BCC with

squamous differentiation.

Aside from an opportunity to clear involved surgical margins, the second stage pedicle division allowed several minor complications to be addressed. Although some surgeons advocate for a planned third stage to allow more aggressive thinning of the flap once vascular ingrowth is assured, this was not necessary in our cohort (9). A recent study found no difference in complication rate between two-stage and three-stage reconstruction in high-risk vascular patients (10). Optimal timing of pedicle division has also been debated. Earlier flap division can be cost-effective and improve quality of life but needs to be balanced against individual patient risk and defect size. Most authors agree that division at two-to-three weeks is safe in appropriately selected patients (3,10). One study assessed accelerated division at an average 7.2 days in 26 patients and found no increase in complications (11). In our series pedicle division averaged three weeks, with a single case of delayed pedicle division at six weeks for partial flap necrosis. The timing of pedicle division is also a function of operating theatre availability in the public sector. However, active deferment of patients with risk factors for small vessel disease is advisable, while in young otherwise healthy patients, pedicle division at one-to-two weeks is optimal. In our study a mix of median and paramedian forehead flaps were utilised to address an average defect maximum diameter of 32 mm with no flap failures. A seminal paper by Park *et al.* (2000) analysed the vascular pedicle in cadaveric specimens comparing midline and paramedian forehead flaps, demonstrating good arterial perfusion from the ipsilateral supratrochlear vessel and significant contributions from the angular branch of the facial artery (4). Of 127 patients with nasal defects >1.5 cm in size, a staged forehead flap was utilised in 62% patients, with complications in up to 24% patients, most commonly superficial epidermolysis, but similarly no instances of forehead flap necrosis and only two cases of post-operative nasal obstruction (4). A later study compared three different pedicle designs (classic paramedian, glabellar paramedian and central artery flap design) and found all to be equally robust (12).

There was a 5% rate of post-operative nasal obstruction in our cohort, which we acknowledge may be under reported given the retrospective nature of the study. However, the 2% rate of further surgical intervention for severe nasal obstruction likely represents the clinically significant stenosis rate. Across the studies that have evaluated post-operative complications of forehead flap reconstruction, there is little consistency with reporting and there remains a need for a well-designed prospective study utilising

standardised assessment of nasal obstruction pre- and post-operatively, such as the validated NOSE score (13). Little *et al.* (2009) published a retrospective study of 205 patients and found 16.1% of patients suffered a major complication, defined as necrosis, alar notching and/or complete nasal obstruction, the latter occurring in nearly 5% of all patients and nearly 10% of those with full-thickness defects (14). Sanniec *et al.* (2017) reviewed 420 cases performed by a single plastic surgeon over a ten-year period and reported a complication rate of 3.8%, without assessing for post-operative nasal obstruction specifically (15). Recently, Chen *et al.* (2019) reviewed 2,175 patients from North America, demonstrating low post-operative bleed (1.4%), infection (2.9%) and venous thromboembolism (VTE) (<0.5%) rates and an overall 31.7% major complication rate, without reporting specific oncologic or functional outcomes (16). Another retrospective review of 53 patients over a 19-year period, reported a partial flap loss rate of 11%, with two patients requiring additional procedures (17). There are alternative reconstructive options to address large nasal defects. However, Genova *et al.* (2019) showed a significant difference in cosmesis and function, favouring the forehead flap over nasolabial options (18). Recent algorithms have attempted to simplify the approach to larger nasal defects in the mid and lower thirds of the nose, however, we believe the forehead flap remains a simple and effective solution with a robust vascular supply and reliable outcomes in the vast majority of accepting patients (18-20).

The need to reconstruct the nose in layers, particularly the use of cartilage alar batten grafts to provide contour and prevent airway obstruction, is well recognised (21). Alternative techniques for internal lining reconstruction in full thickness defects have been described, including septal and turbinate local flaps. The folded forehead flap has performed well in our series, but an alternative bi-valve technique, which sandwiches the cartilage graft between the outer skin and inner pericranium-galea appears similarly reliable and also avoids a second flap complicating the reconstruction (8,21-23).

Overall, a low complication rate relative to the published literature was observed in our cohort, combined with good rates of oncologic clearance and locoregional recurrence. There were no cases of complete flap failure and only one case of partial flap necrosis in an active smoker. Meticulous surgical technique and a low threshold for auricular cartilage harvest and reconstruction of the lower third of the nose is thought to have contributed to the low rates of vascular compromise and post-operative nasal obstruction

observed in our cohort, although variability in reporting measures make direct comparisons difficult. Beyond the inherent limitations of a retrospective study, no objective measurements of functional or aesthetic outcome were available for our series, limiting conclusions. A prospective study with validated standardised measurements for complications and quality of life outcomes is indicated.

The provision of surgical and cancer services in rural and regional Australia is challenging. For advanced facial skin lesions, management can be complex and otherwise require referral and travel to a metropolitan tertiary centre. Within our unit, we have presented the cost saving utility that can be drawn from optimised regional surgical care in partnership with local primary care providers, recognising potential cost savings and working to deliver an improved service for both individual patients and our health service (24). Following this presentation of forehead flap nasal reconstruction oncological and functional outcomes, future study and wider cost-benefit analysis would further support this contribution to regional cancer care service in the context of increasing cost for skin cancer management in Australia.

Overall, this study demonstrates the value of a facial plastic surgery trained ENT surgeon equipped with robust reconstructive options such as the forehead flap in the provision of cancer and reconstructive services, particularly in under-resourced regional settings with a high burden of advanced skin cancer.

Conclusions

Excellent oncologic and functional outcomes can be achieved in the setting of advanced nasal cutaneous malignancy treated with forehead flap reconstruction by ENT head and neck surgeons, comparable to those achieved at tertiary facial plastic surgery centres.

Acknowledgments

Funding: None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <https://dx.doi.org/10.21037/ajo-21-6>

Data Sharing Statement: Available at <https://dx.doi.org/10.21037/ajo-21-6>

Peer Review File: Available at <https://dx.doi.org/10.21037/ajo-21-6>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://dx.doi.org/10.21037/ajo-21-6>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions relating to the accuracy or integrity of any part of the work are appropriately investigated and resolved. An exemption as a low negligible risk research project (LNR 19 QTDD 48702) was granted by the Darling Downs regional Human Research Ethics Committee given the study design posed no risk of harm or discomfort to participants. Adequate protection of patient privacy and confidentiality was ensured through deidentification of data and appropriate data storage. Consent was justifiably waived. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

- Shokri T, Kadakia S, Saman M, et al. The Paramedian Forehead Flap for Nasal Reconstruction: From Antiquity to Present. *J Craniofac Surg* 2019;30:330-3.
- Fang F, Chung KC. An evolutionary perspective on the history of flap reconstruction in the upper extremity. *Hand Clin* 2014;30:109-22, v.
- Baker S. *Local Flaps in Facial Reconstruction*. 3rd edition. Elsevier/Saunders, 2014.
- Park SS. Reconstruction of nasal defects larger than 1.5 centimeters in diameter. *Laryngoscope* 2000;110:1241-50.
- Kleintjes WG. Forehead anatomy: arterial variations and venous link of the midline forehead flap. *J Plast Reconstr Aesthet Surg* 2007;60:593-606.
- Reece EM, Schaverien M, Rohrich RJ. The paramedian forehead flap: a dynamic anatomical vascular study verifying safety and clinical implications. *Plast Reconstr Surg* 2008;121:1956-63.
- Menick FJ. Nasal reconstruction with a forehead flap. *Clin Plast Surg* 2009;36:443-59.
- Menick FJ. A new modified method for nasal lining: the Menick technique for folded lining. *J Surg Oncol* 2006;94:509-14.
- Menick FJ. A 10-year experience in nasal reconstruction with the three-stage forehead flap. *Plast Reconstr Surg* 2002;109:1839-55; discussion 1856-61.
- Lo Torto F, Redi U, Cigna E, et al. Nasal Reconstruction with Two Stages Versus Three Stages Forehead Flap: What is Better for Patients with High Vascular Risk? *J Craniofac Surg* 2020;31:e57-60.
- Somoano B, Kampp J, Gladstone HB. Accelerated takedown of the paramedian forehead flap at 1 week: indications, technique, and improving patient quality of life. *J Am Acad Dermatol* 2011;65:97-105.
- Faris C, van der Eerden P, Vuyk H. The midline central artery forehead flap: a valid alternative to supratrochlear-based forehead flaps. *JAMA Facial Plast Surg* 2015;17:16-22.
- Stewart MG, Witsell DL, Smith TL, et al. Development and validation of the Nasal Obstruction Symptom Evaluation (NOSE) scale. *Otolaryngol Head Neck Surg* 2004;130:157-63.
- Little SC, Hughley BB, Park SS. Complications with forehead flaps in nasal reconstruction. *Laryngoscope* 2009;119:1093-9.
- Sanniec K, Malafa M, Thornton JF. Simplifying the Forehead Flap for Nasal Reconstruction: A Review of 420 Consecutive Cases. *Plast Reconstr Surg* 2017;140:371-80.
- Chen CL, Most SP, Branham GH, et al. Postoperative Complications of Paramedian Forehead Flap Reconstruction. *JAMA Facial Plast Surg* 2019;21:298-304.
- Rudolph MA, Walker NJ, Rebowe RE, et al. Broadening applications and insights into the cross-paramedian forehead flap over a 19-year period. *J Plast Reconstr Aesthet Surg* 2019;72:763-70.
- Genova R, Gardner PA, Oliver LN, et al. Outcome Study after Nasal Alar/Peri-alar Subunit Reconstruction: Comparing Paramedian Forehead Flap to Nasolabial Flap. *Plast Reconstr Surg Glob Open* 2019;7:e2209.
- Woodard CR, Park SS. Reconstruction of nasal defects 1.5 cm or smaller. *Arch Facial Plast Surg* 2011;13:97-102.
- Yong JS, Christophel JJ, Park SS. Repair of intermediate-size nasal defects: a working algorithm. *JAMA Otolaryngol*

- Head Neck Surg 2014;140:1027-33.
21. Eid IN, Arosarena OA. Reconstruction of Cutaneous Cancer Defects of the Head and Neck. *Otolaryngol Clin North Am* 2021;54:379-95.
 22. Austin GK, Shockley WW. Reconstruction of nasal defects: contemporary approaches. *Curr Opin Otolaryngol Head Neck Surg* 2016;24:453-60.
 23. Sedwick JD, Graham V, Tolan CJ, et al. The full-thickness forehead flap for complex nasal defects: a preliminary study. *Otolaryngol Head Neck Surg* 2005;132:381-6.
 24. Nightingale J, Travers L, Campbell J, et al. Outpatient surgical management of non-melanoma skin cancers of the head and neck in a regional centre: an analysis of costs and outcomes. *ANZ J Surg* 2021;91:139-44.

doi: 10.21037/ajo-21-6

Cite this article as: Schmidt C, Nightingale J, Ioannou C, Grigg R. Forehead flap nasal reconstruction: oncologic and functional outcomes in a regional centre. *Aust J Otolaryngol* 2021;4:30.