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# Vascularized Pericranial Flap for Endonasal Anterior Skull Base Reconstruction

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## Abstract

**Introduction** As the limits of advanced skull base malignancies that can be managed through an endoscopic endonasal approach continue to be expanded, the resultant anterior skull base defects are of increasing size and complexity. In the absence of nasoseptal or turbinate flaps, the vascularized pericranial flap has been employed at our institution with excellent results.

**Objective** The study aimed to review the outcomes of patients who underwent endonasal anterior craniofacial resection with anterior skull base reconstruction using a vascularized pericranial flap.

**Design** Retrospective chart review of patients treated by the University of California – San Francisco minimally invasive skull base service from the years 2011 to 2017. Average duration of follow-up was 16.4 months.

**Setting** This study was conducted at Academic tertiary referral center.

**Participants** A total of nine patients with advanced anterior cranial base malignancies were identified who were treated with a minimally invasive, endoscopic anterior craniofacial resection from the years 2011 to 2017. Due to the nature of the resection in these patients, nasoseptal flaps and inferior/middle turbinate flaps were unavailable or insufficient for anterior skull base defect repair. Each patient underwent reconstruction of the anterior cranial base defect using an anteriorly based pericranial flap harvested by bicoronal incision, and tunneled anteriorly to the nasal cavity through a frontoethmoidal incision.

## Keywords

- ▶ Anterior
- ▶ skull base
- ▶ reconstruction
- ▶ pericranial
- ▶ flap

## Introduction

Endoscopic endonasal approach for the resection of anterior skull base malignancy is increasingly performed, and the resultant defects in the anterior cranial base are increasing in size and complexity. A wide variety of reconstructive options

have been explored in the literature, including avascular allografts, pedicled temporoparietal fascia flaps, and inferior or middle turbinate flaps.<sup>1–3</sup> Undoubtedly, the nasoseptal flap, popularized by Hadad et al in 2006, is the workhorse flap of endonasal anterior skull base reconstruction. Its immediate availability, ease of harvest, and reliability

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make it an obvious choice to reconstruct complicated cranial base defects.<sup>4,5</sup> Unfortunately, the nasoseptal flap is not always available for use; potential contraindications include cases when the posterior septal pedicle or septal mucoperichondrium itself is invaded by tumor, or cases in which the septum is surgically absent from prior intervention. Other local flaps such as the inferior or middle turbinate may similarly be insufficient or unavailable. In 2009, Zanation et al reported the endoscopic pericranial flap for anterior cranial base reconstruction, demonstrating feasibility through a cadaveric study and providing a case report of skull base reconstruction after esthesioneuroblastoma using the pericranial flap.<sup>6</sup> Since this introduction, there exist several reports of pericranial flaps used in endoscopic skull base reconstruction,<sup>7</sup> but to our knowledge, there has been no single-institution review of the use of the vascularized pericranial flap for endonasal skull base reconstruction. We seek to report our experience using the vascularized pericranial flap for complex anterior skull base reconstruction at the University of California – San Francisco (UCSF).

## Materials and Methods

After approval was obtained from the UCSF Institutional Review Board, a retrospective review of the UCSF Minimally Invasive Skull Base Surgery service was performed. A total of nine patients were identified who had advanced anterior cranial base malignancies treated with a minimally invasive, endoscopic anterior craniofacial resection, and pericranial flap reconstruction from the years 2011 to 2017. Due to the nature of the resection in these patients, nasoseptal flaps and inferior/middle turbinate flaps were unavailable or insufficient for anterior skull base defect repair. Each patient underwent reconstruction of the anterior cranial base defect using an anteriorly based pericranial flap harvested by the neurosurgeon (M.W.M.) through a bicoronal incision, and tunneled anteriorly to the nasal cavity by the otolaryngologist (I.H.E.S.) either through a frontoethmoidal incision, a curvilinear incision placed between the medial canthus and nasal bridge, or through the frontal sinus and along the posterior frontal wall. All medical records were reviewed, and demographic data including gender, ethnicity, age, tumor type, presence of neoadjuvant or adjuvant therapy, and follow-up time were extracted.

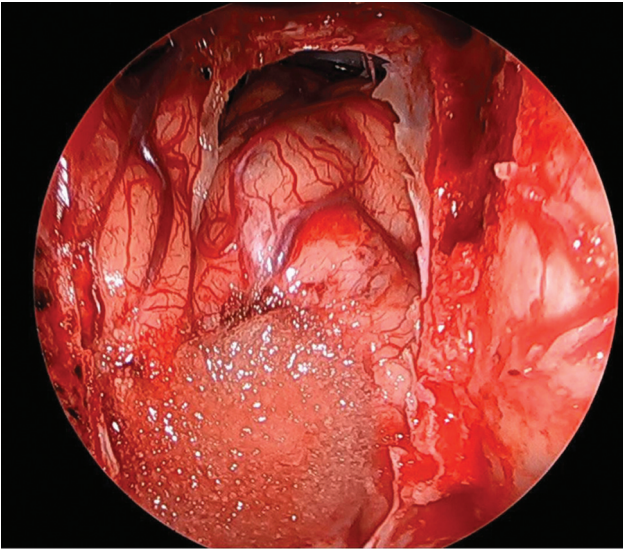
## Results

Nine patients (six men and three women; median age 64 years) underwent endoscopic skull base resection for advanced anterior cranial base malignancy with pericranial flap reconstruction of the surgical defect (see ► **Table 1** for patient characteristics). In each patient, nasoseptal flap reconstruction was not feasible, and skull base reconstruction was accomplished by performing a vascularized pericranial flap. In each case, the pericranial flap was harvested by the attending neurosurgeon (M.W.M.) through a bicoronal incision. Three patients required frontal table craniotomy in conjunction with the craniofacial resection; in these three patients, the pericranial

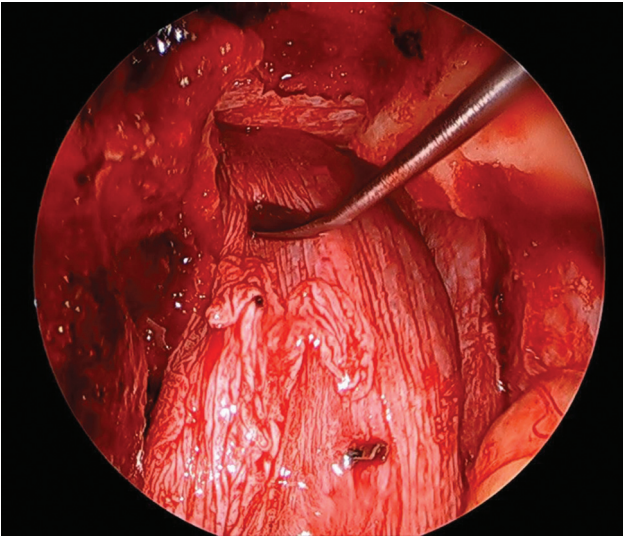
**Table 1** Patient characteristics

Characteristic	Value
Gender	
Male	6 (67%)
Female	3 (33%)
Tumor Pathology	
Squamous cell carcinoma	5 (56%)
Esthesioneuroblastoma	1 (11%)
Ewing sarcoma	1 (11%)
Chordoma	1 (11%)
Sinonasal undifferentiated carcinoma	1 (11%)
Age in years, mean (range)	64 (4–69)
Length of hospitalization in days, mean (range)	7 (3–15)
Follow up in months, mean (range)	16.4 (0.2–44.8)
Adjuvant therapy	
None	1 (11%)
Surgery	1 (11%)
Brachytherapy	1 (11%)
Radiation therapy	3 (33%)
Chemoradiation therapy	3 (33%)
Inset into the nasal cavity	
Frontal sinus (transfrontal)	3 (33%)
Lynch incision	6 (67%)
Lumbar drain	
Yes	6 (67%)
No	3 (33%)
Tracheotomy	
Yes	0 (0%)
No	9 (100%)

flap was tunneled through the frontal sinus and along the posterior frontal sinus wall (transfrontal approach; ► **Figs. 1** and **2**). Six patients did not require frontal table craniotomy, and in these patients, the pericranial flap was tunneled into the nasal cavity through a frontoethmoidal incision made by the otolaryngologist (I.H.E.S.). All patients had bilateral Merocel nasal packing placed at the time of surgery to help support the flap reconstruction against the skull base, and the packs were removed prior to discharge from the hospital. No patients required tracheotomy, and all patients were extubated in the immediate postoperative period. Lumbar drain placement was performed at the time of initial surgery in six (66.7%) patients. Median length of hospital stay was 7 days, and no patients developed meningitis postoperatively. Two patients experienced postoperative complications: one patient developed pneumocephalus in the immediate postoperative period, which was managed with conservative measures, and one patient developed cerebrospinal fluid leak which required a second operation to revise and augment the reconstruction.



**Fig. 1** Anterior skull base defect.



**Fig. 2** Bringing flap through frontal sinus into position.

On close review of the patients who experienced complication, it was identified that both patients had flaps inset through the transfrontal approach. In the case that was returned to the operating room for revision when assessed endoscopically, it was found that the pericranial flap had become separated from the posterior frontal sinus wall due to inadequate packing at the time of the initial operation, preventing the flap from sealing to the sinus wall, and resulting in CSF leak. The flap was repositioned so that there were no gaps between the flap and the posterior frontal sinus wall, and additional packing was placed to keep the flap sealed against the posterior sinus wall, resolving the leak. No patients who had the flap inset through a frontoethmoidal incision experienced postoperative complication. Eight patients received adjuvant postoperative radiation therapy, and at a median follow-up of 16.4 months, there were no cases of skull base dehiscence or delayed CSF rhinorrhea.

## Discussion

We present the outcomes of nine patients who underwent endonasal anterior skull base reconstruction using a vascularized pericranial flap. In our experience, there were no cases of flap compromise, wound complication, or unacceptable cosmetic result. Seven of the nine patients healed with no postoperative complications. One patient required return to the operating room for revision surgery in the setting of cerebrospinal fluid leak. This patient was noted to have a history of heavy cigarette smoking (>40 pack/years), a known risk factor for pericranial flap and wound-healing compromise. One patient developed pneumocephalus in the immediate postoperative period; this was corrected with clamping of the lumbar drain, and the patient required no further intervention and suffered no neurologic sequelae. In the two patients who experienced postoperative complication, both underwent frontal table craniotomy, and in both cases the pericranial flap was inset through the transfrontal approach. In the patient who was returned to the operating room for CSF leak, the pericranial flap was found to be inadequately packed along the posterior frontal sinus wall, resulting in incomplete flap seal to the sinus wall, providing room for egress of cerebrospinal fluid. The patient who experienced pneumocephalus did not require return to the operating room, but as this pericranial flap was also inset through the transfrontal approach using the same technique, we suspect that this flap was also inadequately packed against the posterior frontal sinus wall, allowing for egress of air beneath the flap, resulting in pneumocephalus which was exacerbated by the lumbar drain. No other patients who had a lumbar drain placed at the time of surgery experienced complication. No patients experienced postoperative meningitis, and all patients were able to be discharged home after a median hospital stay of 7 days. Eight (89%) patients received adjuvant radiation therapy to the primary site, with no patients experiencing delayed cerebrospinal fluid leak or skull base osteomyelitis.

At our institution, when the tumor resection is purely endoscopic and a frontal table craniotomy is not being performed, the neurosurgeon harvests the pericranial flap through a traditional bicoronal incision, and the otolaryngologist insets the flap through a frontoethmoidal skin incision. An alternative to the frontoethmoidal lynch incision is to drill out the bone of the nasion, creating a window to pass the flap through the nasion and into the nasal cavity. We have had good success and acceptable cosmetic outcomes using the frontoethmoidal incision to tunnel the flap into the nasal cavity, and the choice of tunneling through a frontoethmoidal incision versus the nasion is one of the surgeons preference. A disadvantage to the pericranial flap is that in the setting of minimally invasive endoscopic and endonasal surgery, it requires a large and external scalp incision for harvest. However, advances have been made to harvest the pericranial flap using endoscopic techniques, thus avoiding a long-skin incision across and the scalp, and potentially avoiding unwanted incisional scar, peri-incisional anesthesia, and alopecia.<sup>6</sup>

## Conclusion

Reconstruction of the anterior skull base after endoscopic resection has advanced significantly in recent years, with the nasoseptal flap becoming the workhorse reconstructive option for most skull base surgeons. However, in the setting of sinonasal malignancy, local flaps in the nasal cavity may be unavailable for closure of anterior skull base defects. When skull base reconstruction using a nasoseptal flap is not an option, the vascularized pericranial flap provides an excellent alternative reconstructive option due to its local availability, robust vascular supply, and excellent reliability. It has been employed at our institution with excellent results and minimal cosmetic deficit.

### Funding

None.

### Conflict of Interest

None declared.

## References

- 1 Thorp BD, Sreenath SB, Ebert CS, Zanation AM. Endoscopic skull base reconstruction: a review and clinical case series of 152 vascularized flaps used for surgical skull base defects in the setting of intraoperative cerebrospinal fluid leak. *Neurosurg Focus* 2014;37(04):E4
- 2 Patel MR, Taylor RJ, Hackman TG, et al. Beyond the nasoseptal flap: outcomes and pearls with secondary flaps in endoscopic endonasal skull base reconstruction. *Laryngoscope* 2014;124(04):846–852
- 3 Fortes FS, Carrau RL, Snyderman CH, et al. Transpterygoid transposition of a temporoparietal fascia flap: a new method for skull base reconstruction after endoscopic expanded endonasal approaches. *Laryngoscope* 2007;117(06):970–976
- 4 Hadad G, Bassagasteguy L, Carrau RL, et al. A novel reconstructive technique after endoscopic expanded endonasal approaches: vascular pedicle nasoseptal flap. *Laryngoscope* 2006;116(10):1882–1886
- 5 Zanation AM, Carrau RL, Snyderman CH, et al. Nasoseptal flap reconstruction of high flow intraoperative cerebral spinal fluid leaks during endoscopic skull base surgery. *Am J Rhinol Allergy* 2009;23(05):518–521
- 6 Zanation AM, Snyderman CH, Carrau RL, Kassam AB, Gardner PA, Prevedello DM. Minimally invasive endoscopic pericranial flap: a new method for endonasal skull base reconstruction. *Laryngoscope* 2009;119(01):13–18
- 7 Chaaban MR, Chaudhry A, Riley KO, Woodworth BA. Simultaneous pericranial and nasoseptal flap reconstruction of anterior skull base defects following endoscopic-assisted craniofacial resection. *Laryngoscope* 2013;123(10):2383–2386