

# Long-Term Radiographic Changes of Vascularized Pedicled Nasoseptal Flaps After Endoscopic Endonasal Skull Base Surgery

Alexander S. Himstead, MD<sup>1</sup>; Nolan Winslow, MD<sup>1</sup>; Jeremy Guinn, MD<sup>1</sup>; Joseph Lockwood, MD<sup>1</sup>; Benjamin F. Bitner, MD<sup>2</sup>; Frank P.K. Hsu, MD, PhD<sup>1</sup>; Edward Kuoy, MD<sup>3</sup>; Edward C. Kuan, MD, MBA<sup>2</sup>

<sup>1</sup>Department of Neurological Surgery, University of California, Irvine, Orange, CA <sup>2</sup>Department of Otolaryngology-Head and Neck Surgery, University of California, Irvine, Orange, CA <sup>3</sup>Department of Radiological Sciences, University of California, Irvine, Orange, CA



- Endoscopic endonasal approaches (EEA) are widely implemented for a variety of pathologies of the sella and parasellar regions and anterior and posterior cranial fossae.
- The vascularized, pedicled nasoseptal flap (NSF) has significantly improved reconstructive outcomes and reduced rates of postoperative cerebrospinal fluid (CSF) leak<sup>1,2</sup>.
- The health of these flaps cannot be readily assessed similarly to other vascularized flaps, but can be evaluated radiographically<sup>3</sup>.
- Evaluation of flap appearance and health on magnetic resonance imaging (MRI) over time is a process still being understood<sup>3-5</sup>.
- We aimed to describe long-term (12-24 months and beyond) changes in NSF appearance on MRI in a large heterogenous retrospective cohort of patients who underwent EEA for resection of various lesions.

## Discussion

- We found similar appearance of NSF across two years of MRI data in a heterogenous cohort of patients who underwent EEA for tumor removal
  - Thickness and enhancement of the NSF and pedicle remained constant over 2 year imaging follow-up.
  - This suggests that change in one of these parameters on follow-up MRI may indicate an issue with flap health and warrant further evaluation.
- The NSF was firmly adherent to the skull base in 97.9% of patients at 1 year.
  - This is similar to 3-month adherence rate in a prior study<sup>3</sup> at our institution.
- The diaphragma descent seen previously at 3 months<sup>3</sup> remained constant markedly over the course of 1-2 years.
- In our cohort, individuals who underwent adjuvant radiation therapy had significantly higher rates of pedicle enhancement than those that did not.
  These results suggest MRI findings in healthy flaps remain consistent at and 24-month time points.



# Methods and Materials

- We performed an Institutional Review Board-approved retrospective analysis of 71 patients who underwent EEA for tumor removal or CSF leak repair with postoperative MRI at least 24 months after index surgery from 07/2018 to 12/2023.
- MRIs at 12 months, 24 months, and most recent (if greater than 24 months) were reviewed for the following variables: Pedicle thickness, pedicle enhancement, flap thickness, flap enhancement, flap adherence to skull base, diaphragma descent
- MRIs were compared to assess for changes in these parameters over time.
- Demographic data including age, BMI, tumor size, bony defect size, pathology type (intra vs. extradural), extent of skull base approach (normal vs. extended), intraoperative CSF leak rate, skull base repair method, and postoperative CFS leak were collected.

## Results

- Fifty-four out of 71 patients with 24-month postoperative MRIs had immediate postoperative MRIs available for comparison.
- NSF thickness (p=0.96), pedicle thickness (p=0.43), pedicle enhancement (p=0.97), and flap enhancement (p=0.5) were similar on immediate post-operative, 12-month, and 24-month MRI.
- Flap adherence to skull base increased significantly between immediate postoperative and 12-month MRI (75.9% vs. 97.9%, p=0.001) and remained adherent at 24 months.
  Diaphragma descended significantly by 1 year (54% vs. 9.4% above tuberculum sella-dorsum sella line, p<0.0001).</li>
  Patients who received adjuvant radiotherapy had a significantly higher rate of pedicle enhancement at all time points (immediate: 80% vs. 19%; 12-month: 100% vs. 21%; 24-month: 87.5% vs. 16.2%; p<0.0001).</li>

Table 1. Demographic Data		
Age (y)	54.3 (18-81)	
Sex (N, % Female)	31 (56.6)	
ASA score	2.78 (0.42)	
Tumor volume (cm3)	12.7 (31.7)	
Bony defect (cm2)	31.2 (20.4)	
Approach (N, %)		
Standard	36 (67.9)	
Extended	17 (32.1)	
Location (N, %)		
Anterior skull base only	11 (20.8)	
Sella turcica only	23 (43.4)	
Posterior skull base only	2 (3.77)	
Anterior & Sella	14 (26.4)	
Posterior & Sella	3 (5.66)	
Intraoperative CSF leak (N,		
%)		
None	3 (5.66)	
Low	19 (35.8)	
High	31 (58.5)	
Lumbar drain usage (N, %)	44 (84.6%)	
Length of bedrest (d)	2.07 (1.07)	
Postoperative CSF leak	0 (0)	
Adjuvant radiation (N, %)	10 (18.9)	
Data are presented in mean (S.	D) unless otherwise	
specified.		
Abbreviations: y, years; N, number; ASA, American		
Society of Anesthesiology; CSF, cerebrospinal fluid; d,		
day; SD, standard deviation		

Table 2. Summary of Pathology		
	N	%
Pituitary Adenoma	32	60.4
Craniopharyngioma	5	9.43
Rathke's Cleft Cyst	5	9.43
Meningioma	5	9.43
Other neoplasm	2	3.77
CSF leak/Encephalocele	2	3.77
Vascular Malformation	1	1.89
Olfactory Neuroblastoma	1	1.89
Abbreviations: CSF, cerebrospinal fluid		

#### Diaphragma Descent



**Figure 1.** Number of patients with diaphragma sella either above, at the level of, or below the dorsum sella-tuberculum sella line

• There were no other significant changes in the adjuvant radiotherapy group.



Figure 4. Representative T1 post-contrast magnetic resonance images showing changes in flap parameters over time. Immediate postoperative



Figure 2. Changes in nasoseptal flap enhancement over time



#### Pedicle Enhancement



Figure 3. Changes in NSF pedicle enhancement over time

Pedicle Enhancement (Radiation)

image sagittal (top left) showing non-enhancing nasoseptal flap measuring 8 mm thick along the skull base with partial pedicle enhancement measuring 1 mm thick. Coronal (bottom left) postoperative MRI showing elevation of the diaphragma sella due to persistent mass effect from the surgical cavity. Middle panels showing 1 year follow up with increased flap enhancement and pedicle enhancement with 1 mm increase in pedicle thickness (top middle) and full diaphragma descent (bottom middle), stable on 2 year follow up study (right panels).

**Figure 5.** Changes in thickness of NSF and pedicle (left axis) and adherence of flap to skull base (right axis) showing significant increase in adherence at 12 months.

**Figure 6.** Comparison of patients who underwent adjuvant radiation vs. no radiation showing significant increase in pedicle enhancement at all time points

### Contact

Edward C. Kuan, MD, MBA University of California, Irvine Department of Otolaryngology - Head & Neck Surgery 101 The City Drive South, Orange, CA 92868 eckuan@uci.edu

### References

- 1. 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. doi:10.1097/01.mlg.0000234933.37779.e4
- 2. Harvey RJ, Parmar P, Sacks R, Zanation AM. Endoscopic skull base reconstruction of large dural defects: a systematic review of published evidence. *Laryngoscope*. 2012;122(2):452-459. doi:10.1002/lary.22475
- 3. Birkenbeuel JL, Abiri A, Nguyen T, et al. Evolution of Radiographic Changes of a Vascularized Pedicled Nasoseptal Flap after Endonasal Endoscopic Skull Base Surgery. *AJNR Am J Neuroradiol*. 2023;44(2):171-175. doi:10.3174/ajnr.A7768
- 4. Jyotirmay H, Saxena SK, Ramesh AS, Nagarajan K, Bhat S. Assessing the Viability of Hadad Flap by Postoperative Contrast-Enhanced Magnetic Resonance Imaging. *J Clin Diagn Res.* 2017;11(6):MC01-MC03. doi:10.7860/JCDR/2017/26737.10118
- 5. Adappa ND, Learned KO, Palmer JN, Newman JG, Lee JY. Radiographic enhancement of the nasoseptal flap does not predict postoperative cerebrospinal fluid leaks in endoscopic skull base reconstruction. *Laryngoscope*. 2012;122(6):1226-1234. doi:10.1002/lary.23351