

Lucien Khalil MD<sup>1</sup>; Lynn Abdel Malak, MD<sup>1</sup>; Hussein Darwish, MD<sup>2</sup> Zeina Korban, MD<sup>1</sup>  
<sup>1</sup> Department of Otolaryngology – Head and Neck Surgery; <sup>2</sup> Department of Neurological Surgery  
 American University of Beirut Medical Center – Beirut, Lebanon

## Introduction

- Cerebrospinal fluid (CSF) leak is a recognized complication of endoscopic endonasal skull base surgery caused by dural breach during tumor resection and may result in meningitis, pneumocephalus, or revision surgery.
- Multilayer reconstruction techniques are widely used to reduce this risk, particularly cost-effective strategies suited to low- and middle-income settings.
- At the American University of Beirut Medical Center (AUBMC), a tertiary care center in Beirut, Lebanon, repairs were performed using a standardized multilayer gasket-seal technique combining autologous fascia lata, septal cartilage buttress, and a vascularized nasoseptal flap.
- This study presents the technique and seven-year surgical outcomes.

## Methods and Materials

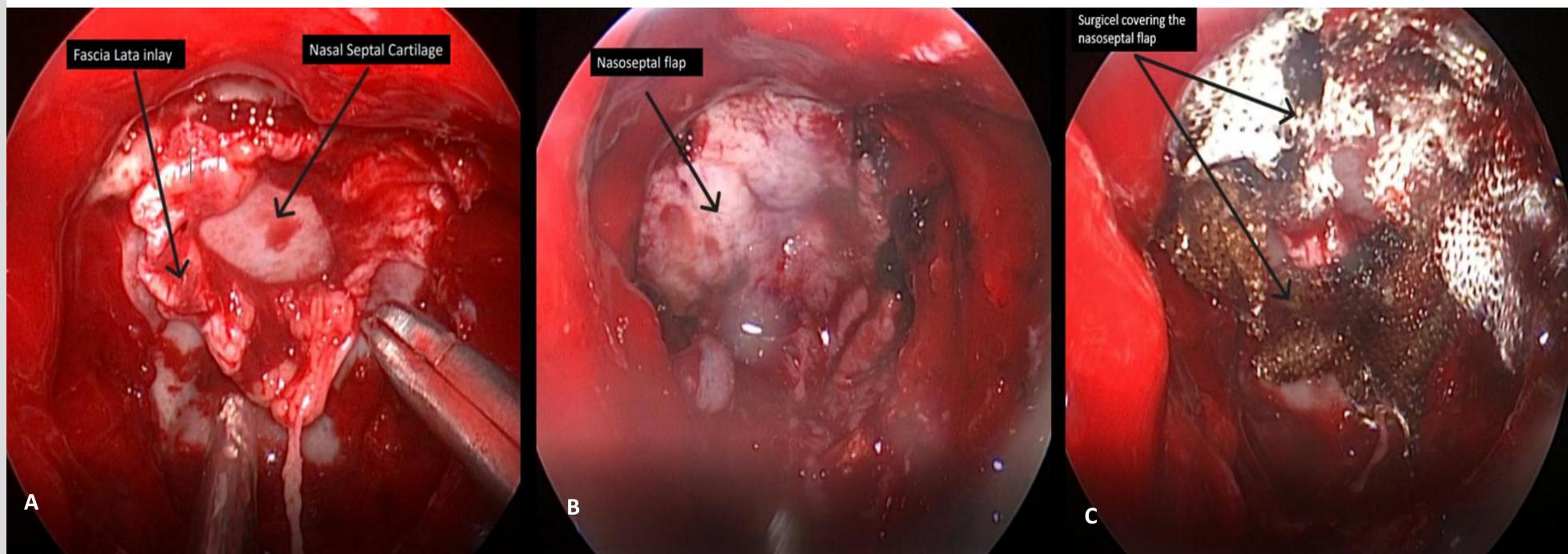
- We retrospectively reviewed adult patients who underwent endoscopic CSF leak repair at the otorhinolaryngology and neurosurgery departments, AUBMC, between November 2018 and July 2025.
- The diagnosis was established through clinical history, physical examination, radiologic imaging, and intraoperative findings.
- Patients with spontaneous leaks or a history of head trauma were excluded.

## Results

- Out of 138 patients, we included 107 patients in the study after excluding trauma cases and spontaneous CSF leaks. 59 women (55.1%) with a mean age of  $46.4 \pm 14.1$  years and 48 men (44.9%) with a mean age of  $44.8 \pm 16.5$  years.
- Twenty-five patients (23.4%) were undergoing revision surgery at the time of inclusion. Intraoperative CSF leaks were encountered in 32 cases (29.9%), 10 of which (9.4%) were high-flow.
- Multilayer closure was performed in 34 patients (31.8%), and a gasket seal was used in 21 cases (19.6%).
- Postoperative CSF leak requiring a repair surgery occurred in only one patient (1.9%).
- No other complications were encountered.

## Discussion

- Postoperative CSF leak rate was 0.9% overall and 3.1% in cases with intraoperative CSF leak, comparing favorably with leading international series.
- Strong results were achieved despite a high-risk cohort, including 23.4% revision surgeries and 9.4% high-flow leaks.
- No failures occurred in low-flow leaks, while high-flow leaks showed a 10% failure rate (1/10), consistent with best published benchmarks.
- Reconstruction relied exclusively on autologous materials using a gasket-seal principle.
- Reconstruction using septal cartilage, fascia lata, and a vascularized nasoseptal flap resulted in 100% flap viability and reliable healing.
- The single postoperative leak occurred after a third revision surgery and was successfully recovered.
- These findings support autologous gasket-seal reconstruction as a safe, effective, and economically sustainable technique, particularly in resource-limited settings.



**1A-** Placement of a fascia lata graft over the bony defect using a combined inlay/onlay technique, reinforced with harvested nasal septal cartilage. **1B-** Rotation and positioning of the nasoseptal flap to fully cover the fascia lata and cartilage layers. **1C-** Final reinforcement with Surgicel and fibrin glue, followed by an additional outer layer of Surgicel and Gelfoam to stabilize the reconstruction.

## Conclusions

- Autologous gasket-seal reconstruction using fascia lata, septal cartilage, and a vascularized nasoseptal flap is a safe and effective strategy for CSF leak repair following endoscopic skull base surgery. This approach yields outcomes comparable to those reported with synthetic materials while remaining economically sustainable. It represents a reliable reconstructive option, particularly in resource-limited settings.
- These findings demonstrate that excellent reconstruction outcomes can be achieved using exclusively autologous materials, supporting the reproducibility of this technique in centers where economic constraints influence reconstructive choices.

## Contact:

**Zeina Korban, MD**  
 American University of Beirut – Beirut, Lebanon  
 Department of Otorhinolaryngology – Head & Neck Surgery  
 Daniel Academic and Clinical Center, Daniel ACC, 7<sup>TH</sup> Floor  
 Administrative Offices: 01-350000 Ext 5471  
[zk27@aub.edu.lb](mailto:zk27@aub.edu.lb)

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