Reconstruction of the Pedicled Nasoseptal Flap Donor Site With a Contralateral Reverse Rotation Flap: Technical Modifications and Outcomes

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Objectives/Hypothesis: A pedicled nasoseptal flap is our preferred reconstructive technique after endoscopic endonasal skull base surgery. Its harvesting implies that the donor site (septal cartilage) is left bare. Secondary healing leads to crusting at the donor site that negatively affects the patient's quality of life and requires multiple outpatient debridements. A nasoseptal reverse rotation flap was designed to eliminate this problem; however, its outcomes have not been reported.

Study Design: Retrospective review.

Methods: We retrospectively reviewed the clinical charts of patients who underwent endoscopic endonasal skull base surgery at the Wexner Medical Center at The Ohio State University from November 2010 to September 2012, and in whom a reverse flap was used. We analyzed patients' demographics, pathology, and outcomes regarding the reverse flap.

Results: Forty-nine patients with various pathologies were included (11 meningiomas, seven craniopharyngiomas, five pituitary macroadenomas, five chondrosarcomas, five meningoencephaloceles, three chordomas, 11 malignant tumors, two other lesions). There were two patients lost to follow-up. Mean follow-up time was 11 weeks (range = 1–39 weeks). A follow-up examination 1 to 2 weeks after surgery revealed a complete re-epithelialization in 46 of 47 patients (97.87%). Adverse events included granuloma (n = 1), anterior dehiscence (n = 1), and excoriated mucosa (n = 1). Factors such as underlying disease, prior chemoradiotherapy, and postoperative chemoradiotherapy did not seem to affect the healing of the reverse flap.

Conclusions: The reverse flap provides complete remucosalization of the denuded donor septum, decreasing septal crusting within the first 1 to 2 postoperative weeks, and adds minimal morbidity.

Key Words: Endoscopy, skull base, nasal flap, Caicedo flap, pedicle nasoseptal flap, Hadad–Bassagaisteguy flap, skull base reconstruction.

Level of Evidence: 4

INTRODUCTION

Endoscopic endonasal skull base surgery has evolved over the past decade to facilitate the exposure and resection of skull base lesions while diminishing the manipulation of neurovascular structures. Other advantages of this approach include avoiding external incisions and cranial or maxillofacial osteotomies. A large dural defect is common, thus increasing the risk of a postoperative cerebrospinal fluid leak and intracranial infection. In this clinical scenario, we favor the use of a vascularized flap to restore the barrier between the subarachnoid space and the sinonasal tract.1

Our preferred reconstructive technique following endoscopic endonasal skull base surgery is the Hadad–Bassagaisteguy flap (HBF) or pedicled nasoseptal flap. An HBF comprises the nasal septum mucoperiosteum and mucoperichondrium with a neurovascular pedicle based on the nasoseptal artery (branch of the posterior septal artery).2 It is a reliable technique even for extensive defects; therefore, its use has led to a sharp decrease in the incidence of postoperative cerebrospinal fluid leaks and related morbidity.2–5 However, the HBF is associated with significant crusting at its donor site, which requires debridement until its secondary healing (remucosalization) is complete. This usually continues for 6 to 12 weeks after surgery.6 Nasoseptal crusting negatively impacts the postoperative quality of life, causing nasal obstruction, discomfort, sleep difficulties, and anosmia. Caicedo et al. designed a reverse rotation flap to reline the bare cartilage and eliminate these problems.7 However, the outcomes of the Caicedo reverse rotation flap (CRF) have not been investigated.
MATERIALS AND METHODS
This study received approval from the institutional review board of the Wexner Medical Center at The Ohio State University. We performed a retrospective chart review of 49 patients, who underwent endoscopic endonasal skull base surgery at the Wexner Medical Center at The Ohio State University from November 2010 to September 2012, and in whom a CRF was used for the reconstruction of the HBF donor site.

Surgical Technique
A CRF is created after the HBF is harvested and placed in the nasopharynx (Fig. 1A). The contralateral mucoperiosteum is elevated (Fig. 1B–D) from the posterior septal cartilage, vomer, and ethmoid plate, which are subsequently removed (Fig. 1E). This exposes the contralateral nasoseptal mucoperiosteum (Fig. 1F) that will be harvested as an anteriorly based vascular flap to resurface the denuded donor septum. Three incisions are carried out using extended insulated needle tip electrocautery on low cut setting. Superior and inferior incisions are performed following a mirror image of the HBF incisions (Fig. 2G, H). A posterior incision at the rostrum of the sphenoid sinus completes the anteriorly based flap that will be harvested as a vascularized anteriorly based random flap. IT = inferior turbinate; NF = nasal floor; SS = sphenoid sinus.

RESULTS
A CRF was performed in 49 patients who presented with a variety of pathological entities, including meningiomas (n = 11), craniopharyngiomas (n = 7), pituitary extrasellar macroadenomas (n = 5), chondrosarcomas (n = 5), meningoencephaloceles (n = 5), chordomas (n = 3), olfactory neuroblastomas (n = 2), other malignant tumors (n = 9), and other conditions (one nasopharyngeal stenosis and one cholesterol granuloma). Two of the 49 patients (4%) were lost to follow-up. Mean follow-up time was 11 weeks (range = 1–39 weeks). During the first postoperative visit (1–2 weeks postoperatively), we encountered complete re-epithelialization of the septal donor site in all but one patient who had an anterior dehiscence of the CRF (97.9%, 95% confidence interval [CI] = 88.9–99.6) and minimal crusting (100%, 47 of 47 patients; Fig. 3).

Some patients had factors that may affect wound healing such as diabetes mellitus (n = 6), chronic corticosteroid use (n = 7), and prior chemotherapy and/or radiotherapy (n = 11); however, these did not seem to influence flap healing. Furthermore, we encountered no
complications associated with the use of a CRF in 11 patients who received postoperative chemotherapy and/or radiotherapy (Fig. 4).

During the first month postoperatively, 29 patients referred complaints that included nasal stuffiness (n = 17 or 58.6%; 95% CI = 40.7–74.5), decreased olfaction (n = 9 or 31.0%; 95% CI = 17.3–49.2), foul smell (n = 2 or 6.9%; 95% CI = 1.9–22.0), and minimal epistaxis (n = 1 or 3.4%; 95% CI = 0.6–17.2). Nine patients with decreased olfaction, including patients who underwent an anterior skull base resection, in whom this was an expected sequela. Two of the remaining three patients with unexpected olfactory dysfunction recovered subjective function at 3 months of follow-up. One patient continued to have poor olfaction (3.4%). Adverse events included three minor complications (one granuloma, one anterior dehiscence of the flap, and one excoriated mucosa).
DISCUSSION

Secondary healing of the denuded septal donor site follows a protracted course that requires 6 to 12 weeks to complete healing. During this period, crusting commonly occurs, requiring debridement and negatively impacting the postoperative quality of life. The CRF seems to yield rapid and complete remucosalization of the septal donor site and decreased crusting within the first 1 to 2 postoperative weeks.

Nasal stuffiness is a common postoperative complaint, but it seems to mostly relate to congestion of sinonasal mucosa and crusting in the posterior sinonasal corridor. These problems are multifactorial and often depend on the thoroughness of postoperative nasal toilette, need for postoperative radiotherapy, and pre-existent or new sinonasal disease (i.e., allergy, rhinitis, rhinosinusitis).

We encountered no serious complications of CRF, such as flap infection or necrosis. Three patients experienced minor complications; one small granulation occurred on the anterior septum, one flap was dehiscent anteriorly (completely remucosalized in 1 month), and one patient suffered minor epistaxis due to excoriated septal mucosa (controlled with silver nitrate). Factors that affect wound healing, such as diabetes mellitus, chronic steroid use, and prior chemotherapy and/or radiotherapy, do not seem to significantly affect flap healing. Furthermore, no patient presented any problems during or after the use of postoperative chemotherapy and/or radiotherapy; therefore, CRF seems to resist adjuvant therapy uneventfully.

If the CRF is not feasible due to invasion of tumor or other reasons, we advocate the use of a free middle turbinate mucosal graft. In a recent article, this technique yielded rates of septal mucosalization of 70%, 97%, and 100% at 3, 6, and 12 postoperative weeks, respectively. Therefore, it decreases the incidence of crusting at the donor site to 5% and 0% at 6 and 12 postoperative weeks. It is our impression, however, that the reverse flap provides a more reliable reconstruction (98% at 2 weeks compared to 70% with the middle turbinate graft), and the septal mucoperiosteum conforms to the cartilage better than that of the middle turbinate; thus, it is less likely to cause obstruction. One theoretical disadvantage of using the CRF is that it precludes the use of the contralateral septal mucoperichondrium as a pedicle flap (synchronously or metachronously). However, this consideration is a moot point for the vast majority of patients. In our experience, the need for bilateral flaps is extremely rare. Furthermore, preserving the contralateral mucoperiosteum in case of a future need is only applicable to those patients in whom a unilateral approach is applied. Prior to the adoption of the CRF, we removed its corresponding mucoperiosteum to provide bilateral access. A bilateral technique implies a posterior septectomy to provide a unicameral corridor; thus, this eliminates the possibility of preserving this mucoperiosteum for future use.

CONCLUSION

CRF is a versatile and robust flap that can reliably reconstruct the denuded septal donor site. It provides rapid complete remucosalization and decreased crusting of the septal donor site within the first 1 to 2 postoperative weeks. This seems advantageous when compared with our initial experience, where the donor site was left to heal by secondary intention.

BIBLIOGRAPHY