Endoscopic Contralateral Superiorly Based Mucoperiosteal Nasal Septal Flap for Closure of Cerebrospinal Fluid Leak

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Abstract

Objective A novel local contralateral superiorly based mucoperiosteal nasal septal flap (CSBMNSF) for closure of a cerebrospinal fluid (CSF) leak from the middle anterior base of the skull is described.

Materials and Methods A retrospective review of patients having endoscopic sinus surgery (ESS) with a CSF leak between 2000 and 2009 was performed. The surgical technique is described. Two vertical parallel incisions are performed anteriorly and posteriorly in the contralateral septal mucosa, joined inferiorly by a horizontal incision. Elevation of the flap is completed, leaving it pedicled superiorly. A window is created at the highest aspect of the nasal septum to allow transfer of the flap to the affected side.

Results Four patients with a CSF leak post-ESS for excision of a congenital meningocele, tumor removal, and chronic sinusitis are described. All were treated successfully using a CSBMNSF.

Conclusion A novel, easy-to-handle local flap for closure of defects in the anterior middle skull base is described. The use of this flap offers less morbidity and less bulkiness compared with other local or regional flaps.

Keywords

- ▶ CSF leak
- ▶ sinus surgery
- ▶ local flap

Introduction

The achievement of endoscopic nasal surgical experience and a better understanding of the endoscopic anatomy expand the indications for endonasal approaches, leading to conversion from the traditional craniofacial approaches to endoscopic procedures.^{1–4} The previously most fearsome endoscopic complication, a cerebrospinal fluid (CSF) leak, is encountered more frequently during endoscopic procedures and elective reconstruction and is more common nowadays.⁵

There are various surgical techniques that aim to seal skull base defects and stop CSF leaks. Intranasal free tissue transfer (e.g., mucoperichondrial nasal septal flaps and turbinate flaps) is commonly used for small defects.⁵ Other free flaps used are fascia lata or fascia temporalis and abdominal fat.

These flaps have high success rates for the closure of small defects of the anterior base of the skull, but their effectiveness in the closure of larger defects is limited.⁶

Regional vascularized flaps such as pericranial and temporoparietal flaps are used for larger defects.^{7,8} Recently, the use of a vascular pedicle nasoseptal flap was introduced by Hadad et al for large dural defects of the anterior skull base post endonasal skull base surgery.⁹ However, the bulkiness of this flap is its major disadvantage.

The decision about which of these techniques is to be used is usually made according to different parameters such as the pathological involvement of the nasal structures, the location of the leak, and the surgeon's preference and experience.^{4,5} The limitation of using free tissue transfer for smaller CSF leaks, and the bulkiness of the more complicated local and

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regional flaps described in the literature, are the main disadvantages that need to be addressed.

We present a new, easy-to-handle, local contralateral superiorly based mucoperiosteal nasal septal flap (CSBMNSF) for closure of CSF leaks from the middle anterior base of the skull.

Materials and Methods

A retrospective review of patients having CSF leaks between 2000 and 2009 was performed. Demographic, surgical, and outcome data of these patients were collected.

Surgical Technique

Complete resection of the sinunasal pathology should be planned and performed. Clear margins should be obtained in case of malignancy, and smoothing of the bone edges at the defect site is required for better adjustment of the flap.

The contralateral nasal cavity is decongested and the nasal septum is infiltrated with lidocaine 0.5 to 1% with epinephrine 1/100,000 to 1/200,000 bilaterally. The use of the contralateral nasal cavity is required as the ipsilateral mucosal coverage is severed during the surgical procedure. The contralateral flap is designed according to the size and shape of the defect with a slight overestimation. Two vertical parallel incisions are performed anteriorly and posteriorly on the contralateral nasal septum mucosa, and the incisions are connected inferiorly by a horizontal incision at a height that will determine the length of the flap. The septal incisions may be completed with scissors or other sharp instruments as necessary. It is advantageous to complete all incisions before elevation of the flap. Multiple modifications of the flap regarding length and width are possible. The mucoperiosteum is then elevated on the contralateral side. The septal bone and cartilage and ipsilateral nasal mucoperiosteum are removed at the highest aspect of the nasal septum at the involved ipsilateral side to create a window large enough to allow transfer of the flap from the contralateral side (►Fig. 1 and 2). The uppermost bony septum can be drilled to allow better transfer of the flap to the contralateral

Fig. 2 The flap created post resection of a unilateral middle anterior base of skull tumor.

side. The nasal flap is then inserted to the involved side through the septal window and placed as an onlay technique to seal the leaking region (►Fig. 3). In the case of a larger defect in the nasal roof, supporting the flap by placing nasal cartilage or bone can be advantageous. The flap is positioned firmly and secured in place with a small piece of Merocele tampon (Medtronic, Fridley, Minnesota, USA) in a finger glove, both of which are secured on the external nose by silk string threads for 5 days and then removed.

Results

Four patients aged 33, 43, 51, and 70 years having a bony defect on the base of the skull and/or a CSF leak were treated successfully using a CSBMNSF between 2000 and 2009. One patient was treated for a congenital meningocele, the second patient for a CSF leak during endonasal endoscopic surgery for nasal polyposis, a third patient for allergic fungal sinusitis, and a fourth patient underwent reoperation for removal of an esthesioneuroblastoma involving the base of the skull to

Fig. 1 Normal anatomy.

Fig. 3 The flap rotated to close the bony gap of the base of skull.

achieve clear margins (► **Table 1**). Two of these patients had undergone prior sinus surgery. A CSF leak was observed in three patients and an exposed dura with no leak was observed in the patient with esthesioneuroblastoma. The defects' sizes were between 1 and 2 cm in their largest diameter. The pathology confirmed the diagnosis in those with chronic sinusitis and benign pathology, and a tumor was not detected in the patient with esthesioneuroblastoma. Only one patient presented with a complication and was diagnosed as having bacterial meningitis that healed completely before discharge.

All patients healed with no further surgical procedures required. No postoperative CSF leaks have been observed after a mean follow-up of 23 months (13 to 37 months).

Discussion

Bony defects in the skull base and CSF leaks are seen more often nowadays during endoscopic sinus surgeries, expanding the need for endoscopic closure techniques. The endoscopic approach, first reported by Wigand in 1981, has several advantages, including better field visualization with enhanced illumination and magnification, and is now the preferred approach, with higher success rates and less morbidity than intracranial surgical repair.^{4,5,10} Multiple studies demonstrate a 90 to 95% success rate when closing skull base defects using the endoscopic approach with a wide variety of grafting materials.

Generally, a small defect can be closed endoscopically with an overlay free mucosal graft or a free fascial graft. Defects smaller than 1 cm can be closed by a soft tissue free graft in an overlay technique alone, with a very high success rate. However, if the defect is more than 1 cm wide, the underlay technique with bone or cartilage is preferred to prevent herniation of cerebral tissue.¹¹ High success rates are reported using free grafts when the dural defect is small. However, these grafts cannot be used for larger defects and, in most cases, regional vascularized flaps will be required.

Regional vascularized flaps such as pericranial and temporoparietal flaps have mostly been used for closure of large defects observed postintracranial surgery or major trauma.¹² Adequate success rates have been reported using these flaps, but the major disadvantages are donor site morbidity and the bulkiness of the flap. Furthermore, utilizing these flaps might make the defect closure a far more complicated procedure than expected, especially in medium-sized defects occurring during functional endoscopic sinus surgery (FESS) operations for sinonasal pathology. In these cases, the use of a local flap is far more advantageous. Recently, the use of vascular pedicle nasoseptal flaps was introduced by Hadad et al for large dural defects of the anterior and ventral skull base after endonasal skull base surgery.⁹ However, the disadvantage of this flap is mainly its bulkiness.

The need for an easy-to-handle, less-bulky flap within the surgical field with low donor site morbidity that could be used for closure of big defects has recently arisen. The major advantage of the CSBMNSF over the nonvascularized free tissue flap and the regional and Hadad flaps is the fact that it

Table 1 Diagnosis and Follow Up of Four Patients Having Contralateral Superiorly Based Mucoperiosteal Nasal Septal Flap

Name	Age	Sex	Diagnosis	Imaging	Procedure findings	Postoperative period	Pathology	Follow-up
DY	51	m	Allergic fungal sinusitis, s/p FESS*	CT scan	CSF leak	Intravenous antibiotics, no meningitis	Mucus with Charcot-Leyden crystals	Chronic sinusitis treated with local steroids
MA	70	m	Chronic sinusitis with nasal polyposis	CT scan	Dura exposure and CSF leak	Bacterial meningitis treated with intravenous Rocephin (Hoffman-La Roche, Basel, Switzerland)	Nasal polyps with eosinophils	No pathology observed during follow-up
FS	43	f	Esthesioneuroblastoma on recent FESS*	CT scan, MRI	Dura exposure	Intravenous antibiotics, No meningitis	No pathology	No pathology observed during follow-up
EF	33	m	Ethmoidal sinus mucopyocele	CT scan	Dura exposure and CSF leak	Intravenous antibiotics, no meningitis	No pathology	No pathology observed during follow-up

Abbreviations: CSF, cerebrospinal fluid; CT, computed tomography; FESS, functional endoscopic sinus surgery; MRI, magnetic resonance imaging.

*Functional endoscopic sinus surgery.

incorporates the advantages of both. First, a CSBMNSF is a local flap big enough to close larger defects due to its rich blood supply. It is feasible to use this flap for closure of large defects that are not to be closed with a free nonvascularized flap. Moreover, it does not have the bulky appearance of other local axial flaps such as the Hadad flap. Third, our flap is placed in the surgical field, which is an advantage compared with regional flaps that are usually placed in the head and neck region, but will require further dissection and usually skin incisions. The use of the latter was acceptable in the past for the closure of posttrauma dural defects or for the closure of defects postexternal sinunasal pathology excision. However, in the era of more complicated endoscopic surgery, the need for local flaps for closure of larger dural defects is heightened. The close proximity of the flap to the resected field could also be a disadvantage. Hence, the use of our flap would not be an option in cases requiring excision of the septum or the contralateral side.

The harvest technique is simple and the flap design is straightforward and easy to manipulate. It can be used with the same ease both for small and large anterior base of skull defects with very high success rates. We would suggest strongly considering the use of this flap in any case of anterior cranial base CSF leak encountered during ESS procedure, as we have done during our last cases. The downfalls of the CSBMNSF are mainly the fact that it can be used for closure of only one side of the nose and that it cannot be used for closure in the frontal sinus or sphenoid sinus region.

Conclusion

A novel, easy-to-handle local flap for closure of defects in the anterior and middle skull base has been described. The use of this flap is recommended for closure of one side of the anterior central cranial skull base between the frontal sinus and the anterior wall of the sphenoid sinus. Closure of larger

defects is possible using this local flap with less morbidity and bulkiness than other local or regional flaps.

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