Reconstructive Options for Endoscopic Skull Base Surgery

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KEYWORDS

• Reconstruction • Nasoseptal Flap • Endoscopic • Endonasal • Skull Base • Septal • Septum • Local flap

EBM Question	Level of Evidence	Grade of Recommendation
How does endoscopic compare to open reconstruction of the skull base?	3a	C

Over the past 10 years, significant anatomic and technical advances coupled with improvements in instrumentation have facilitated the exposure and resection of a multitude of extradural and intradural skull base lesions via fully endoscopic expanded endonasal approaches (EEA). Endonasal skull base surgery encompasses a wide range of surgical pathology including everything from extradural benign tumors to sinonasal cancers to intradural primary brain tumors. When the outcomes of successful endonasal resection were first reported, the primary disadvantage documented was postoperative cerebrospinal fluid (CSF) leak secondary to intraoperative dural violation.

This article describes the sequential learning from initial free tissue grafting reconstructive techniques to the current use of vascularized flaps. Outcomes and limitations of current endoscopic reconstructive techniques are discussed. The pathophysiology

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of idiopathic CSF leak as treatment is well documented and differs from that of surgical skull base defects, thus is not discussed here.

PATHOPHYSIOLOGY

Reconstruction of the skull base directly relates to the nature of the surgical defect with differing goals between surgical groups. For example, many extradural tumor resections necessitate reconstruction to promote healing (especially in the setting of radiation therapy). In these cases, primary reconstructive goals are not avoidance of postoperative CSF leak and potential intracranial infection, but rather defect coverage to facilitate healing. This is in contrast to intradural surgery, as postoperative CSF leak and potential intracranial infection must be taken into consideration. Intradural tumor surgery can be divided into 2 main groups:

1. Intradural, but extra-arachnoidal, as is the case with pituitary surgery when the diaphragm is not violated
2. Intra-arachnoidal surgery where by definition an intraoperative CSF leak is appreciated 100% of the time.

Intra-arachnoidal surgery can be further divided into high-flow and low-flow leaks depending on whether a cistern was directly opened into the sinonasal defect. In addition to anatomic considerations, other important factors that must be noted when approaching reconstruction are the size of the dural defect, the nature of the patient's CSF pressure, obesity, and states of poor healing such as Cushing disease and prior irradiation.

The underlying, foundational goals of surgical defect reconstruction in endonasal skull base surgery are identical to those of conventional external approaches, ie, to completely separate the cranial cavity from the sinonasal tract, eliminate dead space, and preserve neurovascular and ocular function.[1] The principle of a multilayered reconstruction to reestablish tissue barriers is also preserved. Using endonasal pedicled vascular flaps and a reconstruction based on the aforementioned principles, postoperative CSF leak rates are now below 5%, a figure comparable to that reported for open cranial base reconstructive techniques.

CLINICAL PRESENTATION

Postoperative CSF leaks are typically noted within a week following surgery. The patient's history is most suggestive and often diagnostic. Primary symptoms include persistent, often salty tasting, rhinorrhea. Primary physical examination findings include a positive reservoir sign and increased rhinorrhea with Valsava maneuver. Sinonasal endoscopy should be performed and at times the leak can be confirmed or localized; however, in the early postoperative period absorbable packing often remains in place rendering visualization of the skull base defect difficult. Mental status changes are not common findings unless the patient has worsening pneumocephalous, a finding identified on computed tomography (CT) scan. It is important to note that Beta-2 transferrin can be used as a confirmatory test; however, in the early postoperative period the history and physical examination are diagnostic. Intermediate timed CSF leaks (2 to 6 weeks postoperative) are less common and usually present with intermittent low flow leaking episodes from a pinpoint dural opening. Late CSF leaks (more than 6 weeks postoperative) are very rare and are usually seen with patient noncompliance (hard nose blowing) or radionecrosis.