Cerebrospinal fluid leak after microvascular reconstruction of large craniofacial defects with orbital exenteration

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Abstract

Objectives: To assess risk factors for cerebrospinal fluid (CSF) leak after microvascular reconstruction of extensive cranio-orbitofacial resection with orbital exenteration (CFOE).

Study Design: Retrospective Case Series

Methods: 70 consecutive patients at a tertiary hospital underwent 76 procedures with microvascular reconstruction of CFOE defects. Patients were stratified by extent of skull base exposure and presence or absence of dural resection. Patients with exposure of the orbital apex and roof alone were classified as minimal skullbase exposure (MSE, n=32). Those with exposure beyond the orbital apex and roof were classified as significant skullbase exposure (SSE, n=38), including those with dural resection (n=23). The main outcome measure was incidence of postoperative CSF leak according to univariate and multivariate analysis of risk factors.

Results: Five patients developed a postoperative CSF leak, and 3 required operative management. All 5 were SSE with dural resection and had middle fossa exposure, previous radiation and 4 had previous surgery. None of the MSE group or SSE without dural resection or SSE with anterior fossa exposure alone developed a CSF leak. Multivariate analysis revealed middle fossa exposure to be the only significant predictor of CSF leak (p=0.03). The overall complication rate was 31.6%. Major complications were greater in the SSE group (p=0.05).

Conclusion: Middle fossa exposure increases the risk of CSF leak in microvascular reconstruction of CFOE defects.

Introduction

Extirpative surgery of extensive tumors of the periorbital region may require orbital exenteration and may involve the cranial base, thus carrying the attendant risk of complications such as CSF leak.[1-3] Cranial base defects resulting from tumors involving the orbit may involve any number of subsites in the anterior cranial base (Zone I) or middle fossa (Zone II).[4-5] Reconstructive techniques for exenteration vary from simple local flaps to complex free flaps, but large defects with involvement of the cranial base are often best addressed with free tissue transfer to minimize complications.[6] Skull base reconstruction requires protection for the central nervous system and creating a watertight dural seal as outlined in detail by Irish et al.[1, 4-5] The integrity of this seal is critical to the success of skull base surgery, as it prevents complications such as CSF leak and meningitis, the latter of which is reported in 10-25% of patients in the literature.[7-8] Therefore, careful preoperative assessment of the anticipated defect is critical. Limited reconstruction is associated with higher rates of CSF leak, osteomyelitis and sino-orbital fistula, especially in the setting of adjuvant therapy.[9-11]

CSF leak is among the more common and significant complications associated with skull base surgery, and prevention of CSF leak is a primary focus of reconstructive techniques.[5, 12] The reported rate of CSF leak associated with orbital exenteration alone varies in the literature from 1.6-16.7%.[12] In ACF resection the reported leak rate varies from 5-12%. The reported leak rate for microvascular reconstruction of larger defects varies: one study of 31 patients who underwent microvascular free flap reconstruction in anterior and middle cranial fossa identified a 16.1% leak rate.[13] Another study looking specifically at latissimus dorsi free flap reconstruction of anterior skull base defects reported two out of seventeen cases of CSF leak (11.7%).[14]

The purpose of this study was to evaluate the risk of CSF leak in a select subgroup of complex cranio-orbitofacial resections with exenteration that underwent free tissue transfer reconstruction. To our knowledge, this is the largest reported series of such defects reconstructed with free tissue transfer.

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Methods

This study was approved by our institutional review board. Retrospective review of free flap cases performed by our department identified 70 patients who underwent free tissue transfer for reconstruction of craniofacial defects between 2006-2014. Included patients underwent craniofacial resection with orbital exenteration and free tissue transfer for reconstruction. Patients were excluded if they had periorbital or craniofacial defects without exenteration, had simple exenteration (preservation of the lids and no exposure of the orbital apex), or had reconstruction without free tissue transfer.

Thirty-two patients had exposure of the orbital apex and / or orbital roof alone and were classified as minimal skullbase exposure (MSE); this represents patients at low risk for a CSF leak. Thirty-eight patients had additional dural exposure beyond the orbital apex or orbital roof and were classified as significant skullbase exposure (SSE) **(Figure 1).** Those without dural resection (n=15) were deemed to have a moderate risk for CSF leak, and those with dural resection (n=23) were identified as having a high risk for CSF leak **(Figure 2)**. Defects of the skull base were also classified as anterior fossa, middle fossa, or both for statistical analysis.

Seventy-six free flaps were used in this series as follows: 57 (75%) ALT flaps, 14 (18%) RF flaps, 3 (4%) latissimus dorsi flaps, 1 fibula flap, and 1 rectus flap. The most common recipient vessels were the facial artery (40 cases, 57%), the superficial temporal artery (20 cases, 29%), and the external carotid artery (9 cases, 13%).

Figure 1

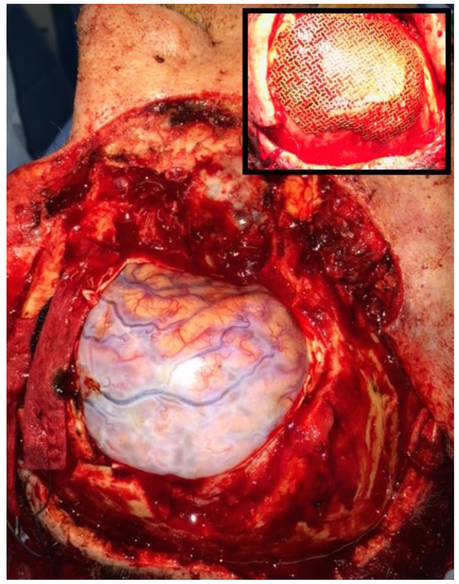
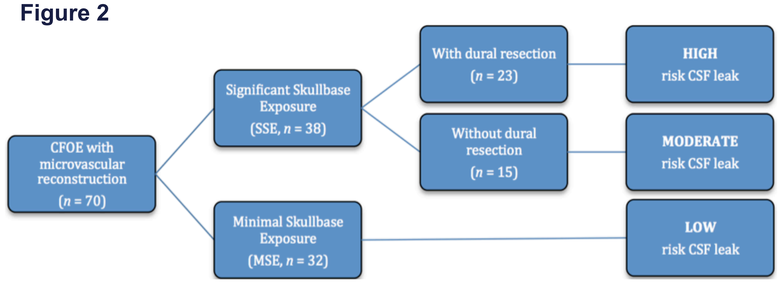


Figure 2



Results

The overall complication rate was 31.6% **(Table 1)**. There were 5 incidences of post-operative CSF leaks in this patient series. No MSE cases or SSE with isolated anterior skullbase defects resulted in postoperative CSF leak. All CSF leaks occurred in previously irradiated patients with SSE resections having middle fossa defects or both middle and anterior fossa defects. Three of the 5 cases had lumbar drains placed at the initial surgery. Use of intraoperative lumbar drains was not associated with any complication (p=0.417), major complications (p=1), or CSF leak (p=1). Management of the CSF leak cases is described in **Table 2**.

Univariate analysis revealed independence of previous surgery and CSF leak (p=0.37), and a strong relationship between surgery location (SSE defects with middle fossa involvement) and CSF leak **(p<0.01)**. There was evidence to suggest a relationship between previous radiation and CSF leak, though the result was not statistically significant (p=0.06). Conditional independence of previous radiation and defect location was tested via the exact Mantel-Haenszel-Cochran test, and was not statistically significant (p=0.228), implying that previous radiation and CSF leak are in fact independent. Previous surgery was similarly found to be independent of CSF leak (p=0.627), as was the type of free flap used (p=0.57).

Table 1

	N	% total
Major Complications	**17**	**22.4%**
Stroke	2	2.6%
MI	1	1.3%
CSF leak	5	6.6%
Immediate flap loss	2	2.6%
Delayed flap loss	2	2.6%
Donor site hematoma	5	6.6%
Minor Complications	**7**	**9.2%**
Minor wound breakdown	6	7.9%
Minor wound infection	1	1.3%
Any Complication	24	31.6%

Table 2

CSF Leak Patient	Pathology	Intraoperative Lumbar Drain	Management of Leak	Repair Details
Patient 1	Meningioma	Yes	Operative (POD #14)	Endoscopic nasal septal vascularized pedicle, mucoperiosteal graft
Patient 2	ACC of Lacrimal Gland	Yes	Conservative	Resolved with head of bed elevation, diamox, continued lumbar drainage
Patient 3	Meningioma	Yes	Operative (POD #9)	Open revision craniotomy using abdominal free fat graft and pericranial autograft
Patient 4	Inflammatory Pseudotumor	No	Operative (POD #3)	Open revision craniotomy and external ventriculostomy drain placement
Patient 5	Meningioma	No	Conservative	Resolved with postoperative lumbar drain

Conclusion

In our series of microvascular reconstruction of CFOE defects, patients with middle fossa exposure were at increased risk of CSF leak, while patients with anterior skull base exposure were not. No patients with MSE or anterior skull base exposure alone developed CSF leaks. We evaluated prior surgery and radiation as risk factors, but only defects involving the middle fossa were at risk in our series.