Naso- or Orbitocutaneous Fistulas after Free Flap Reconstruction of Orbital Exenteration Defects: Retrospective Study, Systematic Review, and Meta-Analysis

Patrick Tassone¹ Kurren S. Gill^{1,*} David Hsu¹ Gurston Nyquist¹ Howard Krein¹ Jurij R. Bilyk²
Anna P. Murchison² James J. Evans³ Ryan N. Heffelfinger¹ Joseph M. Curry¹

¹ Department of Otolaryngology-Head and Neck Surgery, Thomas Jefferson University Philadelphia, Pennsylvania, United States

² Skullbase Division, Neuro-ophthalmology Service, Wills Eye Hospital, Philadelphia, Pennsylvania, United States

³ Department of Neurological Surgery, Division of Neuro-Oncologic Neurosurgery, Thomas Jefferson University Philadelphia, Pennsylvania, United States

Address for correspondence Patrick T. Tassone, MD, 925 Chestnut St, 6th Floor, Philadelphia, PA 19107, United States (e-mail: patrick.tassone@jefferson.edu).

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Abstract

Objective Naso- or orbitocutaneous fistula (NOF) is a challenging complication of orbital exenteration, and it often requires surgical repair. We sought to identify the incidence and risk factors for NOF after orbital exenteration.

Study Design Retrospective chart review, systematic review, meta-analysis.

Setting Tertiary care center.

Participants Patients undergoing free flap reconstruction following orbital exenteration. Records were reviewed for clinicopathologic data, operative details, and outcomes.

Main Outcome Measures Univariate analysis was used to assess risk factors for incidence of postoperative NOF. PubMed and Cochrane databases were searched for published reports on NOF after orbital exenteration. Rates of fistula and odds ratios for predictive factors were compared in a meta-analysis.

Results Total 7 of 77 patients (9.1%) developed NOF; fistula formation was associated with ethmoid sinus involvement ($p < 0.05$) and minor wound break down ($p < 0.05$). On meta-analysis, pooled rates of fistula formation were 5.8% for free flap patients and 12.5% for patients receiving no reconstruction.

Conclusion Immediate postoperative wound complications and medial orbital wall resection increased the risk for NOF. On review and meta-analysis, reconstruction of orbital exenteration defects decreased the risk for fistula formation, but published series did not demonstrate a significant decrease in risk with free flaps compared with other methods of reconstruction.

Keywords

- ▶ nasocutaneous
- ▶ orbitocutaneous
- ▶ fistula
- ▶ orbital exenteration
- ▶ complication

*Equal contributing first author

Introduction

Naso- or orbitocutaneous fistula (NOF) is a challenging complication of midface and orbital resection and reconstruction. NOF can occur after craniofacial or transfacial resections, especially when orbital exenteration is performed.¹ These fistulas lead to functional and cosmetic problems such as malodorous discharge, pain, crusting, further wound breakdown, difficulty with nose blowing, hypernasal speech, or inability to wear an orbital prosthesis.¹ Occasionally, small fistulas may spontaneously heal or remain minimally symptomatic, but most fistulas persist and require surgical repair.² Because local tissues may be disturbed after midface resection and orbital exenteration, repair of these fistulas can be difficult.

The risk of NOF is thought to increase with increasing extent of surgical resection, for example orbital exenteration with violation of the nasal cavity or paranasal sinuses.^{3–5} Therefore, classifying ablative defects can be useful. Rabey et al reported a classification system for orbital exenteration: resection of the orbital contents alone (type I); exenteration with resection of periorbital bone (type II); or exenteration involving resection the anterior cranial base (type III).⁶ Exenteration can also be classified as lid-sparing or lid-sacrificing, though this binary classification scheme does not include information about other midface or even cranial base structures that may be involved.¹ NOF after orbital exenteration has been reported to occur in as many as 68% of patients.⁷

Because orbital exenteration is most often performed for malignant disease, many patients require postoperative adjuvant radiation treatment. Postoperative radiation has been reported to increase the risk of fistula formation after both periorbital resection and orbital exenteration.^{8,9}

There is disagreement in the literature regarding the best reconstructive option to minimize the risk of NOF formation after orbital exenteration. Because malignant disease is the norm in this patient population, some authors have favored granulation of an exenteration defect to monitor for disease recurrence. However, the reported rate of fistula formation following wound granulation is 28 to 71%.^{5,10} In contrast, rates of fistula formation following regional reconstruction or free tissue transfer are substantially lower, with some series reporting no fistulas after free flap reconstruction.² There has, however, been no published systematic review to compare rates of NOF across types of reconstruction, and rates are not reported in all series.

Once fistulas form, they are challenging to repair. A variety of repair techniques have been described, with varying levels of success. Cianchetti et al describe the use of a pedicled glabellar flap in patients with NOF after treatment of nose and paranasal sinus cancer.¹¹ Nelson et al describe a four-layer closure technique, using a paramedian forehead flap with galea, frontalis, and pericranial extension for effective closure of sinonasal fistulas.¹² However, fistulas remain a challenging complication, and prevention at the time of initial reconstruction should be the goal.

The current study reviews NOFs in a population of patients undergoing orbital exenteration and free flap recon-

struction with or without craniofacial resection. Treatment of NOFs in our series is described. Patients' clinical characteristics were evaluated to determine risk factors for NOF formation. Our series, the largest to our knowledge to focus on fistulae following orbital exenteration, is added to the available published literature as part of a systematic review and meta-analysis of NOF formation following orbital exenteration, with goals to identify rates of NOF following orbital exenteration, potential contributing factors to NOF formation, and strategies for fistula treatment and repair.

Subjects and Methods

Retrospective Study

After institutional review board (IRB) approval, a retrospective review of free flap reconstructions performed at the authors' institution was performed. Patients were included if they had undergone orbital exenteration with free flap reconstruction between September 2006 and October 2015. For each patient, demographic, clinical, and pathologic data were obtained from the medical record. Clinical data included prior and subsequent treatment, length of stay, length of follow-up, adjuvant therapy, and complications. Details of surgical resection and reconstruction were reviewed, including: subsites involved in resection, type of free flap used, and adjuvant reconstructive techniques. Pathologic data, including disease stage and histologic type, were also recorded.

Univariate analysis using Fisher's exact test was performed to identify variables associated with fistula formation. Two-tailed *p* values were calculated using 2×2 contingency tables. Multivariate logistic regression using NOF as a binary outcome was also conducted using age, extent of resection, use of radiation, length of stay, and type of reconstruction. Data were analyzed using R statistics package version 3.3.1 (R Foundation, Vienna, Austria).

Systematic Review

PRISMA guidelines for retrospective review were followed.^{13,14} PubMed and Cochrane databases were searched for the following terms: "nasocutaneous fistula" or "orbitocutaneous fistula" or "orbital exenteration fistula" or "orbital exenteration complication" or "craniofacial resection fistula." Titles were then reviewed to eliminate duplicates and assess for relevance. After selecting relevant titles, two of the authors (P.T. and K.G.) reviewed full text articles to determine eligibility. References of selected studies were also reviewed. Eligibility criteria for this systematic review included (1) English language; (2) human subjects; (3) retrospective studies, case series, or case reports involving patients with orbital exenteration; (4) available data on extent of defect; (5) data on type of reconstruction; (6) reported number or rate of NOF; and (7) at least 6 months follow-up. When available, data on pathology, type of reconstruction, pre- or postoperative radiation, timing of fistula formation, and type of fistula repair were also included.

Two of the authors (P.T. and J.C.) reviewed each included study to assess for risk of bias using the Cochrane Collaboration's tool. Bias was assessed across the following

categories: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other bias. Each category was rated as “low risk,” “unclear risk,” or “high risk” for each study. Studies with a high risk of bias were excluded.

Meta-analysis

PRISMA guidelines for meta-analysis were followed.^{13,14} All studies identified in systematic review were included in meta-analysis. Pooled rates of fistula formation were calculated from reported numbers of patients undergoing different types of reconstruction and number of patients who developed fistula. Rates of fistula formation were compared across group using 2×2 and 3×2 table chi-square analyses. When detailed data were available, odds ratios for fistula formation as a binary outcome variable were calculated as described by Tierney et al.¹⁵ Odds ratios were then used in a generic inverse variance, fixed effect meta-analysis. Meta-analysis was performed using RevMan 5.1 software (Nordic Cochrane Centre, Copenhagen, Denmark). Level of heterogeneity was evaluated using an I^2 statistic, with substantial heterogeneity for I^2 greater than 50%.¹⁶

Results

Retrospective Study

Seventy-seven patients undergoing orbital exenteration with free flap reconstruction were included (►Table 1). Most patients were male, and mean age was 63.6 years. Most patients had previous treatment including surgery (61%) and radiation (42%). The most common etiology overall was intraorbital and skull base extension of cutaneous (27%) or sinonasal (13%) squamous cell carcinoma, followed by cutaneous basal cell carcinoma (19%). Two patients underwent orbital exenteration as part of treatment for invasive fungal sinusitis. There were six (8%) cases of recurrent meningioma and six (8%) cases of sinonasal adenocarcinoma. Mean follow-up was 29 months (range: 1–84 months). Four patients died within 6 months of orbital exenteration, two from metastatic disease and two from other causes; all other patients had at least 6 months' follow-up.

Seventy-seven free flaps were used in this series. There were 59 (77%) anterolateral thigh (ALT) flaps, 15 (19%) radial forearm (RF) flaps, 2 (2.5%) latissimus dorsi, and 1 (1.5%) rectus abdominis flap (►Table 1). Average length of hospital stay following surgery was 8.9 days (range: 3–52 days).

A classification scheme for orbital exenteration has been previously published, and classifies exenterations as type 1 (exenteration only), type 2 (exenteration plus bony resection), or type 3 (exenteration plus anterior cranial base resection).⁶ Among our 77 patients, 5 (6.5%) had type 1 exenteration, 33 (43%) had type 2, and 39 (50.5%) had type 3. The high incidence of type 3 exenterations is likely because patients were identified in this series by their need for free flap reconstruction.

Seven patients developed postoperative fistulas, for a total fistula rate of 9.1%. Three fistulas developed within 6 months,

Table 1 Patient demographics for retrospective review

Demographic	n
Sex	57 M/20 F
Age (range)	64.1 (20–93)
Follow-up (range, mo.)	29 (1–88)
Prior surgery	46 (58%)
Prior XRT	31 (40%)
Postoperative XRT	51 (66%)
Pathology	
Skin SCC	21 (27%)
Skin BCC	15 (19%)
Sinonasal SCC	10 (13%)
Sinonasal adenocarcinoma	6 (8%)
Meningioma	6 (8%)
Invasive fungal	2 (3%)
Other	17 (22%)
Exenteration type	
Type 1: Exenteration only	5 (6.5%)
Type 2: Bony resection	33 (43%)
Type 3: Anterior skull base	39 (50.5%)
Reconstruction	
Anterolateral thigh	59 (77%)
Radial forearm	15 (19%)
Latissimus dorsi	2 (2.5%)
Rectus abdominis	1 (1.5%)

Abbreviations: BCC, basal cell carcinoma; F, female; M, male; SCC, squamous cell carcinoma; XRT, radiation therapy.

and four arose more than 6 months postoperatively (average: 22.3 months, range: 4–42 months). All fistulas occurred at the medial or superior margins of the orbit, and all involved the incision line. The most common skin defect among these patients was the eyelids, and the ethmoid sinus was most commonly involved sinus (►Table 2). The most common bony defects were of the cranial base, maxilla, inferior orbital rim, and medial orbital wall. Among those patients with late-appearing fistulas, no recurrent tumor was discovered as the source of fistula.

All seven fistula patients had medial orbital wall resection/ethmoid sinus involvement, and this was significantly associated with NOF formation ($p = 0.044$). All seven fistula patients also received postoperative radiation; however, the association between postoperative radiation and NOF was not significant ($p = 0.08$). In the immediate postoperative period, six patients had minor flap breakdown, defined as flap dehiscence from the native facial tissues without full-thickness loss of any portion of the flap; among these six patients, four developed fistulas. This association between breakdown and fistula formation was statistically significant on Fisher's exact test ($p = 0.008$). Extent of skin resection and sinus violation were evaluated as potential risk factors

Table 2 Details of free flaps used to reconstruction craniofacial resection with orbital exenteration defects

Defect details	NOF patients (n)
<i>Skin</i>	
Forehead	2
Brow	2
Temporal	3
Malar	3
Lower cheek	1
Eyelids	7
Nose	6
<i>Bone</i>	
Cranial base	4
Frontal bar	2
Lateral orbital rim	1
Orbital floor	4
Medial orbital wall	7
Maxilla	5

Abbreviations: NOF, naso- or orbitocutaneous fistula.

for fistula formation as well. While nasal skin involvement showed a trend toward significance ($p = 0.056$), malar skin, and frontal sinus involvement did not ($p = 1$, $p = 0.108$, respectively). Similarly, previous surgery ($p = 0.695$), type of exenteration ($p = 0.532$), and increasing length of stay ($p = 0.996$) did not correlate with fistula formation.

On multivariate logistic regression analysis of ethmoid sinus involvement and minor flap breakdown, minor flap breakdown maintained a significant association with fistula formation ($p = 0.007$); however, ethmoid sinus involvement was no longer significant ($p = 0.83$).

Among the seven patients with fistulas, five were reconstructed with ALT free flaps and three had RF free flaps. Type of flap did not predict fistula formation ($p = 0.719$). One

fistula patient's repair had been augmented with a titanium plate, and one patient underwent synthetic dural repair in the form of DuraSeal (Covidien, Dublin, Ireland) and DuraMatrix (Stryker, Kalamazoo, Michigan, United States). None of the NOF patients developed CSF leak.

All fistula patients required operative repair. Types of repair were four local rotation flaps, one paramedian forehead flap, one lateral arm free flap, and one debridement with primary closure (►Table 3). Two fistulas recurred despite surgical intervention; the overall success rate of initial fistula repair was 71% (5/7). Of the patients who failed initial attempts at fistula closure, one was ultimately closed after further debridement, and one had persistent fistula despite paramedian forehead flap.

Systematic Review

PubMed and Cochrane database searches initially yielded 163 published reports for review (►Fig. 1). Fourteen duplicates were excluded. After review of titles, 25 full text articles were evaluated for study eligibility. Six studies did not include any discussion of complications, and thus were excluded from this review of an important complication of orbital exenteration. An additional four studies were case series that included orbital exenteration patients, but only as extensions of lateral temporal bone resections. Because these series included only lateral defects, they were assessed to be high risk of selection bias. One study was similarly excluded as a series of infratemporal fossa resections. Thus, 14 studies, all of which were series of orbital exenteration patients, met all eligibility criteria and were included in this systematic review (►Table 4).^{1–7,10,17–22} Our retrospective series was included as well, for a total of 15 studies.

Among all but one of the reported studies, risk of selection bias was assessed to be low, as all studies were continuous series of exenteration patients. In one study, only patients receiving one type of reconstruction were included; thus it was unclear whether a selection bias occurred based on patients' appropriateness for a particular type of reconstruction.²⁰ Because no studies were blinded prospective studies, the risk of blinding was unclear and no studies were excluded

Table 3 Details of flap type, exenteration type, fistula type, time to fistula, and management of NOF

Fistula patients (n = 7)							
Patient	Free flap	Exenteration type	Postoperative XRT	Type of fistula	Time to fistula (mo)	NOF repair	Outcome
1	RF	2	Yes	NC	37	ATR	Closed
2	RF	2	Yes	OC	27	ATR	Recurred
3	ALT	1	Yes	OC	4	PMFF	Closed
4	ALT	2	Yes	OC	5	Debridement	Recurred
5	RF	3	Yes	OC	20	Lateral arm	Closed
6	ALT	3	Yes	OC	21	ATR	Closed
7	ALT	3	Yes	NC	42	ATR	Closed

Abbreviations: ALT, anterolateral thigh; ATR, adjacent tissue rearrangement; Lateral arm, lateral arm free flap; NC, nasocutaneous; NOF, naso- or orbitocutaneous fistula; OC, orbitocutaneous; PMFF, paramedian forehead flap; RF, radial forearm; XRT, radiation therapy.

Fig. 1 Systematic review flow diagram.

on this criterion. In all studies except two, follow-up was provided and attrition bias was assessed as low risk; two studies did not specify average length of follow-up.^{5,18} A risk of bias table is included in ►Fig. 2.

Total 1,152 patients were included in 15 series; series size ranged from 14 to 429, with an average size of 76.8 patients (►Table 4). Average age of all patients was 61.7 years. Neoplastic disease was the indication for nearly all patients, with a total of six patients undergoing exenteration for inflammatory conditions, and three patients with infectious etiology. Three series^{3,10,17} included only exenterations, but all other series had patients with extended resections. All but three series reported reconstruction other than granulation or free flap reconstruction. Other reconstruction was most commonly split-thickness skin grafting, and some authors also used temporalis muscle transfer or regional pedicled flaps such as pectoralis major or trapezius flaps.

Meta-analysis

Seven of 15 studies reported rates of fistula formation following free flap reconstruction, with NOF occurring in 13 of 227 total patients for a pooled NOF rate of 5.7% (►Fig. 3). Twelve studies also reported rates of fistula following non-free flap reconstruction techniques, with NOF occurring in 12 of 234 total patients for a pooled NOF rate of 5.1%. Nine studies reported rates of fistula when exenteration defects were allowed to granulate without any recon-

struction, with NOF occurring in 80 of 640 total patients for a pooled NOF rate of 12.5%.

On 3×2 table chi-square analysis, the 40% rate for NOF following granulation was significantly higher than among free flap and non-free flap reconstruction patients ($p < 0.001$). However, NOF rate was not significantly different between free flap and non-free flap reconstruction on 2×2 table chi-square analysis ($p = 0.77$).

In addition to our series, two additional studies had evaluable data for meta-analysis of risk for NOF after postoperative radiation.^{2,6} In these series, a high proportion of patients (70 and 43%) had free flap reconstructions of their orbital exenteration defects, and in our series all patients had free flaps. On meta-analysis, overall odds ratio for fistula formation after postoperative radiation was 3.58, but it did not reach statistical significance (95% confidence interval [CI] 0.58–22.25, $p = 0.17$, ►Fig. 4). This meta-analysis had low heterogeneity with $I^2 = 0\%$.

Discussion

NOFs are frustrating complications for both patients and surgeons. We explored our series of free flap reconstruction after orbital exenteration and added this to the available literature in a meta-analysis. While free tissue transfer provides substantial tissue for surface area and volume defects, NOF can still occur. Postoperative fistulas occurred in seven patients in our series. This 9.1% rate closely

Table 4 Systematic review

Author	Year	Total (n)	FF	FF fistulas	Rate in FF	Other reconstruction	Other fistulas	Rate in other	Granulation	Granulation fistulas	Rate in granulation	Average age	Length of F/U	Pathology	Defects	Other reconstruction
Bartley et al	1989	100	0	0	–	0	0	–	49	17	35%	62	55 mo	Neoplastic disease in all	49/100 exenteration plus skin	27 STSG, 10 temporalis, 14 regional
Günalp et al	1996	429	0	0	–	0	0	–	429	26	6%	36	25.2 mo	425 neoplastic, 4 inflammatory	All exenteration only	None
Mohr and Esser	1997	77	14	0	0%	38	0	0%	25	17	68%	52.2	57.8 mo	74 neoplastic	45 bony; 13 orbit roof; 26 other orbit	13 temporalis, 14 regional
Shields et al	2001	56	0	0	–	1	0	0%	55	1	2%	63	–	54 neoplastic, 1 infectious, 1 inflamm	47 eyelid-sparing, 9 eyelid-sacrifice	1 STSG
Goldberg et al	2003	13	10	3	30%	3	0	0%	0	0	–	66.8	44.8 mo	Neoplastic disease in all	All exenteration only	1 TPF flap
Rahman et al	2005	64	0	0	–	21	3	14%	43	12	28%	68.2	–	Neoplastic disease in all	3 orbital rim resection	21 STSG
Taylor et al	2006	14	0	0	–	7	2	29%	7	5	71%	66	35 mo	13 neoplastic, 1 inflammatory	All exenteration only	3 STSG
Limawarut et al	2007	110	11	1	9%	92	2	2%	7	2	29%	63	23.4 mo	Neoplastic disease	26 orbital rim resection	1 STSG w/ dermal fat, 1 regional
Nemet et al	2007	38	0	0	–	14	1	7%	24	0	0%	67.7	48 mo	Neoplastic disease in all	4/38 exenteration plus skin	11 dermal fat, 2 STSG, 1 FTSG
Hanasono et al	2009	79	55	0	0%	24	1	4%	0	0	–	62.2	20.8 m	Neoplastic disease in all	48 extended bony exenteration, 7 maxillectomy	18 STSG, 6 regional
Kovacevic et al	2009	21	0	0	–	20	1	5%	1	0	0%	68	38 mo	Neoplastic disease in all	All medial orbit wall resection	20 galea-skin flaps
Kuo et al	2011	38	33	0	0%	5	1	20%	–	–	–	68	34 mo	Neoplastic disease in all	8 craniotomy, 15 maxilla, 7 ethmoid, 1 rhinectomy	1 fat graft, 1 local flap
Roche and Timon	2012	22	21	1	–	1	0	0%	0	0	–	62	60 mo	Neoplastic disease in all	9/22 maxillectomy	–
Rabey et al	2014	14	6	0	0%	8	1	13%	0	0	–	61	75 mo	Neoplastic disease in all	4 exenteration only, 5 bony, 5 ant cranial base	8 CFAF
Tassone	2016	77	77	8	10%	0	0	–	0	0	–	59.4	19 mo	75 neoplastic, 2 infectious	5 exenteration only, 33 bony, 39 ant cranial base	All free flaps

Abbreviations: CFAF, common femoral artery flap; F/U, follow-up; FF, free flap; FTSG, full-thickness skin graft; STSG, split-thickness skin graft; TPF, temporoparietal fascia.

Fig. 2 Risk of bias assessment of studies included in systematic review.

Fig. 3 Pooled fistula rates according to type of reconstruction. p Values shown are for chi-square testing.

approximates the 6% average reported rate of NOF among orbital exenteration patients on systematic review of published studies.

All our patients who developed fistulas had undergone postoperative radiation therapy, which trended toward but was not significantly associated with fistula formation ($p = 0.08$). Postoperative radiation therapy also did not reach statistical significance as a risk factor for NOF on meta-analysis; however, only three studies had evaluable data to inform this meta-analysis, and additional series and subsequent meta-analysis may validate radiation as a risk factor for NOF formation. Also of note, many patients included in the radiation meta-analysis had free flap reconstructions, which may influence likelihood of NOF formation from radiation.

Of the 77 total patients in our series, 6 patients had minor wound breakdown along their incision lines after the initial surgery; this breakdown was associated with fistula formation later. Minor wound breakdown may indicate poor wound healing in these patients; however, length of stay, a surrogate marker for fitness, was not significantly associated with NOF.

Fig. 4 Meta-analysis of fistula formation in the setting of postoperative radiation versus no postoperative radiation. Note $I^2 = 0\%$, indicating low heterogeneity.

Fig. 5 Photograph and axial cut computed tomography or magnetic resonance imaging for each patient in our series who developed naso- or orbitocutaneous fistula. Note dead space behind free flap reconstruction for all but one patient.

We suspect that multiple factors influence the formation of NOF, but that the ultimate determining factor is alignment and communication of the sinonasal cavity with external incisions; dead space from either native or resected sinus cavities may leave patients at risk for fistula. Resection of the ethmoid sinuses and medial orbital wall allows communication of the sinonasal cavity with the skin incision of the free flap, especially when the nasal skin or medial lid skin is resected. Radiation or wound complications can produce defects predisposed to breakdown, which can lead to fistula formation. We suspect that any number of variables that increase the volume of the defect, impede wound healing, or increase exposure of the incision line to the sinonasal cavity increase the risk of NOF. In each case, the variables may differ.

► **Fig. 5** shows a photo and axial imaging cut of each patient who developed NOF in our series. In each case except one, there was dead space behind the skin of the flap overlying the orbit; for five patients, this was a space that

resulted from tumor resection, and in one patient there was native ethmoid sinus underlying the free flap. In the patient without significant dead space, a foreign-body reaction to a reconstructive plate likely caused the fistula.

Avoiding the creation of dead space or hematoma under flaps is critical to orbital exenteration reconstruction to minimize the risk of infection and potential for fistula formation. To achieve this, bulky flaps such as the ALT are optimal for orbital exenteration reconstruction to fill the resulting dead space behind the incision lines. Myocutaneous flaps with large muscle components such as scapular system or latissimus dorsi free flaps may be more durable after radiation than the subcutaneous fat of the ALT, though the dermal layer of this flap is very durable. Though in our series type of flap did not predict NOF formation, it should be noted that most patients in our series (77%) were reconstructed with ALT flaps, making comparisons with relatively small numbers of other flaps difficult.

Fistulas may not develop for weeks to months postoperatively, which emphasizes the importance of long-term follow-up care of these patients. They commonly present as breakdown of the incision site if closure has been with a free or local flap.¹ Certainly, if fistula formation occurs late and the exenteration is performed for a malignant tumor, the socket should be evaluated for evidence of tumor recurrence, including imaging studies to exclude the presence of a malignant fistula. Though several of our patients presented with late fistulas, none was found to have recurrent disease as a source. Four patients died within 6 months of surgery, and none of these four had developed fistula or wound breakdown by the time of their deaths.

Reporting of NOF varies in published series, as does duration of follow-up, either of which can contribute to variability in incidence. Further, the extent of surgery varies from case to case, and it can be difficult to assess whether the resection from our series aligns with prior series. To our knowledge, this represents the largest series of orbital exenteration with free flap reconstruction used to determine fistula rates.

Management of fistulas varies depending on the size and location of the defect, but closure of fistulas is indicated, especially if bothersome symptoms develop. Achieving a minimum two-layered closure is an essential reconstructive requirement to prevent recurrence.¹ While reconstructive options ranging from simple rotation flaps to free tissue transfer have been described, NOFs remain a challenging surgical problem.

Conclusion

Patients with minor postoperative wound breakdown and medial orbital wall resection were at increased risk of developing NOFs. Postoperative radiation therapy showed a trend toward significance for fistula formation. Reconstruction of orbital exenteration defects minimizes the rate of fistula formation, though it does not eliminate it; moreover, meta-analysis of the current available data does not show a difference between free tissue transfer and other methods of reconstruction.

Presentations

This retrospective review was presented as a poster at the Combined Otolaryngology Spring Meeting (COSM) in Chicago, IL in May 2016.

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