A novel approach for successful closure of sinonasal fistulae

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Summary
Medial canthus sinonasal fistula is associated with troublesome aesthetic and functional issues. Corneal irritation and drying results from escape of both air and secretions from the nasal cavity across the ocular surface as well as misting of spectacles if worn. Reconstruction of such fistulae is associated with a high rate of recurrence and thus presents a difficult surgical challenge.

Methods: This paper describes the senior author’s surgical approach to manage medial canthus sinonasal fistulae utilizing an interpolated forehead flap combined with extended galea-frontalis and pericranial flap for stepped closure. The technique of flap elevation and inset is discussed, with emphasis on key manoeuvres to prevent sinus recurrence. A retrospective review of consecutive cases is presented.

Results: Four patients were treated using this technique over 12 months. In all cases, fistulae developed following adjuvant radiotherapy for tumour resection. Flap elevation was performed in combination with a bicoronal approach in 2 patients and via direct forehead approach in 2 patients. No post-operative complications or recurrence of fistula have occurred over 12 months follow-up.

Conclusion: The success of this technique is attributed to inclusion of a galeafrontalis and pericranial extension to the forehead flap. In addition, the fistula site must be prepared to accommodate the flap by dissection of a wide subcutaneous pocket. This stepped method of closure provides an effective barrier to air and nasal secretions and also achieves an excellent aesthetic outcome.

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Sinonasal-cutaneous fistulae at the medial canthus arise most commonly following treatment for sinonasal malignancy with a reported incidence of 10% at 5 years post-treatment. Chemoradiation may lead to poor wound healing and decreased vascularity, thus predisposing to fistula development. Other aetiological factors include orbital exenteration and endoscopic laser dacryocystorhinostomy.

The complexity of fistulae in this region may compromise eyelid function, lacrimal drainage system patency, ocular protection and aesthetics. Corneal irritation and drying results from escape of both air and secretions from the nasal cavity across the ocular surface as well as misting of spectacles if worn. Whilst many patients wear customized silicone prostheses, localized skin reaction and inadequate seal may be a problematic. In addition, patients may feel self-conscious when the prosthesis is not in-situ.

Reconstruction of such fistulae is associated with a high rate of recurrence and thus present a difficult surgical challenge. Treatment by primary closure, skin grafts and simple local flaps have a limited role due to a lack of vascularized bed and impaired healing of irradiated tissues. Achieving a minimum two-layered closure is an essential reconstructive requirement to prevent recurrence.

This paper describes the senior author’s surgical approach to manage medial canthus sinonasal fistulae utilizing an interpolated forehead flap combined with extended galeafrontalis and pericranial flap for stepped closure.

Method

Patient assessment

Factors to consider when assessing sino-nasal fistulae include: dimensions of the defect, involvement of adjacent structures such as the eyelids, medial canthus and lacrimal system, quality of surrounding tissues and stability of the wound. The limits of donor site harvest determine the size of defect that can be reconstructed using this technique. Reconstruction should be delayed until all adjuvant treatment is complete.

Surgical technique

The supratrochlear artery of the contralateral forehead is identified using Doppler ultrasound and its anatomical course is traced and marked. This improves flap survival and allows for a narrower pedicle base.

A paper template of the defect is created and positioned on the contralateral forehead in line with the marked pedicle. A circumferential 2–3 cm marking is drawn around the template. This corresponds to the width of the underlying galeafrontalis and pericranial extension that will be included in the flap (Figure 1).

Local anaesthetic (1% lignocaine & adrenaline 1 in 80 000) is infiltrated around the skin markings.

The skin is incised around the marked pedicle and template and subcutaneous skin flaps are elevated. The galeafrontalis extension of the flap is then incised and elevated with a periosteal elevator to also include...
pericranium (Figure 2). Dissection of the flap pedicle continues subperiosteally towards the supraorbital rim until adequate interpolation of the flap to the fistula defect is achieved. Whilst this approach to flap harvest is appropriate in most cases, improved access via a bicoronal incision may be required if additional procedures such as removal of previous fixation plates or remodeling of the frontal bone is necessary.

The medial canthal region is prepared by excising the edge of the fistula. A subcutaneous pocket measuring 1–2 cm is then dissected circumferentially. The flap pedicle is de-epithelialised and a subperiosteal tunnel between the flap base and the medial canthal region is created to facilitate interpolation of the flap to the fistula site. The galeafrontalis extension of the forehead flap is inset into the wide subcutaneous pocket around the fistula, producing a stepped closure (Figure 3). Four layers of sutures are then performed: a deep layer from the deep edge of the fistula margin to the deep surface of the galeafrontalis pericranial flap (4-0 vicryl); an intermediate layer from the edge of the galeafrontalis flap to the periphery of the subcutaneous pocket (5-0 monocryl); a deep dermal (5-0 monocryl) and superficial skin layer (6-0 prolene) from the skin component of the forehead flap to the skin around the margin of the fistula. The donor site is closed with interrupted 5-0 monocryl to the muscle/subcutaneous tissue and 6-0 prolene to skin.

Clinical follow-up is performed on a weekly basis for 1 month post-operatively, and then at three monthly intervals. Patients are advised to avoid nose blowing and to sneeze through the mouth.

Review

A retrospective review of consecutive cases treated using this technique was performed. Information extracted from the medical casenotes included demographic data, defect classification, surgical procedure, complications, and recurrence of fistula. Aesthetic outcome was assessed by patient and surgeon satisfaction at clinical follow-up.

Results

Four patients underwent the described procedure between January 2012 and January 2013.

Case 1

A 39-year old female developed a left sinonasal fistula following craniofacial ethmoidectomy and radical radiotherapy for Grade II pleomorphic sarcoma in 2008 (Figure 4). A bicoronal approach was utilized to facilitate removal of titanium plates and mesh from the frontoparietal region following previous craniotomy repair. In addition, Hydoset bone substitute was used to fill some contour defects of the calvarium.

A forehead flap with galeafrontalis extension was elevated and inset as described. Closure of the fistula was achieved with a very satisfactory result (Figure 5) with follow-up extending to 18 months.
Case 2

A 49-year old male underwent craniofacial resection of adenocarcinoma from the left ethmoid sinus with fixation of the medial canthus using a titanium plate to the glabellar region. A left sinonasal fistula measuring 1 x 1.5 cm arose following completion of adjuvant radiotherapy. Dehiscence of the medial canthus was noted clinically. A bicoronal approach was also adopted in this case to remove the exposed titanium plate. In this case, a longer extension to the galeafrontalis was included in the forehead flap to augment a contour deficiency of the left infra-orbital region/medial cheek (Figure 6).

Clinical review 10 months following surgery demonstrated effective reconstruction of the sinonasal fistula repair (Figures 7 and 8).

Case 3

A 74-year old man was treated for ex-pleomorphic metastasis to the frontal sinus by resection and radiotherapy in 2011. A prosthesis was worn by the patient following development of a sinonasal fistula. However, problematic eye irritation developed due to persistent leakage from the fistula. A forehead flap with galeafrontalis extension reconstruction was performed via the direct flap harvest approach described. Follow-up review at 12 months revealed a very pleasing outcome with resolution of eye symptoms.

Case 4

A 64-year old man underwent neo-adjuvent chemo-radiotherapy followed by excision of left nasolacrimal SCC. The medial canthus was repaired with a titanium plate and prolene suture by another surgical team. He subsequently developed sinonasal fistula and complained of his glasses...
steaming up due to escape of air. He also had epiphora secondary to medial canthal common tendon separation.

Removal of plate and elevation of a forehead flap with galeafrontalis extension was performed via the direct forehead approach. The common medial canthal tendon was also repaired with a prolene suture and anchored to periosteum.

Early post-operative outcome was highly satisfactory at 4 months.

No post-operative complications or recurrence of fistula are reported in this patient series. All patients were pleased with the aesthetic outcome, and no longer having to wear a prosthesis as well as resolution of corneal symptoms.

Discussion

Reconstruction of sinonasal-cutaneous fistulae presents a difficult surgical challenge due to the involvement of peri-orbital structures, loss of underlying bony support, poor vascularity of local irradiated tissues and high rate of recurrence.

A fundamental reconstructive principle in the management of such fistulae is achieving a minimum stepped two-layer closure. Local or regional flaps do not survive over a hole and attempted closure leads to fistula recurrence.

The paramedian forehead flap is an excellent choice for reconstruction of small to moderate sized defects. The advantages of this flap include a robust, reliable vascular supply with provision of a good colour and texture match for the periorbital tissues. Despite criticism of the forehead flap relating to poor cosmesis of the donor site, we report excellent healing of forehead scars with a very satisfactory aesthetic outcome in all cases.

The functional success of this technique is attributed to inclusion of a galeafrontalis and pericranial extension to the forehead flap. Pericranial flaps have an established role in craniofacial surgery and are useful in reconstruction of irradiated tissues due to their reliable blood supply. Raising the galea and pericranium simultaneously further increases the robustness of flap vascularity. Therefore, inclusion of the galeafrontalis and pericranium introduces a dependable, well-vascularized flap to promote effective wound healing. However, the additional key manoeuvre to prevent fistula recurrence adopted in this technique is the stepped inset of the flap. Dissection of a pocket into which the galeafrontalis and pericranial extension to the forehead flap is sutured provides an effective four-layer airtight closure and seal barrier to escape of air and nasal secretions.

Harvest of a galeapericranial flap via a bicoronal incision has previously been described for closure of sinonasal fistulae in two patients. Skin cover of the fistula site was provided by a cheek advancement flap. However, the limits of a cheek advancement flap to cover defects involving the medial canthus as well as additional donor site scarring are the potential drawback of this technique.

Use of a pericranial flap covered by a full-thickness skin graft has also been described for medial canthal reconstruction. However, in the reported series of 21 cases, complete flap failure with skin graft necrosis occurred in two patients, and partial skin graft necrosis in five patients. Therefore, the high risk of graft failure associated with this technique may not be an effective solution.

Another technique for closure of sinonasal fistulae reported in two patients utilizes a nasolabial flap to line the inside of the fistula and a forehead flap to reconstruct the outside area. Both flaps were pedicled and divided at three weeks. Whilst the concept of a layered closure is advocated by the author, the disadvantages of this technique include two donor sites, and reconstruction involving two stages.

Temporoparietal fascial flaps have been described to reconstruct orbito-antral fistulae but advancement of this flap to the medial canthus is restricted.

In summary, the paramedian forehead flap with galeafrontalis and pericranial extension meets the reconstructive goals for effective closure of sinonasal-cutaneous fistulae. A four-layer closure is achieved from one donor site in a single stage procedure. Satisfactory aesthetic outcome of both the medial canthus region and forehead donor site can be achieved, although deficiency of medial orbit skeletal support may limit medial orbital aesthetics.

Although we acknowledge the small number of cases reported in this study, we believe this is a novel and effective technique associated with no episodes of recurrence.
Conclusion

The success of this technique is attributed to inclusion of a galeafrontalis and pericranial extension to the forehead flap. In addition, the fistula site must be prepared to accommodate the flap by dissection of a wide subcutaneous pocket. This stepped method of closure provides an effective barrier to air and nasal secretions and also achieves an excellent aesthetic outcome.

Ethics

This retrospective review was undertaken with the verbal and written consent of each patient for their case to be published. High ethical standards including data protection were adhered to throughout.

Conflict of interest statement

The authors have no conflict of interest.

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References