Original Article

A cross-sectional study of hybrid reconstruction of the anterior skull base following extended endoscopic transnasal resection of skull base tumours

Fiona Ip[1], Yi-Yuen Wang[1], Benjamin Dixon[1,2]

[1]Epworth Richmond, Epworth Healthcare, Melbourne, Australia; [2]Department of Otolaryngology Head and Neck Surgery, St Vincent's Hospital Melbourne, Melbourne, Australia

Contributions: (I) Conception and design: YY Wang, B Dixon; (II) Administrative support: F Ip; (III) Provision of study materials or patients: YY Wang, B Dixon; (IV) Collection and assembly of data: F Ip; (V) Data analysis and interpretation: F Ip; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Fiona Ip, MD. Head and Neck Surgery, Epworth Richmond, Epworth Healthcare, 9 Durant Avenue, Sunshine West 3020, Melbourne, Australia. Email: fionahiuip@gmail.com.

Background: Despite recent advances in endoscopic transnasal skull base surgery reconstruction of a large skull base defect can still be challenging. Robust techniques are essential for preventing cerebrospinal fluid (CSF) leakage and associated complications. While many techniques with flaps and grafts have been described the use of vascularized pedicled flaps has shown to be successful in reducing postoperative complications. The nasoseptal flap has gained popularity. However, this may not be viable in cases of malignant infiltration, revision or salvage procedures. We describe our hybrid endoscopic/open technique of using autologous fascia lata and a pedicled vascular pericranial flap to reconstruct the skull base defect following extended endoscopic skull base surgery. This study describes the technique and outcomes of hybrid reconstruction of dural defect after extended endoscopic transnasal resection of skull base tumours in situations whereby the nasoseptal flap is non-viable.

Methods: This is a retrospective cross- sectional study in which 16 cases of extended endoscopic transnasal resections of skull base tumours (14 malignant and 2 benign) since December 2018 were evaluated. An autologous tensor fascia lata graft was underlay in the dural defect and it is augmented externally by a vascularized pericranial flap rotated through a modified Lynch incision. Information on complications such as CSF leakage, postoperative infection and bleeding were collected.

Results: There were no post- operative complications of CSF leakage, meningitis, tension pneumocephalus or significant bleeding requiring additional packing or operative intervention.

Conclusions: The use of pedicled pericranial flap in combination with autologous fascia lata in reconstruction of large dural defects resulting from an extended endoscopic transnasal skull base resection is a reliable method for skull base reconstruction.

Keywords: Craniofacial resection; endoscopic skull base surgery; skull base repair

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Introduction

The increase in anatomic understanding and the development of instrumentation over the past decades have facilitated the endoscopic transnasal approaches in resection of skull base lesions (1). Despite advances in endoscopic transnasal skull base surgery reconstruction of a large skull base defect can still be challenging (2). Robust techniques are essential for preventing cerebrospinal fluid (CSF)

Table 1 Demographics and pathologies of patients undergoing endoscopic transnasal skull base tumour resection

Variables	Value
Age, median [range], years	71 [44–86]
Female:male	1:2.2
Benign tumours	2
Meningioma	2
Malignant tumours	14
Sinonasal adenocarcinoma	5
Sinonasal squamous cell carcinoma	6
Basaloid carcinoma	1
Neuroblastoma	1
Melanoma	1

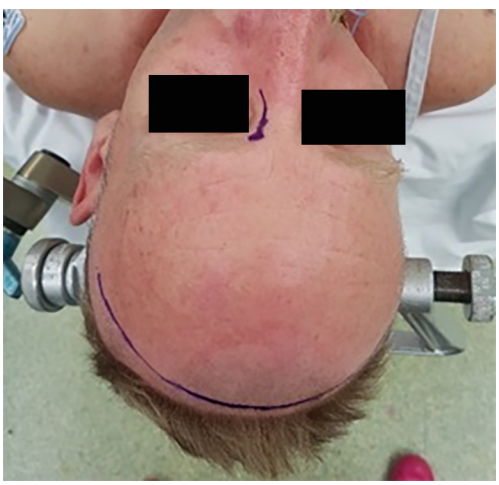

Figure 1 A coronal and lateral rhinotomy incision were marked. This image is published with the patient's consent.

leakage and associated complications (3). Traditionally, large dural defects were reconstructed with inlay and onlay fascial grafts which were associated with a high incidence of postoperative CSF leak (4). The use of vascularized pedicled flaps has shown to be successful in reducing postoperative complications (4-6). The nasoseptal flap has gained popularity, however, this may not be viable in cases of malignant infiltration, revision or salvage procedures. Recent research has reported numerous materials and techniques used in skull base repair (7,8). There are different advantages and disadvantages to each approach and factors such as location and size of defect must be taken into consideration (9). We describe our hybrid endoscopic/open technique of using autologous fascia lata and a pedicled vascular pericranial flap to reconstruct the skull base defect following extended endoscopic skull base surgery. We present this article in accordance with the STROBE reporting checklist (available at https://www.theajo.com/article/view/10.21037/ajo-22-16/rc).

Methods

This is a retrospective cross-sectional study of sixteen consecutive cases of extended endoscopic transnasal resections of skull base tumours performed by a single ear, neck, and throat (ENT) surgeon and a neurosurgeon at two different major hospitals in Melbourne, Australia since December 2018. Clinical data on patient's demographics and information on complications such as CSF leakage, postoperative infection and bleeding were recorded. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by ethics committee of St Vincent's Hospital Melbourne (SVHM), Melbourne, Australia (No. QA20044). Informed consent was obtained from patients.

Results

Demographics

Sixteen patients (eleven males and five females) with a median age of 71 underwent the procedure (*Table 1*). There were two benign tumours and fourteen malignant tumours (*Table 1*). None of the patients had previous endoscopic transnasal resection of skull base or received radiotherapy prior to surgery.

Surgical technique

All patients were in the supine position with their head secured in Mayfield headframe. Intra-operative navigation was used in all cases. A coronal and lateral rhinotomy or Lynch incision were marked (*Figure 1*). Endoscopic resection of the tumour was carried out according to the position, extent and margins required. Full ablation of the ethmoid sinuses and endoscopic resection of the cribriform plate including septectomy was performed in all cases with additional ablation case dependent. Subgaleal dissection was done from a limited coronal incision to the supraobrbital ridge. The pericranial flap was then raised from the cranium

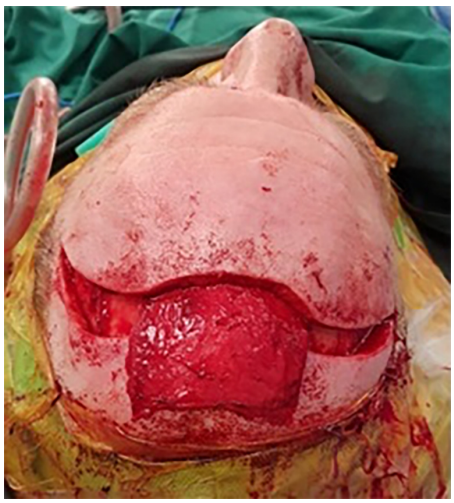

Figure 2 A pericranial flap was raised from the cranium. This image is published with the patient's consent.

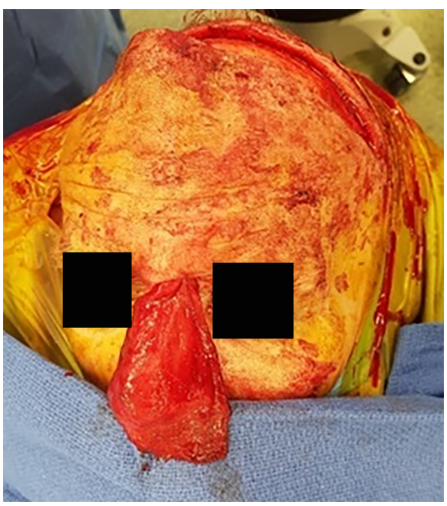

Figure 3 The pericranial flap was rotated through the lateral rhinotomy incision. This image is published with the patient's consent.

(*Figure 2*). A scalp drain was inserted prior to the closure of the coronal incision. A modified Lynch incision was made and dissection undertaken to communicate with the harvest site in the scalp, taking care not to disturb the blood supply to the pericranium or injure the pedicle. A small external frontoethmoidectomy was then drilled to allow the flap to access the skull base defect. An autologous tensor fascia lata graft was harvested from lateral thigh and underlay in the dural defect. It is augmented externally by the vascularized pericranial flap rotated through the external bone defect (*Figure 3*). Surgical strips were utilized to help tack the flap in position and Tisseel was used to cover the flap edges. The flap was then supported by bilateral 7.5 nasopharyngeal airways with a Foley Balloon catheter and dissolvable packing.

Post-operative recovery

A computed tomography (CT) brain scan was performed for all patients on day-1 post operation. Minor pneumocephalus was noted in all patients. One patient had a small subdural haemorrhage that was treated conservatively and monitored with repeat scans. The scalp drain was removed by day-2. No significant scalp oedema or haematoma was reported. No other immediate post-operative complications such as CSF leakage or major bleeding were noted. All patients were followed up at 3-week post operation. Most patients had some nasal crusting which was debrided at time of review. One patient had a minor cutaneous fistula at the lateral rhinotomy incision which was conservatively managed with dressings. No patient required return to the operating theatre for post operative CSF leak.

Discussion

The aim of reconstruction after skull base resection is to provide a watertight barrier separating the intracranial contents from the sinonasal cavity to prevent postoperative CSF leakage and consequent intracranial complications (7,9). The introduction of the vascularlized flaps has significantly reduced the incidence of CSF leak as they were shown to promote faster and more complete healing (2,9,10). There has been extensive use of the pericranial flap for reconstruction of anterior skull base defects since it was first reported in 1981 (11). With the introduction of the nasoseptal flap, the pericranial flap has lost favour. The nasoseptal flap is harvested and positioned completely endoscopically without external incisions. With increasing completely endoscopic sinonasal and anterior cranial fossa tumour ablation, efforts have been made to keep the entire case endoscopic. Unfortunately, the most robust skull base repair may not be available endoscopically and external incisions for flap harvest and positioning should be considered. An external approach with the additional morbidity of the coronal incision and subgaleal dissection has its drawbacks but should not be abandoned (3,12,13). In this case series, pericranial flap was used as the vascularized pedicled flap instead of nasoseptal flap because of evidence

or suspicion of tumour invasion of the nasal septum of those with malignant tumours. In the case of meningioma, the dural defect was too large to be repaired by nasoseptal flap.

The first case has 12 months of follow-up and it has been 2 months since the most recent case was done. All patients had no CSF leakage and excellent healing of the skull base. There were no complications at the harvest site. All patients with malignant tumour received post-operative radiotherapy. Similar to previous studies (10,14), the flap has shown to be robust and resistant to radiotherapy with no case reported to have any post-radiation complications thus far.

The harvest of pericranial flap is technically challenging particularly in elderly population where the tissue can be very fragile and extra caution will be required not to damage the flap. However, the morbidity of the coronal incision and dissection is minimal and haematoma can be avoided with the insertion of a scalp drain. Impairment of sensory and motor function of the scalp were not reported in any of the cases.

This case series is limited by its small sample and short-term outcomes. As research on approaches to endoscopic skull base reconstruction continues, data on long-term healing or complications can be collected to evaluate the association between risk factors and failures and to identify the population that may benefit from certain methods of endoscopic skull base reconstruction.

Conclusions

There were no post-operative complications of CSF leakage, meningitis, tension pneumocephalus or significant bleeding requiring additional packing or operative intervention. The use of pedicled pericranial flap in combination with autologous fascia lata in reconstruction of large dural defects resulting from an extended endoscopic transnasal skull base resection is a reliable method for skull base reconstruction. This technique should not be avoided simply because tumour ablation is completely endoscopic as the additional morbidity is small and it provides a robust skull base repair.

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None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://www.theajo.com/article/view/10.21037/ajo-22-16/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by ethics committee of St Vincent's Hospital Melbourne (SVHM), Melbourne, Australia (NO: QA 20044). Informed consent was obtained from patients.

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