ORIGINAL ARTICLE

Endoscopic-Assisted Craniofacial Resection: A Case Series and Post-Operative Outcome

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SUMMARY

Craniofacial resection is commonly performed in the surgical resection of sinonasal tumours involving anterior skull base. It entails a bicoronal scalp flap with lateral rhinotomy or an extended lateral rhinotomy to expose the anterior skull base. Transfacial approach is necessary in the resection of the nasal part of the tumour. The choice of surgical approach is based heavily on the surgeon's experience and training. The results of endoscopic-assisted craniofacial resection for sinonasal tumours performed in our center in eight patients from 1998 to 2005 were reviewed. There were seven males and one female with age ranging from 18 to 62 years (mean 42.4 years). There was each a case of mature teratoma, poorly differentiated squamous cell carcinoma, undifferentiated squamous cell carcinoma, olfactory neuroblastoma, fibrous dysplasia, inverted papilloma and two cases of sinonasal neuroendocrine carcinoma. The mean follow up duration for these eight patients post surgery was 21.4 months. Out of eight patients, five underwent surgery with no adverse complications. The complications encountered were a cerebrospinal leak and a postoperative transient V and VI cranial nerve palsy. One patient with sinonasal undifferentiated carcinoma died of lung metastasis at 11 months post-surgery. The endoscopic-assisted craniofacial resection is a highly useful surgical technique to avoid the unsightly facial scar of the lateral rhinotomy or the Weber-Ferguson incision, postoperative paranasal sinuses infection and avoidance of tracheostomy in selected cases. We found that this approach has lower morbidity rate in selected cases.

KEY WORDS:
Sinonasal tumours, Anterior craniotomy, Endoscopic assisted resection, Post-operative outcome

INTRODUCTION

"Endoscopic assisted craniofacial resection" is defined as surgery in which the endoscope is used to complement a "traditional approach" to remove the tumour from the anterior skull base and not merely visualize the tumour or to ascertain its removal.

Endoscopic approaches to skull base tumours are in a state of rapid change. Advances in computer-assisted surgery (intraoperative navigational instruments), intraoperative CT/MRI fusion scans, customized instruments, high definition cameras and surgical experience all contribute to the advancement of this field.

Craniofacial resection for sinonasal carcinoma involving anterior skull base was first reported by Smith *et al.*[1] in 1954. Ketchum *et al.*[1] in 1963 and Van Buren *et al.*[1] in 1968 reported good success with the operation. However, open surgical procedures usually involved facial incisions and removal of facial skeleton components. Complications included meningitis, CSF leakage, injury to brain or orbital structures, reconstructive flap failure, post-operative paranasal sinuses infection and cosmetic defect. The development of endoscopic surgical techniques through the pioneering work of Messerklinger, Stammberger and Kennedy[3] in the early 1980s, has provided technology that allows surgical excision of sinonasal tumors, which can avoid the unsightly facial scar and post-operative paranasal sinuses infections. Furthermore, the integrity of the facial skeleton is maintained. In the present report, we describe an approach to combine the functional and aesthetic techniques of endoscopic sinonasal tumour resection with joint bifrontal craniotomy performed by the neurosurgeon for anterior skull base extension.

In cases where "traditional" approaches are needed to remove tumours that extend beyond the reach of the endoscopic visualization, the endoscopic technique can be used to complement the "traditional" exposure.

MATERIALS AND METHODS

From February 1998 to September 2005, eight patients underwent endoscopic-assisted craniofacial resection of sinonasal tumours involving anterior skull base at the National University of Malaysia Hospital (HUKM). These cases were reviewed retrospectively. The patients' demographic data, nature of the tumour and complications of the surgery as well as the duration of the follow-up period were analysed. Radiological imaging (CT and MRI scan) was performed in all eight patients prior to surgical intervention to assess sinonasal and intracranial extent. The tumour was unilateral in all eight cases and there was evidence of tumour extension to the opposite side in two cases. All operations were performed by the senior author jointly with the neurosurgeon.

Operative Procedure

Patients' were orotracheally intubated and their head placed on Mayfield clamp and patient draped prior to anterior craniotomy. Intracranial tumour resection was performed by the neurosurgical team via a bifrontal craniotomy, taking care to preserve separately a vascularized pericranial fascia flap for repair of the skull base defect.

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The intranasal part of the operation was then performed with the 0º and 30º endoscopes (Storz,Germany) and standard instruments used in functional endoscopic sinus surgery. All patients had the senior author as their primary endoscopic surgeon. A bilateral greater palatine block was performed transorally using 7.5% Naropine with adrenaline (1:100 000). An oropharyngeal pack was placed and both nostrils packed with cotton pledgets soaked in cocaine and adrenaline (1:1000) for vasoconstriction. The tumour in the nasal cavity was debulked with a 4-mm microdebridder attached to a tracheal trap to collect the removed tumour tissue for histopathological analysis. Trucut forcep was utilized to expose the nasal septum, lateral nasal wall and posterior choanal structures. After injecting 1% lidocaine with epinephrine (1:100 000) into the nasal mucosa, infundibulotomy was performed by removing the mucosa of the lateral nasal wall immediately anterior to the uncinate process with a back bitting forceps. Removal of the uncinate process superiorly provided access to the frontal recess. The ostium of the maxillary sinus which was located laterally was identified using a blunt probe and widened using a back bitting forceps. Then the ethmoidal bulla and anterior and posterior ethmoid cells were removed with trucut forceps. After total ethmoidectomy, the ostium of the frontal sinus was identified using a blunt probe. The ostium of the frontal sinus was enlarged until the galea-pericranium flap was visualized. The ostium of the sphenoid sinus is located posteriorly in the sphenoethmoid recess. The sphenoid sinus was opened widely by removing its anterior wall using Stammberger punch and Hyjack Koftler forceps. The tumour was carefully removed from the sinus extension. Bleeding was controlled with suction and bipolar cautery. With the help of an endoscope, the same procedure was repeated on the contralateral side and a wide subtectomy established. At the end of surgery, the nose was packed with merocel and removed two days post-surgery.

For anterior skull base tumours which invariably are centrally located, a wide endonasal endoscopic resection was performed. In all eight cases a subtectomy extending from the frontal recess to the anterior wall of the sphenoid was performed which allowed adequate inspection of anterior skull base post operatively using a 30 and 70 degree endoscopes for tumour recurrences.

RESULTS

From February 1998 to September 2005, eight patients underwent endoscopic-assisted craniofacial resection of sinonasal tumours involving the anterior skull base at our

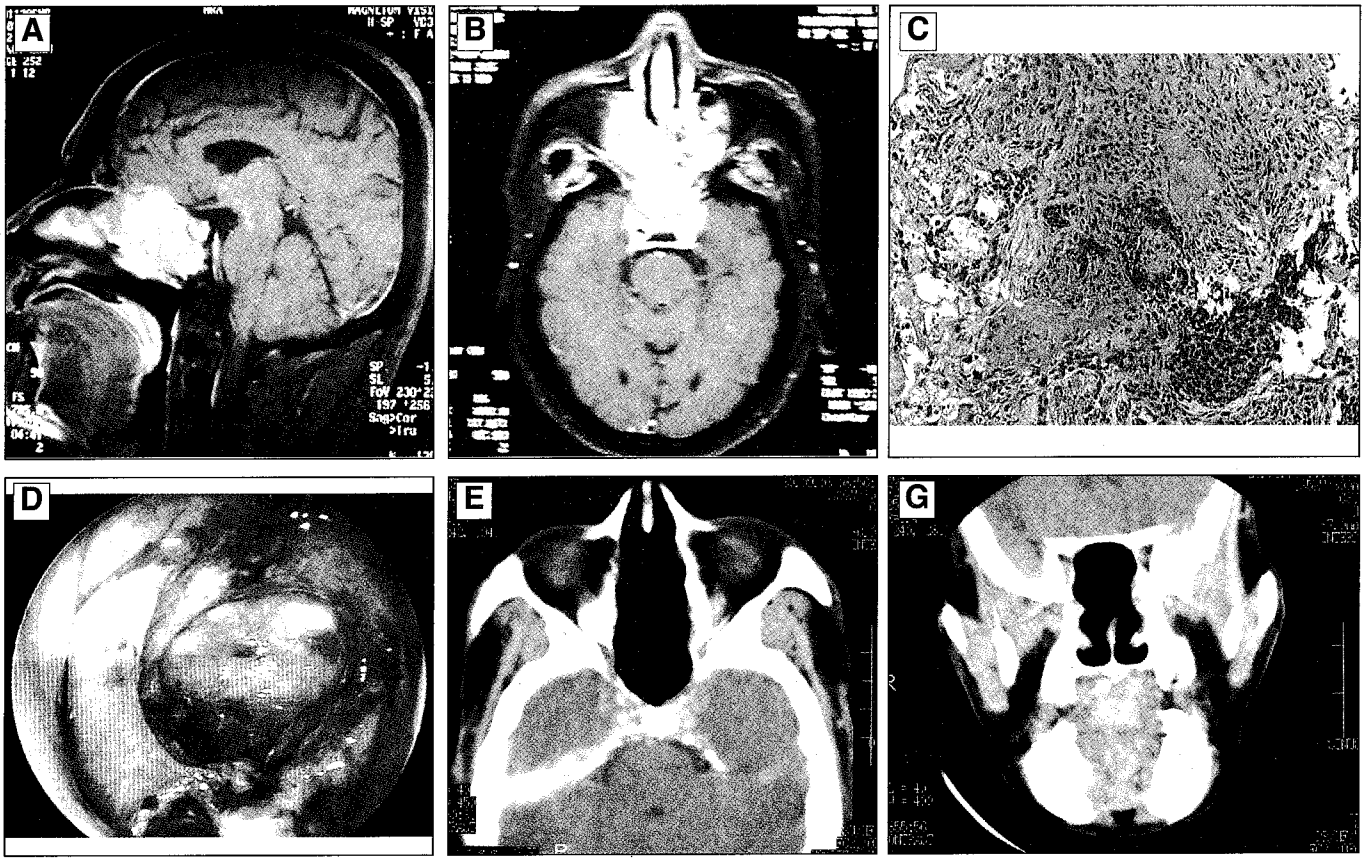

Figure V - A Representative Case (page 10 - result).
Radiological, histological and post-operative findings of representative case treated by the endoscopic-assisted craniofacial resection. A 62-year-old man with sinonasal undifferentiated carcinoma. A & B : Admission MRI showed sinonasal tumour extending to anterior skull base. C : Low magnification of the undifferentiated carcinoma (hematoxylin and eosin). D : Post-operative endoscopic view of total removal by endoscopic-assisted craniofacial resection . E & F : A CT scan obtained 3 years post surgery with no evidence of tumour recurrence.

referral center. There were seven males and one female. The age range was 18 to 62 years, with a mean age of 42.4 years (Appendix).

In all patients, the tumour or infectious lesion extended to anterior cranial fossa; of the seven tumours, five were malignant and two benign; (Appendix). Total tumour removal was possible in all patients, except for one patient with a large malignant sinonasal undifferentiated carcinoma extending to the clivus.

Out of eight patients, five underwent the surgery with no adverse complication. The complications encountered were post-operative cerebrospinal leak and transient V and VI cranial nerve palsy in one patient each (Appendix). There were no postoperative infectious complications in any of the eight operated patients. The patient with evidence of post-operative CSF fistula after intracranial extension resection using an anterior craniotomy, had endoscopic resection of intranasal tumour and endoscopic repair of CSF fistula performed successfully as second stage procedure. One of the patients developed right V and VI nerve palsy six days post-surgery. The patient was treated conservatively and the symptoms resolved subsequently at follow up one month post-surgery.

One patient with sinonasal undifferentiated carcinoma extending to the clivus died of lung metastasis at 11 months post-surgery. After an average period of 21.4 months of follow-up, the rest of patients had no evidence of tumour recurrence. Two patients received post-operative chemotherapy, one radiotherapy alone and another received both chemotherapy and radiotherapy.

DISCUSSION

Tumours of the paranasal sinuses involving the floor of the anterior cranial fossa and roof of the nasal cavity are commonly removed by a craniofacial resection. En-bloc removal of tumour is facilitated by exposing the tumour from above and from below through the transcranial-transfacial approach. The bicoronal flap and anterior craniotomy facilitate exposure and resection of the tumour from above. The approach to the tumour from below is often facilitated by transfacial route through a lateral rhinotomy incision. The endoscopic transnasal approach can be used to assist the resection of tumour in the nasal and sinus roof without resorting to a lateral rhinotomy or Weber-Ferguson approach. The endoscopic intranasal procedure can be used to detach the lower attachments of the tumour from the nasal septum, lateral attachment of middle turbinate, ethmoid sinuses, roof of the sphenoid sinus and clival region easily with the powered endoscpic sinus surgery instruments. The tumour can be resected en bloc superiorly from the floor of the anterior cranial fossa via the anterior craniotomy after a transnasal resection from inferiorly. The ability to deliver sinonasal tumours involving anterior skull base in an en bloc fashion via this technique was demonstrated by Yuen *et al*[2] and Thaler *et al*[3] in 1997. The transcranial-transnasal approach in this endoscopic-assisted craniofacial resection is oncologically comparable to the standard transcranial-transfacial approach in craniofacial resection.

The advantages of endoscopic techniques derive chiefly from the fact that these approaches are "minimally invasive" and external skin incisions are avoided. A minimum amount of intervening tissue requires removal and growth centers are not disturbed. Endoscopic approaches result in smaller wounds requiring less packing. As a result, postoperative pain and postoperative paranasal sinuses infection are less, healing is faster with a shorter hospital stay. Creating a smaller surgical defect often obviates the need for flap reconstruction. During tumour removal, a panoramic view may be obtained using angled endoscopes (30 and 70 degree) to see around corners resulting in better tumour removal and preservation of normal tissue. Should revision surgery be required, an endoscopic approach usually results in less scarring; hence, regaining access to the surgical bed is easier than with open techniques. Through this endoscopic approach, it is also possible to remove centrally located tumours in the cribriform, sellar, parasellar and clival regions. Disadvantages of endoscopic approaches include the need for expensive and specialized instrumentation that can be used only by a relatively small number of surgical specialties. Depending on the size and situation of tumours, piecemeal removal may be necessary. It may be difficult to obtain accurate intraoperative tumour margins with endoscopic techniques, depending on the size and location of the tumour. This has led many investigators to advocate the use of endoscopic techniques only for small tumours or tumours that arise from a narrow stalk. Unless a specialized scope-holding device is used, the endoscopic surgeon is able to employ only one hand for instrument manipulation. If brisk bleeding is encountered, it may be difficult to maintain adequate endoscopic visualization, and it may be even more difficult to definitively control the bleeding endoscopically. The availability of single instrument with suction and cautery has made this surgery to be performed endoscopically.

Patients in the present series with sinonasal tumours involving anterior skull base were effectively resected via an endoscopic-assisted craniofacial approach. There was no evidence of postoperative paranasal sinuses infections or recurrence of cerebrospinal leak. Facial incisions were avoided and no skeletal framework was disrupted.

CONCLUSION

In conclusion, the joint endoscopic-assisted craniofacial resection consisting of otolaryngologist and neurosurgeon is recommended as an alternative surgical technique for selected cases of sinonasal tumour involving the anterior skull base. This surgical technique is the preferred approach at our tertiary referral center for selected tumours of the sinonasal tract with evidence of intracranial extension. Inspection of the huge ipsilateral nasal and sinus cavity and the anterior skull base for evidence of tumour recurrence at follow up is possible with 30 and 70 degree endoscopes.

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APPENDIX

Summary of eight patients with sinonasal tumour involving the anterior skull base operated by the endoscopic-assisted craniofacial resection.

No	Name	Age	Sex	Diagnosis	Staging	Post operative complication	Follow-up
	Malignant tumours :						
1.	AMS	42	M	Mature teratoma	Stage I (GOC)	Nil	22 mths
2.	CFL	62	M	Sinonasal poorly differentiated squamous cell carcinoma	T4aNoMo (AJCC)	Nil	60 mths
3.	AG	25	M	Sinonasal undifferentiated carcinoma	T4bNoM1 (AJCC)	*	11 mths
4.	SES	50	F	Sinonasal neuroendocrine carcinoma	T4bNoMo (AJCC)	Nil	22 mths
5.	WKL	28	M	Sinonasal neuroendocrine carcinoma	T4bNoMo (AJCC)	Nil	16 mths
6.	RG	70	M	Olfactory neuroblastoma	Stage C (Kadish)	Nil	3 mths
	Benign tumours:						
7.	RTBP	19	M	Sinonasal Fibrous Dysplasia	Stage 3 (Enneking)	Transient right V and VI cranial nerve palsy	32 mths
8.	AS	54	M	Sinonasal Inverted Papilloma	T4 (Krouse)	Cerebrospinal leak	5 mths

* died of lung metastasis.