

Anterior skull base surgery

History

With its inception nearly half a century ago through the pioneering work of [Walter Edward Dandy](#), McLean, and Smith, [anterior skull base](#) (ASB) surgery is a relatively young discipline. It became a distinct entity in 1963 when Ketcham popularized the combined transcranial transfacial approach for [en bloc resection](#) of tumors of the paranasal sinuses extending into the anterior cranial fossa. However, because these procedures resulted in major morbidities and mortalities, alternative modes of treatment were sought.

Types

Open microscopic anterior skull base surgery

[Endoscopic anterior skull base surgery](#)

Both open, microscopic and transnasal endoscopic approaches have gained considerable attention. Recent data have evaluated the endoscopic anatomy of the skull base, defined surgical corridors, addressed anatomical limitations to endoscopic skull base surgery, and discussed the limitations of skull base reconstruction. Over the same period of time, new surgical transcranial approaches have challenged the traditional operative corridors to the anterior skull base.

The data provide support for both open and endoscopic approaches to the anterior cranial base ¹⁾.

Endoscopic surgery is more cost-effective than open procedures because it reduces duration of hospitalisation, operating time and theatre consumables and obviates the need for postoperative intensive care unit admission ²⁾.

Principles

The basic principle of anterior skull base surgery is to provide adequate exposure to enable three dimensional resection of skull base tumors. Negative surgical margins, which is within the control of surgeon, is the principle prognostic factor in anterior skull base tumors. Open skull base approaches is the standard of care for malignant anterior skull base tumors. Benign lesions may be resected by alternate minimally invasive approaches. Advances in anterior skull base surgery, in particular the facial translocation approaches allows wide exposure of the tumors with minimal retraction of the brain ³⁾

Technical aspects

Drilling of the clinoid process and tuberculum sella, and optic canal unroofing are important surgical techniques, which may be performed relatively safely by a skilled neurosurgeon ⁴⁾.

Minimally invasive accesses to the anterior skull base include the endoscopic endonasal approach (EEA) and the supraorbital eyebrow approach. These 2 are often seen as competing approaches, not

alternative or combinatory approaches. In this study, we evaluated the anatomic limitations of each approach and the combined approach for accessing the anterior skull base.

METHODS: Ten neurovascular injected cadaver heads were used for the study. The supraorbital approach to the anterior skull base was performed on 5 heads, and EEA was done on the other 5 heads. Then, the supraorbital approach was added to the 5 heads receiving EEA. Visualization and surgical limitations were recorded by the ability to perform resection of the crista galli, anterior clinoid, cribriform plate, and planum sellae.

RESULTS: The maximal lateral extension of EEA for anterior skull base was the midorbit line anteriorly but narrowing down toward the orbital apex. The limitation of the supraorbital approach was found mostly medial and anterior. Drilling of anterior skull base was impossible medially between the sphenoethmoidal suture and the posterior aspect of the crista galli. The combined approach showed complementary areas of visualization and surgical maneuverability. Three clinical cases were presented to illustrate the indications for the stand-alone supraorbital approach, EEA, and combined approach.

CONCLUSION: The limitations of the EEA when dealing with lateral extension of anterior skull base meningiomas, and the limitations of the supraorbital eyebrow approach for medial skull base drilling and reconstruction, can be overcome by a judicious, anatomically based combination of both approaches ⁵⁾.

Lumbar drain placement

Routine placement of perioperative lumbar drain may be associated with an increased risk of tension pneumocephalus and intracranial complications during surgery of the anterior cranial base ⁶⁾.

A retrospective review of 93 patients who underwent LD placement at a institution between 2006 and 2011. Of these patients, 43 underwent elective LD placement prior to ASB surgery; 2 patients had evidence of CSF rhinorrhea prior to surgery, and 41 had no evidence of a preoperative CSF leak. Of those 41 patients, 2 developed CSF rhinorrhea ($2/41 = 4.9\%$) as a result of surgery—all in endoscopic patient population ($N = 21$; $2/21 = 9.5\%$). No postoperative CSF leaks were noted in the ASB surgery cohort ($N = 20$). Other complications were rare, but we encountered two instances of delayed malignant cerebral edema in the open ASB cohort. Overall, preoperative LD placement was found to be an effective means of preventing postoperative CSF leaks after ASB approaches, but potential and significant intracranial complications may occur in select patients that merit careful consideration prior to LD placement ⁷⁾.

Outcome

The outcome of anterior skull base tumors have steadily increased over the years with disease free survival comparable to other malignant neoplasm of the head and neck region.

Between 1973 and 2005, 234 patients underwent anterior skull base surgery at Memorial Sloan-Kettering Cancer Center. Of these, 19 patients were <21 years of age. Survival outcomes were analyzed using the Kaplan-Meier method and compared with patients ≥ 21 years old. Nineteen patients <21 years old underwent a total of 20 procedures for lesions of the anterior skull base.

Sarcoma was the most common indication for surgery including 6 (32%) patients treated for radiation-

induced malignancies. Minor complications were noted with 6 (30%) procedures. There were no major complications and no perioperative deaths. The difference in 3-year recurrence-free (68% versus 59%; $p = 0.623$) and overall survival (83% versus 66%; $p = 0.309$) compared with patients ≥ 21 years old did not reach statistical significance. Anterior skull base surgery is well tolerated in pediatric and young adult patients < 21 years of age. Survival is comparable to older patients treated similarly and appears strongly influenced by histology ⁸⁾.

Quality-of-Life

The Anterior Skull Base Surgery QOL questionnaire, a disease-specific multidimensional instrument dedicated to this population, was used to collect and prospectively analyze demographic, medical, and QOL data on 48 patients. Thirty-nine patients completed the questionnaire preoperatively and at 6 and 12 months postoperatively. Seventeen patients (44%) had malignant histology and 22 (56%) had benign tumors. The overall QOL score decreased significantly at 6 months postoperatively ($p < 0.05$) and improved significantly at 12 months postoperatively ($p < 0.04$). The emotional domain improved significantly at 12 months postoperatively compared with the preoperative scores ($p < 0.03$). Patients with malignant tumors had lower scores at 6 months postoperatively compared with patients with benign lesions ($p < 0.002$), although the scores for both groups at 12 months postoperatively were similar. Adjuvant radiation therapy was associated with a poor QOL ($p < 0.005$). The results of this prospective study show that the overall deteriorated QOL of patients after anterior skull base tumor resection returns to baseline by 1 year after surgery. Histology and radiotherapy are significant predictors of health-related QOL in this population ⁹⁾.

A literature search using the electronic databases of Ovid Medline and Embase. Additional articles were identified through a search using the phrase anterior skull base. Further articles were sought through hand-searching relevant journals and reference lists of identified articles.

The search strategy identified 29 articles for inclusion in a systematic review, with considerable variation between studies in population characteristics, methodological design and quality, follow-up length, and outcome assessment. The most commonly used QoL tools were the Karnofsky Performance Status and the Anterior Skull Base Questionnaire. QoL following anterior skull base surgery appears to improve beyond preoperative levels in the months after surgery. For patients undergoing endoscopic skull base surgery, the gain in QoL appears to be greater and may manifest earlier, with no clear long-term deleterious effect on sinonasal outcomes compared with open surgery.

QoL after anterior skull base surgery in adults appears to improve within several months of surgery, but earlier and to a larger extent if the endoscopic approach is used. Given the relative paucity and heterogeneity of anterior skull base tumors, large-scale prospective multicentre studies utilizing valid and reliable multidimensional QoL tools are required. This may result in improved patient care, by understanding patients' needs better and facilitating the provision of reliable outcome data for clinical trials ¹⁰⁾.

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