Who Is the Skull Base Surgeon of the Future?

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Over the past 20 years, we have witnessed the evolution of cranial base surgery into a subspecialty encompassing multiple specialties (neurosurgery, otolaryngology, maxillofacial surgery, and plastic surgery). A variety of external approaches have been described that access the anterior, lateral, and posterior cranial base from multiple transcranial and transfacial directions. In the last decade, there has been a paradigm shift linked to developing endoscopic technologies with the introduction of completely endoscopic endonasal approaches to the ventral skull base.¹⁻³

Endoscopic skull base surgery requires “re-tooling” on the part of the skull base surgeon. For otolaryngologists or head and neck surgeons training in the era of endoscopic sinus surgery, acquisition of endoscopic skills occurs in conjunction with training in external approaches to the cranial base. Acquisition of endoscopic skills has been more problematic for the neurosurgeon who rarely uses the endoscope in other surgical procedures. We have suggested training guidelines that build incrementally for teams of otolaryngologists and neurosurgeons performing endoscopic endonasal skull base surgery.⁴ Endonasal skull base procedures are categorized into five levels based on their technical difficulty, potential risk to neural and vascular structures, extent of intracranial dissection, and type of pathology. Mastery of each level is recommended before proceeding to the next level.

At this time, it is unclear who will be performing these endoscopic procedures. Although some procedures, especially endoscopic pituitary surgeries, will be performed entirely by neurosurgeons, and others (cerebrospinal fluid leaks, extradural sinonasal tumors) will be performed entirely by otolaryngologists, we are strong proponents of team surgery with the participation of both specialties. Working as a team builds the necessary skills for more advanced endonasal procedures and promotes cross-fertilization of ideas. Both surgeons and patients benefit from the combined expertise of these specialties.

From a training perspective, who is best equipped to perform these surgeries? The ideal skull base surgeon understands oncological principles, is familiar with principles of cerebrovascular surgery, is able to perform both open and endoscopic approaches, can offer patients the best approach for their pathology, is able to choose the best reconstruction for the defect, and is prepared to deal with emergencies that require a transition from an endoscopic to an open approach. This question can be addressed from the perspectives of the otolaryngologist-head and neck surgeon and the neurosurgeon separately.

The traditional pathway of training for the non-neurosurgeon is a residency in otolaryngology, plastic surgery, or oral-maxillofacial surgery followed by a fellowship in oncological head and neck surgery

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with an emphasis on traditional external skull base approaches. Most oncological head and neck surgeons have forsaken endoscopic sinus surgery to focus on their oncological practice and may rarely use an endoscope outside of office examinations. This may be changing, however, as endoscopic techniques are adopted for the resection of pharyngeal, laryngeal, and thyroid neoplasms. The head and neck oncologist/skull base surgeon is well trained in oncological principles and external approaches to the skull base. In contrast, the rhinologist is facile with the endoscope and rarely performs major head and neck resections. Endoscopic tumor resections are generally reserved for benign neoplasms and small malignancies. There is a concern that rhinologic surgeons may be less aggressive with their resections with an increased potential for residual tumor. Until longer follow-up data are available, there is a risk that recurrence rates may actually rise with the adoption of completely endonasal "craniofacial" resections. These disparities of training are reflected in the membership of the subspecialty societies and their respective publications. Each pathway of training has its own advantages and disadvantages.

The traditional pathway of training for the neurosurgeon has been more straightforward, with a fellowship in cranial base surgery following residency training. In practice, the neurosurgical skull base surgeon is often involved in trauma surgery and may have additional training in pituitary surgery. Exposure to endoscopic techniques is usually limited to ventricular surgery and now pituitary surgery. In our opinion, cranial base surgery is centered around management of the internal carotid artery (whether open or endoscopic) and cranial nerves; thus, the ideal skull base surgeon is foremost a vascular surgeon. The neurosurgeon should have complete familiarity with principles of cerebrovascular surgery since the most devastating complications are related to vascular issues. The cranial base surgeon shouldn't be intimidated by the vascular anatomy in designing the optimal surgical approach and must be able to deal with vascular emergencies when they arise.

Of equal concern is the surgeon's comfort with conventional approaches to the skull base. As surgeons increasingly transition to endonasal approaches, experience with traditional approaches will diminish. We are concerned about the training of future surgeons and whether they will be adequately trained in all skull base approaches. In order to truly understand the options, relative advantages, and limitations of different surgical approaches, the surgeon needs to have a sound anatomical foundation with experience in all surgical approaches. This allows the surgeon to tailor the surgical approach to the patient's disease, combining different approaches when desirable. We do not believe in the concept of an endonasal "midline skull base surgeon"; rather, the complete skull base surgeon employs the endoscope as another tool in his or her armamentarium.

The shortcomings of unidimensional training are the limitation of treatment options for the patient (informed consent), differing surgical philosophies, and inability to convert to an open approach when necessary (incomplete tumor resection, bleeding emergency, difficult reconstruction). These limitations may increase patient morbidity and mortality and delay further advances in surgical care. It is unrealistic to expect that future surgeons can be trained in all surgical techniques. It is inevitable (and proper) that some techniques will fall by the wayside and become obsolete, but there is still some value in having these surgical relics in your "tool chest" to pull out when needed. Modern training programs in cranial base surgery should incorporate aspects of open and endoscopic surgery with competency-based training. This may require creation of a team of otolaryngological surgeons with training in oncologic head and neck surgery and rhinology, and neurosurgeons with experience in pituitary, neurovascular, and trauma surgery, so that trainees will acquire a complete set of skills and be exposed to differing philosophies of care. Courses with cadaveric dissection and the advent of surgical simulators will help maintain familiarity with rarely performed procedures.

This editorial cannot answer the question of who will be the skull base surgeon of the future. We

hope that it will generate more discussion, however, about the optimal training and skill set that are necessary to achieve our shared goal of advancing the care of patients with diseases involving the cranial base.

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