Endoscopy and skull base

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It is hard to conceive of the fact that surgical endoscopy is more than 100 years old. It is also always sobering to realize, when it comes to medical innovation, how hard it is to come by true original contributions and how much is generally owed by those who are here today to those pioneers of yesteryear. While most would associate the birth of pure endonasal endoscopic resection of pituitary tumors with the mid-1990s, very few might be aware that the credit duly belongs to Guiot and colleagues, who documented the first such case at Hospital Foch in Paris as far back as 1962. Skull base endoscopy has made timid strides since, awaiting the development of the 2 usual ingredients of “progress,” that is, technological advances and creativity, not always in that order.

The modern observers of the field would probably agree that a true explosion in skull base endoscopy seems to have occurred around 2005. Not unlike the famed “big bang” that lies behind the genesis of all things, the generated cosmic dust and ripples of influence are understandably hurling through space and time at an accelerated pace. There is no sign of slowing down, as there seems to be ever more “space” to expand into. Like a child in a candy store, the modern skull base surgeon, armed with his endoscope, finds new ways to explore the world, new ways to play old games. These statements may appear to be criticisms, but they are not. I have personally been an enthusiastic, yet hopefully selective, user of endoscopy for 5 years. There is absolutely nothing wrong with this collective “frenzy” that has taken the skull base community by storm. It is human nature, the undeniable sequel of our urge to discover new frontiers. All we have to do, as researchers, is to make sure that the new “games” we play are better than the old. For that we need to swallow our daily dose of realism and common sense. As surgeons, it behooves us to ensure that “newer” also means safer, more effective, more durable, and better tolerated.

The study by Komatsu et al. is no exception to this trend. The authors are a very well-respected group whose anatomical laboratory has made seminal contributions to the field. The senior author has had a long-lasting interest in the application of endoscopy to the study of skull base anatomy. The immediate goal of the authors in this study is to define the role of endoscopy in the surgical exposure of various components of the trigeminal nerve. The ultimate goal and clinical application is to devise a comprehensive algorithm to select the appropriate approach to specific types of trigeminal schwannomas. The authors conduct a purely cadaveric study in 10 human heads and describe in a nonquantitative manner the structures exposed from each vantage point.

The trigeminal nerve naturally travels from the posterior fossa through the middle fossa and exits into 3 extracranial compartments as follows: the orbit (for V1), the pterygopalatine fossa (for V2), and the infratemporal fossa (for V3). The authors used a total of 5 surgical approaches to elucidate which portion(s) of the trigeminal nerve is best exposed with which approach. Their obvious intent is to choose purely endoscopic approaches to test their individual limits. Based partly on published work from other centers as well as on prior anatomical explorations with extradural intracranial endoscopic dissections from their own laboratory, they examined the following purely endoscopic approaches and summarized their findings in Table 1: the extradural supraorbital approach (which really amounts to the Dolenc approach, done endoscopically), the extradural subtemporal approach (which really amounts to the Kawase approach, done endoscopically), the intradural retrosigmoid approach, the endonasal transpterygoid approach, and the endonasal transmaxillary transpterygoid approach.

The first 3 approaches are obviously transcranial (meaning through the skull vault), via small craniotomies, and the remaining are endonasal. The anatomical pictures obtained are of excellent quality. Not surprisingly, however, given that none of the described approaches is original in itself, no new anatomical relationships are uncovered. With each approach, the authors describe qualitatively the parts of the trigeminal nerve uncovered. This in itself is very useful, even if not entirely novel. The authors extrapolate from their anatomical findings applicability to resecting trigeminal schwannomas.

As with every purely anatomical study, this report suffers from the following intrinsic limitations in its applicability to real clinical scenarios.
Additional, there are no engorged veins, no hypertrophy of perfusing arteries, no distortion or displacement of arterial branches, let alone carotid artery blowout, can all obscure the field, lengthen surgery, or make it simply impossible. The authors may want to explore performing these anatomical dissections in a perfused cadaver, such as in the model used by Aboud et al.1 to render the exercise more lifelike.

**Perfusion.** Showing the final view of a dissection is hardly a description of surgical steps. Getting there is harder than being there. Hemostasis, particularly in the setting of endoscopy, is particularly challenging. Bleeding from drilled bone, venous plexus, venous sinuses, arterial branches, let alone carotid artery blowout, can all obscure the field, lengthen surgery, or make it simply impossible. The authors may want to explore performing these anatomical dissections in a perfused cadaver, such as in the model used by Aboud et al.1 to render the exercise more lifelike.

**Seeing is Not Removing.** A classic drawback of advanced endoscopic techniques is that the view is superior, but maneuverability is (vastly) inferior when compared with the situation with the microscope. And of course the smaller the access aperture, the lesser the degree of surgical freedom. This is reflected in lower gross-total resectability rates and a higher incidence of “staged” resections in recent endoscopic series compared with open series. However, instrumentation is improving, and this, like most other innovations, is a moving target.

**Absence of Tumor.** The most obvious limitation of the study is, of course, the absence of the trigeminal schwannoma. This point plays both ways, by which I mean that the conclusions may be either falsely optimistic or falsely pessimistic. The absence of a large tumor gives predictability to the anatomical structures encountered. Additionally, there are no engorged veins, no hypertrophied perfusing arteries, no distortion or displacement of neighboring structures, and no rootlets or neural branches stretched and thinned out beyond recognition. What if the nerve fibers were located medial to the tumor during an endonasal approach, in the path of dissection? How realistic is the requirement to actually “resect” the internal maxillary artery and its branches in the pterygopalatine fossa, during the endonasal endoscopic transmaxillary transpterygoid approach, as was shown in Fig. 6C in the paper to expose the V3 in the infratemporal fossa and conclude that this approach is appropriate for this infratemporal fossa location? These facts lead to a falsely optimistic conclusion regarding the feasibility of a given approach.

On the other hand, a large tumor, particularly a trigeminal schwannoma that classically erodes bone smoothly, offers “surgical opportunity.” It creates a path for its own resection, such that normal anatomy would not have predicted. For example, the authors predict in their Table 1 that an anterior petrosectomy (Kawase approach, whether performed endoscopically or not) is needed from the subtemporal approach to resect the posterior fossa component of a tumor. This is sometimes true, but often times not, as others and I have experienced. The petrous apex may have been already totally eroded. A similar phenomenon applies to the anterior endonasal approach. The widened quadrangular space lateral to the cavernous carotid artery is a path to the middle fossa, and with appropriate instrumentation, may allow resection of soft tumors well into the Meckel cave, a conclusion not suggested by Table 1. The retrosigmoid approach, when supplemented with suprameatal drilling, not explored in this report, often allows “PM” lesions (that is, those primarily located in the posterior fossa, with some middle fossa extension) to be resected, another missed conclusion from Table 1. These are all examples of false pessimism. Table 1 should thus not be thought of as a “recipe” or a “menu,” but as a “suggestion,” a starting point from where surgeons might consider exploring alternatives to the classic microscopic approaches that have been generally very successful for trigeminal schwannomas. On the other hand, Table 1 might be quite applicable to cases in which simple biopsy sampling of various sections of the trigeminal nerve is needed, because there, the live situation is closer to the cadaveric anatomy depicted here.

In summary, I do congratulate the authors for their ongoing work in establishing and reinforcing the often forgotten tenet, that is, that the bedrock of surgery is anatomy. There is indeed no substitute to dedicated laboratory dissections in achieving real surgical proficiency. However, I equally remind the readers that anatomy is not pathology. Great surgeons often share a specific trait, that is, their ability to “imagine” in their mind’s eye how pathological processes distort anatomy in individual cases, and to select the most appropriate surgical strategy for the specific scenario. Trigeminal schwannomas are no exception. I also warn the readers about the lure and seduction of the “new.” No beginner should arm him- or herself with the endoscope tomorrow and drill the anterior clinoid extradurally in a patient through a 2.5-cm minicraniotomy, on the way to resect a 5-cm trigeminal schwannoma of the middle fossa. He or she will be thoroughly disappointed. The case for an extradural endoscopic transcranial approach has not been made here. Clinical series with appropriate non-overzealous selection criteria are needed before ever claiming feasibility. I do believe that endoscopy is here to stay. Its advantages are not in question. The limits of its applicability are, and the fact that these limits are being modified constantly (widened and narrowed) is only natural. It is part of what we call experiential learning, part of the parabolic path of all innovations.

**Disclosure**

The author reports no conflict of interest.

**References**

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