Endoscopic Access to the Infratemporal Fossa and Skull Base

A Cadaveric Study

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Objectives: To demonstrate that the regions of the infratemporal fossa and skull base at the level of the foramen ovale can be visualized endoscopically and that structures can be manipulated within these regions using endoscopic instruments.

Methods: Cadaveric dissection of 3 human cadavers using an endoscopic optical dissector. In all, 6 endoscopic infratemporal fossa and skull base approaches were performed.

Setting: Human temporal bone laboratory.

Results: A Gillies incision was coupled with a lateral brow incision, and then subperiosteal planes were developed. Endoscopic visualization and instrumentation was then performed. The infratemporal fossa was readily identified. The skull base at the level of the foramen ovale and the branches of the third division of the trigeminal nerve were seen distinctly. A probe was placed with ease within the foramen ovale itself.

Conclusions: Endoscopic access to the infratemporal fossa is readily accomplished, with excellent visualization and instrumentation ability. This novel technique provides access to this remote region for evaluation, possible biopsy, and potential treatment of infratemporal fossa lesions.


The infratemporal fossa is a relatively remote region beneath the skull base. Access to this region requires thorough knowledge of the anatomy of the region itself and of the surrounding structures. Surgical procedures to gain access to this region have been well described by Fisch1-4 and Sekhar5,6 and their colleagues, among others; these procedures are major surgical endeavors that require precision and planning.

The anatomy of the infratemporal fossa was well described by Grant7 in 1972. The superior border is composed of the greater wing of the sphenoid bone and the temporal fossa containing the temporalis muscle, and the medial border is formed by the lateral pterygoid plate. The infratemporal fossa is bounded laterally by the mandibular ramus, extends anteriorly to the posterior wall of the maxillary sinus, and opens inferiorly into the parapharyngeal space.

A host of neoplasms can either arise from or extend into the infratemporal fossa.8 Specific to the realm of pediatric otolaryngology, neoplasms found in this region can include rhabdomyosarcoma, lymphoma, and juvenile nasopharyngeal angiofibroma. Many of these tumors can undergo biopsy at some other, more readily accessible area, or the diagnosis is secured using imaging studies (computed tomography or magnetic resonance imaging). For a small subset of infratemporal masses, biopsy results before a major operative procedure might prove useful in guiding management.

This study arises from preliminary work9 in which endoscopic access was gained to the region of the infratemporal fossa to facilitate diagnosis of a cerebrospinal fluid leak at the region of the foramen ovale. Having gained access to visualize this region, the question arises whether this region can be accessed endoscopically such that manipulations such as biopsies can be performed safely without injuring neighboring structures. This study presents initial cadaveric dissections that demonstrate such an ability.

Figure 4 shows the incised periosteum, and the muscles in the infratemporal fossa are clearly displayed. By remaining on the
MATERIALS AND METHODS

Three fresh frozen cadaver heads were used for the dissections, which took place in the Temporal Bone Laboratory, Department of Otolaryngology–Head and Neck Surgery, University of Cincinnati, Cincinnati, Ohio. The infratemporal fossa was endoscopically identified on both sides of each head, for a total of 6 dissections. On 2 dissections, the zygomatic arch was removed after the endoscopic approach was performed to confirm the anatomical features that had been visualized endoscopically. A craniotomy was then performed on this cadaver head to further confirm the identification of the foramen ovale.

The endoscopic approach proceeded as follows. Two separate 2-cm incisions were made (one at the lateral rim and one just anterior to the temporal hairline) and carried down through the pericranium (Figure 1). An optical dissector with a distal spatula (Karl Storz Endoscopy-America Inc, Culver City, Calif) was placed through one incision, and a suction catheter (Karl Storz Endoscopy-America Inc) was placed in the other (Figure 2). Using endoscopic perosteal elevators and the suction freer elevator, the peristeme was elevated to the level of the zygomatic arch, which was palpated using the endoscopic instruments (Figure 3). Inferiorly, subperisteal elevation was performed to the region of the infratemporal fossa. Once the infratemporal fossa was accessed, the foramen ovale and the third division of the fifth cranial nerve could be identified.

face of the skull base and continuing to elevate the periosteum, the foramen ovale and the third division of the fifth cranial nerve are visualized. A probe can then be placed that allows for manipulation of the nerves themselves (Figure 5) or for direct access to the foramen ovale itself (Figure 6). After the zygomatic arch is subsequently removed and a craniotomy is performed, the structures identified endoscopically are confirmed to be truly representative.

Figure 1. Model of a skull with arrows pointing to the 2 sites of incision (one at the lateral rim and one just anterior to the temporal hairline) for the endoscopic approach to the regions of the infratemporal fossa and skull base at the level of the foramen ovale.

Figure 2. An endoscopic optical dissector in position through one incision (large arrow) and a suction elevator in position through the other incision (small arrow).

Figure 3. Endoscopic optical dissector instruments. The inset shows the spatula and the 30° scope at its distal tip.

Figure 4. Endoscopic view at the level of the skull base just medial to the zygomatic arch. The peristeme has been incised, and the infratemporal fossa musculature is visualized inferiorly; the foramen ovale is in the distance medially.

COMMENT

Modern endoscopic equipment has revolutionized many surgical disciplines, including otolaryngology. Specific to otolaryngology, endoscopes and related instruments have enabled the development of endoscopic sinus surgery and endoscopic middle ear otoscopy. The great benefit that using endoscopic equipment provides is the ability to avoid open surgical
maneuvers while still performing safe and effective investigations or procedures.

Endoscopic access to the infratemporal fossa may provide a unique means of visualizing and performing minor biopsies in this region. To date, we have performed 6 cadaveric and 1 clinical dissection. The patient was a child and was placed under general anesthesia for the procedure. Certainly for children, and probably for adults, the procedure requires general anesthesia, because it includes substantial periosteal elevation. As the technique evolves, it may be possible to perform the procedure on adults with the use of local anesthesia.

The equipment used for these dissections was designed initially for brow lifting. As such, the angulations of some of the instruments are not conducive to this form of surgery. We are presently developing instruments that are specifically designed to navigate around the angles of the skull base. To that end, we are also developing insulated instruments that will allow for electrocautery and may allow for some degree of hemostatic control.

As stated previously, the procedures for which this form of endoscopy might be warranted include those in which visualization of the fossa would change management or in which a biopsy might be required. Another possible use for this surgical technique may be to provide a simple and direct route to the foramen ovale. Procedures such as percutaneous rhizotomy require access to the foramen ovale. With the percutaneous approach, a small radiation dose in the form of fluoroscopy is required to demonstrate the position of the needle tip relative to the foramen; an endoscopic approach might alleviate the need for fluoroscopy and provide another means of access. Finally, bony deficits, acquired and congenital, associated with cerebrospinal fluid fistula may be directly and noninvasively addressed.

In conclusion, this study represents a small initial investigation concerning a new surgical endoscopic technique. More work will be required first in the cadaveric model and then in the clinical realm to define the role of endoscopy in the surgical armamentarium of the otolaryngologist.

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REFERENCES