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Endoscopic approach to the infratemporal fossa

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The infratemporal fossa is a deeply situated region that can give rise to a range of benign and malignant tumors. The endoscopic endonasal approach provides an alternative to open surgical approaches and may obviate the need for facial nerve transposition, middle ear obliteration, and brain retraction. A transmaxillary corridor with transpterygoid dissection is used to expose the pterygopalatine fossa. Further removal of the posterior wall of the maxillary sinus transgresses the pterygomaxillary fossa to provide access to the infratemporal fossa. The extradural nature of most pathology is associated with low rates of cerebrospinal fluid leakage. Understanding of the complex neurovascular anatomy of this region is essential to achieving successful resection and preventing complications.

The infratemporal fossa (ITF) is a region of the skull base that is situated inferior to the temporal fossa. It is bounded superiorly by the squamous temporal bone and the greater wing of the sphenoid, medially by the lateral pterygoid plate and the medial pterygoid muscle, laterally by the mandibular ramus and condyle, and anteriorly by the posterior wall of the maxillary sinus. The posterior border is defined by a coronal plane through the articular tubercle of the temporal bone and the sphenoid spine, and the inferior border is defined by a transverse plane through the alveolar border of the maxilla. The ITF communicates medially with the pterygopalatine fossa (PPF) via the pterygomaxillary fissure and posteroinferiorly with the parapharyngeal space. Important neural structures contained within the ITF include the facial nerve, the mandibular division of the trigeminal nerve (V3), the chorda tympani, the lesser superficial petrosal nerve, and the otic ganglion. Vascular structures in the ITF include the internal carotid artery (ICA) as it enters the carotid canal posteromedially, the middle meningeal artery as it enters the foramen spinosum posterolaterally, and the internal maxillary artery (IMA) and its branches. The tensor veli palatini, levator veli palatini, lateral pterygoid muscle (LPtM), and Eustachian tube are also found within the ITF.

The open approach to the ITF was classically described by Fisch, which is delineated into 3 types.[1] The type A approach provides exposure of the infralabyrinthine temporal bone and jugular foramen and is useful for management of glomus jugulare tumors, neuromas, and meningiomas. The type B approach exposes the petrous apex and midclivus, including the horizontal ICA, which facilitates resection of chordomas and extensive cholesterol granulomas. The type C approach extends the exposure to the parasellar region, cavernous sinus, and foramen rotundum and permits resection of nasopharyngeal carcinomas and angiofibromas. All 3 variations lie within the domain of the neuro-otologist and involve mastoidectomy, facial nerve dissection and transposition, and obliteration of the Eustachian tube, middle ear, and external auditory canal with a resulting permanent conductive hearing loss. Open approaches with intracranial exposure have also been described.[2] Because of the significant morbidity associated with open approaches to the ITF, less invasive alternatives including endoscopic techniques have been sought.[3,4] Anatomic studies have detailed

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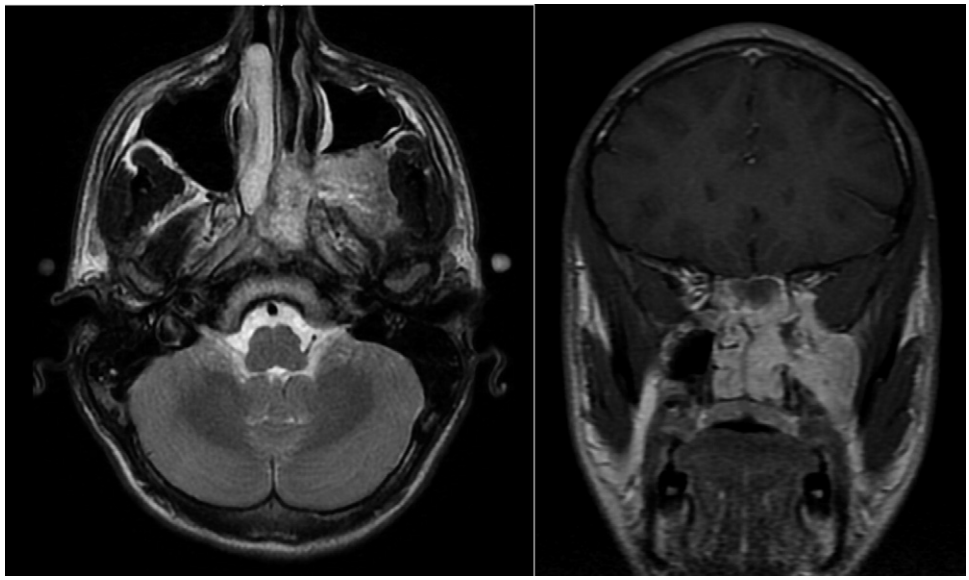

Figure 1 Axial MRI showing a juvenile angiofibroma arising from the left pterygopalatine fossa and extending to the infratemporal fossa and skull base.

the operative approach and the limits of endoscopic dissection (Lee et al, unpublished data, 2011).[5,6]

Indications

The range of pathologic entities of the ITF is similar to that of the parapharyngeal space and may include tumors that arise in adjacent anatomic regions. Angiofibromas, gliomas, schwannomas, and meningiomas are the most frequently encountered benign tumors of the ITF[3] (Figure 1). Malignant lesions arising within or extending into the ITF include salivary carcinoma, clival chordoma, nasopharyngeal carcinoma, fibrosarcoma, and osteosarcoma.[7] Lesions that have been previously managed using Fisch type B and C approaches may be accessed with the endonasal endoscopic approach. The currently accepted extent of practical dissection via the endonasal approach is the jugular foramen.[8] Preoperative radiologic study, including computerized tomography and magnetic resonance imaging (MRI), is essential to localizing the pathologic lesion and defining the normal anatomy. Vascular lesions such as angiofibroma may benefit from preoperative angiography, which includes the ability to embolize vascular supply to the tumor.

Technique

MRI with a neuronavigation protocol is performed on the morning of surgery to provide accurate intraoperative image guidance. Preparation of the nasal cavity begins with topical application of 4% cocaine on cottonoid pledgets for 10 minutes. A lumbar puncture or lumbar drain is performed preoperatively and intrathecal fluorescein is administered to assist with detection of interaoperative cerebrospinal fluid leak.[9] The patient's head is secured with pins in a Mayfield bracket to facilitate accurate intraoperative neuronavigation. After draping the patient, a 0-degree endoscope is used to inspect the nasal cavity. Local injection with 1% lidocaine with 1:100,000 epinephrine is performed at the sphenopalatine foramen, uncinate process, vertical lamella of the middle turbinate, and bilateral mucoperichondrial septal flaps. The posterior septum is resected up to the anterior tip of the middle turbinates, which facilitates a 2-nostril, 4-handed surgical technique and greater maneuverability of surgical instruments.

The endoscopic endonasal approach to the ITF uses a transmaxillary corridor as previously described.[10] The first step consists of uncinectomy and exposure of the ethmoid infundibulum. A maxillary antrostomy is performed by enlargement of the natural ostium. A total ethmoidectomy is performed with wide exposure of the lamina papyracea and fovea ethmoidalis. Sphenoidotomy is performed by entering the sinus through a medial and inferior transethmoidal approach, which allows for broad identification of landmarks including the intrasphenoidal ICA. Full exposure of the inferior maxillary sinus may require medial maxillectomy with removal of the inferior turbinate, although preservation of this structure is preferred (Figure 2).

The transpterygoid approach continues with removal of mucosa overlying the posterior maxillary sinus wall crista ethmoidalis, which is the vertical process of the palatine bone that contains the sphenopalatine foramen. The sphenopalatine artery is exposed as it exits the sphenopalatine foramen, where it is clipped or cauterized with endoscopic bipolar forceps and divided (Figure 3). The orbital process of the palatine bone, which is anterior to the sphenopalatine foramen, is removed using Kerrison rongeurs and a high-speed drill to expose the PPF (Figure 4). The second division of the fifth cranial nerve (V2) is an important landmark, which can be followed posteriorly in the infraorbital canal toward the foramen rotundum. Further drilling lateral to V2