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## Endoscopic approach to the infratemporal fossa



Ahmed Youssef <sup>a,\*</sup>, Ricardo L. Carrau <sup>b</sup>, Ahmed Tantawy <sup>a</sup>, Ahmed Aly Ibrahim <sup>a</sup>

<sup>a</sup> Department of Otolaryngology-Head and Neck Surgery, Alexandria University, Egypt

<sup>b</sup> Department of Otolaryngology-Head and Neck Surgery, Ohio State University Wexner Medical Center, USA

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### KEYWORDS

Infratemporal fossa;  
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 V3

**Abstract** *Introduction:* Multiple surgical approaches have been described to access the infratemporal fossa. One of them is the endoscopic endonasal transpterygoid approach to the infratemporal fossa. The endoscopic endonasal transpterygoid approach is considered the best to access the mid-line structures such as the nasopharynx, Eustachian tube, sella, and clivus. Through this work, we try to describe the anatomical structures and landmarks of the infratemporal fossa from the endoscopic endonasal transpterygoid point of view.

*Methods:* A cadaveric study was performed on five adult specimens. Endoscopic medial maxillectomy and complete resection of the posterior wall of the maxillary antrum were performed. Extension of the medial maxillectomy anteriorly was done to reach the lateral part of the infratemporal fossa. Endoscopic Denker's or Sturman–Canfield approach was done. Dissection of the pterygopalatine fossa was done with identification of maxillary artery branches, V2 (maxillary nerve) and masticatory muscles. Resection of the lateral pterygoid muscle and drilling the lateral pterygoid plate improve exposure of the infratemporal fossa, including V3 (mandibular nerve), which lies posterior to the lateral pterygoid plate.

*Results:* A total of ten infratemporal and pterygopalatine fossae (five cadaveric specimens) were dissected endoscopically using a transpterygoid approach. Dissection of different anatomical structures in the infratemporal fossa was done to describe the anatomical structures and landmarks of the infratemporal fossa.

*Abbreviations:* LPM, lateral pterygoid muscle; ICA, internal carotid artery; IMA, internal maxillary artery; TMJ, temporomandibular joint.

\* Corresponding author. Present address: Department of Otolaryngology-Head and Neck Surgery, Faculty of Medicine, Alexandria University, Champollion St, El azareeta 21131, Egypt. Tel.: +20 1110003881.

E-mail addresses: [ahmedyouseef2002@yahoo.com](mailto:ahmedyouseef2002@yahoo.com) (A. Youssef), [Ricardo.Carrau@osumc.edu](mailto:Ricardo.Carrau@osumc.edu), [carraul@gmail.com](mailto:carraul@gmail.com) (R.L. Carrau), [ahmedtantawy@ahmedtantawy.com](mailto:ahmedtantawy@ahmedtantawy.com) (A. Tantawy), [aly284@hotmail.com](mailto:aly284@hotmail.com) (A.A. Ibrahim).

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**Conclusions:** Endoscopic endonasal transpterygoid approach is considered one of the most useful surgical solutions to manage selected tumors that involve the infratemporal fossa. A good understanding of the endoscopic anatomy of infratemporal fossa allows safe and complete resection of lesions arising or extending to infratemporal fossa.

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## 1. Introduction

The infratemporal fossa is present below the middle cranial fossa floor, posterior to the maxillary sinus, medial to the ramus of the mandible, and lateral to the nasopharynx. The infratemporal surface of the greater wing of the sphenoid bone forms its roof. The lateral pterygoid plate forms its medial wall. The insertion of temporalis muscle into the coronoid process, the mandibular ramus and condylar process of mandible constitute the lateral boundary of the infratemporal fossa.<sup>1–3</sup>

The infratemporal fossa contains the lateral and medial pterygoid muscles, and important neurovascular structures, such as the mandibular nerve (V3) and the internal maxillary artery. Caudally, the infratemporal fossa is occupied by the medial pterygoid muscle, that inserts into the angle of mandible. Posteromedially, the infratemporal fossa contains the carotid sheath (internal carotid artery [ICA], internal jugular vein, and cranial nerves IX–XII) in the poststyloid part of parapharyngeal space.<sup>1–3</sup> Other contents of the infratemporal fossa include the pterygoid venous plexus, maxillary vein, and the branches of mandibular nerve and chorda tympani nerves. Medially, the infratemporal fossa communicates with the pterygopalatine fossa via the pterygomaxillary fissure.<sup>2,3</sup>

Multiple surgical approaches to the infratemporal fossa have been described including lateral preauricular and postauricular approaches, anterior trans-maxillary, and inferior transmandibular approaches.<sup>3</sup> Anterior surgical approaches to the infratemporal fossa include the sublabial transmaxillary approach, Le Fort osteotomies, maxillary swing, and facial translocation.<sup>4</sup> Endoscopic endonasal transpterygoid approaches have been described to manage multiple pathologies in the paramedian and lateral skull base.<sup>5</sup>

Endoscopic endonasal transpterygoid approaches were first described to access the lateral recess of the sphenoid sinus and was then expanded to manage lesions of the middle cranial fossa and infratemporal fossa.<sup>5–7</sup> Understanding the anatomic landmarks of the infratemporal fossa from the endoscopic view is important before doing the endoscopic endonasal transpterygoid approaches.<sup>8–10</sup>

In this work, we studied the anatomy of the infratemporal fossa from the endoscopic view through applying the endoscopic endonasal transpterygoid approach.

## 2. Materials and methods

We studied five human anatomic specimens, dissecting the infratemporal fossa and pterygopalatine fossa bilaterally, in accordance with institutional protocols. Using a standardized method, all specimens were injected with red and blue silicone, through the internal carotid artery and internal jugular vein, respectively.

Visualization was facilitated by the use 0°, 30°, and 45° rod lens endoscopes coupled to a high definition camera and monitor (Storz Endoscopy, Tuttlingen, Germany). The surgical dissection was performed using paranasal sinus and skull base/neurosurgical endoscopic instruments (Storz), and a high-speed drill with angled hand-piece, and diamond and cutting burrs (Total Performance System, Stryker, Kalamazoo, MI, USA).

Photographs were taken with 0°, 30°, and 45° rod lens endoscopes coupled to an HD camera and monitor (Storz Endoscopy, Tuttlingen, Germany).

## 3. Results

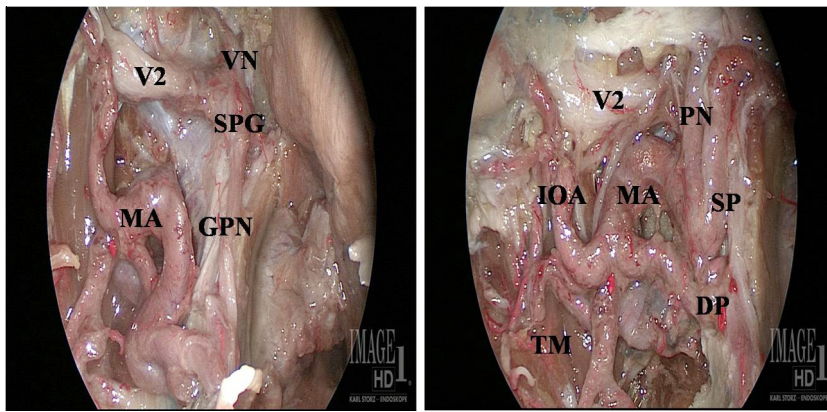
A total of ten infratemporal and pterygopalatine fossae (five cadaveric specimens) were dissected endoscopically using a transpterygoid approach. Access was obtained after performing an endoscopic medial maxillectomy and the complete resection of the posterior wall of the antrum. The latter was accomplished using Kerrison rongeurs, starting its removal at the anterior aspect of the sphenopalatine foramen, and proceeding in a medial to lateral direction.

The lateral exposure provided by a medial maxillectomy, performing posterior septectomy may enhance this angle of approach. To dissect the most lateral aspect of the infratemporal fossa, however, it is best to extend the medial maxillectomy anteriorly with or without displacing the nasolacrimal duct. To reach the most lateral part of the infratemporal fossa, we remove the pyriform aperture and ascending process of the maxilla (endoscopic Denker's or Sturman–Canfield approach). This is done by making a vertical incision just anterior to the head of the inferior turbinate, directly over the edge of the aperture. Extension of the dissection laterally, following a subperiosteal plane, exposes the entire anterior maxilla till the infraorbital foramen and its corresponding nerve and vessel.

After dissecting the periosteum and the fat of the pterygopalatine fossa, the main branches of the third part of the internal maxillary artery were identified including the infraorbital, descending palatine, vidian, sphenopalatine, and posterior nasal arteries (Fig. 1). All branches were transected to expose the underlying neural structures including the infraorbital, descending palatine, vidian, and pharyngeal nerves.

The infraorbital nerve traversing the infraorbital fissure is dissected, just after arising from the maxillary nerve near the foramen rotundum, and before entering the infraorbital canal. This portion of the infraorbital nerve accurately defines the border between the infratemporal fossa and pterygopalatine fossa.

Wide exposure of the infratemporal fossa requires complete removal of the posterior wall from floor to roof of the maxillary sinus. Removal of bone from the floor and lateral wall of the sphenoid sinus exposes the bone comprising the floor of



**Figure 1** Endoscopic dissection of the infratemporal fossa. MA, maxillary artery; PN, posterior nasal artery; SP, sphenopalatine artery; DP, descending palatine artery; IOA, infraorbital artery; V2, maxillary nerve; VN, vidian nerve; SPG, sphenopalatine ganglion; GPN, greater palatine nerve; TM, temporalis muscle.

the middle cranial fossa, which is the superior boundary of the infratemporal fossa. The lateral limit is reached when the vertically-oriented temporalis muscle is visualized, while the lateral pterygoid muscle is readily identified by the horizontal orientation of the muscle fibers. The second part of the internal maxillary artery has a variable course, which may run lateral or medial to the lateral pterygoid muscle. This segment of the internal maxillary artery gives off several branches near the anterior border of the lateral pterygoid muscle, including the lingual and buccal arteries, which course anteriorly. The middle meningeal artery may be seen medial to the lateral pterygoid muscle, coursing superiorly toward the foramen spinosum. Resection of the lateral pterygoid muscle and drilling the lateral pterygoid plate improve exposure of the infratemporal fossa, including V3, which lies posterior to the lateral pterygoid plate (Fig. 2).

#### 4. Discussion

Multiple surgical approaches have been described to access the infratemporal fossa. Anterior and lateral approaches were very famous to manage lesions extending in the infratemporal fossa (ITF).<sup>11,12</sup> Compared to lateral approaches to the infratemporal fossa, the endoscopic endonasal transpterygoid approach

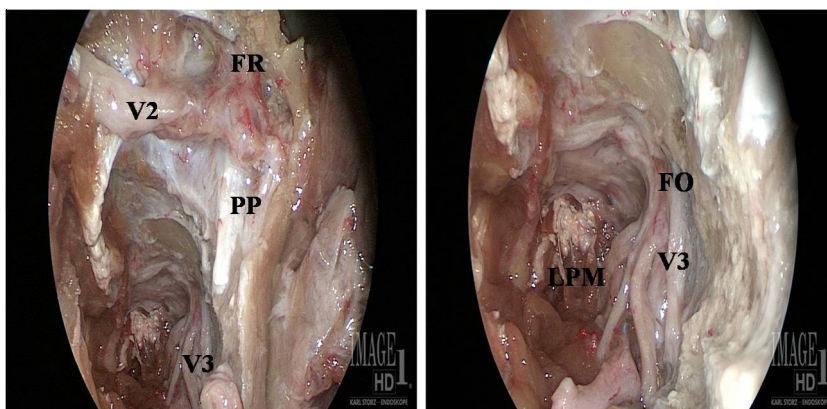
allows better exposure of midline structures such as the nasopharynx, sella, and the clivus.

Moreover, it provides excellent exposure of foramen rotundum, V2, nerve of pterygoid canal, foramen ovale and V3 by drilling of lateral pterygoid plate and dissection of lateral pterygoid muscle. However, some bleeding from the pterygoid venous plexus is expected, that can be controlled with cautry, hemostatic agents and warm saline irrigation.<sup>13</sup>

In this approach, some of the branches of V2 like descending palatine and alveolar branches are sacrificed. This leads to loss of sensation of hard palate and ipsilateral upper dentition.

The exposure done utilizing the endoscopic endonasal transpterygoid approach to the infratemporal fossa equals or exceeds the exposure provided by traditional anterior approaches and more extensive than the sublabial transmaxillary approach. Moreover, the endoscopic endonasal transpterygoid approach avoids multiple morbidities that are resulting from other lateral and non-endoscopic anterior approaches like cosmetic issues related to skin incision, need for orbitozygomatic osteotomies, or temporalis muscle manipulation, TMJ dysfunction, facial nerve paralysis, craniotomy, and brain retraction, but trismus can also result from resection of lateral pterygoid muscle.<sup>14</sup>

Also the transpterygoid approach to the infratemporal fossa allows dissection of foramen ovale and V3, that is important



**Figure 2** Endoscopic view of the infratemporal fossa. V2, maxillary nerve; FR, foramen rotundum; PP, pterygoid plate; V3, mandibular nerve; FO, foramen ovale; LPM, lateral pterygoid muscle.

for the management of most of tumors that extend to the infratemporal fossa like nasopharyngeal angiofibroma, trigeminal schwannoma and low grade adenocarcinoma. Other extensive malignant tumors of maxilla and/or nasopharynx that extend to the infratemporal fossa can be safely and completely resected using the traditional anterior or lateral approaches or combinations. Sizeable defects are expected and the issue of reconstruction should be taken in consideration.<sup>14</sup>

Moreover, one of the most important landmarks for the endonasal endoscopic location of the post-styloid space, hence the ICA was the third division of the trigeminal nerve at the level of foramen ovale. Other anatomical landmarks include the Eustachian tube and the Vidian nerve. As a result of the variability of the position of parapharyngeal ICA in close relation to the lateral or even the posterior pharyngeal wall, surgeons should rely on certain landmarks in endoscopic endonasal transpterygoid approach. These anatomical landmarks allow safe and complete resection of lesions that arise or extend to the infratemporal fossa (ITF).<sup>15,16</sup>

## 5. Conclusions

Endoscopic endonasal transpterygoid approach is considered one of the most effective surgical solutions for most of benign and some malignant tumors that involve the infratemporal fossa and middle cranial fossa. A good understanding of the endoscopic anatomy of the infratemporal fossa allows safe and complete resection of lesions arising or extending to infratemporal fossa.

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