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ABSTRACT

Importance: The intracranial approach to dissection of the infratemporal fossa (ITF) via a combined transzygomatic and middle fossa intracranial approach is poorly described in extant literature. In our practice we have found it to be a useful and relevant technique for extirpation of intracranial tumors with extension into the ITF. However, the surgical anatomy and procedure steps are poorly described. A better model for understanding this complex anatomy from a trajectory unfamiliar to the Otolaryngologist/Head and Neck Surgeon is needed to improve visuospatial understanding of this approach.

Objective: 1) To describe the relevant anatomy and intracranial middle surgical approach to the ITF; 2) to model 3-dimensionally the surgical approach and anatomy of cadaveric dissections utilizing volumetric photogrammetry; 3) to describe our clinical experience with the approach with case illustrations of the approach; and 4) to gauge the resident experience and satisfaction with 3-dimensional models of the ITF.

Design: Volumetric photogrammetry of cadaveric dissections was utilized to develop a 3-dimensional model of the intracranial approach to the infratemporal fossa, as well as the ITF in general. A retrospective case series of patients undergoing this approach for removal of tumors extending into the ITF was also performed. Resident surgeons completed surveys regarding their experience and satisfaction with interactive 3-dimensional infratemporal fossa models.

Setting: Laboratory cadaveric dissections were performed. Retrospective chart review was performed of patients at a tertiary academic medical center. Resident surgeons were electronically surveyed.

Participants: Cadaveric head specimens were utilized for anatomic dissections and creating volumetric models. Cases of patients undergoing transcranial middle fossa approach to ITF dissection in conjunction with neurosurgery for tumor extirpation at the UCSF between 2018 and 2019 were also reviewed. Active resident physicians in Otolaryngology-Head and Neck Surgery at UCSF received 3-dimensional models and surveys.

Results: A detailed volumetric cadaveric anatomic model of the intracranial approach to the ITF is described including relevant ITF anatomy from this approach including medial/lateral pterygoid musculature, temporomandibular joint capsule, V3 division of trigeminal nerve, internal maxillary artery, internal carotid artery, and middle meningeal artery. Our clinical experience with 3 clinical cases for which this approach was utilized, with tumor pathology encompassing hemangiopericytoma, V3 schwannoma, and pigmented villonodular synovitis of the temporomandibular joint are reported. Based on surveys provided to resident surgeons, the 3-dimensional ITF models were well received as far as enjoyability of interface with the models, and learners overall reported a high likelihood of using similar models for anatomic learning in the future, if available.

Conclusions and Relevance: An understanding of infratemporal fossa from an intracranial approach is critical for any skull base surgeon and resident in Otolaryngology-Head and Neck Surgery. A detailed anatomic description and 3-dimensional volumetric model of the intracranial approach to the ITF are described. The 3-dimensional ITF models were overall well received by resident surgeons, and were described as a valuable tool for learning complex skull base anatomy.

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A Fresh Perspective on the Infratemporal Fossa:

Transzygomatic Middle Fossa Approach and 3-Dimensional Anatomic Modeling

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INTRODUCTION

- To access the infratemporal fossa (ITF) intracranially, typically a frontotemporal (i.e. pterional) craniotomy is performed by the neurosurgeon. Exposure of the zygomatic arch and zygomatic osteotomies greatly facilitate the ITF exposure.
- The literature describing the the anatomy and limits of dissection from this corridor is scarce, and we've developed a cadaveric model to more precisely describe this approach
- Additionally, we have generated 3-Dimensional anatomic models to facilitate learner comprehension of the complex anatomy described in this approach

OBJECTIVES

- To describe the relevant anatomy and intracranial middle surgical approach to the ITF
- To model 3-dimensionally the surgical approach and anatomy of cadaveric dissections
- To gauge the resident experience and satisfaction with 3-dimensional models of the ITF

METHODS AND MATERIALS

- Laboratory cadaveric dissections of the surgical approach were performed
- Volumetric photogrammetry of cadaveric dissections was utilized to develop a 3-dimensional model of the intracranial approach to the infratemporal fossa, as well as the ITF in general.
- Resident surgeons were electronically surveyed on their learning experience with generated 3D anatomic models

RESULTS

Transzygomatic Middle Fossa Approach

- A cadaveric model was created to define the steps and anatomy of this surgical approach
- Following frontotemporal (i.e. pterional) craniotomy, exposure of the zygomatic arch and zygomatic osteotomies greatly facilitate the ITF exposure
- Subsequent removal of the middle cranial fossa floor (greater wing of sphenoid) affords excellent exposure to ITF. Bone can be removed safely to foramina spinosum and ovale.
- Relevant exposed anatomy via this approach is picture in Figure 1

RESULTS

Transzygomatic Middle Fossa Approach

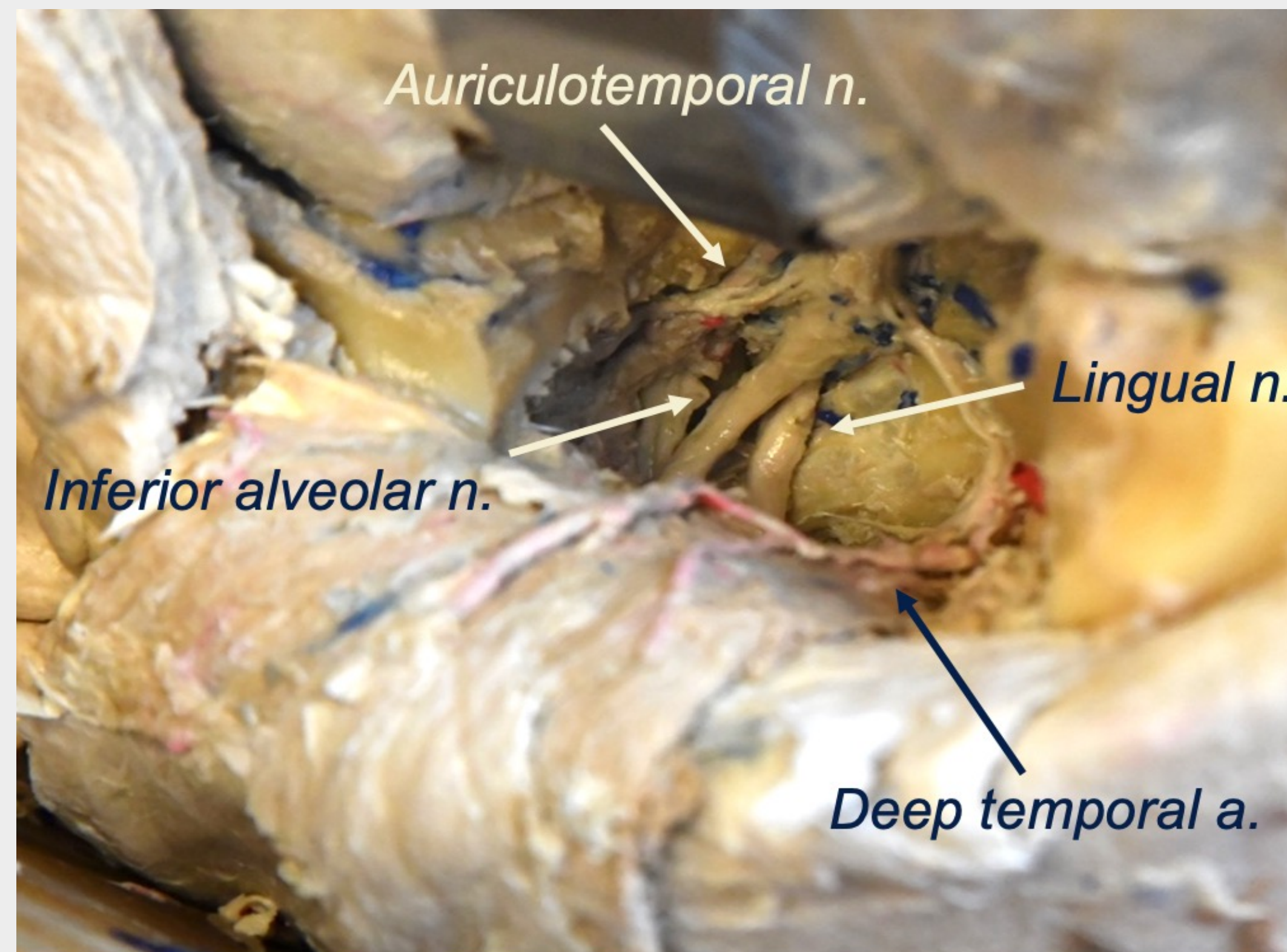


Figure 1. Exposure and relevant anatomy afforded by the transzygomatic middle fossa approach

- The parapharyngeal space (PPS) can also be accessed by this approach through a small corridor between the lingual and buccal nerves. Dissection through medial pterygoid muscle will lead to PPS

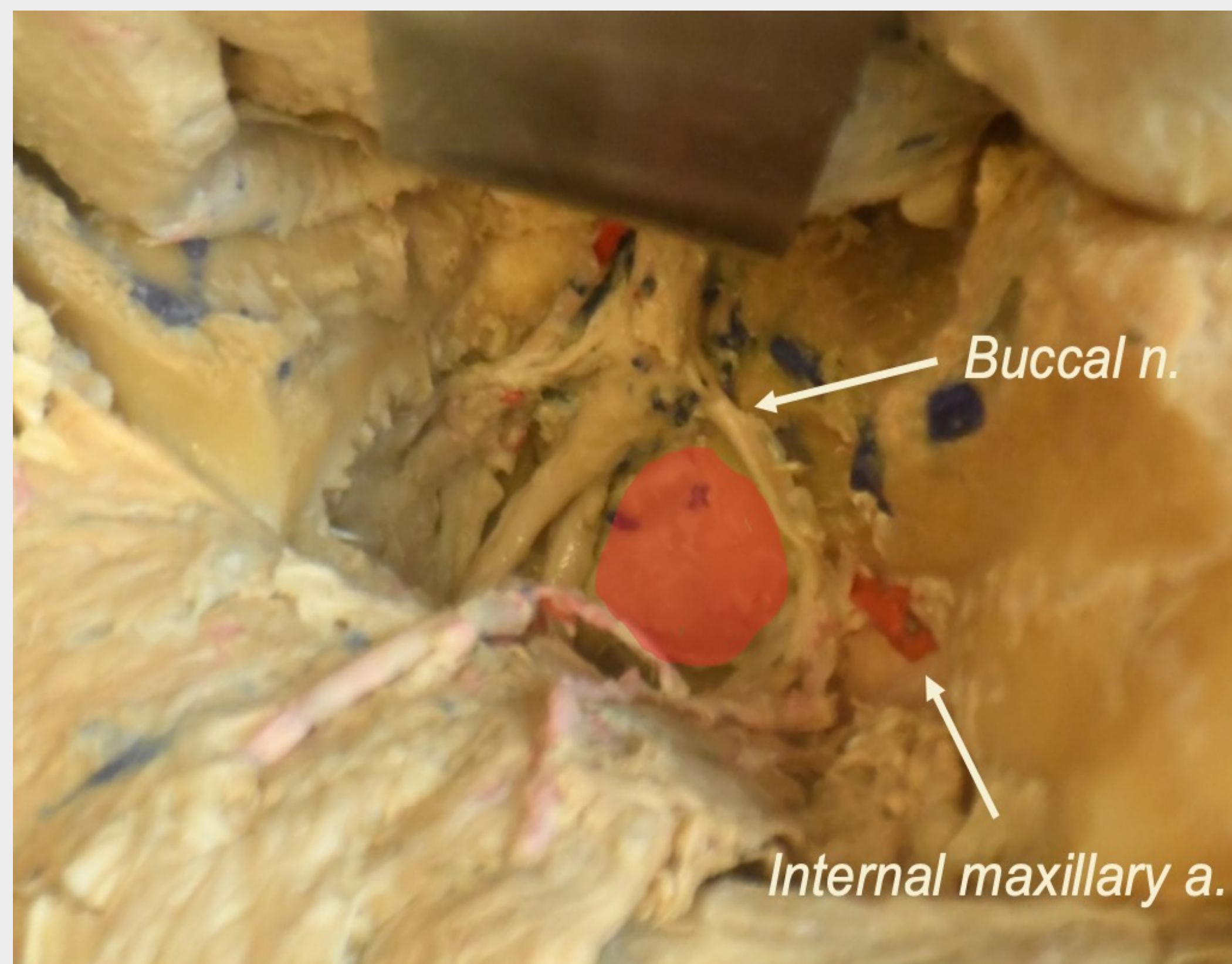


Figure 2. The parapharyngeal space can also be accessed from this approach via a narrow corridor between the lingual and buccal nerves.

RESULTS

3D Anatomic Modeling of ITF

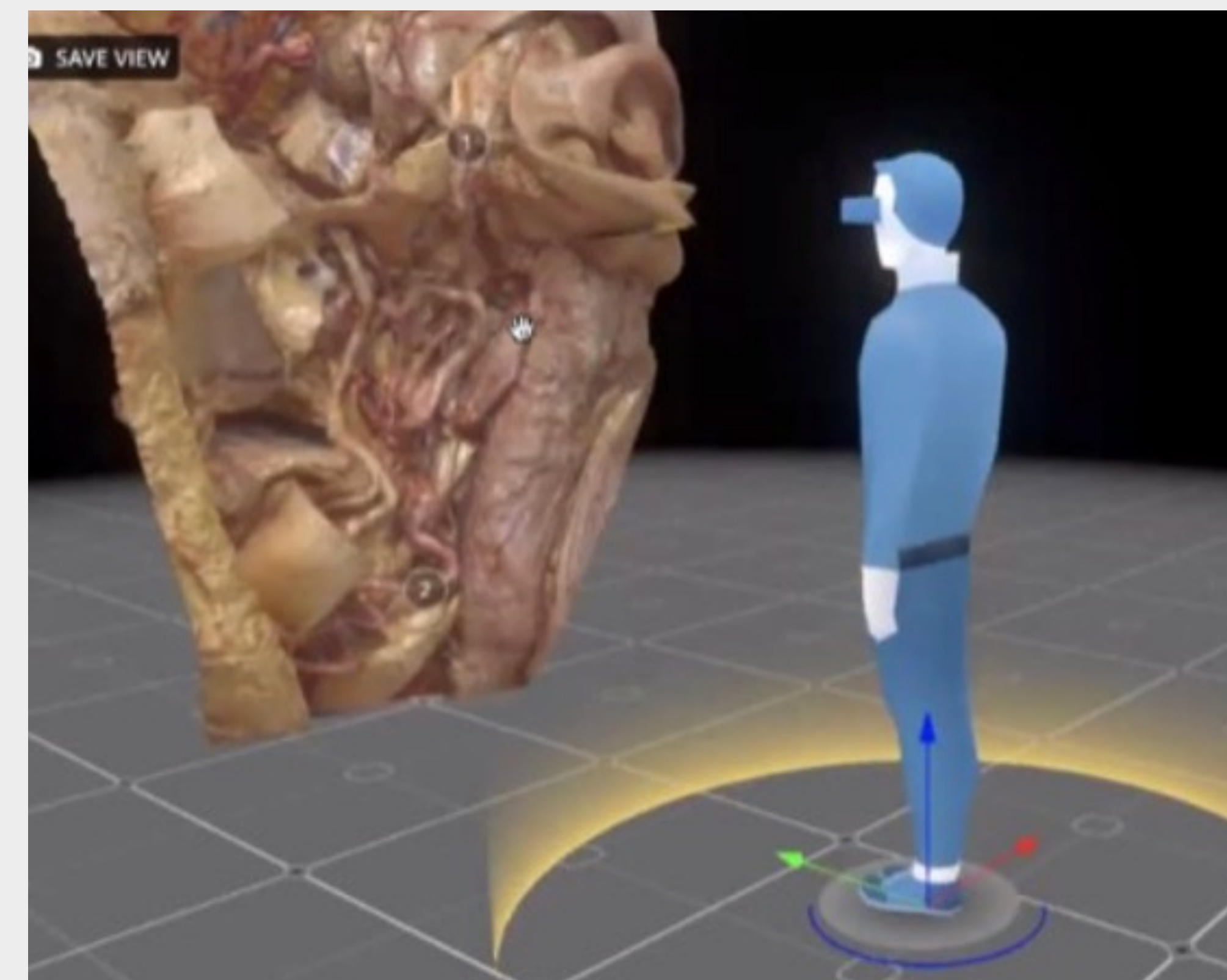


Figure 5. Immersive 3D ITF model puts the learner within the anatomic space when a virtual reality (VR) system is used to interact with the model

- Utilizing volumetric photogrammetry of cadaveric dissections, 3D models were created to provide an immersive learning experience for resident surgeons

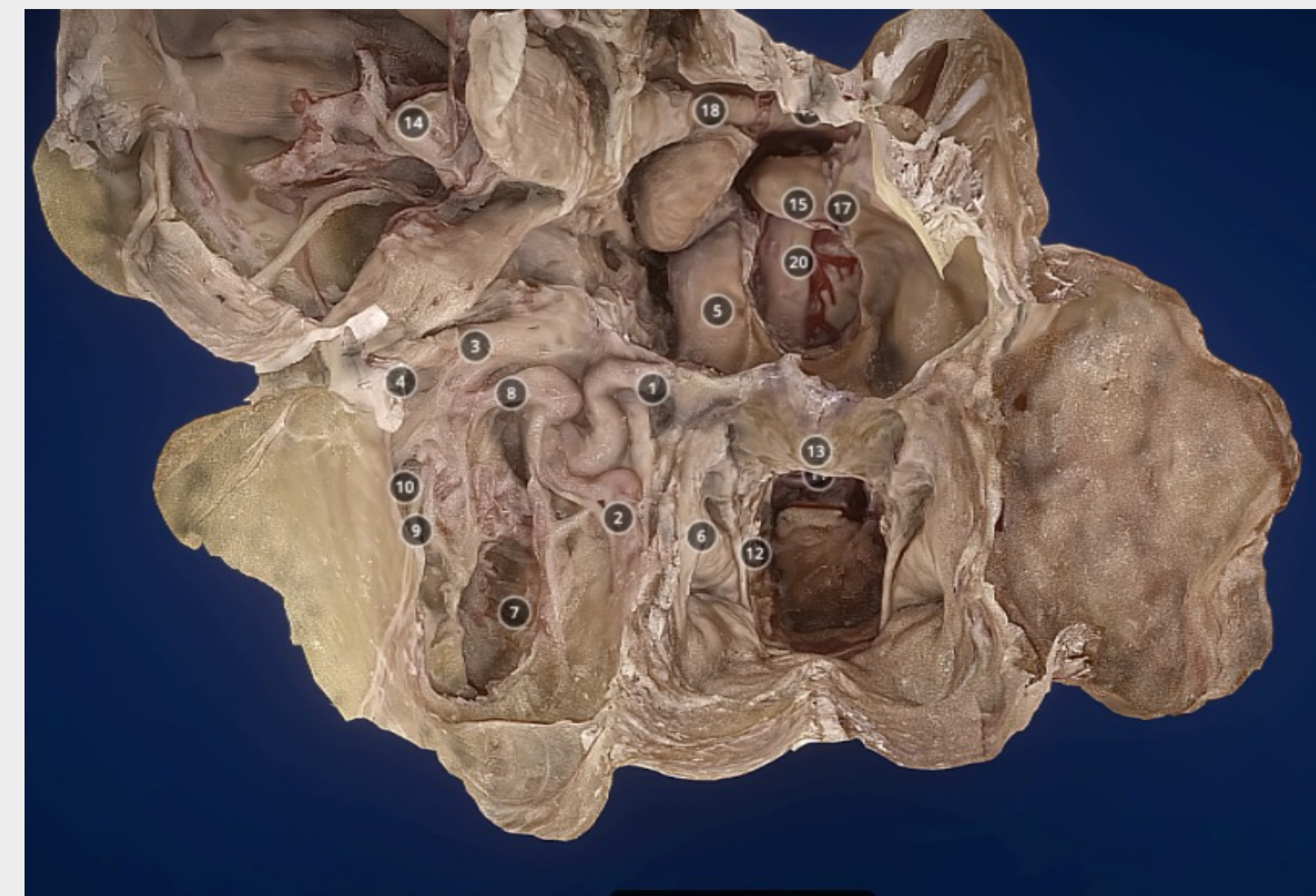
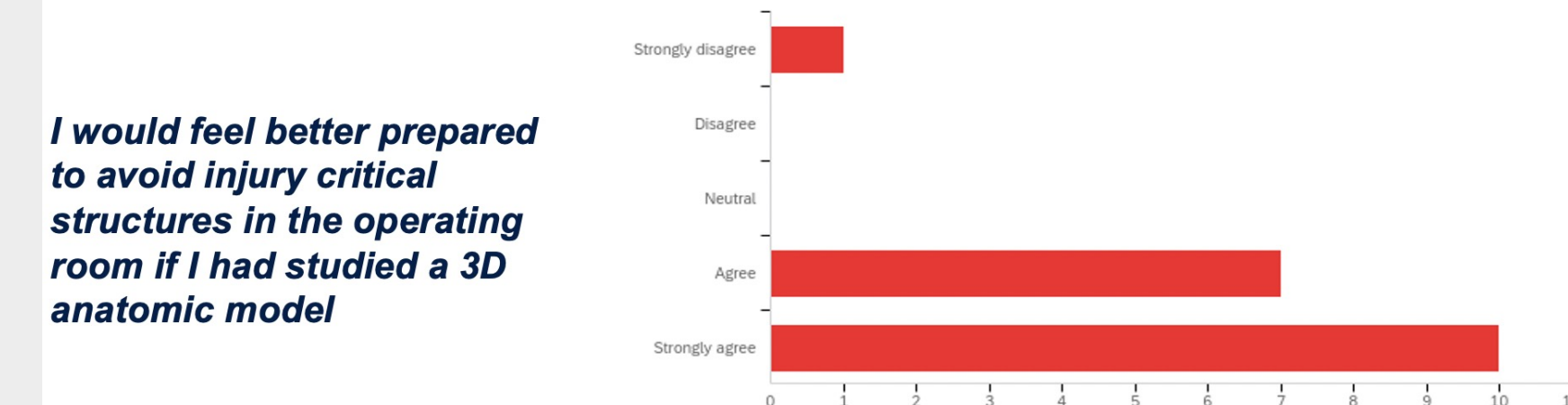


Figure 4. Interactive 3D ITF model

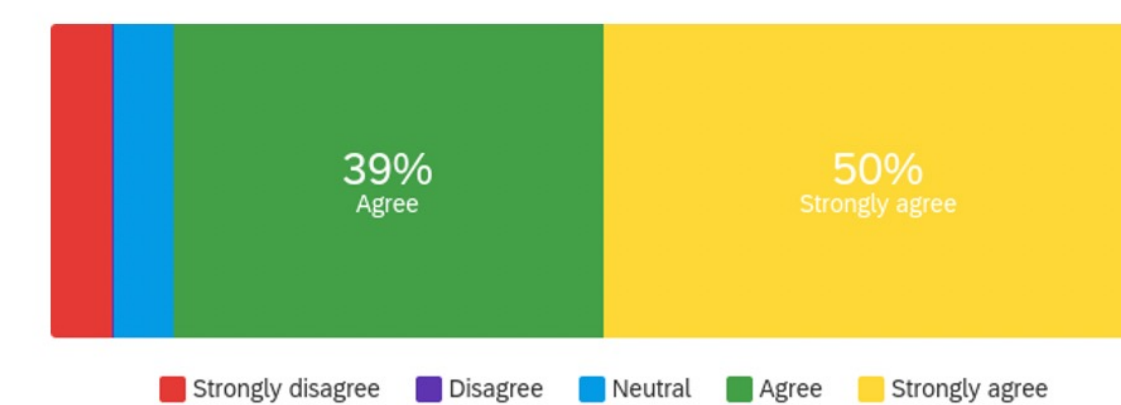
RESULTS

Resident Surgeon Surveys

- Electronic surveys were collected from 18 Otolaryngology Residents after interacting with the 3D ITF models on an online 3D viewing platform.
- The majority of residents reported that the 3D models were enjoyable to use, better prepared them to perform the dissection safely in the operating room, and that they would be likely to use similar models in the future.



Using the 3D models was an enjoyable experience



I would be likely to use similar 3D models for learning other anatomic spaces, if available

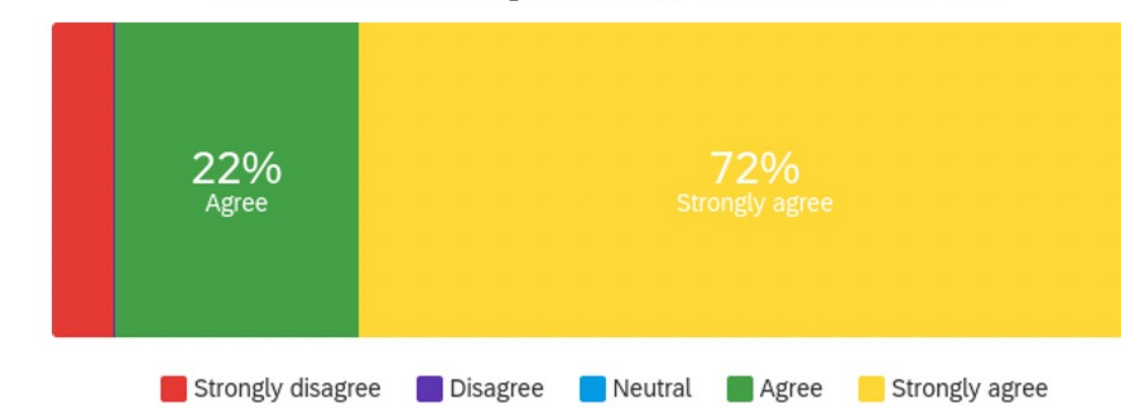


Figure 6. Survey of 18 otolaryngology residents after interacting with 3D ITF models

RELEVANCE/CONCLUSIONS

- An understanding of infratemporal fossa from an intracranial approach is critical for any skull base surgeon and resident in Otolaryngology
- A detailed anatomic description and 3-dimensional volumetric model of the intracranial approach to the ITF are described.
- The 3-dimensional ITF models were overall well received by resident surgeons, and were described as a valuable tool for learning complex skull base anatomy.