Exclusive Endoscopic Transcanal Transpromontorial Approach: Defining the Surgical Corridor

Cameron C. Wick, MD[1]; Amy M. Moore, BS[1]; Jacob B. Hunter, MD[1]; Carlos L. Perez, MD[2]; Alejandros Rivas, MD[3]; Brandon Isaacson, MD[1]

[1] Dept. of Otolaryngology, University of Texas Southwestern Medical Center, Dallas, TX, [2] Dept. of Radiology, University of Texas Southwestern Medical Center, Dallas, TX, [3] Dept. of Otolaryngology, Vanderbilt University, Nashville, TN

Abstract

Objectives: To define the anatomical boundaries and working distances of the exclusive endoscopic transcanal transpromontorial approach (EETTA), an emerging option for vestibular schwannoma (VS) management.

Study Design: Cadaver study with case series comparison.

Methods: The EETTA was performed on 5 fresh adult temporal bone specimens. Post-dissection computed tomography was compared with post-operative imaging from 2 patients that previously underwent EETTAs for vestibular schwannoma.

Results: The EETTA provided access to the internal auditory canal (IAC) with facial nerve preservation in all dissections. The approach requires expansion of the external auditory canal (EAC), transpromontorial tract, and porus acousticus. The height and width of that corridor was measured radiographically at three locations. The lateral measurements were at the osseous EAC. The mid-corridor measurements were taken between by the horizontal facial nerve-jugular bulb and the vertical facial nerve-petrous carotid artery, respectively. The medial measurements were at the porus. The lateral, mid-, and medial corridor mean widths were 11.4 mm (SD 2.0), 11.3 mm (SD 2.4), and 11.8 mm (SD 3.4), while the mean heights were 13.4 mm (SD 1.8), 9.8 mm (SD 1.0), and a 7.9 mm (SD 1.8), respectively. The mean length was 34.5 mm (SD 2.2). Only the mid-corridor width significantly differed between the cadaver and patient dissections (12.4 mm versus 8.5 mm; p = 0.028) secondary to residual bone on the carotid.

Conclusions: The EETTA provides a surgical corridor to the IAC porus for resection of intracanalicular VS. Precise identification of surgical landmarks is necessary to preserve neurovascular structures.

Introduction

Exclusively endoscopic approaches to the lateral skull base through the external auditory canal (EAC) are feasible. The three main routes include the suprageniculate corridor, transpromontorial corridor, and the infracochlear corridor.[1] Thus far, the exclusive endoscopic transcanal transpromontorial approach (EETTA) for the management of vestibular schwannomas (VS) has only been reported by two Italian centers with promising results.[2-4] For the EETTA to gain wider acceptance there will need to be a better understanding of the anatomical relationships, corridor size, and approach limitations. In this study we sought to define the boundaries of the EETTA corridor, measure the working distances, highlight important anatomical relationships, and compare the corridor size with our institution's initial experience using the EETTA for VS management.

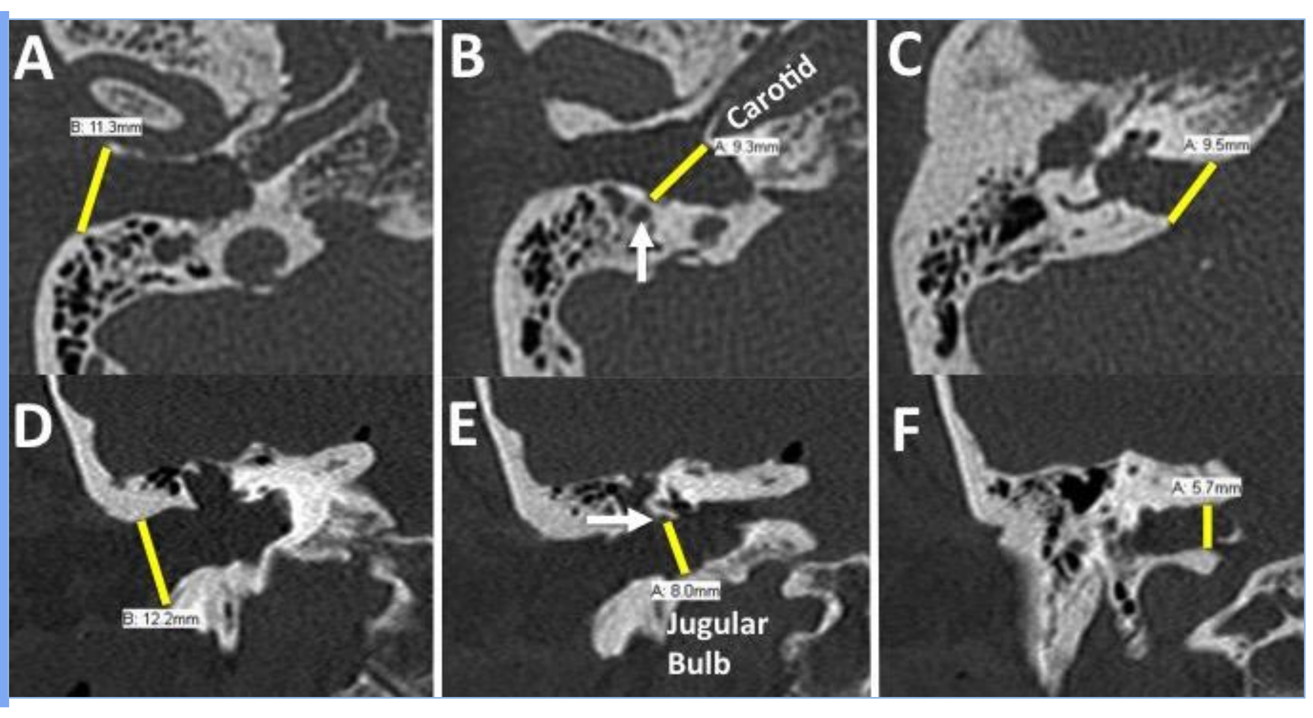
Methods

This study met institutional review board exemption. All cadaveric tissue was handled in compliance with the Willed Body Program at the University of Texas Southwestern Medical Center (UTSW). Five temporal bones from three fresh whole head specimens underwent EETTA dissections. The EETTA steps include:

- Opening the EAC meatus via a modified Rambo meatoplasty
- Removal of all EAC skin, tympanic membrane, and ossicles
- Expansion of the EAC with a wide canaloplasty
- Identification of the jugular bulb and petrous carotid artery
- Creation of an infracochlear tract to the porus acusticus
- Anterior transposition of the tensor tympani from the tensor canal
- Opening the cochlea to create a transpromontorial corridor
- Incising dura to identify the facial, cochlear, and vestibular nerves
- Closure of the meatoplasty

The cadaver specimens then underwent computed tomography (CT) to facilitate corridor measurements. The measurements were compared to post-operative CT images from two patients who underwent EETTA at UTSW. See figure 1 for measurement details.

Figure 1. CT corridor measurements. Axial images (top row) define the width; coronal images (bottom row) define the height. A,D) Lateral EAC. B,E) Mid-corridor between the vertical facial nerve (arrow) and carotid canal (B) and horizontal facial nerve (arrow) and jugular bulb (E). C,F) Medial porus acousticus.



Results

The mean cadaver, patient, and combined corridor sizes are listed in Table 1. Only the mid-corridor width significantly differed secondary to increased bone on the carotid canal during the patient dissections. Key anatomical relationships of the facial nerve are highlighted in figures 2 and 3. Skeletonization of the carotid, jugular bulb, and facial nerve are necessary to maximize the corridor working distances. The facial nerve was kept intact in all dissections.

Table 1	Lateral		Middle		Medial		Length
	Height mm (SD)	Width mm (SD)	Height mm (SD)	Width mm (SD)	Height mm (SD)	Width mm (SD)	Length mm (SD)
Cadavers	13.7 (2.1)	11.4 (2.4)	9.9 (0.6)	12.4 (1.6)	8.5 (1.5)	12.8 (3.6)	35.4 (1.9)
Patients	12.7 (0.6)	11.3 (0.0)	9.4 (2.0)	8.5 (0.8)	6.3 (1.5)	9.2 (0.3)	32.3 (0.1)
Combined	13.4 (1.8)	11.4 (2.0)	9.8 (1.0)	11.3 (2.4)	7.9 (1.8)	11.8 (3.4)	34.5 (2.2)
p-value	0.534	0.950	0.575	0.028*	0.132	0.230	0.074

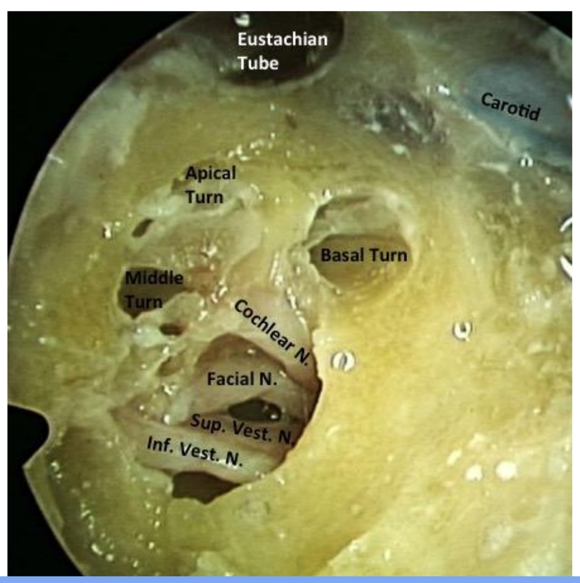


Figure 2. Nerve relationships at the fundus of the internal auditory canal.

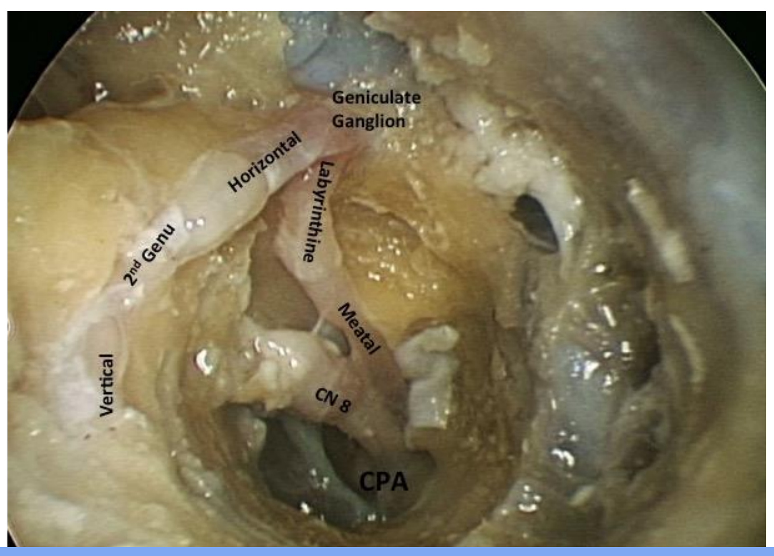


Figure 3. Facial nerve course as seen through the EETTA. The cerebellopontine angle (CPA) has been accessed through a widened porus.

Discussion

Anatomical studies are the foundation of safe surgical approaches. This study adds data on the EETTA corridor size and key anatomical relationships. Despite different measurement techniques, this study supports a previous cadaver study that the approach is feasible.[5] Additionally, this study correlates cadaveric dissections with data from the ETTAA performed on real patients. Surgeons should be aware of jugular bulb height as a potential limiting factor in creation of an adequate working corridor. Also, removal of the tensor tympani muscle and the tensor canal enables easier identification of the labyrinthine segment of the facial nerve.

Conclusions

The EETTA creates a corridor that could facilitate removal of cochlear and intrameatal VS. Further work on tumor dissection and the risk/benefit profile is needed before this approach can be widely accepted.

Contact

Brandon Isaacson, MD, FACS
Associate Professor
UT Southwestern Medical Center
Dallas, TX, U.S.A.
Email: brandon.isaacson@utsouthwestern.edu
Website: www.utsouthwestern.edu

References

1. Marchioni D, Alicandri-Cifuelli, Rubini A, Presutti L. Endoscopic transcanal corridors to the lateral skull base: Initial experiences. *Laryngoscope.* 2015;125:S1-13.
2. Presutti L, Alicandri-Ciufelli M, Cigarini E, Marchioni D. Cochlear schwannoma removed through the external auditory canal by a transcanal exclusive endoscopic technique. *Laryngoscope* 2013; 123:2862-2867.
3. Marchioni D, Alicandri-Ciufelli M, Rubini A, Masotto B, Pavesi G, Presutti L. Exclusive endoscopic transcanal Transpromontorial approach: a new perspective for internal auditory canal vestibular schwannoma treatment. *J Neurosurg* 2017;126:98-105.
4. Presutti L, Alicandri-Ciufelli M, Bonali M, et al. Expanded transcanal transpromontorial approach to the internal auditory canal: Pilot clinical experience. *Laryngoscope* 2017; Mar 8. doi: 10.1002/lary/26559 [Epub ahead of print]
5. Master A, Hamiter M, Cosetti M. Defining the limits of endoscopic access to internal auditory canal. *J Int Adv Otol* 2016;12:298-302.