The Preoperative Temporal Bone CT: A Systematic Approach & Mnemonic for Identifying Variants and Preventing Complications

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Introduction

- Otologic surgery treats various ear and skull base pathologies but carries risks of serious complications due to the need for sub-millimeter precision in a complex anatomic region
- Preoperative temporal bone computed tomography (CT) is valuable for identifying anatomic variants that influence surgical approach, though its analysis and reporting are often inconsistent

Objective

To illustrate important landmarks and anatomic variants on the preoperative temporal bone CT, with special attention towards features important in otologic surgery and that may impact surgical risk

Methods

This study synthesizes imaging findings, literature, and expert opinion to propose the mnemonic **"Making Miracles Involves Focused Vision,"** a systematic framework for analyzing the mastoid, middle ear, inner ear, facial nerve, and vascular structures, improving temporal bone CT reporting and optimizing surgical outcomes

Results

Mastoid Anatomy

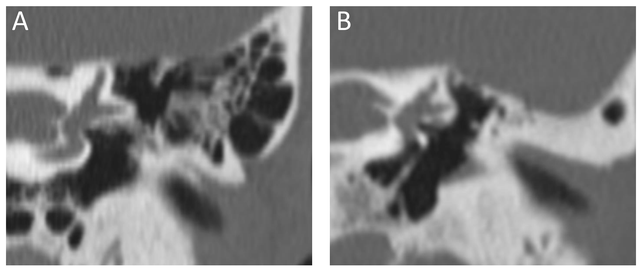

Figure 1a. Coronal CT shows normal tegmen height

Figure 1b. Coronal CT shows reduced tegmen height

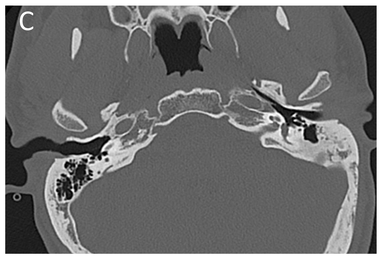

Figure 1c. Axial CT shows highly pneumatized mastoid air cells on the right and sclerotic air cells on the left.

Facial Nerve Anatomy

Overhanging Facial Nerve

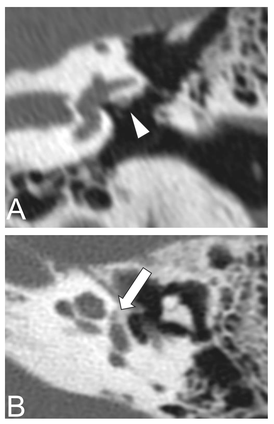

Figure 4a, 4b. Coronal (A) and axial (B) CT images show dehiscence of the facial nerve canal with extension of the tympanic segment of the facial nerve below the bone margin (arrowhead), in this patient with fenestral otosclerosis (arrow).

Facial nerve schwannoma

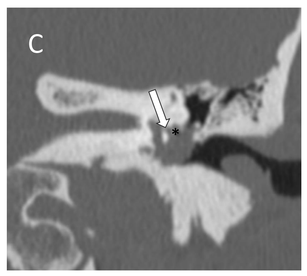

Figure 4c. Coronal CT shows an intratympanic soft tissue mass (asterisk) which contacts the tympanic facial nerve canal (arrow).

Middle Ear Anatomy

Cholesteatoma

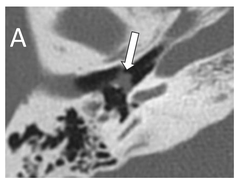

Figure 2a. Axial CT demonstrates a soft tissue mass abutting the tympanic membrane and extending to the cochlear promontory medially (arrow).

Chronic idiopathic polyneuropathy

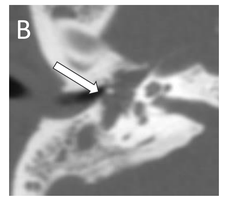

Figure 2b. Axial CT shows remodeling and expansion of the middle ear cavity (arrow) due to enlargement of the facial nerve and chorda tympani.

Chronic otitis media

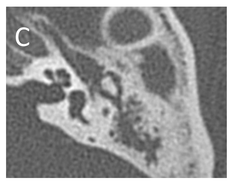

Figure 2c. Axial CT shows complete opacification of the left middle ear and mastoid air cells, superimposed on chronic left mastoid temporal bone sclerosis.

Fenestral otosclerosis

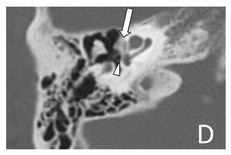

Figure 2d. Axial CT shows lucency at the fissula ante fenestram (arrow), located anterior to the oval window adjacent to the stapes footplate (arrowhead).

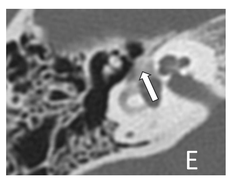

Figure 2e. Axial CT shows fixation of the stapes footplate (arrow), often associated with fenestral otosclerosis.

Retrofenestral otosclerosis

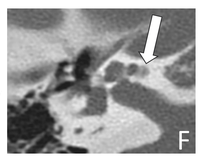

Figure 2f. Axial CT shows focal lucency medial to the cochlea (arrow).

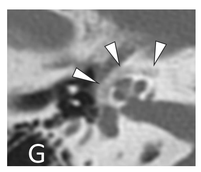

Figure 2g. Axial CT shows circumferential lucency about the cochlea (arrowheads), producing a "double ring" sign.

Ossicular chain variation

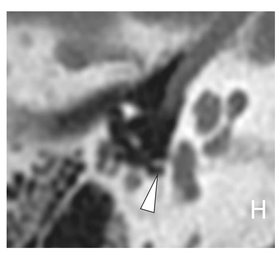

Figure 2h. Axial CT of a patient with fenestral otosclerosis shows a monocrural stapes (arrowhead).

Round window stenosis

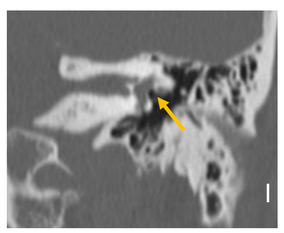

Figure 2i. Axial CT in this patient with otosclerosis shows bony overgrowth causing severe stenosis of the round window (arrow).

Inner Ear Anatomy

Labyrinthitis Ossificans

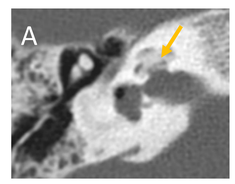

Figure 3a. Axial CT shows extensive ossification of the cochlea (arrow) due to severe labyrinthitis ossificans.

Third Window Defect

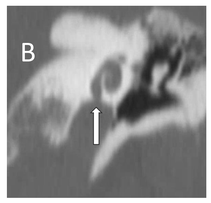

Figure 3b. Coronal CT image shows dehiscence of the cochlea (arrow).

Common cavity malformation

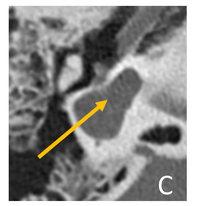

Figure 3c. Axial CT shows a common cavity (arrow) comprising both the vestibule and cochlea.

Incomplete partition (IP)

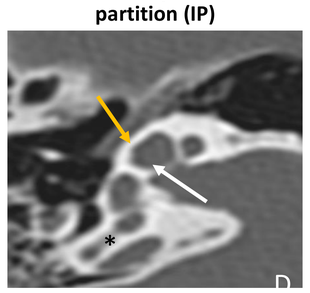

Figure 3d. Axial CT in this patient with IP type II shows coalescence of the middle and apical turns (arrow), a deficient modiolus (arrow), and an enlarged vestibular aqueduct (asterisk).

Cochlear hypoplasia

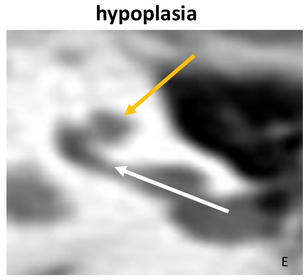

Figure 3e. Axial CT in this patient with branchio-oto-renal syndrome shows a dysplastic "unwound" basal turn (arrow) and hypoplasia of the apical and middle turns (arrow).

Vascular Structures

Jugular bulb

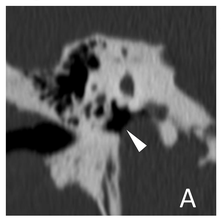

Figure 5a. Axial CT shows a dehiscent high-riding jugular bulb protruding into the hypotympanum (arrowhead).

Carotid artery variation

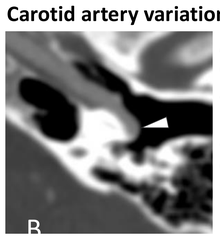

Figure 5b. Axial CTA demonstrates an aberrant left internal carotid artery (arrowhead) coursing across the cochlear promontory.

Conclusions

By systematically evaluating preoperative temporal bone CTs with the mnemonic **"Making Miracles Involves Focused Vision,"** surgeons can identify critical landmarks and anatomic variations, enabling tailored strategies that enhance surgical planning, safety, and outcomes.

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