CT Imaging of the Temporal Bone: an anatomical review with illustrative cases of Cholesteatomas

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Outline

- Review of the Normal Ear Anatomy
  - Tympanic Membrane
  - Middle Ear Cavity
    - Ossicular Chain
    - Spaces
    - Walls

- Characteristic CT of the Normal Temporal Bone
  - Axial
  - Coronal

- Cholesteatoma: Illustrative Pathology on CT
  - Patient presentation
  - Overview of cholesteatoma
    - Diagnosis, Pathogenesis, Differential, Management
  - Selected cases from companion patients
Human Ear

Netter FH, 2003
Human Ear

External Ear

Netter FH, 2003
Human Ear

Middle Ear
Human Ear

Inner Ear
Middle Ear Anatomy

- **Air-containing space**
  - communicates with the nasopharynx via the eustachian tube.
  - normally sealed laterally by TM.

- **Function:**
  - transmission and amplification of sound from TM to stapes footplate.
Spaces of the Middle Ear

Middle Ear divided into five spaces based on relationship to tympanic annulus.

- **Epitympanum (Attic)** - superior to annulus
  - Contains: body of incus and head of malleus.
  - Communicates with the mastoid via aditus.

- **Mesotympanum** - on level with the TM
  - Contains:
    - oval and round windows
    - long process of incus, articulation with stapes.
    - facial nerve in bony canal

- **Hypotympanum** - below annulus
  - Contains: jugular bulb

- **Protympanum** - in anterior recess of the middle ear
  - Contains: eustachian tube

- **Retrotympanum** - posterior to annulus
  - Contains: sinus tympani, facial recess
Inside the Middle Ear: Ossicular Chain

- **Malleus**: long process (manubrium), short process, head
  - Tensor tympani m.

- **Incus**: short process, long process
  - Lenticular process: distal portion of long process
    - Most tentative blood supply → susceptible to resorption in otitis media

- **Stapes**: Superstructure and footplate
  - Stapedius m.
Walls of Middle Ear (Tympanic) Cavity
Walls of Tympanic Cavity: Roof and Floor

Roof: tegumen tympani

Floor: Superior bulb of internal jugular v.
Walls of Tympanic Cavity: Lateral

Roof: tegemen tympani

Lateral:
• TM, malleus handle

Floor: Superior bulb of internal jugular v.
Walls of Tympanic Cavity: Medial

Roof: tegemen tympani

Lateral:
• TM, malleus handle

Medial:
• Promontory
• Oval window--stapes
• Round window (inferiorly)

Floor: Superior bulb of internal jugular v.

Agur AM, 1999
Walls of Tympanic Cavity: Posterior

Lateral:
• TM, malleus handle

Posterior:
• aditus ad antrum: epitympanic recess → mastoid cells.
• pyramidal eminence → stapedius m.
• Chorda tympani n. aperture

Medial:
• Promontory
• Oval window--stapes
• Round window (inferiorly)

Floor: Superior bulb of internal jugular v.
Walls of Tympanic Cavity: Anterior

- Lateral:
  - TM, malleus handle

- Posterior:
  - aditus ad antrum: epitympanic recess → mastoid cells.
  - pyramidal eminence → stapedius m.
  - Chorda tympani n. aperture

- Medial:
  - Promontory
  - Oval window--stapes
  - Round window (inferiorly)

- Anterior:
  - Tensor tympani m.
  - Eustachian tube

Floor: Superior bulb of internal jugular v.

Roof: tegemen tympani

Agur AM, 1999
Walls of Tympanic Cavity

Let’s take another look inside the Tympanic cavity by cutting through the cavity in this plane…

Lateral:
• TM, malleus handle

Posterior:
• aditus ad antrum: epitympanic recess → mastoid cells.
• pyramidal eminence → stapedius m.
• Chorda tympani n. aperture

Roof: tegmen tympani

Medial:
• Promontory
• Oval window -- stapes
• Round window (inferiorly)

Floor: Superior bulb of internal jugular v.

Anterior:
tensor tympani m.
eustachian tube.

Agur AM, 1999
Middle Ear Anatomy: An additional view

Netter FH, 2003
CT imaging of the temporal bone

Axial View
Axial Slice (Superior to Inferior)

- The following slides are representative axial slices through the normal temporal bone, proceeding inferiorly from the most superior cut (through the superior semicircular canal).

Silver JA et al. 1987
Axial: Superior slice
Axial: Superior SCC

- **Superior SCC:**
  - perpendicular to long axis of temporal bone

- **Superior petrosal sinus:**
  - receives blood from cavernous sinus, drains to transverse sinus

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Axial: Epitympanum

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Epitympanum: space above TM annulus (ring)

- Epitympanum: space above TM annulus (ring)

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Epitympanum: space above TM annulus (ring)

What do the structures in the box resemble?

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Axial: Epitympanum “ice cream”

- Epitympanum: space above TM annulus (ring)

- What do the structures in the box resemble?
  - Ice cream cone!
Epitympanum: space above TM annulus (ring)

What do the structures in the box resemble?  
- Ice cream cone!
- Correspond to ossicles: malleus head, incus body

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Anterior genu (ag):
- first turn of the facial nerve
- labyrinthine segment in fallopian canal (fc) turns to tympanic segment.
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- first turn of the facial nerve
- labyrinthine segment in fallopian canal (fc) turns to tympanic segment.
Facial nerve: Anterior genu

- Anterior geniculate/First genu
- Labyrinthine segment
  - curls anteriorly over cochlear terminates at geniculate
- Tympanic segment
  - courses from 1st (anterior) to 2nd (posterior) genu.
  - underneath horizontal SCC and superior to oval window
  - can be identified using short process of the incus as landmark. (box)

Axial: moving inferiorly...

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Axial: IAC outlined

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Axial: Internal auditory canal

- **Internal auditory canal (IAC)**

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Axial: relationship of IAC to cochlea

- Internal auditory canal (IAC)
- Note:
  - Structures anterior to IAC are cochlear

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Axial: relationship of IAC to vestibular system

- Internal auditory canal (IAC)
- Note:
  - Structures anterior to IAC are cochlear
  - Structures posterior to IAC are vestibular

Fatterpek et al., 3D CT of the temporal bone. www.terarecon.com
Axial: Characteristic landmark

- What do the structures in the box resemble?

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Axial: “Signet Ring”

- What do the structures in the box resemble?
  - Signet ring!
Axial: Vestibule and LSCC

What do the structures in the box resemble?

- Signet ring!
- Corresponds to Vestibule and LSCC

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Vestibular aqueduct:
- bony canal that passes to posterior fossa dura
- Opens lateral to IAM
- transmits endolymphatic duct and 2 blood vessels into blind sac (reservoir for excess endolymph)

Common crus: union of superior and posterior SC ducts.
Axial: Relationship of Incus (short process) to the Facial n.

- Note:
  - The relationship of the **incus (short process)** to help identify **facial n. (tympanic segment)**
Axial: moving inferiorly...

Canal for Tensor tympani
Eustachian tube
Lenticular process of incus
Stapes
LSCC
V aqueduct

Canal for Tensor tympani
Eustachian tube
Lenticular process of incus
Stapes
LSCC
V aqueduct

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
A section through this plane will thus reveal the **tensor tympani m.**, lateral SCC and stapes.
**Tensor tympani m.:**
- arises from cartilaginous and bony margins of eustachian tube
- inserts on handle of malleus
- Dampens ossicular chain

**Lateral SCC**

**Stapes**

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Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
A section through this plane will thus reveal the **round window**, **promontory** and **eustachian tube**.

- **Prominence of Lateral SCC**
- **Tensor tympani m.**
- **Eustachian tube**
- **Round Window**
- **Promontory**

Axial: Middle Ear Cavity

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Axial: Round Window

- **Round window:**
  - opening between middle and inner ear, associated with scala tympani
  - below oval window

- **Promontory:**
  - medial wall of tympanic cavity formed by basal turn of cochlea
Axial: continuing to move inferiorly...
Facial nerve (mastoid segment, ms), here it gives off:

- Chorda tympani (ct):
  - taste fibers to anterior 2/3 tongue
  - preganglionic parasympathetic to submandibular & sublingual glands
  - Courses between incus and handle of malleus
Axial: Inferior view, facial n.
Facial nerve (mastoid segment, ms)
- Courses from second genu to the stylomastoid foramen
- Gives off 3 branches:
  - Nerve to stapedius (ns)
  - Chorda tympani (ct)
  - nerve from the auricular branch of vagus (pain fibers to posterior auditory canal)
CT imaging of the temporal bone

Coronal View
• The following slides are representative coronal slices through the normal temporal bone, proceeding anteriorly from the most posterior cut (through the semicircular canals).

Silver JA et al. 1987
Coronal: Semicircular Canals (posteriorly)

- Posterior, Lateral and Superior SCC

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
90° angle between Lateral and Superior SCC

Coronal: Semicircular Canal Relationship

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Coronal: more anteriorly, the vestibule is visualized:

- Vestibule: union of Superior and Posterior SC ducts.

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Coronal: continuing anteriorly
Coronal: External auditory canal

- External Auditory Canal

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Coronal: Scutum

- **Scutum**: spur-shaped bony projection top of tympanic membrane
  - Often eroded by cholesteatoma
Coronal: Tympanic Membrane

Outline of Tympanic Membrane

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Coronal: Prussak’s space

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
**Coronal: Prussak’s space**

- **Prussak’s space**: anterior recess of TM, between neck of malleus and pars flaccida of tympanic membrane
  - *most common site of acquired attic cholesteatoma.*

  Prussak’s space (pars flaccida (lateral border) removed)


Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Coronal

- Observe:
  - Cochlea "snail"
Coronal

- Observe:
  - Cochlea “snail”  

Anderson JF, 1983
Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Coronal

- Observe:
  - Cochlea “snail” 🐌
  - Two low attenuating areas above

Anderson JF, 1983
Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Coronal

- Observe:
  - Cochlea “snail”
  - Two low attenuating areas above
**Coronal**

- "**snake eyes**": distal labyrinthine and proximal tympanic segments of facial nerve.
- Locate anterior to the "**snail**" (cochlea)
Question: How can the facial nerve appear twice in a single coronal slice?
Coronal

Question: How can the facial nerve appear twice in a single coronal slice?

Answer: facial nerve turns at the anterior genu (turn)!

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Coronal: Anterior genu

Anterior genu

Fatterpekar et al., 3D CT of the temporal bone. www.terarecon.com
Patient Presentation
Patient 1: HPI

- S. A. is a 32 year old male with left-sided hearing loss and foul smelling otorrhea for 2 months.
  - No otalgia, dizziness or tinnitus.
S. A. is a 32 year old male with left-sided hearing loss and foul smelling otorrhea for 2 months.
- No otalgia, dizziness or tinnitus.

PMH: Frequent ear infections as a child.
Medications/Allergies: None
FH: negative for hearing loss or ear abnormalities.
Patient 1: Physical Exam

- S. A. is a 32 year old male with left-sided hearing loss and foul smelling otorrhea for 2 months.
  - No otalgia, dizziness or tinnitus.

- **PMH:** Frequent ear infections as a child.
- **Medications/Allergies:** None
- **FH:** negative for hearing loss or ear abnormalities.

- **Physical Exam:**
  - Weber Test localizes to left.
  - Rinne Test:
    - Right: AC>BC
    - Left: BC>AC (abnormal)
  - Facial nerve intact.
  - **Audiometry:** Left conductive hearing deficit.
  - **Otoscopic Exam:**
Patient 1: Otoscopic Exam

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Roland PS. http://www.emedicine.com/ent/topic220.htm
Patient 1: CT of Left Temporal Bone (coronal view)
Patient 1: Describe the lesion

Coronal C- CT, Left ear

PACS, MEEI. Courtesy of Dr. Hines-Parelta
Patient 1 CT Evaluation: Start with a Comparison

- Compare to Right Ear (normal)!
Patient 1 CT Evaluation: Familiar findings

- Compare to Right Ear (normal)!
  - Observe:
    - Cochlea “snail”
    - Snake’s eyes: labyrinthine and tympanic segments of facial nerve

PACS, MEEI. Courtesy of Dr. Hines-Parelta
Patient 1 CT Evaluation: Right ear

- **Right ear:**
  - normal scutum
  - Prussak’s space
  - ossicles in epitympanum.

PACS, MEEI. Courtesy of Dr. Hines-Parelta
Patient 1 CT Evaluation: Left ear

- **Left ear:** soft tissue mass
  - erosion of scutum
  - erosion of malleus
  - extension into aditus ad antrum
  - inferiorly bulges through superior external auditory canal and TM
Patient 1: Temporal Bone CT: Axial Views

These are representative Axial CT images of Patient A. S.'s temporal bones taken at the corresponding plane indicated in the coronal images. Identifying familiar structures and landmarks helps in evaluating the pathology in the left ear.
Patient 1: Axial CT evaluation: Right ear

- Observe:
  - Right: ice cream cone!
  - Mallear head and incus body

PACS, MEEI. Courtesy of Dr. Hines-Parelta
Axial View

- **Observe:**
  - **Right:** ice cream cone!
    - Malleal head and incus body
  - **Left:** mass extending through to attic
    - Ossicular remnants; loss of "ice cream cone"

PACS, MEEI. Courtesy of Dr. Hines-Parelta
Patient 1: Diagnosis and Management

- **Diagnosis: Acquired Cholesteatoma**
  - Patient’s presentation, physical exam/otoscopic findings consistent with Acquired Cholesteatoma.
  - CT findings of soft tissue mass with bony erosion support diagnosis of Cholesteatoma and illustrate the extent of disease.

- **Management:**
  - S.A. underwent tympanomastoidectomy for removal of the cholesteatoma
  - no evidence of recurrence to date.
Cholesteatoma: Overview

- Benign epidermoid cyst of the middle ear or mastoid
  - “Skin in the wrong place”
  - Prone to recurrent infection
  - Grows progressively as it accumulates epithelial debris
  - Progressive erosion of bone of ossicles and otic capsule

- Incidence:
  - estimated 3 in 100,000 (children) and 9 in 100,000 (adults)

Clinical Presentation

- **Hallmark**: chronic otitis, painless otorrhea, conductive hearing loss.
  - Persistent/recurrent despite antibiotics
    - difficult to treat (lack of blood supply)
  - **Hearing loss**
    - Middle ear space filled with desquamated epithelium +/- mucopurulent discharge
    - ossicular damage.

- Occasionally present with complications of cholesteatoma:
  - Dizziness and hearing loss (labyrinthine fistula)
  - Facial nerve paralysis
  - Intracranial infection
  - Sigmoid sinus thrombosis
  - Epidural abscess
  - Meningitis
Pathology

- **Histology:**
  - Perimatrix: granulation tissue
    - secrete proteolytic enzymes
  - Matrix: keratinizing squamous cell epithelium
  - Cystic: keratin filled center

- **Mechanism of bone erosion:**
  - Mechanical:
    - pressure effects of growing mass induce bony remodeling
  - Biochemical:
    - bacterial elements (endotoxin)
    - host inflammatory mediators and enzymes
Etiology

- Three subtypes of Cholesteatomas reported
  - Congenital
  - Primary acquired
  - Secondary acquired

- Differ in presentation, pathogenesis and natural history.
  - At least four theories have been proposed to explain the pathogenesis of acquired cholesteatomas, with different theories predominating in primary vs. secondary acquired cholesteatomas.
Congenital Cholesteatoma

- Rare: 2% of all cases of Cholesteatomas

- Clinical presentation:
  - Mass behind intact/normal TM
  - Young child (6mo-5 years)
  - no history of recurrent infections/perforation.
  - M:F ratio= 3:1

- Etiology: squamous epithelium rests trapped within temporal bone during embryogenesis.

- Location: anterior mesotympanum, perieustachian tube area, petrous apex.
Primary Acquired Cholesteatoma

- Etiology: Eustachian tube dysfunction, negative middle ear pressure
- Most common type: 82% of acquired cases
- Location/Extension:
  - pars flaccida retraction into the epitympanum, erosion of scutum (lateral wall of epitympanum).
    - Posteriorly (most common): Prussak’s space → epitympanum, lateral to incus body
    - Inferiorly: via pouch of von Tröltsch into the middle ear
    - Anteriorly: into the protympanum

Swartz JD, 1984
Secondary Acquired Cholesteatoma

- Etiology: secondary to TM injury
  - 18% of acquired cases
  - Posterior marginal perforation from otitis media, trauma, surgery
  - Extension route: pars tensa retracts into mesotympanum to form cholesteatoma
    - Ossicles displaced laterally
  - Can invade sinus tympani and facial recess
    - Difficult to remove

Swartz JD, 1984
Bailey BJ et al. 2006
Pathogenesis of Acquired Cholesteatomas

- Four theories:
  - Imagination of the tympanic membrane (retraction pocket)
  - Epithelial ingrowths through a perforation (migration)
  - Basal cell hyperplasia
  - Squamous metaplasia of middle ear epithelium
Negative pressure theory (primary acquired)

- Eustacian tube dysfunction resulting in poor aeration and relative negative pressure in the middle ear
  - medial retraction of pars flaccida
  - progressive deeping of the retracted areas
  - pit formation and collection of epithelial debris
  - poor clearance of debris
  - encystment and cholesteatoma formation.

Cummings CW et al., 2005
Migration theory (secondary acquired)

- Chronic infection/ recurrent otitis media
  - Destruction of the marginal portion of pars tensa
  - In growth of epithelium from external auditory canal into middle ear through perforation
  - Progressive deeping of the retracted areas
  - Subsequent encystement and cholesteatoma formation.

Cummings CW et al., 2005
Basal cell hyperplasia theory

- Breaks in the basal lamina
  - invasion of epithelial cones into subepithelial connective tissue
  - Microcholesteatomas form and enlarge
  - perforate secondarily through the TM (resulting in classic appearing attic cholesteatoma)

Cummings CW et al., 2005
Metaplasia theory

Middle ear infection/chronic inflammation

→ metaplasia of middle ear mucosa to stratified squamous epithelium secondary to middle ear infection

→ secondary TM perforation

→ subsequent encystement and cholesteatoma formation.

Cummings CW et al., 2005
## Cholesteatoma Subtypes: Summary

<table>
<thead>
<tr>
<th></th>
<th>Primary Acquired</th>
<th>Secondary Acquired</th>
<th>Congenital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td>98%</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>82%</td>
<td>18%</td>
<td></td>
</tr>
<tr>
<td><strong>Clinical Presentation</strong></td>
<td>Eustachian tube</td>
<td>TM perforation</td>
<td>Child with mass behind intact TM</td>
</tr>
<tr>
<td></td>
<td>dysfunction</td>
<td>History of infection, trauma or surgery</td>
<td>No history of chronic infection</td>
</tr>
<tr>
<td><strong>Pathogenesis (theories)</strong></td>
<td>Negative middle</td>
<td>Inward migration of squamous epithelium</td>
<td>Embryonic epithelial rests</td>
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<tr>
<td></td>
<td>ear pressure</td>
<td></td>
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<tr>
<td><strong>Inflammation</strong></td>
<td>Noninflammed ear</td>
<td>Inflamed ear</td>
<td>Noninflammed ear</td>
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<tr>
<td><strong>Tympanic membrane</strong></td>
<td>None, retraction</td>
<td>Marginal perforation in pars tensa</td>
<td>None</td>
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<tr>
<td><strong>perforation</strong></td>
<td>pocket in pars</td>
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<td></td>
<td>flaccida</td>
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<tr>
<td><strong>Location and direction</strong></td>
<td>Prussak’s space</td>
<td>Inferior tympanum</td>
<td>Petrous apex, mastoid, middle ear.</td>
</tr>
<tr>
<td><strong>of growth</strong></td>
<td>Superiorly into</td>
<td>Displaces ossicles laterally</td>
<td></td>
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<tr>
<td></td>
<td>antrum</td>
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<tr>
<td></td>
<td>Displaces ossicles medially</td>
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</table>
Diagnosis of Cholesteatoma

- **Otoscopic Exam:**
  - Canal filled with mucous and granulation tissue.
  - Yellowish mass eroding through TM
  - TM perforation > 90% cases
    - Exception: congenital cholesteatomas.

- **Audiometry:**
  - Conductive hearing loss

Roland PS. http://www.emedicine.com/ent/topic220.htm
Role of Imaging in Diagnosis of Cholesteatoma

- Diagnosis often made otoscopically

- Radiologic imaging serves as adjunct:
  - Assess extent of disease
  - Evaluate complications:
    - chronic supportive otitis media (CSOM).
    - Suspected congenital abnormalities.
    - Loss of landmarks due to previous surgery.
Characteristic Findings of Cholesteatoma on CT Imaging

CT without contrast:

- **Modality of choice:**
  - identifies soft tissue masses and bony erosions
- **Findings:**
  - nondependent soft tissue mass and bony erosion (80% specificity)
  - Can be difficult to distinguish cholesteatoma from granulation tissue, pus or fluid.
  - Often different pathologies related to chronic ear infection coexist
Characteristic Findings of Cholesteatoma on MRI Imaging

MRI:

- **Advantage:** differentiate cholesteatoma from surrounding fluid/inflammation
  - New reports suggesting role in post-surgical surveillance of recurrence
- **Limitation:** poor visualization of bony landmark
- **Findings:**
  - Medium signal intensity on T1-weighted images
  - High intensity on T2-weighted images
  - Nonenhancing (unless infiltrated with granulation tissue)
Differential Diagnosis: Soft Tissue Mass in Middle Ear

- Cholesteatoma*
- Cholesterol Granuloma*
- Chronic otitis media*
- Globus tympanicum tumor
- Granulation tissue
- Malignant otitis externa
- Neoplasm
  - Squamous cell carcinoma (adult)
  - Rhabdomyosarcoma (children)

* Can have accompanying bone erosion
Complications: bone erosion and recurrent infection

- **Hearing loss:**
  - conductive: erosion of ossicles (esp incus)
  - sensorineural: suppurative labyrinthitis or from the cochlear hair cell loss adjacent to cholesteatoma

- **Labyrinthine fistula: 10%**
  - horizontal SCC most common
  - sensorineural hearing loss and vertigo

- **Facial nerve paralysis:**
  - acute (infection) or chronic (compression from expanding cholesteatoma)
  - anterior geniculate most common

- **Dural involvement:**
  - Intracranial infections, subdural/epidural abscess, sigmoid sinus thrombosis, brain hernia or cerebrospinal fluid leakage (erosion of tegmen tympani or tegmen mastoideum)
Complications identified by CT imaging

- The following slides are illustrative CT images from patients with Cholesteatomas that help to illustrates additional pathologies.
Companion Patient 1: Tegemen erosion

- Extensive cholesteatoma
- tegemen erosion; dura exposed
- bony sclerosis obliterating cochlea

Coronal C- CT, Right ear

Yates PD et al., 2002.
Companion Patient 2: Labyrinth Fistula

- Extensive Cholesteatoma
- Ossicular erosion
- Labyrinth fistula (white arrow)
  - Erosion of bone covering lateral SCC.

Round window (black arrow)

Silver JA et al. 1987
Companion Patient 3: Erosion of Facial n. canal

Observe:

- **Familiar Landmarks:**
  - Cochlea “snail”
  - “Snake’s eyes”: tympanic and labyrinth segments of facial n.

- **Pathology:**
  - 1. epitympanic cholesteatoma
    - Erosion of tegmen tympani, scutum, ossicles
  - 2. erosion of bony canal of facial nerve

Waizel, S. http://www.emedicine.com/RADIO/topic676.htm
Companion Patient 4: Identify the Structure
Companion Patient 4: TORP

- **TORP:**
  - positioned between stapes footplate and tympanic membrane.
  - prosthesis is placed perpendicularly to footplate to ensure optimum sound transmission.

PACS, MEEI. Courtesy of Dr. Hines-Parelta
http://www.kbbmnt.com/torpporp.html
Companion Patient 4: Hearing Loss s/p TOPR

- 10-year-old male with a congenital cholesteatoma (left) s/p removal with TORP.

- Now with decreased hearing for 2 years.

- Evaluate for recurrence.
Companion Patient 4: Malpositioned Prosthesis

- 10-year-old with a congenital cholesteatoma (left) s/p removal with TORP.
- Now with decreased hearing for 2 years.
- Evaluate for recurrence.
- Observe:
  - No soft tissue mass/recurrence.
  - Thickened TM secondary to scarring.
- **Prosthesis** displaced anteriorly and articulates mostly with bone adjacent to **oval window**.
Management: Surgical Options

- Surgery to remove Cholesteatoma is the mainstay of treatment.
  - Indication: eradication of disease, complications
  - Options:
    - Atticotomy: transcanal
    - Simple mastoidectomy
    - Tympanomastoidectomy:
      - **Canal-wall-down procedure:**
        - Bony partition between external ear canal and mastoid removed.
        - Outcome: enlarged meatus, difficult to fit hearing aids; low rate of persistent/recurrent dz, canal cleaning needed, can have problem with water exposure. single procedure.
      - **Canal-wall-up procedure:**
        - Bony parition intact.
        - Outcome: normal appearance, relatively high rate of recurrent/persistent dz, high tolerance for water exposure. Staged procedure to evaluate recurrence.
Management: Conservative therapy

- **Conservative Therapy**
  - Reserved for patients who are poor surgical candidates or refuse surgery
  - Regular ear cleaning
    - Topical microbial therapy +/- systemic therapy as adjunct
  - Helps control infection and may slow growth
  - Does not stop expansion
Prognosis

- Recurrent/residual cholesteatoma: 15 to 40% in 5 years
  - Canal wall up tympanomastoidectomies usually return to the OR for a “second look” in one year.

- Regular follow up required.
References

Roland PS. Middle Ear, Cholesteatoma. eMedicine. 2006 http://www.emedicine.com/ent/topic220.htm
<http://radsmd.com>