The Temporal Bone
Anatomy & Pathology

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Temporal Bone
Axial View
Temporal Bone
Coronal View
Longitudinal Fracture
The Temporal Bone

Longitudinal fractures

- Most common fracture (80%)
- Pass through EAC, mastoid & middle ear
- High incidence of ossicular derangement
- Inner ear usually spared
- Facial paralysis in about 15%
- CSF otorrhea or rhinorrhea
History: 40 y/o man with hearing loss following a 40 foot fall

Dx: Transverse fracture
The Temporal Bone

Transverse Fractures

- Commonly involve the inner ear
  - Cochlear fracture - sensorineural hearing loss
  - Labyrinthine fracture - severe vertigo
- Facial palsy in 50%
- Perilymph fistula
- Injury to carotid artery
Diseases of the Mastoid and Middle Ear

- Acute otomastoiditis
- Chronic otomastoiditis
- Acquired cholesteatoma
- Paraganglioma
  - Glomus jugulare
  - Glomus tympanicum
Temporal Bone Inflammation

Otitis Media / Mastoiditis
History: 5 month old girl with left ear pain

Dx: Otomastoiditis and external otitis
History: 24 y/o man with a left conductive hearing loss

Dx: Cholesteatoma
Acquired Cholesteatoma

Critical Imaging Findings

- Erosion of scutum and ossicles
- Integrity of lateral semicircular canal
- Facial nerve involvement
- Erosion through tegmen or sigmoid sinus plate
History: 33 y/o male with left ear deafness
History: 48 y/o woman with sensorineural hearing loss
Dx: Glomus jugulare (paraganglioma)
Paragangliomas

- **Origin**: paraganglia along CN 9 and 10
  - Glomus jugulare - Nerve of Arnold (X)
  - Glomus tympanicum - Jacobson's nerve (IX)

- **Presentation**: pulsatile tinnitus, conductive hearing loss, retrotympanic mass, and cranial nerve deficits

- **Biological behavior**: slow growing but locally invasive
Location of Glomus Tissue
History: 60 y/o man with polycystic kidney disease, tinnitus, hoarseness & paretic right vocal cord
Dx: Glomus jugulare
Aberrant Carotid Artery
Aberrant Carotid Artery
History: 13 y/o girl with pulsatile tinnitus
Dx: High dehiscent jugular bulb
Middle Ear Masses

Differential Diagnosis

- Paraganglioma
- High & exposed jugular bulb
- Aberrant carotid artery
- Persistent stapedial artery
- Schwannoma
- Primary & metastatic bone tumors
- Other middle ear tumors - cholesteatoma, squamous cell carcinoma
Diseases of the Inner Ear

- Labyrinthitis
- Otosclerosis
- Acoustic schwannoma
- Endolymphatic sac tumors
"The ringing in your ears -- I think I can help."
History: 55 y/o woman with acute hearing loss in the right ear 10 days ago

Dx:
Labyrinthitis

- Presentation: sensorineural hearing loss and vertigo
- Viral most common, but other agents possible
- Source: tympanic, meningeal, hematogenous, posttraumatic or postsurgical
- Imaging features:
  - Acute & subacute: enhancement with gadolinium
  - Chronic: fibrosis and ossification (labyrinthitis ossificans)
Otosclerosis

- Acute phase: otospongiosis - resorption of bone
- Chronic phase: otosclerosis - sclerosis of bone
- Resorption of enchondral bone around otic capsule & replacement with spongy vascular new bone
- 65% females & 80% of cases are bilateral
- Onset during the 2nd and 3rd decades
- Two types: Fenestral & Cochlear
History: 58 y/o woman with progressive bilateral hearing loss for 8 years
Dx: Cochlear otosclerosis
Retrofenestral Otosclerosis
(Cochlear Otospongiosis)

- Sensorineural hearing loss
- CT findings:
  - Acute phase - patchy band-like lucency around the cochlear
  - Chronic phase - no visible abnormalities
- Cochlear implantation does not work
History: 58 y/o woman with vertigo & hearing loss
Dx: Fenestral otosclerosis
Fenestral Otosclerosis

- Most common form
- Conductive hearing loss
- Fixation of the foot plate of the stapes
- CT findings:
  - lucent focus just anterior to oval window
  - dense bone encroaches on oval window
- Surgical correction possible
History: Right sensorineural hearing loss & facial palsy

Courtesy Mahmood Mafee,
Causes of Sensorineural Hearing Loss

- Vestibular Schwannoma
- Other CP angle & petrous tumors
- Brain stem lesions
- Labyrinthitis
- Cochlear otosclerosis
- Bone dysplasias
- Leptomeningeal processes
- Congenital
- Trauma (transverse fx's)
Diseases of the Petrous Apex

- Cholesterol granuloma (cyst)
- Primary cholesteatoma
- Petrous apicitis (*Gradenigo's syndrome*)
- Intrapetrous carotid artery aneurysm
- Chondrosarcoma
- Metastatic tumors
Diseases of the Petrous Apex

Cholesterol Granuloma

- Chronic inflammatory cysts
- Contain blood products & cholesterol crystals
- Cyst capsule lined by fibrous tissue
- Hyperintense on T1 & T2-weighted images
Diseases of the Petrous Apex

Primary Cholesteatoma

- Also called epidermoid tumor or cyst
- Arise from epithelial rests
- Capsule lined by stratified squamous epithelial
- Cyst contents are primarily desquamated keratin
- Usually high T2 signal & low T1 signal
Cholesterol Granuloma
Temporal Bone Inflammation

Petrous Apicitis (Gradinego's Syndrome)

Schwartz & Harnsberger, Imaging of the Temporal Bone, Thieme, 1992, p. 334
History: 62 y/o female with right ear deafness & pain
Dx: Multiple myeloma – MGUS for several years
History: 60 y/o woman with vertigo, left sensorineural hearing loss & left facial palsy
The Facial Nerve
Normal Anatomy
The Facial Nerve

Inflammatory Disease

- Bell's palsy
- Ramsey Hunt syndrome
  - Herpes zoster oticus
- Lyme disease
- Syphilis
- Imaging - gadolinium enhancement of the 7th nerve
History: 37 HIV\(^+\) male with 7th nerve deficits
History: 81 y/o woman with chronic lymphocytic leukemia and a right 7th nerve palsy

Dx:
Facial Nerve Tumors

Differential Diagnosis

- Schwannoma
- Hemangioma
- Epidermoid tumor
- Acquired cholesteatoma
- Tympanic segment - glomus tympanicum, cholesteatoma, persistent stapedial artery
- Stylomastoid segment - glomus jugulare
Facial Nerve Schwannoma
History: 21 y/o woman with progressive left facial weakness & hearing loss for 11 months
Dx: Plexiform neurofibroma
Congenital Anomalies

External & Middle Ear

- Associated with facial, cervical & skeletal dysplasias
- External ear deformities
- Conductive hearing loss
- More common anomalies
  - Atresia of external ear
  - First branchial arch dysplasia
  - Second branchial arch dysplasia
Atresia of External Auditory Canal

Critical Imaging Information

- Thickness of atresia plate
- Size of tympanic cavity
- Status of the ossicles and oval window
- Presence of any congenital cholesteatoma
Atresia of External Auditory Canal
Membranous Labyrinth

Swartz et al, AJNR 17:17-21, 1996
Inner Ear Anatomy

Endolymphatic sac
Dura

Endolymphatic duct
Vestibular aqueduct
Saccule
Saccular duct
Scala vestibuli
Scala tympani
Cochlear duct
Cochlear aqueduct (perilymphatic duct)
Ductus reuniens

Stapes in oval window
Round window

Superior semicircular duct
Utricle
Crus commune
Utricular duct
Posterior semicircular duct
Lateral semicircular duct
Ampulla
Inner Ear Anomalies

- Semicircular canals & vestibule
- Cochlear anomalies
  - Labyrinthine aplasia (Michel's deformity)
  - Incomplete partition (Mondini malformation)
- Atresia/stenosis of the internal auditory canal
- Perilymphatic hydrops
Cochlear Aplasia with Labyrinthine Dysgenesis

Hasso et al., in Som & Curtin, Head & Neck Imaging, Mosby, 1996, p1367
History: 17 y/o male was partially deaf in the left ear
Perilymphatic Hydrops

- Increased pressure in the inner ear due to CSF fistula
- Can lead to perforation of the stapes foot plate
- Etiology:
  - Defective lamina cribrosa
  - Congenitally wide cochlear aqueduct
  - Trauma most common
History: 27 y/o man with deaf right ear & progressive sensorineural hearing loss in left ear
Dx: Endolymphatic hydrops – Vestibular aqueduct syndrome
Endolymphatic Hydrops

Sensorineural hearing loss & vertigo

Deficient absorption of endolymph

Can be congenital, acquired, or idiopathic

Meniere's disease: Idiopathic form

Imaging: Dilated endolymphatic sac and vestibular aqueduct

- < 1.5 mm
- No larger than semicircular canal
History: 77 y/o man developed vertigo with loud noises
Superior Canal Dehiscence Syndrome

- Caused by dehiscence of bone overlying the superior semicircular canal
- Causes vertigo & oscillopsia with sound or pressure stimuli
- Diagnosed with thin-section coronal CT
- Rx: Surgical plugging of the SSC