

Ear

Dr. Abdulrahman Hagr Al-Ghamdi MBBS FRCS(c)
Assistant Professor King Saud University
Otolaryngology Consultant
Otologist, Neurotologist & Skull Base Surgeon
King Abdulaziz Hospital

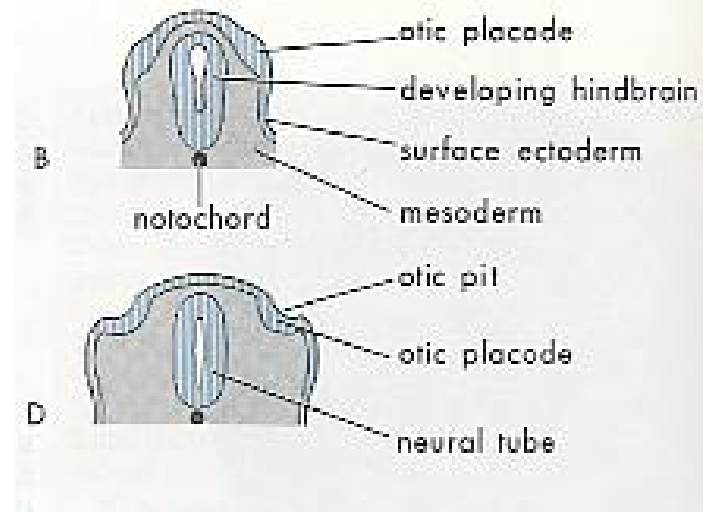
Ear

- **Embryology**
- Congenital anomalies
- Anatomy
- Physiology
- Disease of external ear
- Acute Otitis media

The Ear

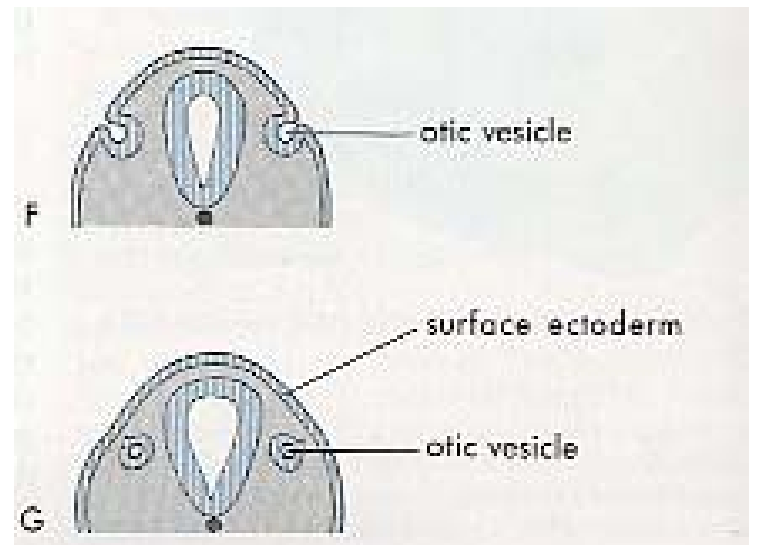
Otic placode

- 4th week
- Thickening in surface ectoderm
- Otic vesicle

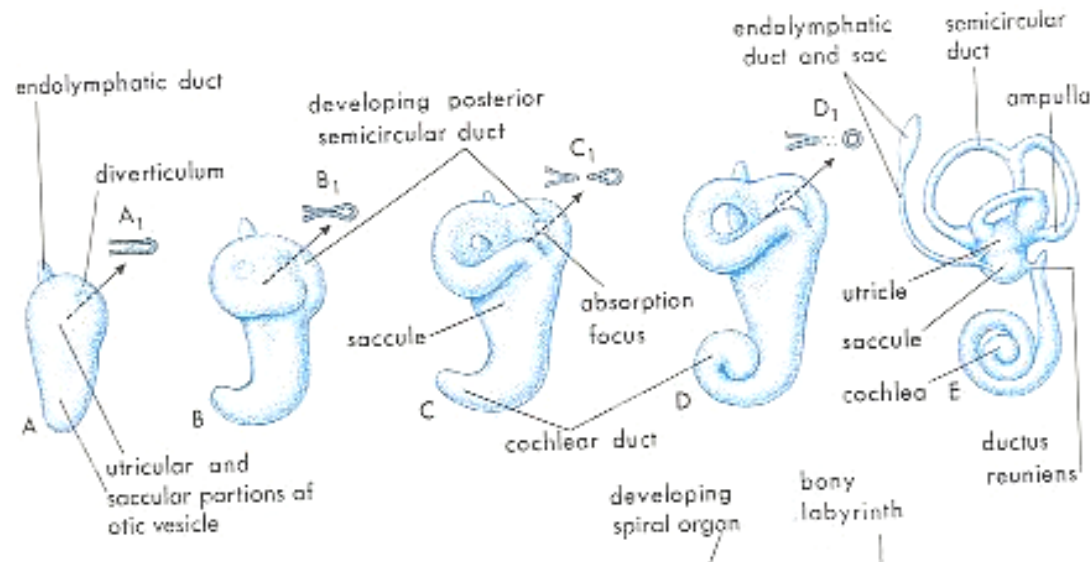


The Ear

- Otic vesicle
 - Invaginates of mesenchyme
 - Detaches from ectoderm
 - divides into 2 regions:
- **Utricular portion**
 - Utricle
 - Semicircular canals
- **Saccular portion**
 - Sacculle
 - cochlea



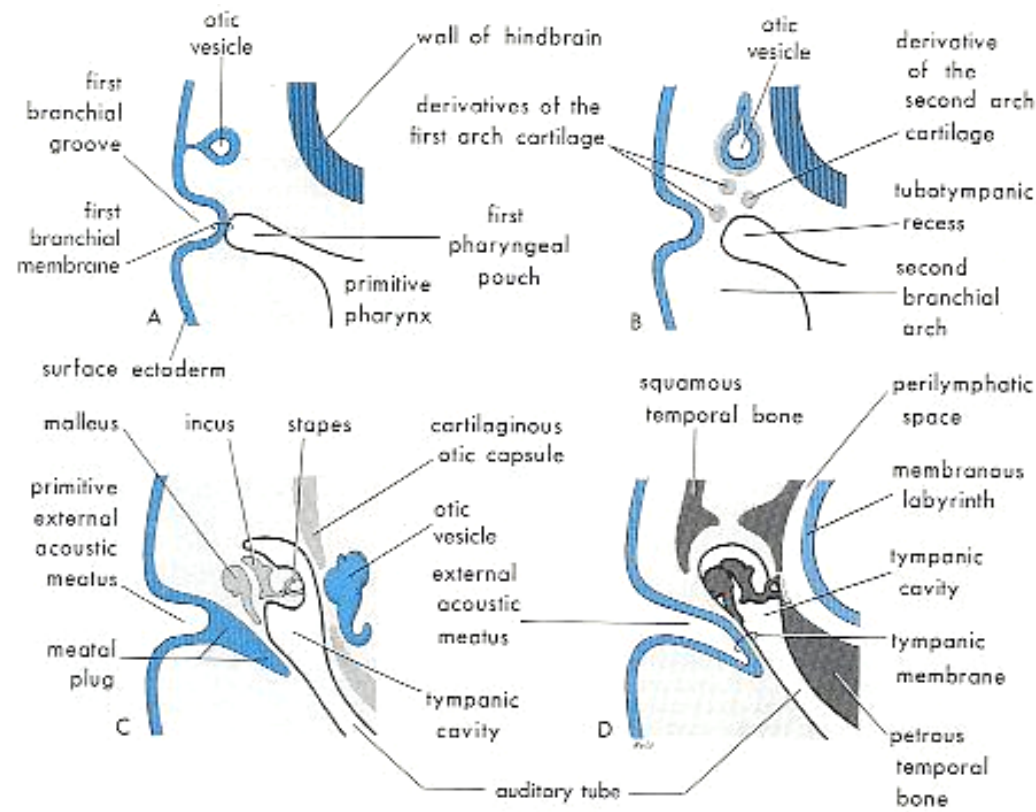
Inner Ear



1st Pharyngeal Pouch

- Elongates into the tubotympanic recess
- The tubotympanic recess becomes the tympanic cavity and mastoid antrum
- Distally contacts the 1st pharyngeal cleft → TM
- Proximally connects the pharynx → eustachian tube

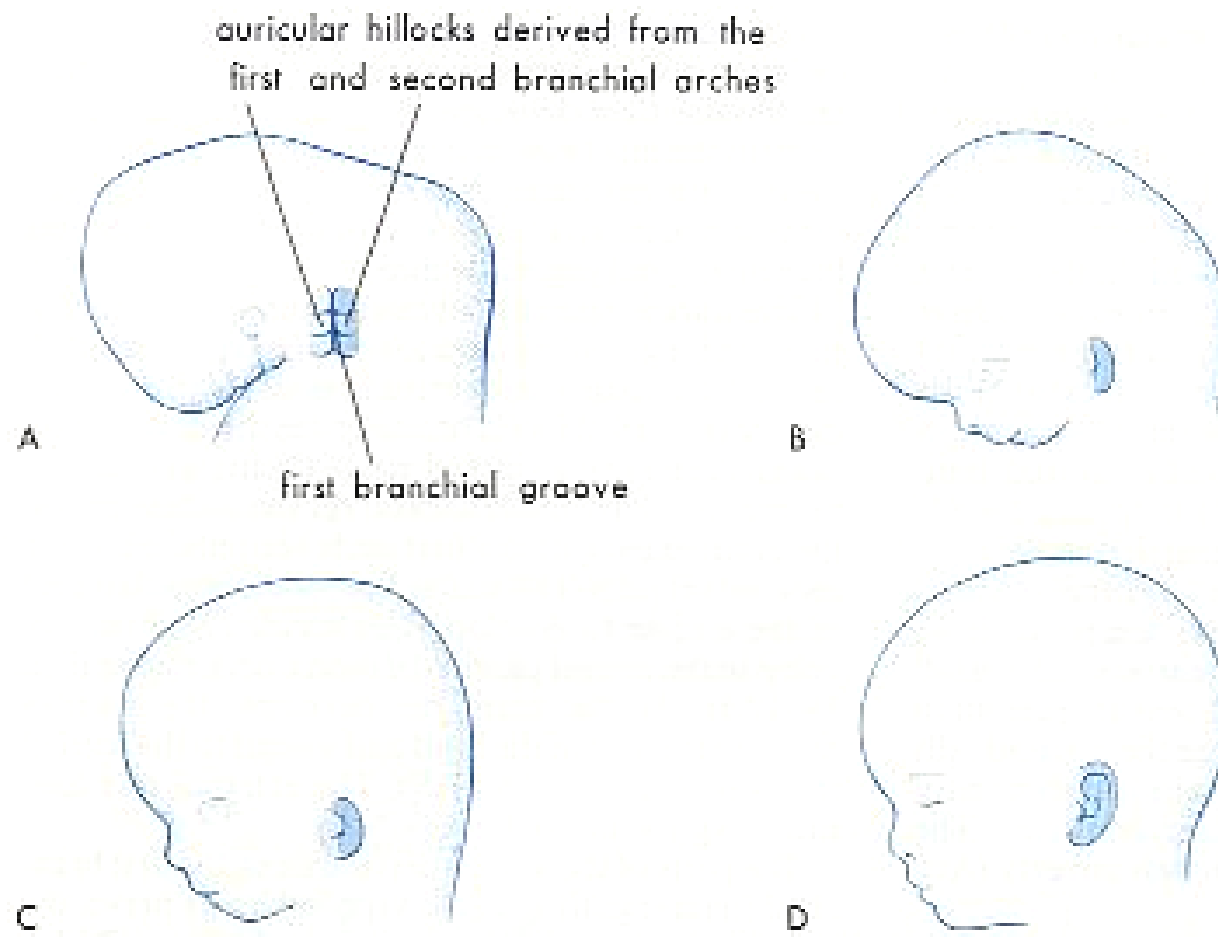
Middle Ear



External Ear

- 6 auricular hillocks
- The pinna
 - Initially develops in the neck.
 - Mandible grows → level of the eyes.
- Part of the auricle originating from
 - 1st branchial arch (innervated by CN V)
 - 2nd branchial arch (innervated by CN VII)

External Ear



External Ear

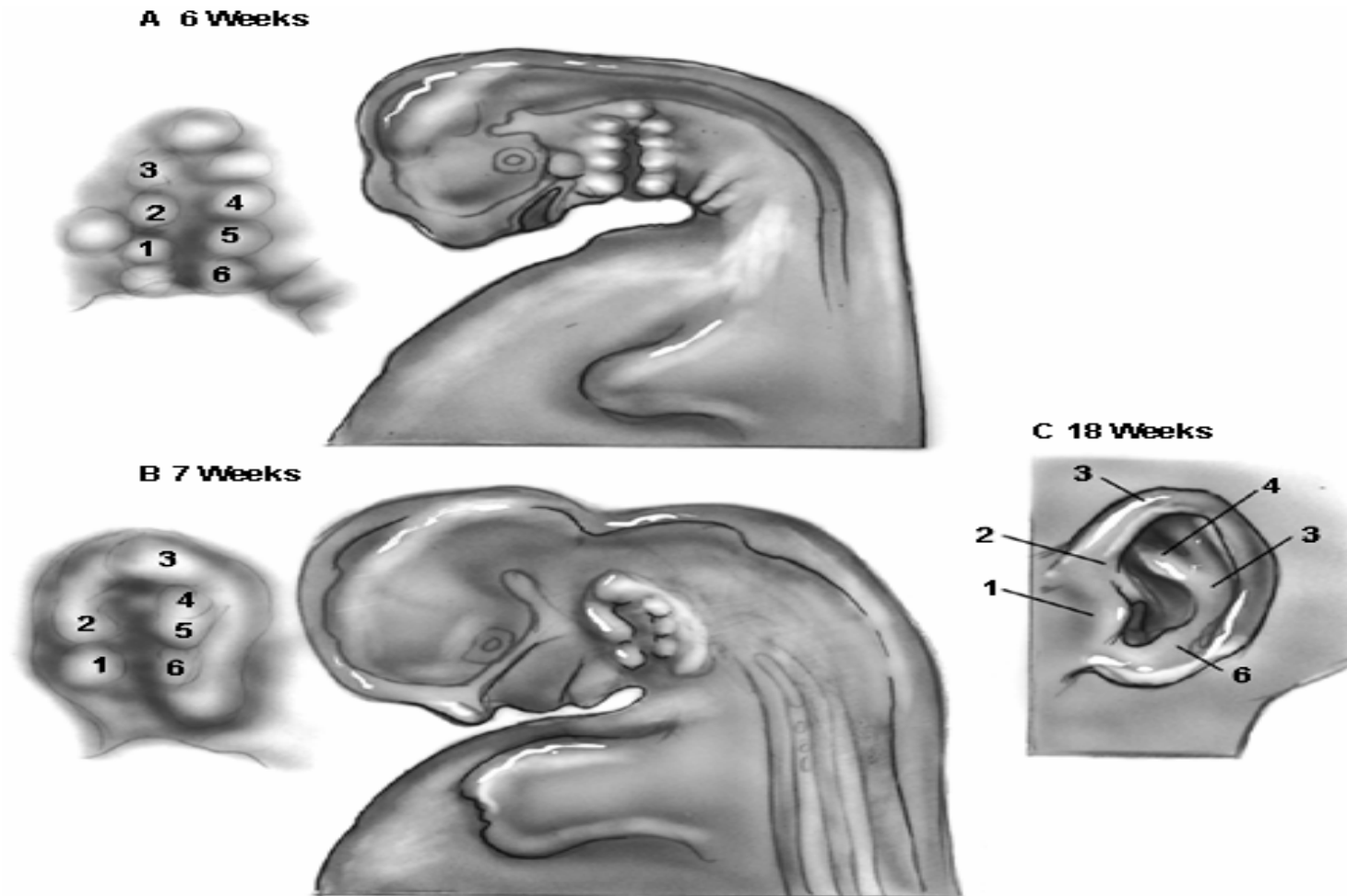


FIG. 5-1. Development of the auricle. A: Six hillocks form on the first and second branchial arches; all are identifiable at 6 weeks. B: Seven-week stage. C: By 18 weeks, the adult form is recognizable.

Ear

- Embryology
- **Congenital anomalies**
- Anatomy
- Physiology
- Disease of external ear
- Acute Otitis media

Congenital anomalies

- **Outer ear**
 - Microtia
 - Bat Ear
- **Middle ear**
 - eustachian tube dysfunction
 - Otosclerosis
- **Inner ear**
 - Aplasia (Michel Aplasia)
 - Partial Aplasia (Mondini Aplasia)

Microtia



Grade I



Grade II

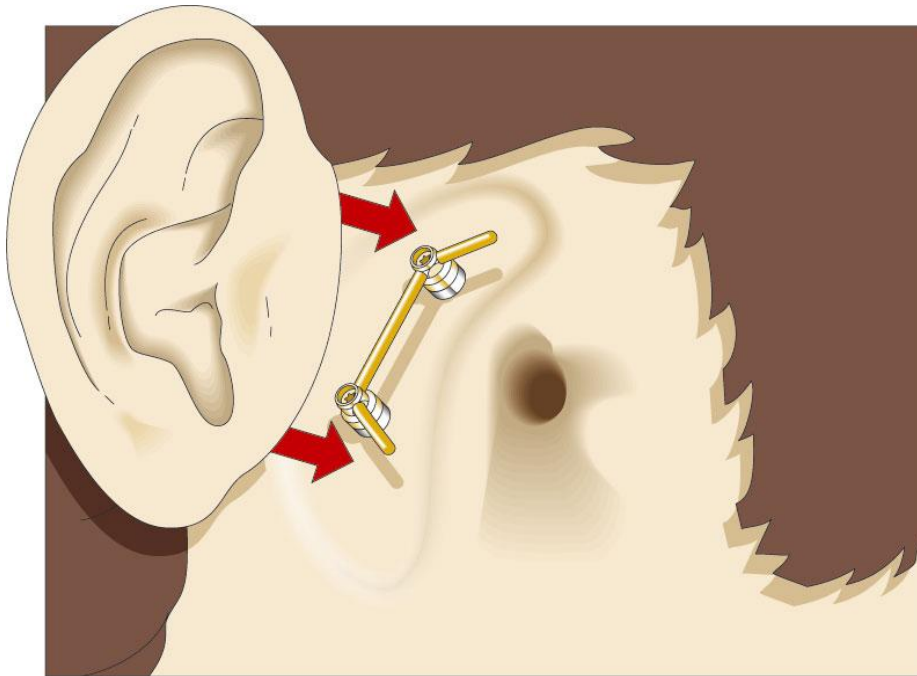


Grade III



Anotia

Microtia

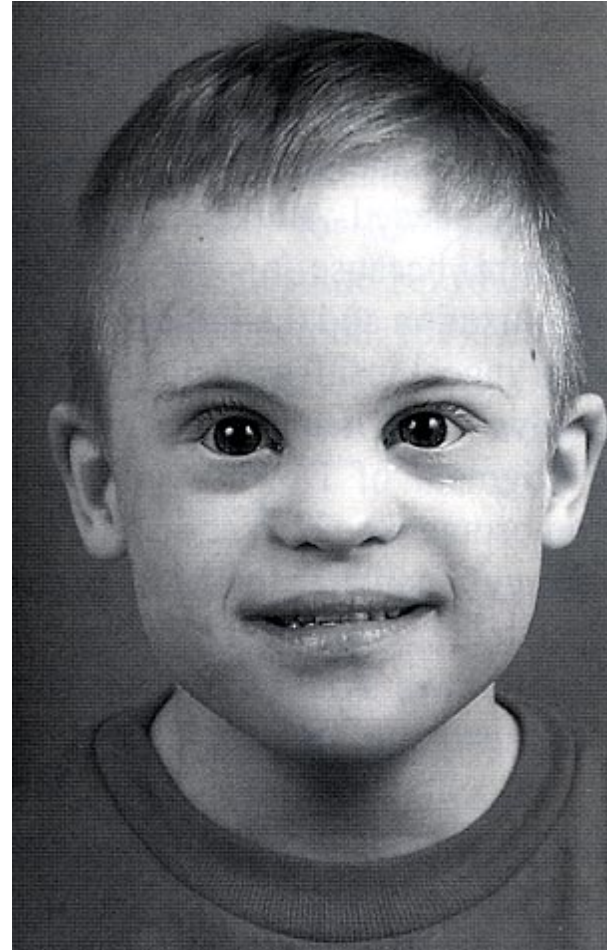


Bat ear



Down Syndrome

- **Trisomy 21**
- **1 in 700 births**
- **Maternal age >35**



Hearing Concerns

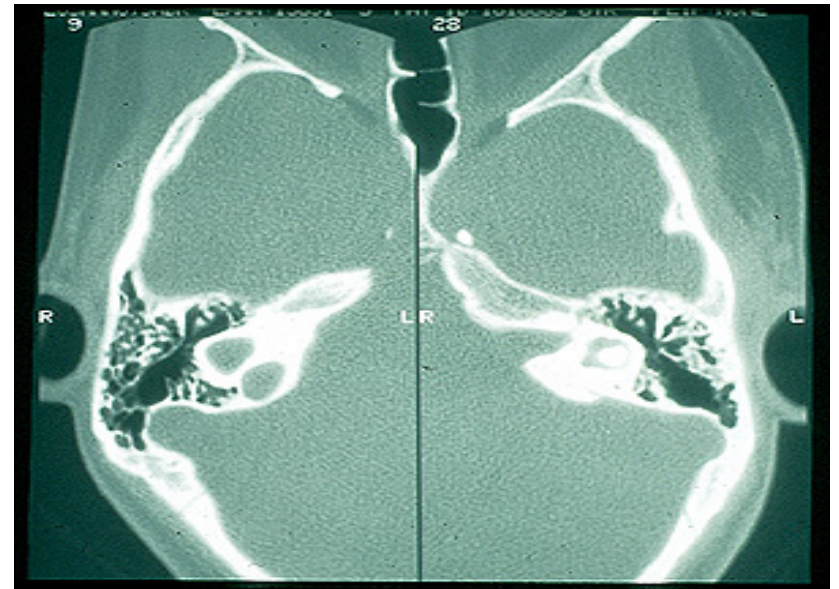
- Conductive hearing loss
 - more common
 - small pinna
 - stenotic EAC
 - eustachian tube dysfunction
 - ossicular fixation
- Sensorineural hearing loss
 - less common

Michel Aplasia

- 9 weeks gestation Cochlea fully formed
- Complete agenesis of IE
- Normal External and middle ear
- Affected ears are anacusic

Mondini Aplasia

- Only the basal coil can be identified
- Interscalar septum is absent
- enlarged endolymphatic duct

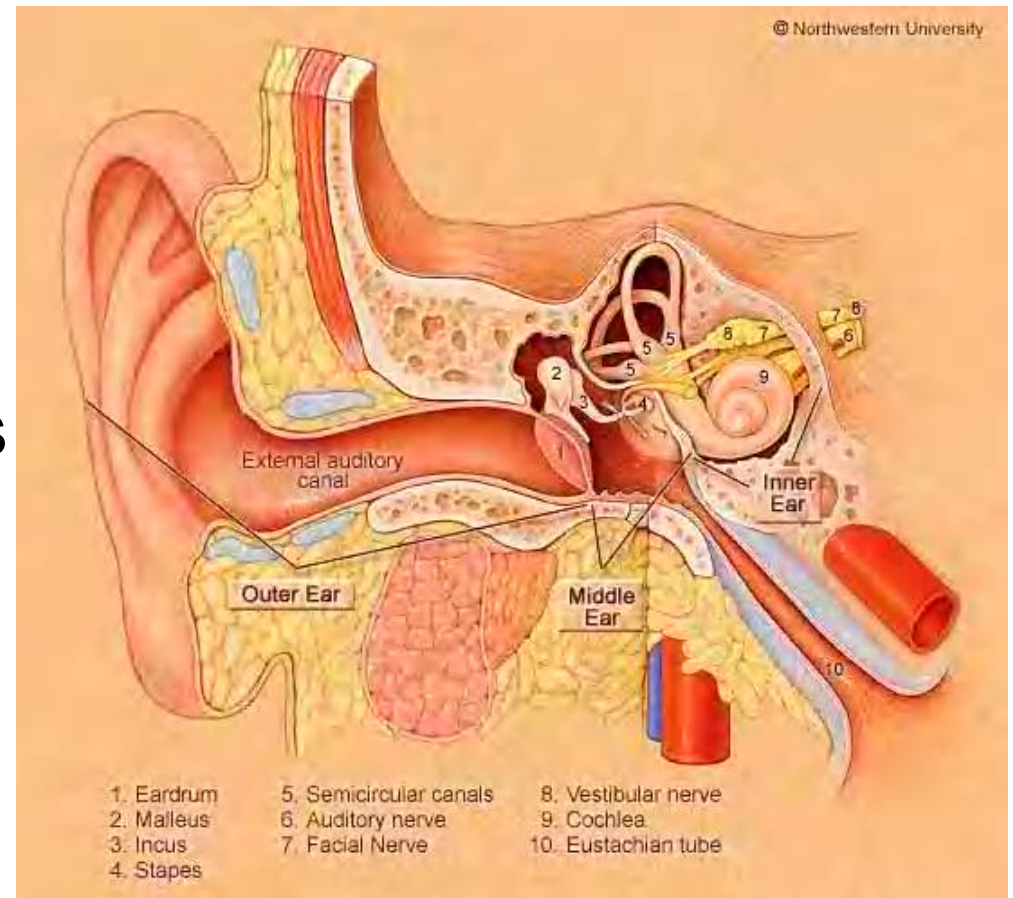


Ear

- Embryology
- Congenital anomalies
- **Anatomy**
- Physiology
- Disease of external ear
- Acute Otitis media

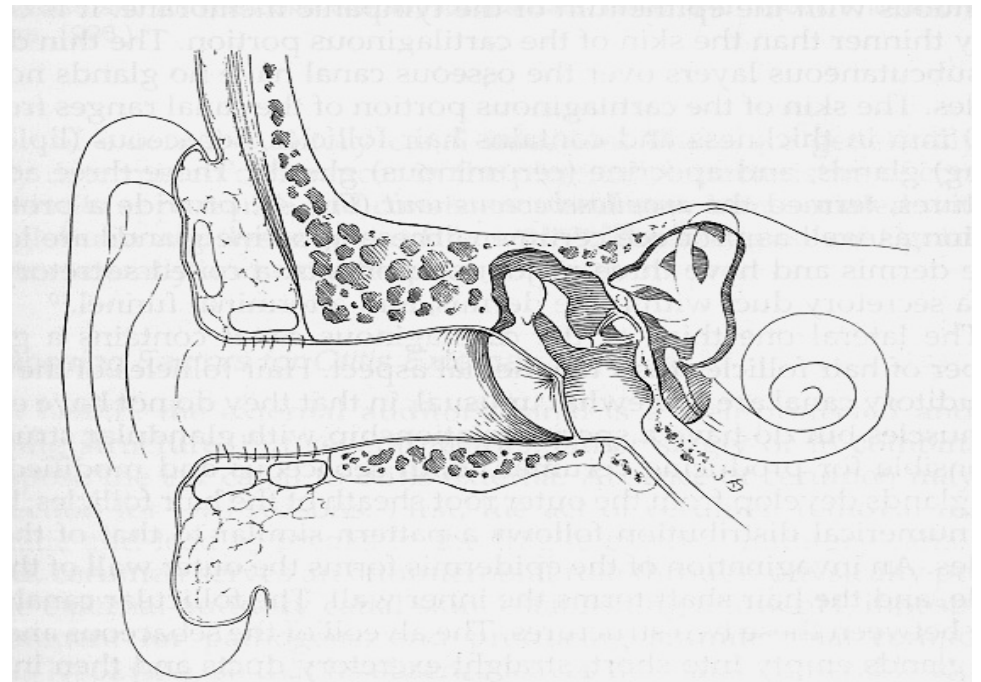
Anatomy

- Inner Ear
 - Cochlea
 - Sacule
 - Utricle
 - Semicircular canals
- Middle Ear
 - 3 ossicles
 - Mastoid
 - Eustachian Tube



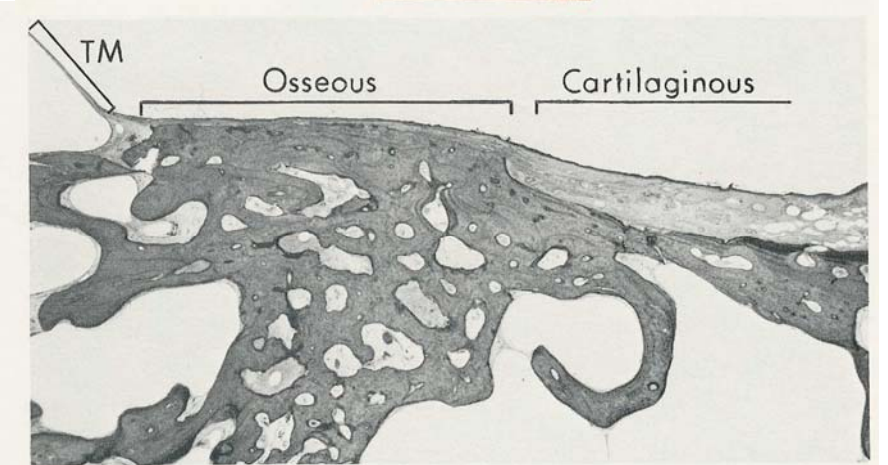
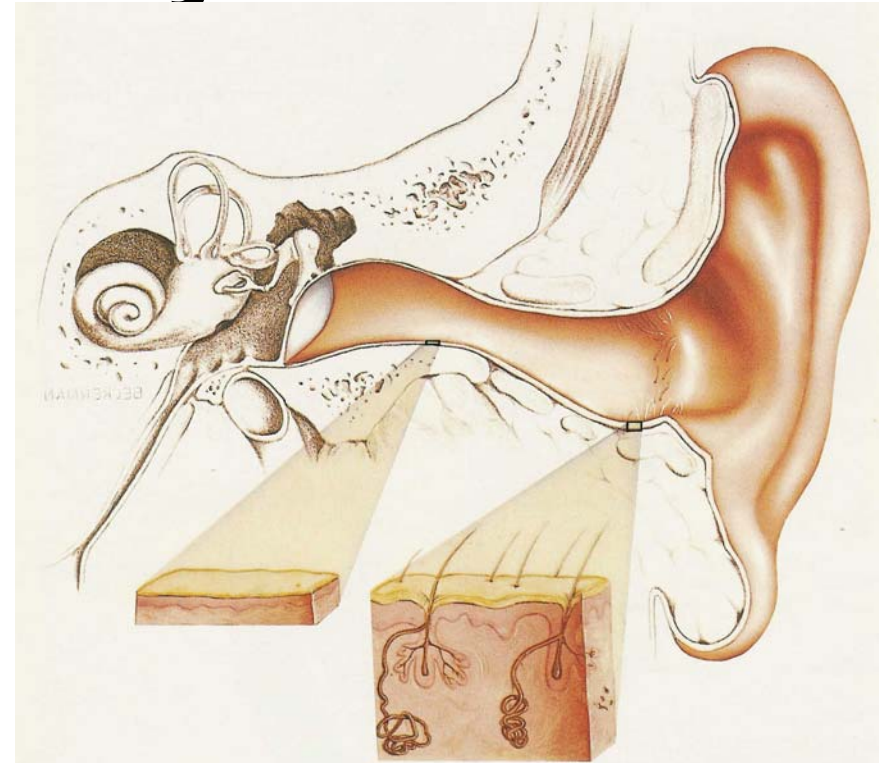
Anatomy

- Auricle is mostly skin-lined cartilage
- External auditory meatus
 - 2.5 cm long
 - Cartilage: ~40%
 - Bony: ~60%
 - S-shaped
 - Narrowest portion at bony-cartilage junction



External Auditory Canal

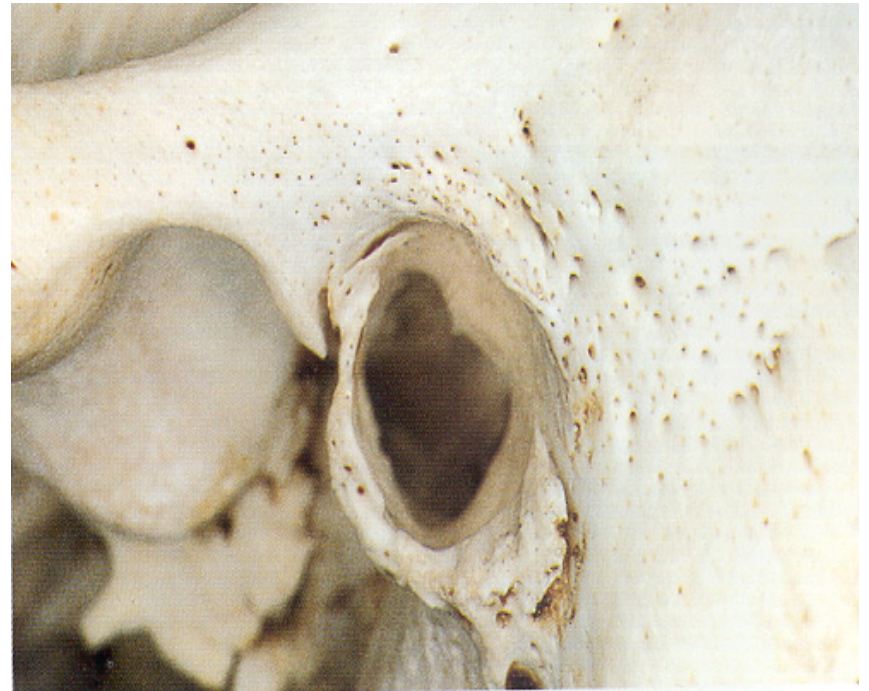
- Skin
 - Cartilage
 - 1.0 mm
 - Epidermis with papillae
 - Dermis
 - Sub-Q
 - Bone
 - 0.2 mm
 - No papillae, no sub q



Anatomy

EAC is related to various contiguous structures

- Tympanic membrane
- Mastoid
- Glenoid fossa
- Cranial fossa
- Infratemporal fossa



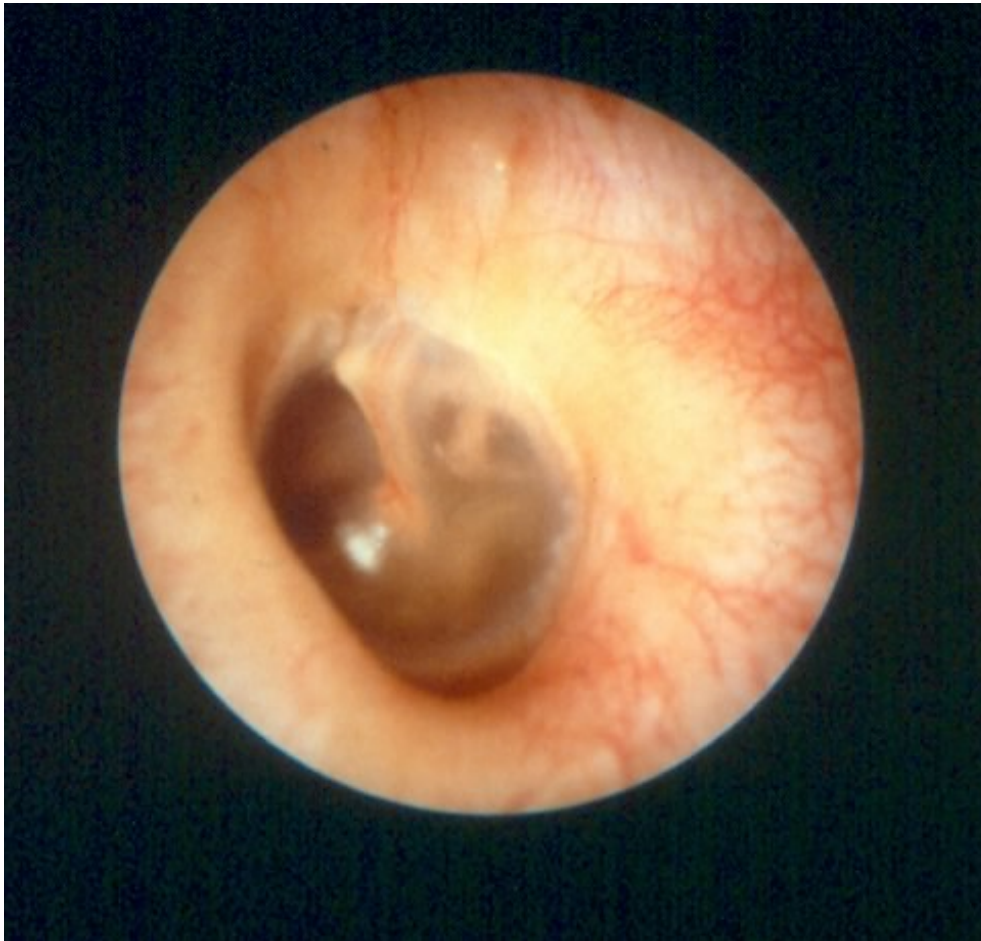
Anatomy

Innervation:

- Cranial nerves
 - V (Itching AR)
 - VII (*Acoustic neuroma* sign)
 - IX (Cough)
 - X (Vaso-Vagal)
- Greater auricular nerve (Post-Parotidectomy)

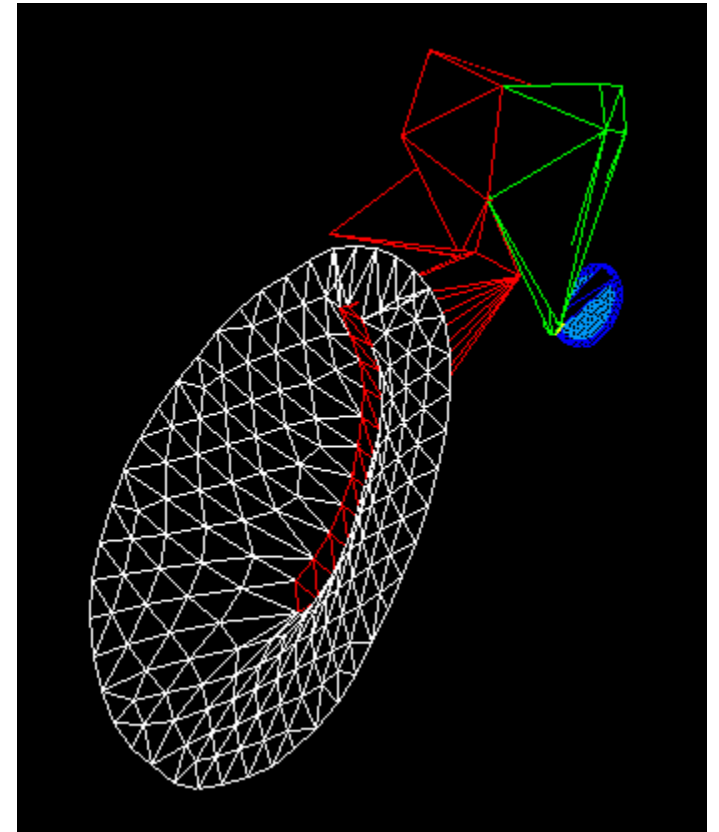
Anatomy

- Arterial supply
 - Superficial temporal
 - Posterior auricular
- Venous drainage
 - Superficial temporal
 - Posterior auricular veins
- Lymphatics
 - External ear :Parotid, deep cervical
 - Middle ear : Retropharyngeal



Ear

- Embryology
- Congenital anomalies
- Anatomy
- **Physiology**
- Disease of external ear
- Acute Otitis media



ورد في القرآن الكريم

لفظي السمع و البصر معاً (19) مرة

ذكر في (17) سبعة عشر لفظة السمع قبل البصر منها

– قوله تعالى: (و هو الذي أنشأ لكم السمع والأبصار و الأفئدة)المؤمنون : 78

– قوله (إن السمع و البصر و الفؤاد كل أولئك كان عنه مسؤولاً) الإسراء : 36 .

ما عدا ايتين اثنتين فقط هما

– قال تعالى : ام لهم اعين يبصرون بها ام لهم آذان يسمعون بها

– قال تعالى : ابصر به واسمع في سورة.... الكهف

فما السر؟؟

Hearing: Mechanics

- 1 Sound waves strike the tympanic membrane and become vibrations.
- 2 The sound wave energy is transferred to the three bones of the middle ear, which vibrate.
- 3 The stapes is attached to the membrane of the oval window. Vibrations of the oval window create fluid waves within the cochlea.
- 4 The fluid waves push on the flexible membranes of the cochlear duct.
- 5 Energy from the waves transfers across the cochlear duct into the tympanic duct and is dissipated back into the middle ear at the round window.
- 6 Hair cells within the cochlear duct create action potentials in the sensory neurons of the cochlear nerve.

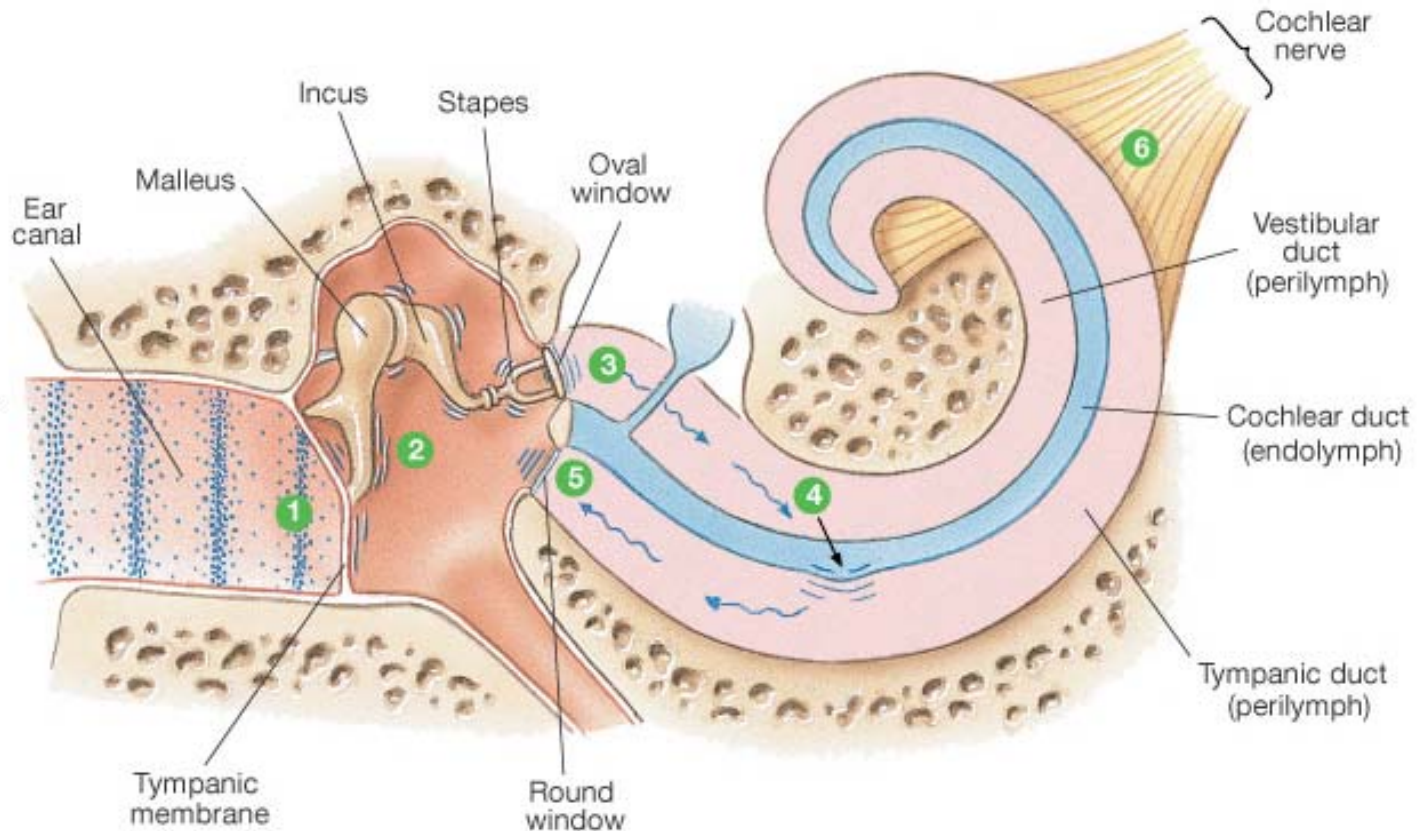


Figure 10-19: Sound transmission through the ear

A Little Vestibular Physiology.....

Why have a VOR?

1. Stabilize retina in space – fast!



On head
movement

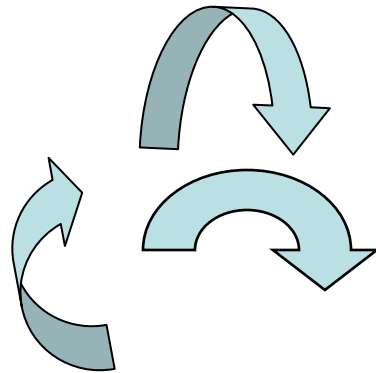


2. Posture Control

Do finger test

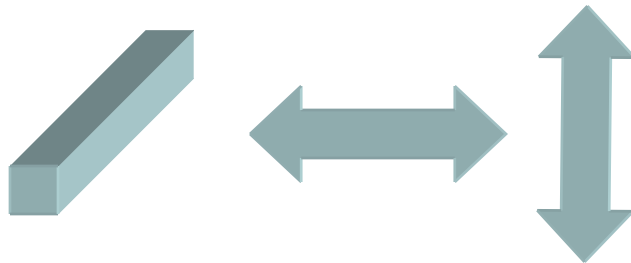
Types of Spatial Movement

- Rotational – 3 degrees of freedom



Semicircular Canals

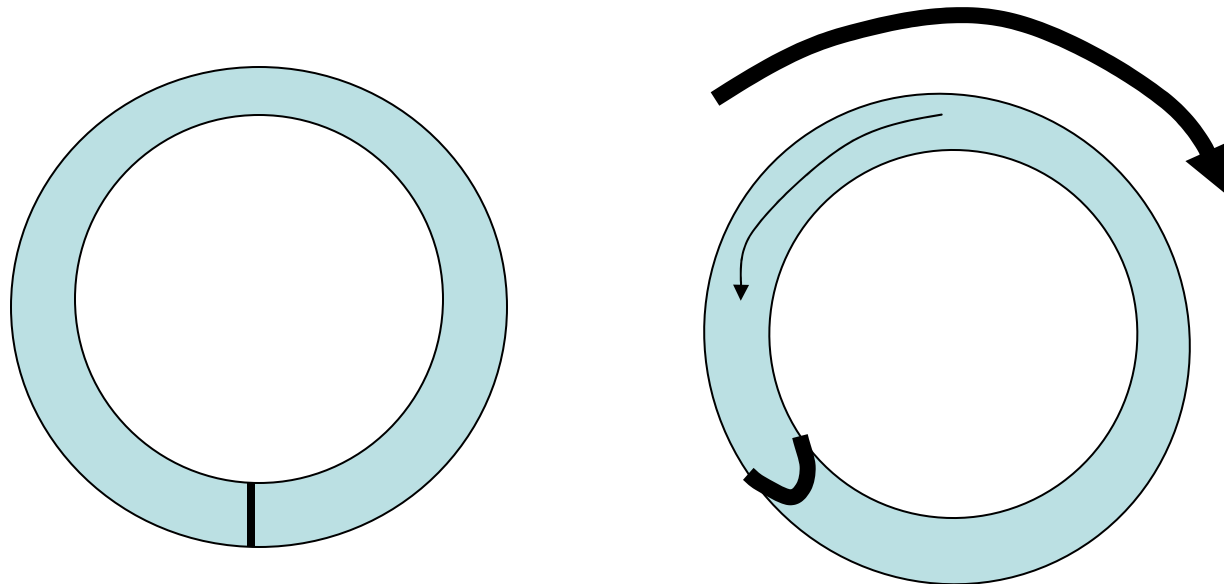
- Translational – 3 degrees of freedom



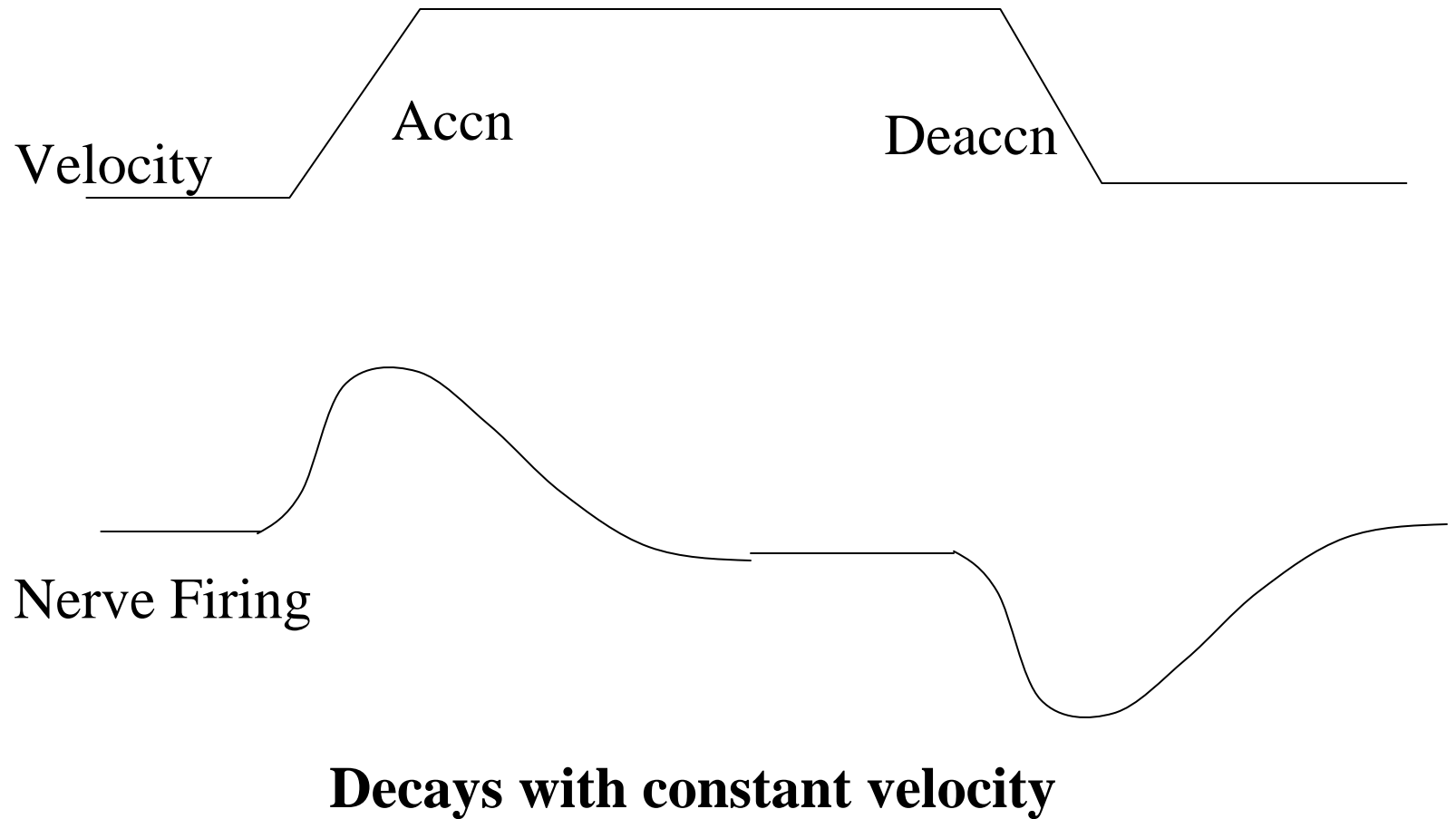
Otolith Organs

Basic Mechanism of Detection of Rotation

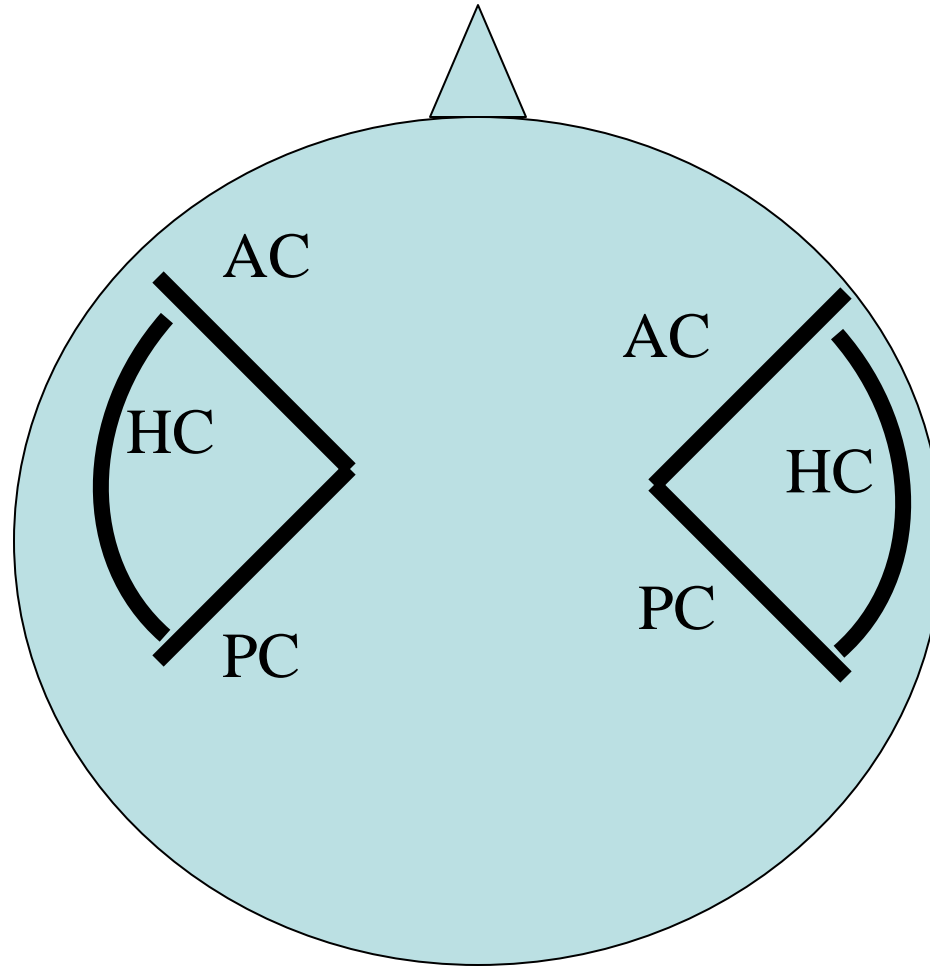
- INERTIA
- Detects head acceleration – but encodes head velocity (i.e. integrator)



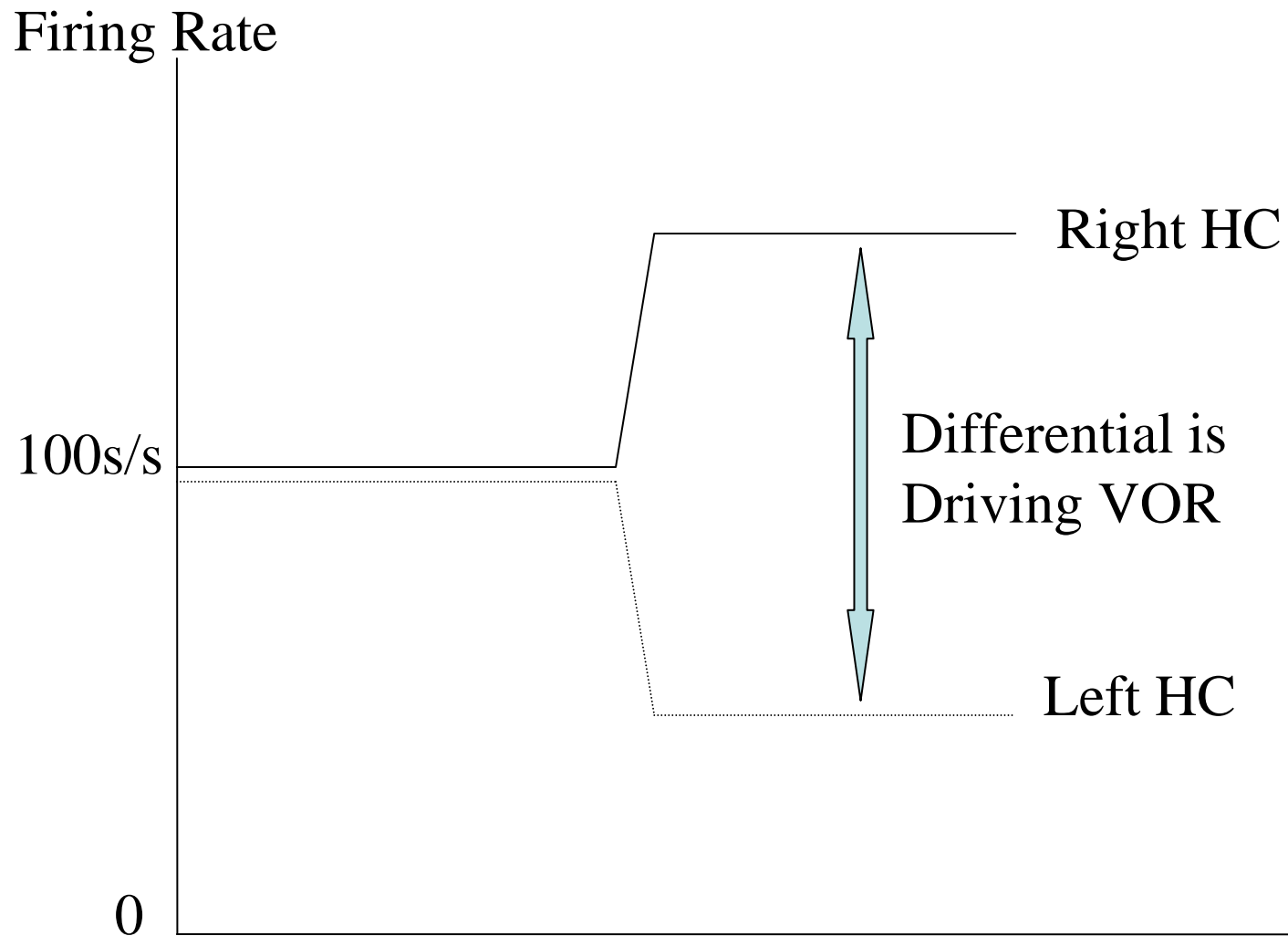
Velocity Profile vs Signal



Canals are Paired



Push-Pull System



Ear

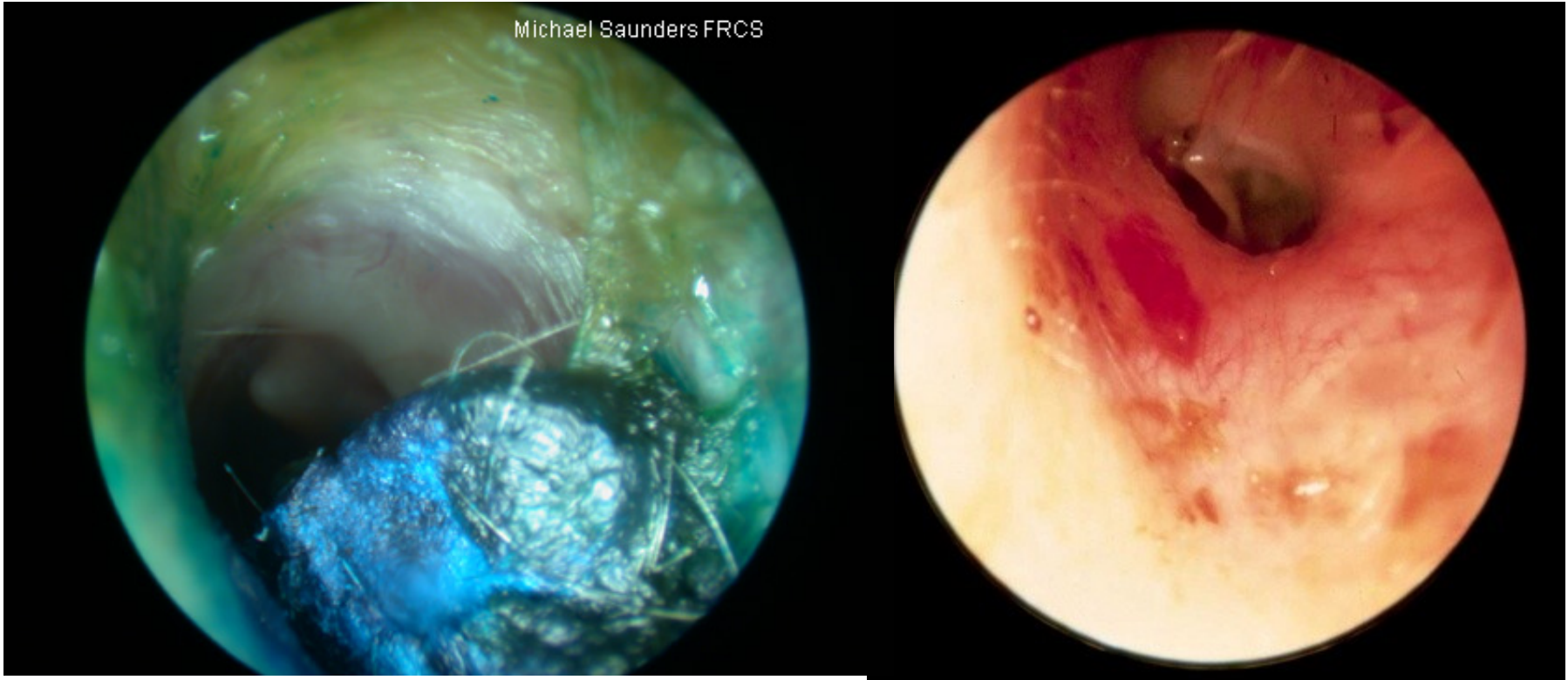
- Embryology
- Congenital anomalies
- Anatomy
- Physiology
- **Disease of external ear**
- Acute Otitis media

Disease of external ear

- Wax
- Tumor
 - Exostosis
 - Osteoma
- Foreign body
- Infection
- Trauma

Wax

Michael Saunders FRCS





Tumor

- Benign
 - Exostosis
 - Osteoma
- Malignant
 - Rare
 - Metastasis



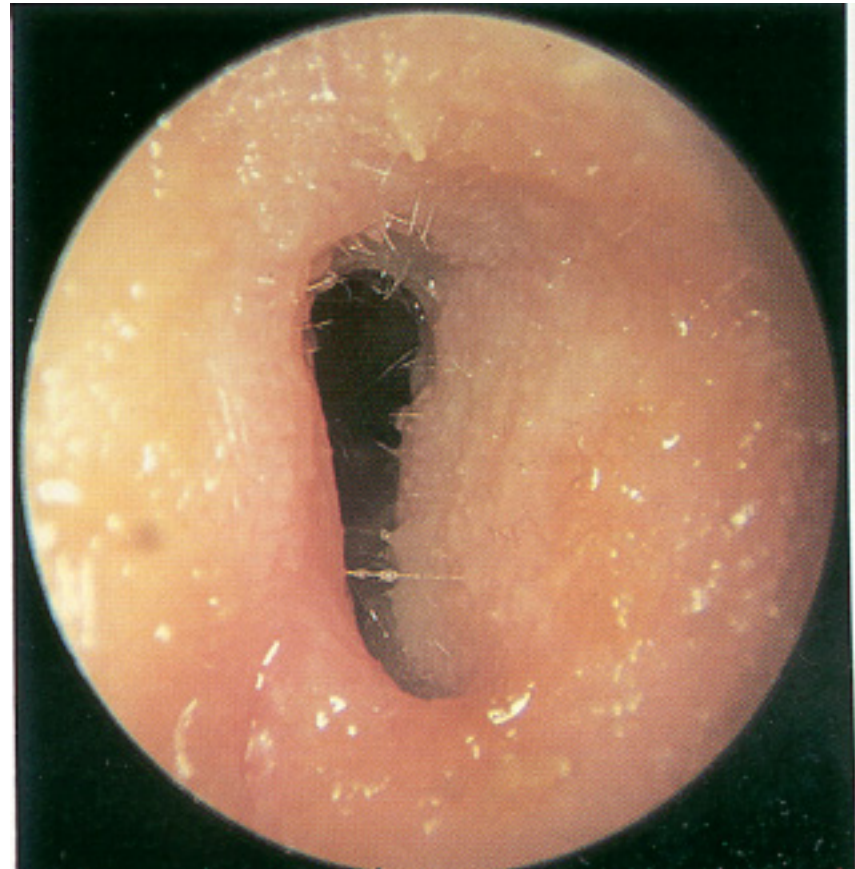
Otitis Externa

Clinical Course

- Itching
- Progresses to:
 - Pain
 - Decreased hearing
 - Drainage (usually from bacterial infection)

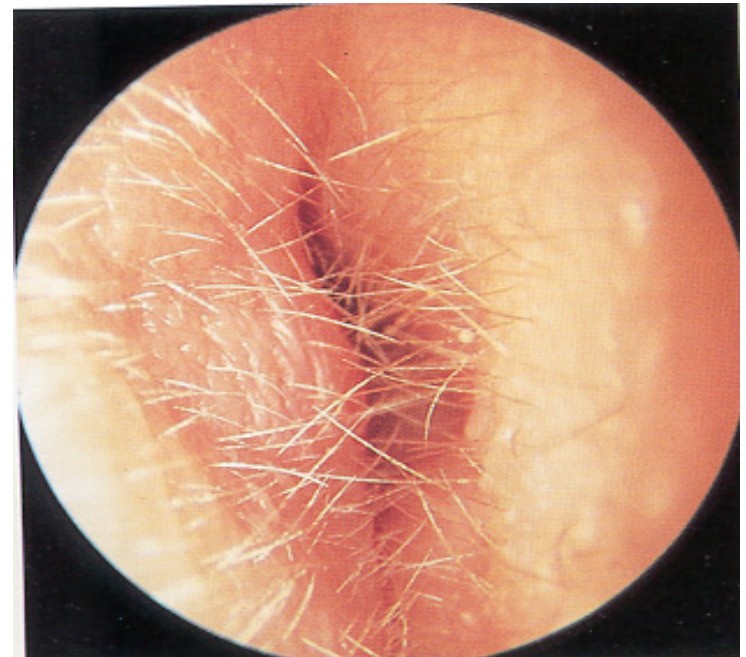
AOE: Mild to Moderate Stage

- Symptoms
 - Pain
 - Increased pruritus
- Signs
 - Erythema
 - Increasing edema
 - Canal debris, discharge



AOE: Severe Stage

- **Severe pain, worse with**
 - Ear movement
 - Chewing
- **Signs**
 - Lumen obliteration
 - Purulent otorrhea
 - Involvement of periauricular soft tissue

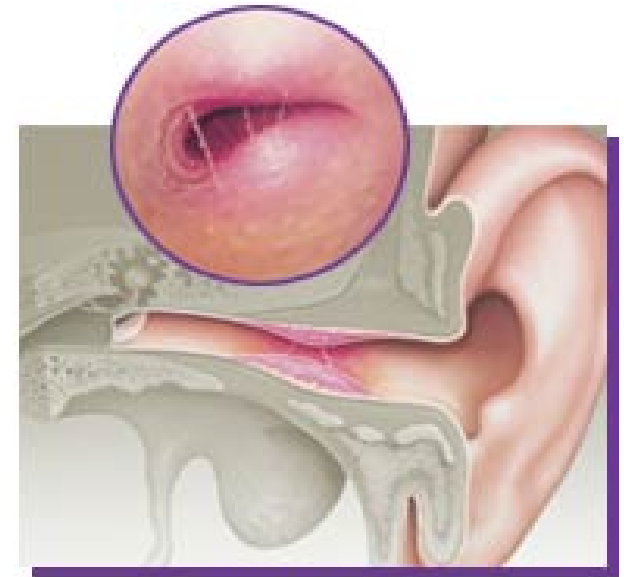


Microbiology

- Bacteria 50% of cases
 - Staph aureus
 - Pseudomonas
 - Proteus
- Fungi
 - Aspergillus – tropical
 - Candida albicans – temperate

Epidemiology

- Warm, humid climate
 - “swimmer’s ear”
- Poor hygiene
- Closed canal
 - Hearing aid
 - Turbans in India
- Composition of cerumen
 - pH changes from acid to alkaline (D.M)
 - Softer – washed out
 - Hard block the canal
- Instrumentation of ear canal



Swimmer's Ear (AOE)

Diagnosis

- Persistent disease
 - Resistant
 - Fungal
 - Dermatological etiologies
- Cultures will be helpful

Treatment

- meticulous cleaning
 - every 2-3 days
 - weekly
- Topical antibiotic
- Water precautions

Furunculosis

- Acute localized infection
- Lateral 1/3 of posterosuperior canal
- Obstructed apopilosebaceous unit
- Pathogen: *S. aureus*

Furunculosis: Symptoms

- Localized pain
- Pruritus
- Hearing loss (if lesion occludes canal)

Furunculosis: Signs

- Edema
- Erythema
- Tenderness
- Occasional fluctuance



Furunculosis: Treatment

- Local heat
- Analgesics
- Oral anti-staphylococcal antibiotics
- Incision and drainage reserved for localized abscess
- IV antibiotics for soft tissue extension

Otomycosis

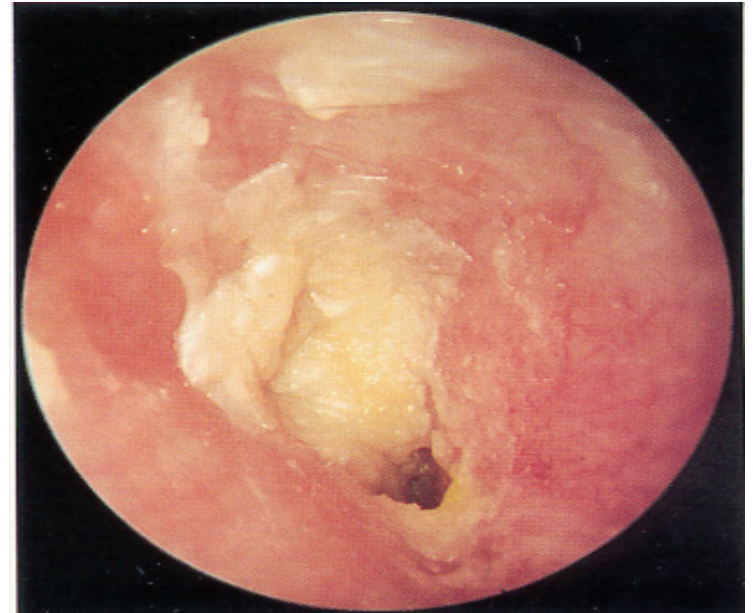
- Fungal infection of EAC skin
- Primary or secondary (AB)
- Most common organisms: *Aspergillus* and *Candida*

Otomycosis: Symptoms

- Often indistinguishable from bacterial OE
- Pruritus deep within the ear
- Dull pain
- Hearing loss (obstructive)
- Tinnitus

Physical Exam

- Early
 - Normal
 - Canal erythema
 - Mild edema
- Later
 - “wet newspaper”
 - red, tender skin
 - Fungal hyphae



Otomycosis

Fungal hyphae



Otomycosis: Treatment

- Thorough cleaning
- Drying of canal
- Topical antifungals

Bullous Myringitis

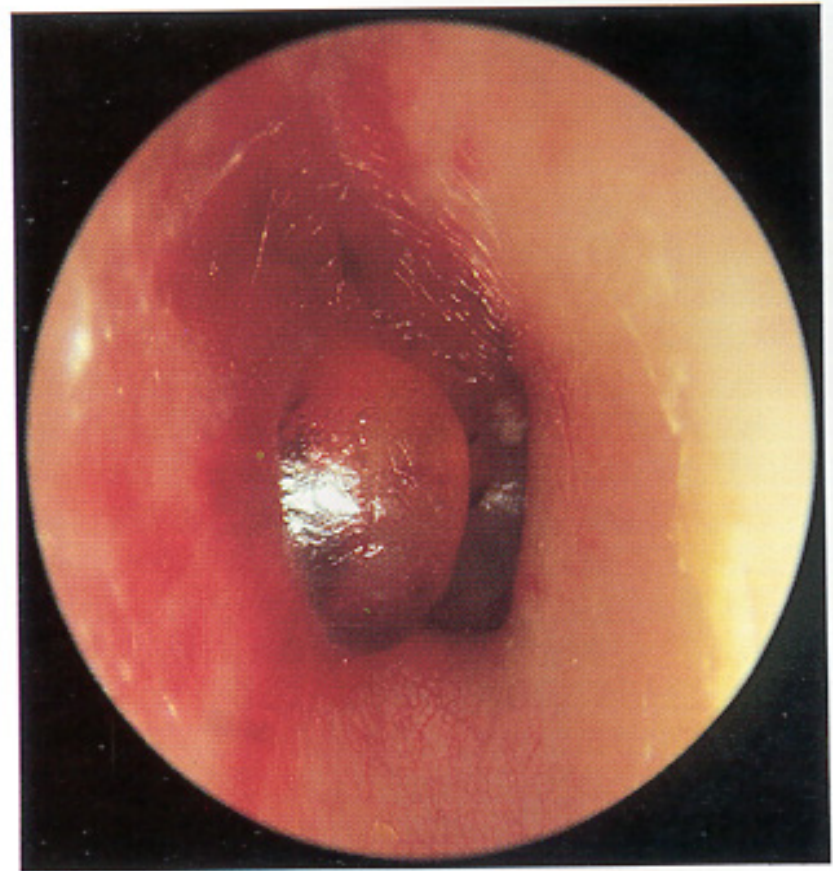
- Viral infection
- Bacteria of OM
- Confined to tympanic membrane
- Children

Bullous Myringitis: Symptoms

- Sudden onset of severe pain
- No fever
- No hearing impairment
- Bloody otorrhea (significant) if rupture

Bullous Myringitis: Signs

- Inflammation limited to TM & nearby canal
- Multiple reddened, inflamed blebs
- Hemorrhagic vesicles



Bullous Myringitis: Treatment

- Self-limiting
- Analgesics
- Topical antibiotics to prevent secondary infection
- Incision of blebs is unnecessary

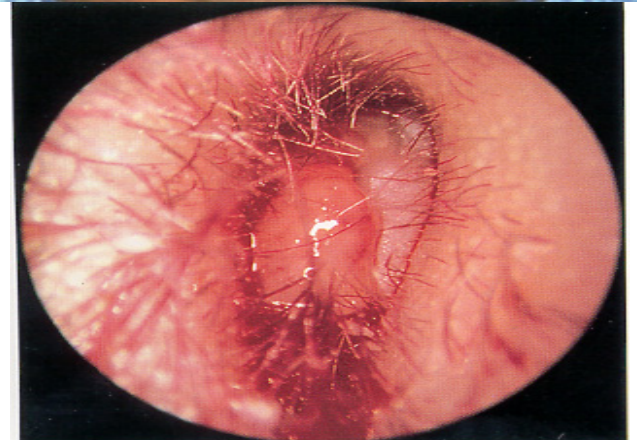
Necrotizing External Otitis(NEO)

- Potentially lethal infection
- DM and immunocompromised patients
- *Pseudomonas aeruginosa*

Malignant Otitis Externa

4 Ds

- **D**iabetes mellitus
 - **D**ischarge (Purulent)
 - **D**iscomfort
 - **D**ysfunction Cranial nerve
-
- Granulation obscured TM



NEO: Imaging

- Plain films
- Computerized tomography – most used
- Technetium-99 – reveals osteomyelitis
- Gallium scan – useful for evaluating Rx
- Magnetic Resonance Imaging

NEO: Treatment

- Antibiotics
 - Intravenous
 - At least 4 weeks
- Local canal debridement
- DM control
- Pain control
- Hyperbaric oxygen experimental
- Serial gallium scans monthly

NEO: Mortality

- 25 % Death rate
- 60% with multiple cranial neuropathies
- 25 % Recurrence
- May recur up to 12 months after treatment

Perichondritis: Signs

- Tender auricle
- Induration
- Edema
- Advanced cases
 - Crusting
 - Involvement of soft tissues



Herpes Zoster Oticus

- J. Ramsay Hunt
- Varicella zoster
- Shingles: Infection along one or more cranial nerve dermatomes
- Ramsey Hunt syndrome:
 - Herpes zoster of the pinna
 - Otalgia
 - Facial paralysis

Herpes Zoster Oticus: Symptoms

- Early: burning pain in one ear, headache, malaise and fever
- Late (3 to 7 days): vesicles, facial paralysis



Herpes Zoster Oticus: Treatment

- Corneal protection
- Oral steroid taper (10 to 14 days)
- Antivirals

Erysipelas

- Acute superficial cellulitis
- Group A, beta hemolytic streptococci
- Skin: bright red; well-demarcated,
- Rapid treatment with oral or IV antibiotics if insufficient response



Ear Trauma

Auricle injuries

- Hematomas
separate the perichondrium (blood supply) from the cartilage
→ excise fibrous tissue
- Apply pressure dressing , drain
- Avulsion:
 - Reimplantation
 - Microvascular anastomosis



PROCEEDING



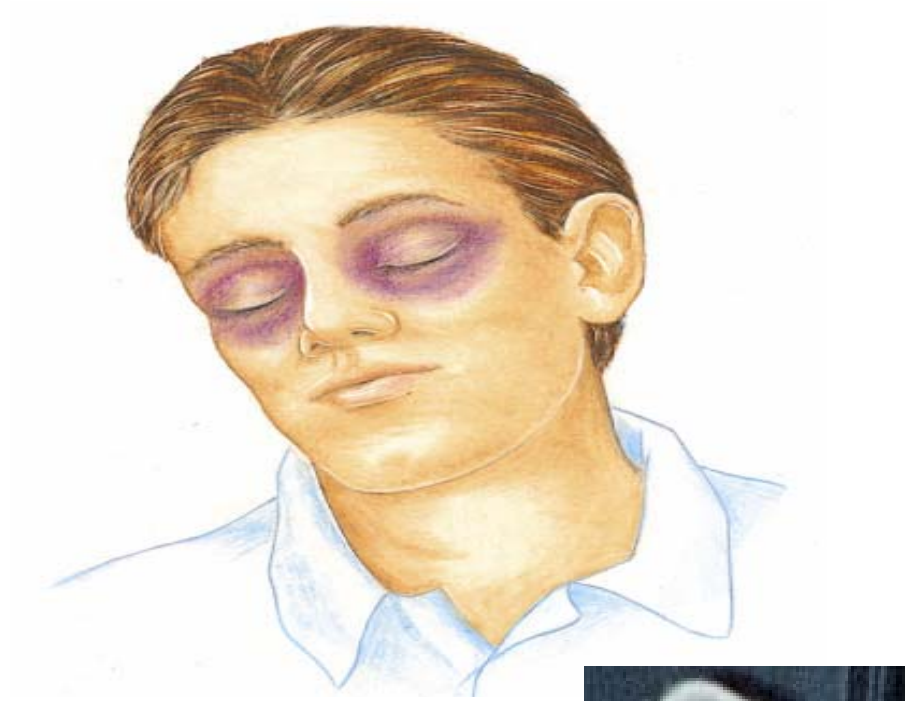
PROCEEDING



Cauliflower Ear



Raccoon eyes sign

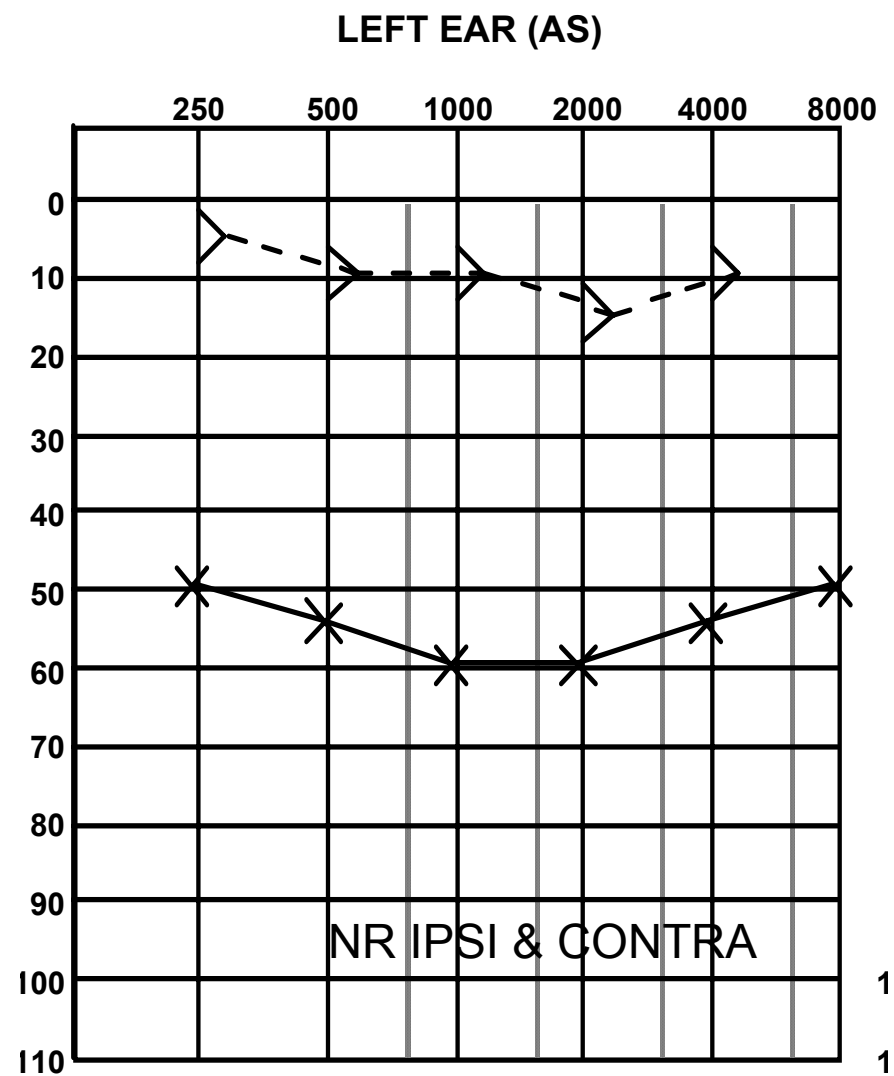


Battle's sign



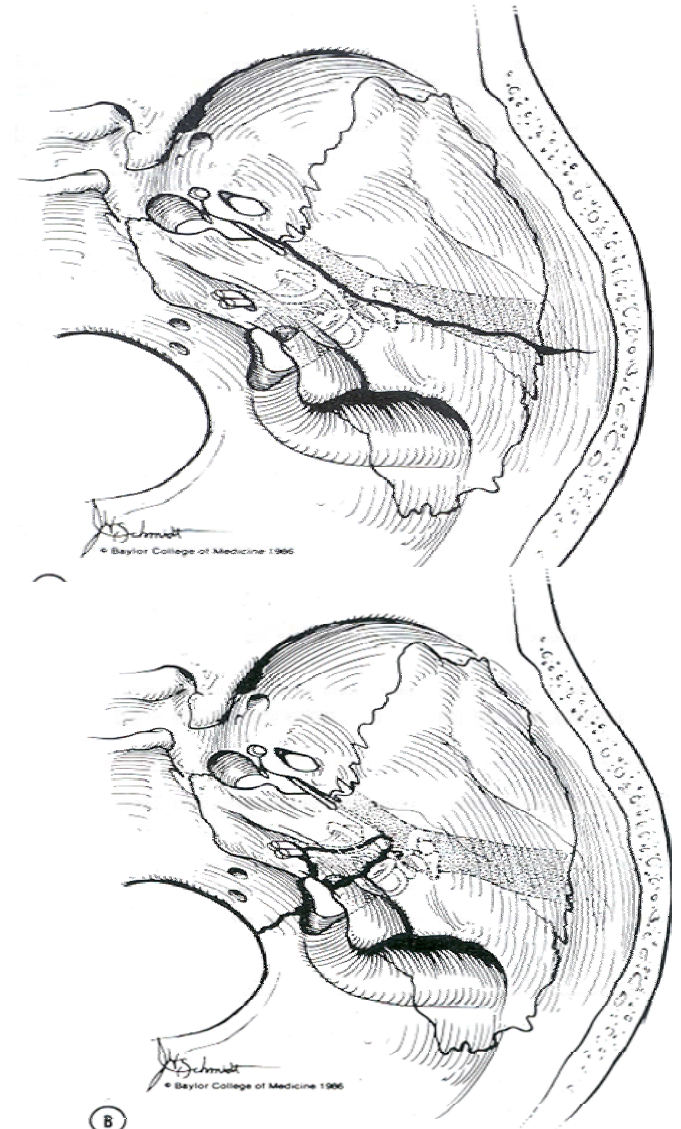


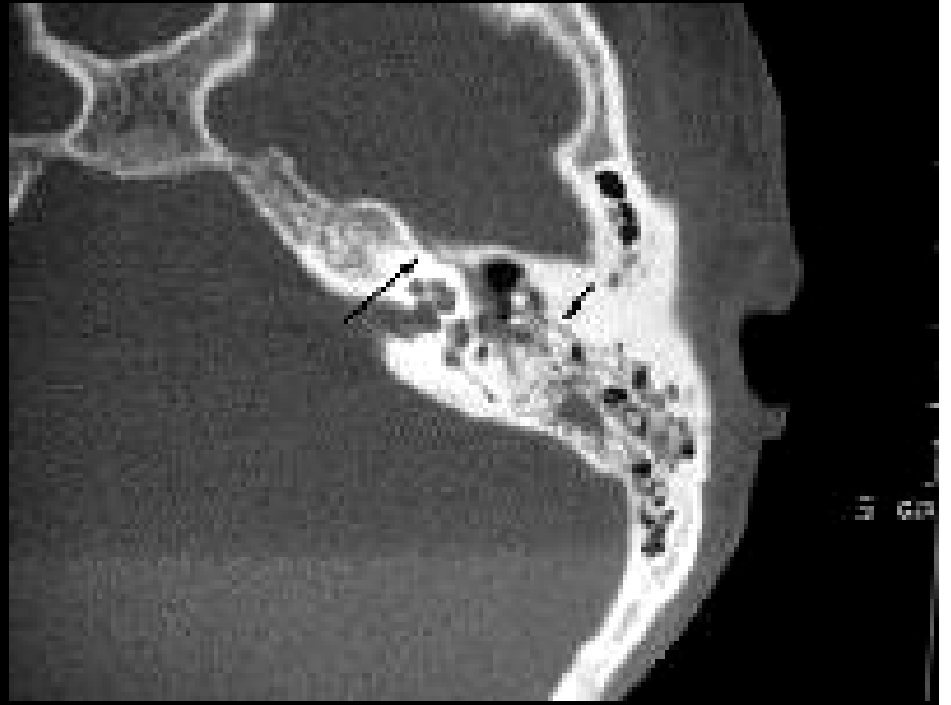
Case

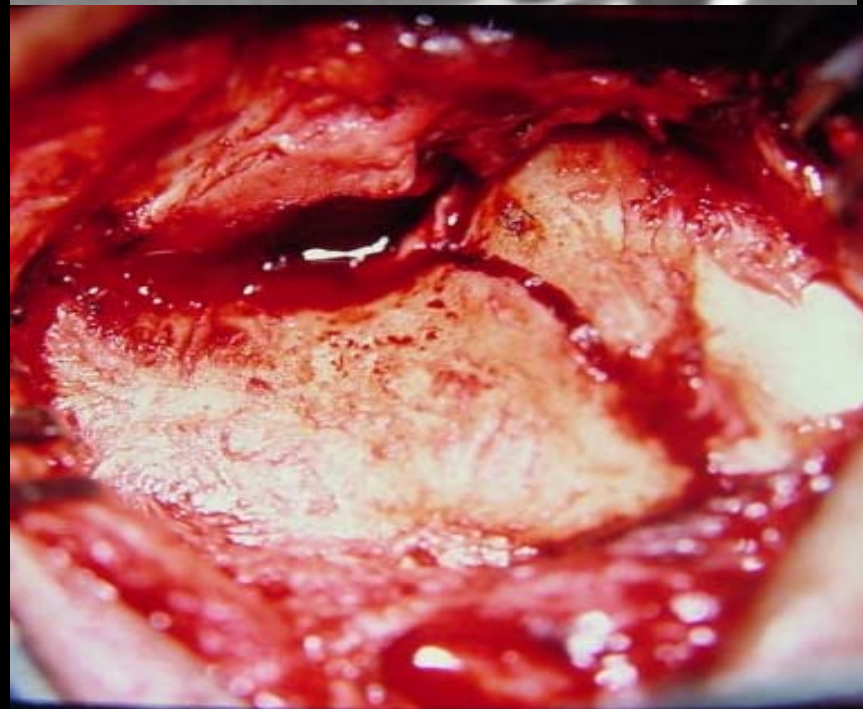
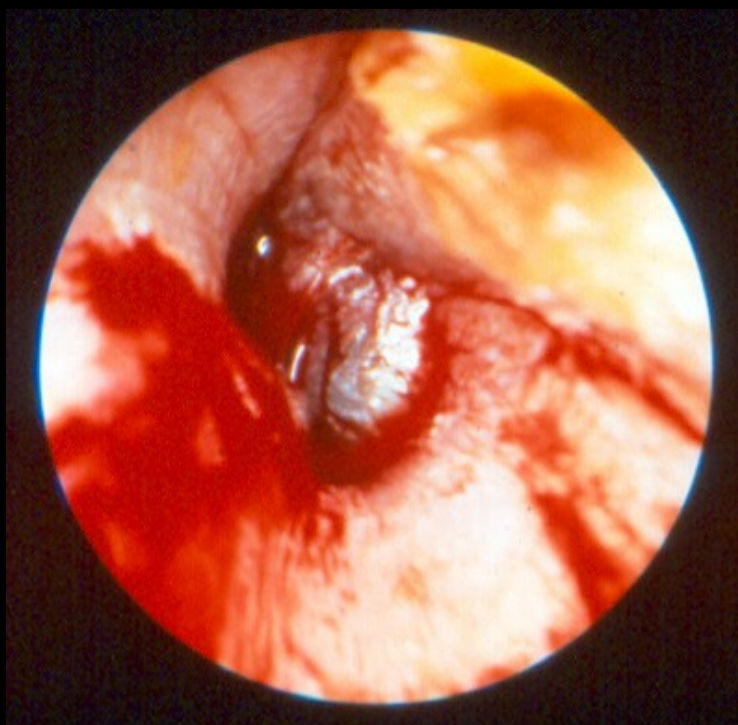
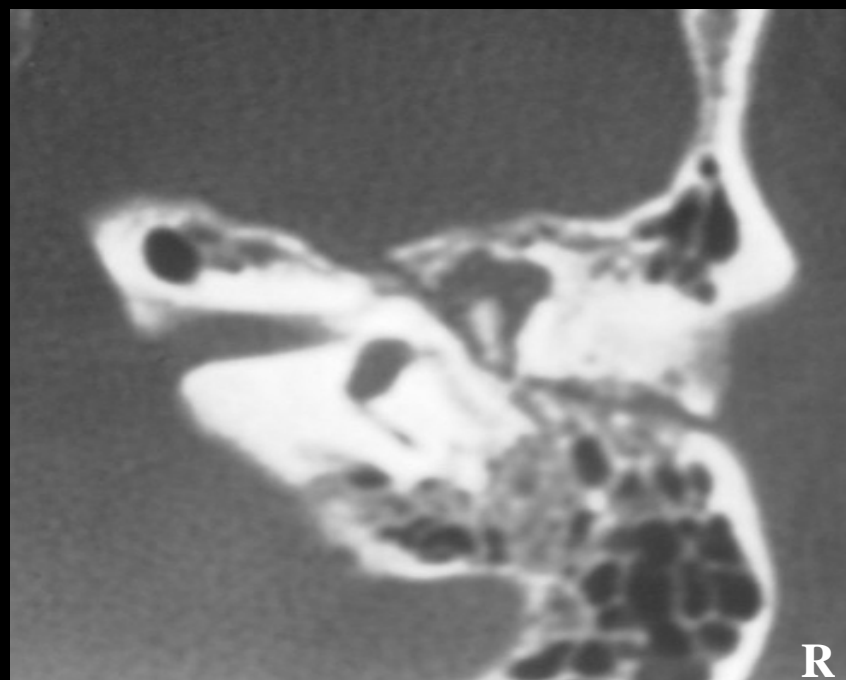


Fractures

- **Longitudinal**
 - 80% of Temporal Bone Fractures
 - 15-20% Facial Nerve involvement
- **Transverse**
 - 20% of Temporal Bone Fractures
 - 50% Facial Nerve Involvement







Ear

- Embryology
- Congenital anomalies
- Anatomy
- Physiology
- Disease of external ear
- **Acute Otitis media**

Otitis Media

Definition

Inflammation of the middle ear
May also involve inflammation of
mastoid, petrous apex, and
perilabyrinthine air cells

Otitis Media

- Most common reason for visit to pediatrician
- Tympanostomy tube placement is 2nd most common surgical procedure in children
- Development of multidrug-resistant bacteria

Otitis Media - Classification

- Acute OM < 3 wk
- Subacute OM 3 wks to 3 months
- Chronic OM > 3 mos

OM - Epidemiology

- Age
- Sex
- Day care
- Seasons
- Genetics
- Breast-feeding
- Smoke exposure
- Medical conditions

OM - Medical Conditions

- Cleft palate
 - decreases after repair
- Craniofacial disorders
 - Treacher-Collins
- Down's syndrome
- Ciliary dysfunction
- Immune dysfunction
 - AIDS
 - steroids, chemo
 - IgG deficiency
- Obstruction
 - adenoids
 - NG tubes
 - NT intubation
 - malignancy

OM - Epidemiology

- Increasing incidence?
- Increases after newborn period
- 2/3 with AOM by one year of age
- 1/2 with >3 episodes by three years
- most common in 6 - 11 mos

OM - Day Care

- Greater risk of AOM in children < 3 years
- Home care best
- Day care
 - Large group
 - Exposures with wider range of flora
 - Increased URI's

OM - Breast-feeding

- Decreases incidence of URI and GI disease
- Decreases duration of OM
- Protective factor in breast-milk?

OM - smoke exposure

- Induces changes in respiratory tract
- Increased AOM and persistent effusion
- Increased chronic and recurrent AOM

التدخين في المملكة

- 23 في الترتيب العالمي (نسبة استهلاك للفرد)
- المدخنين يحرقون اكثر من 5مليارات ريال
- اكثر من 40الف طن
- 30 % القطاع الصحي والتعليمي
(الاطباء ومعلمين والطلاب)
- 600 الف مدخنة معظمهن من المراهقات.

Eustachian Tube

- Connects middle ear and nasopharynx
- Lumen shaped like two cones
- Mucosa
 - Mucous producing cells
 - Ciliated cells

Eustachian tube

- Usually closed
- Tensor veli palatini → active opening
- Opens during
 - Swallowing
 - Yawning
 - Sneezing
- Opening involves cartilaginous portion

Eustachian tube

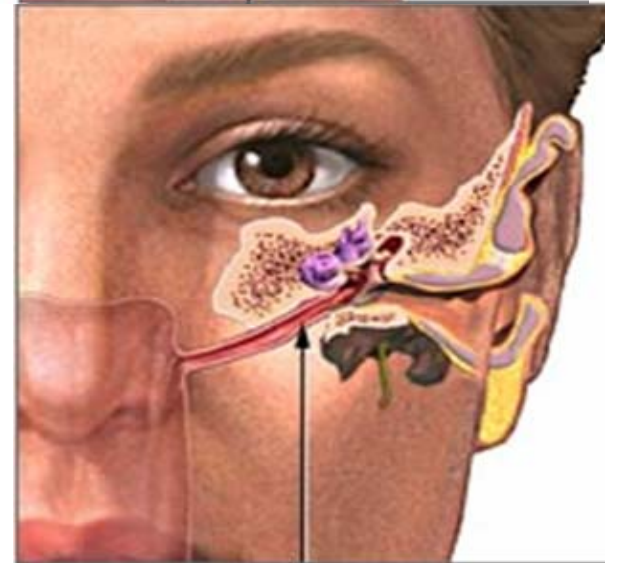
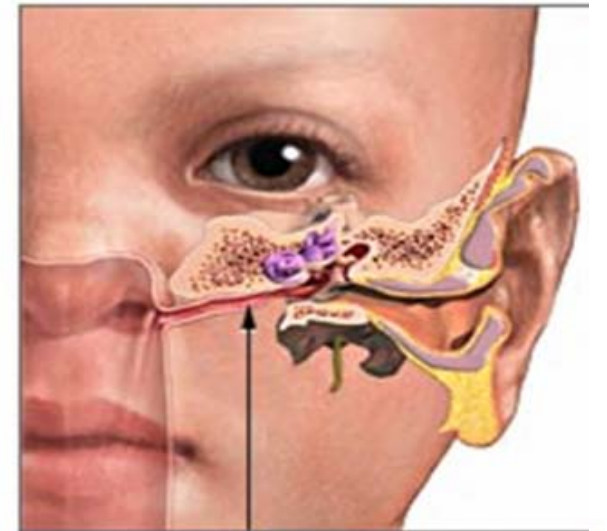
Functions

- Protection from nasopharyngeal
 - Sound
 - Secretions
- Clearance of middle ear secretions
- ME Ventilation (pressure regulation)

Eustachian tube

Children

- Longer bony portion
- 10 degree angle (Horizontal)
- Larger isthmus
- Nasopharyngeal orifice
 - Relatively large
 - Obstructed by adenoid
 - Supine
 - Crying & Sniffing



Middle ear Pathology

- Inflammation Edema
- PMN infiltration
- Epithelial ulceration
- Granulation tissue
- Fibrosis,
- influx of chronic inflammatory cells
- Increased columnar and goblet cells
- Osteitis

Microbiology

- *S. pneumoniae* - 30-35%
- *H. influenzae* - 20-25%
- *M. catarrhalis* - 10-15%
- Group A strep - 2-4%
- Infants with higher incidence of gram negative bacilli

Virology

- RSV - 74% of middle ear isolates
- Rhinovirus
- Parainfluenza virus
- Influenza virus

Treatment - AOM

- Adults and older children - observation
- Antibiotics - consider drug resistance patterns

Antibiotics

- First line
 - Amoxil –
 - Ceftin - B lactam stable
 - Bactrim
- Second line
 - Augmentin
 - Ceftin
 - Rocephin
 - Macrolides - Zithromax, Biaxin

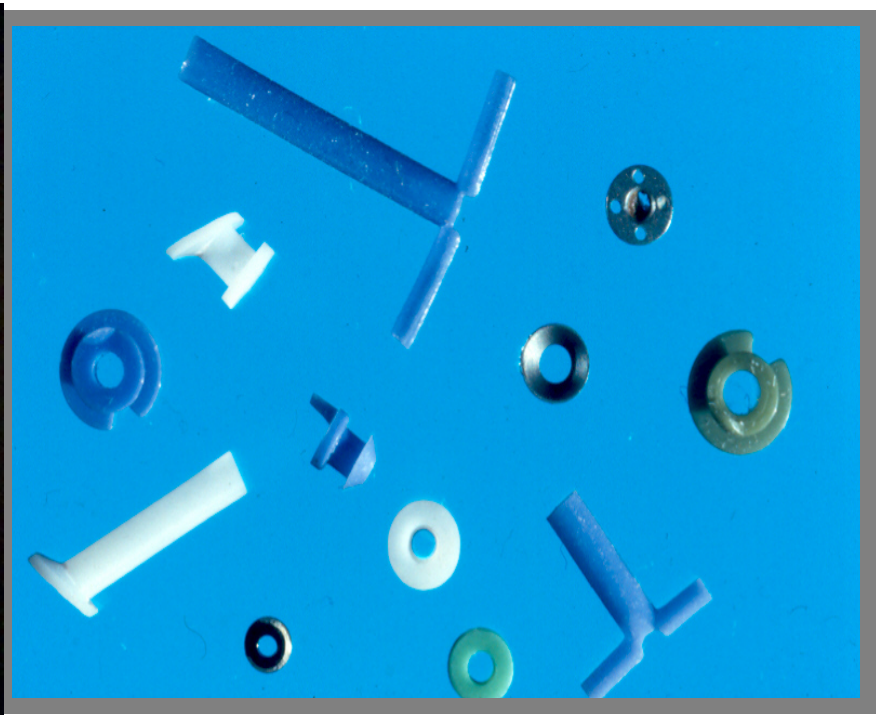
Treatment - Recurrent AOM

- Chemoprophylaxis
 - Sulfoxazole, amoxicillin, ampicillin, pcn
 - less efficacy for intermittent prophylaxis
- Myringotomy and tube insertion
 - decreased # and severity of AOM
 - otorrhea and other complications
- Adenoidectomy

Tympanostomy tube insertion

- Unresponsive OME > 3 months
- Recurrent MEE
- Suppurative complication

Ventilating Tubes

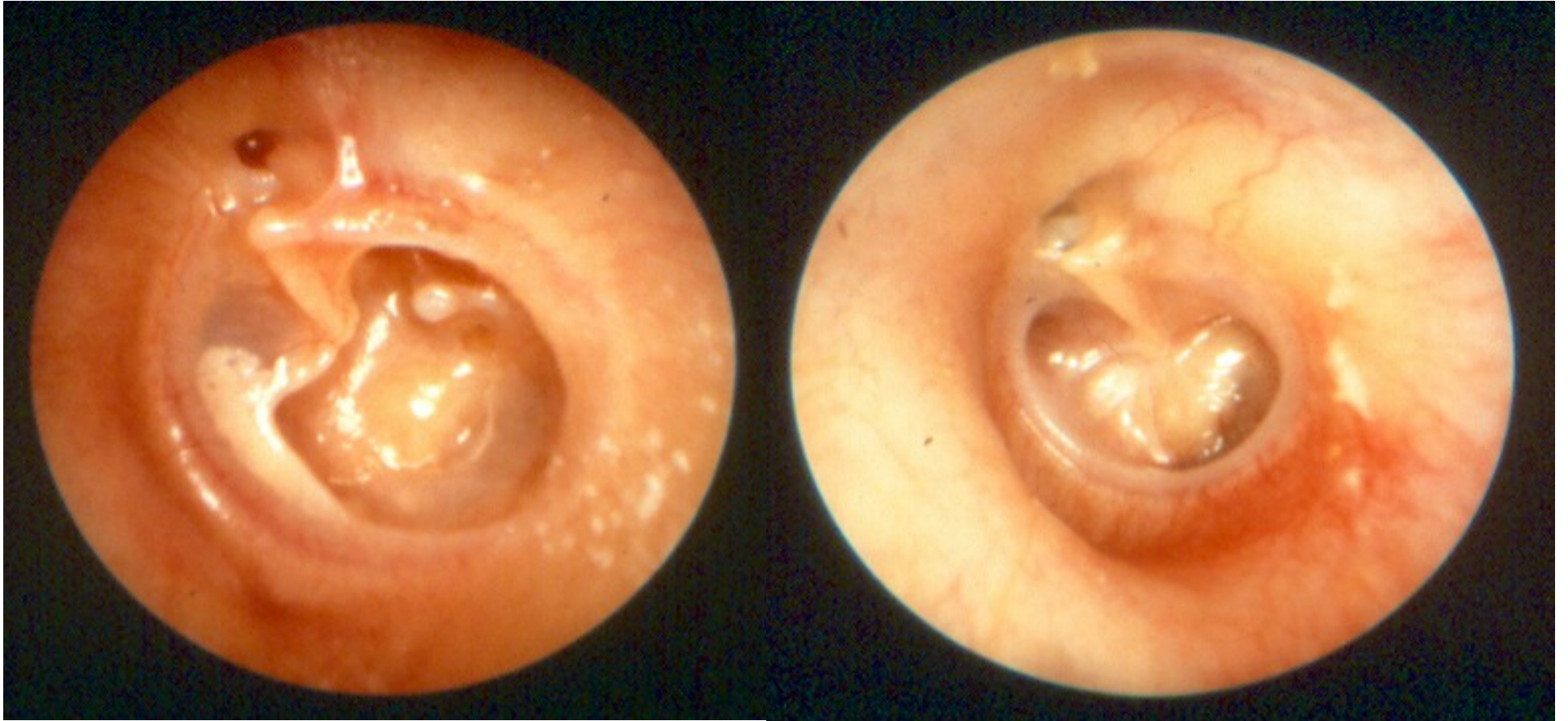




Complications

- Intratemporal
 - hearing loss
 - TM perforation
 - CSOM
 - retraction pockets
 - cholesteatoma
 - mastoiditis
 - petrositis
 - labyrinthitis
 - adhesive OM
 - tympanosclerosis
 - ossicular discontinuity and fixation
 - facial paralysis
- Intracranial
 - meningitis
 - extradural abscess
 - subdural empyema
 - focal encephalitis
 - brain abscess
 - lateral sinus thrombosis
 - otitic hydrocephalus

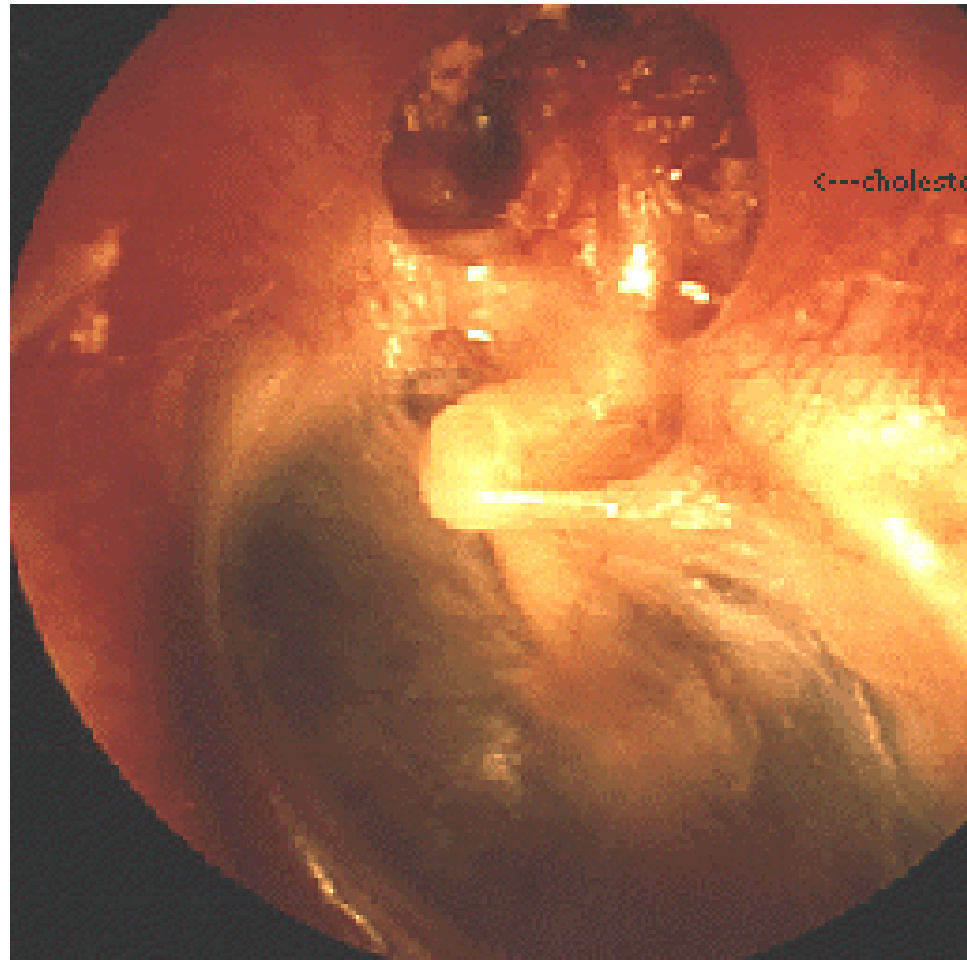
Drum Retraction (Adhesive OM)



Tympanosclerosis



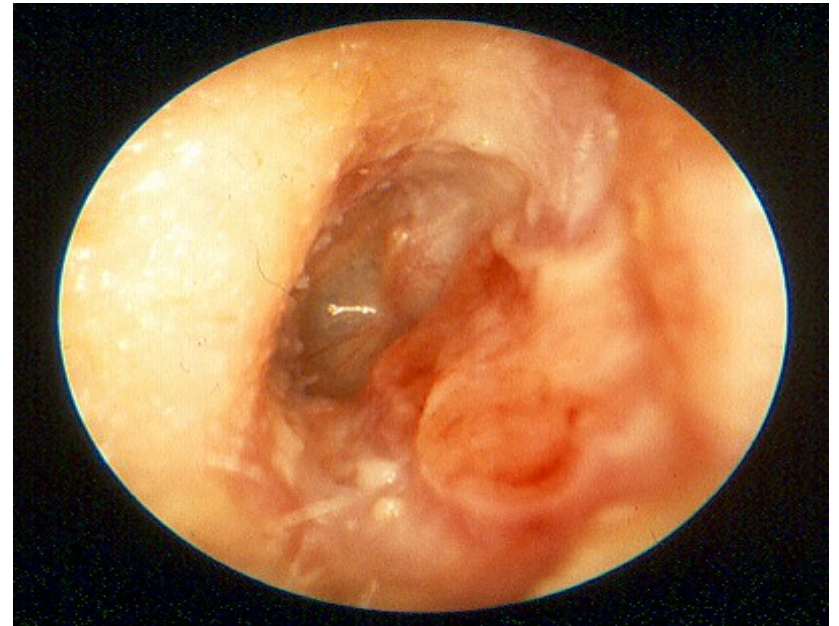
Cholesteatoma



Cases

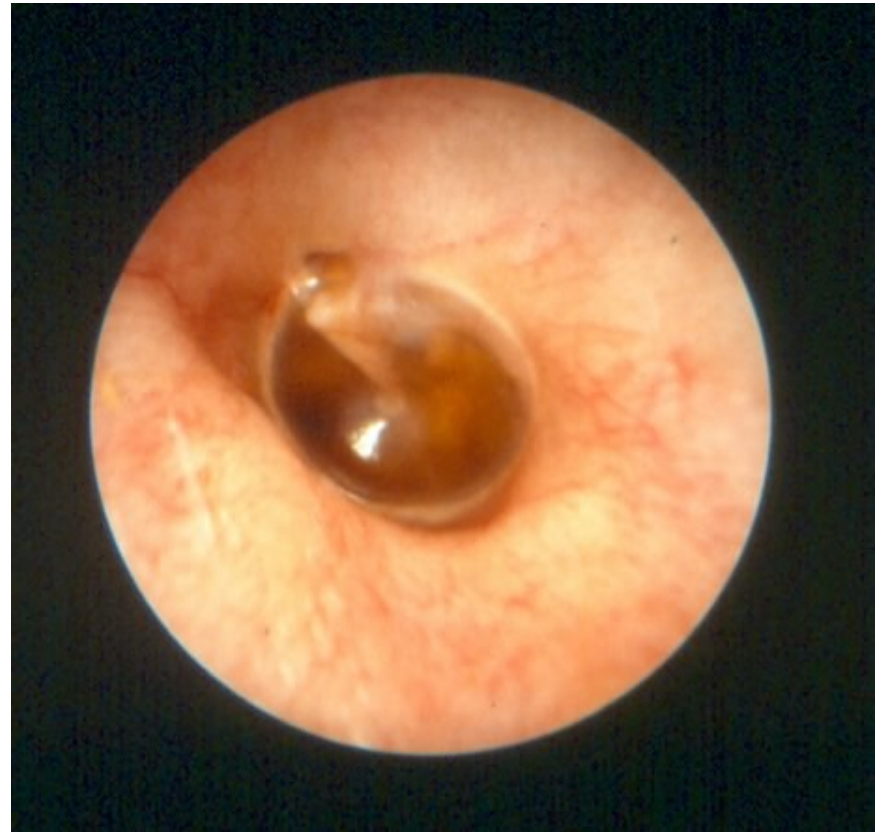
Malignant (Necrotizing) Otitis Externa

- 55 Y
- Left ear
 - Pain
 - Discharge
- Left VII paralysis



Secretory Otitis Media (Glue Ear)

- 3 Y
- Recurrent OM
- Hearing Loss



Otomycosis

- 45 Y
- Severe itching
- Pain
- Hearing loss



Fracture Base of Skull

- MVA
- Left earache
- Hearing loss



Ramsay Hunt Syndrome

- 55 Y
- Bilateral Earache
- Facial weakness



Mondini

- 4 Y
- Normal exam
- Rt moderate SNHL



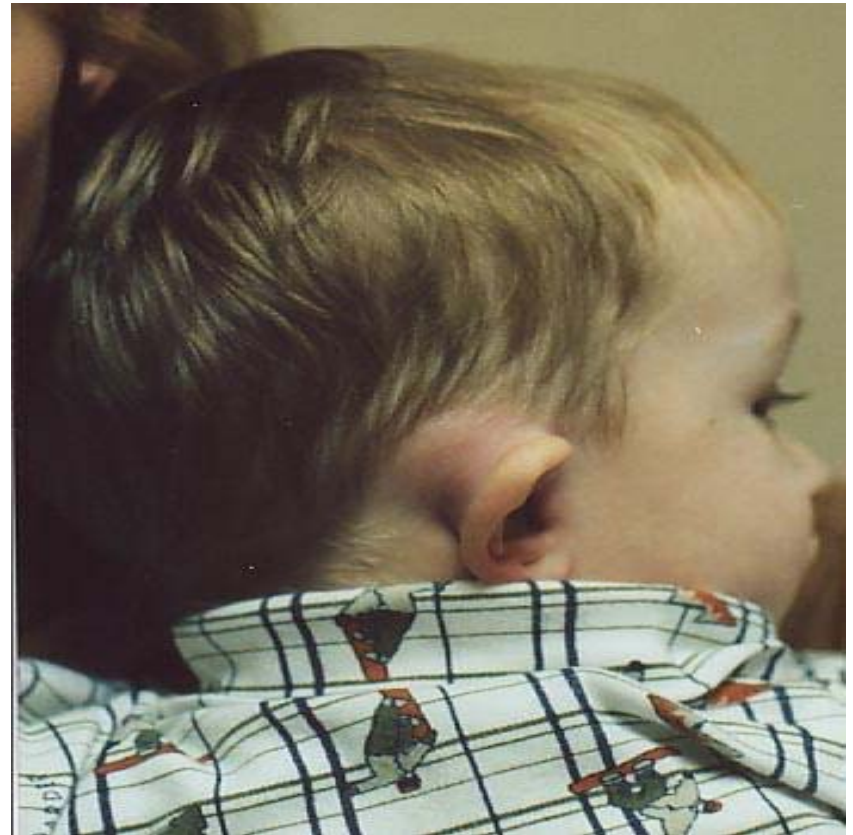
Otosclerosis vs Tympanosclerosis

- 33 y
- No hearing loss
- Ear exam →



Mastoiditis

- **3 Y**
- **Fever**
- **Earache**
- **Irritability**



Bat ear

- 4 Y
- Ear deformity



Thank

You