



# The Ear

# The Ear

The ear is divided into 3 anatomical divisions.  
Function and pathology follow these divisions.

## Anatomy

- External ear
- Middle ear
- Inner ear

## Function

### External ear

- Capture and conduction of sound

### Middle ear

- Amplification and transfer of sound and conversion of vibration in air to vibration in fluid

### Inner ear

- Hearing and balance

## Pathology

### External ear

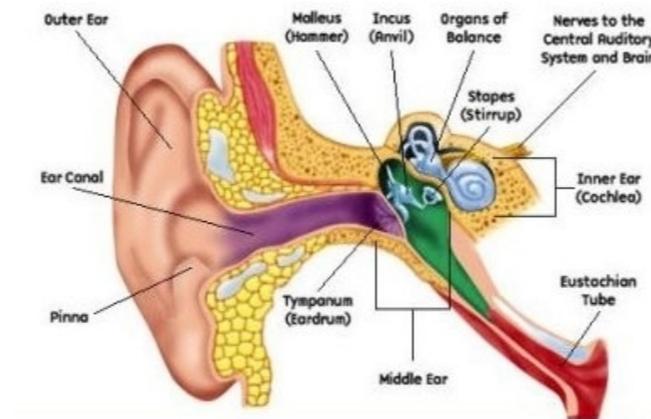
- Injury/inflammation of skin and cartilage

### Middle ear

- Inflammation, infection, perforation and effusion

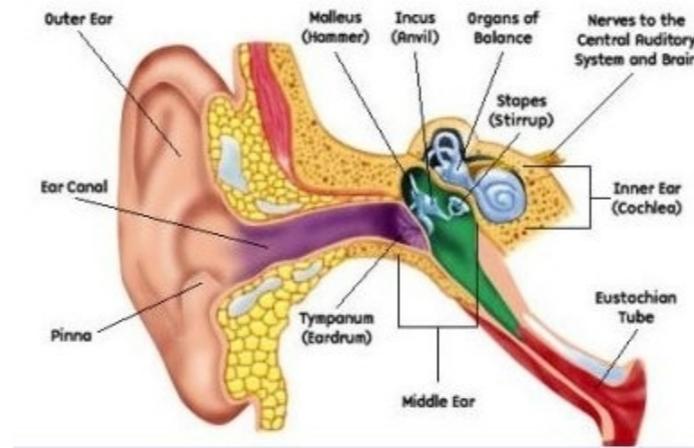
### Inner ear

- Vertigo and dysequilibrium



# External ear

- Otitis externa
  - swimmer's ear
- Impacted wax
- Cartilage injury



## Otitis externa

Otitis externa is most commonly caused by a combination of factors such as:

- maceration of canal skin from scratching with a Q-tip or pencil
- loss of protective lipid layer in the presence of humidity
- ingress of bacteria through epithelial tears

## Cause

- Warm, humid environment (swimmers & divers)
- Harsh, cleaning of ear canal (everyone)
- Dry, cracking skin of ear canal (eczema/dermatitis)
- Lack of cerumen (over-zealous cleaning)

# Otitis externa

## Signs and symptoms

- redness and itching of outer ear
- pain, especially when touching or displacing the ear lobe or tragus
- drainage from the ear
- swollen ear canal
- conductive hearing loss



## Treatment

- Removal of offending factors!!
- Combination of corticosteroid and antibiotic drops
- Placement of ear wick if severe
- Prophylaxis in swimmers and divers

# Ear wax

It's customary to see some wax in almost every ear - it's a normal secretion and protective



- Larger deposits may obscure the view of the drum - this does not necessarily imply that wax is causing deafness
- However, the presence of wax in the inner third of the ear canal may indicate inappropriate use of cotton buds to clean the ears

Wax can be removed by:

- gentle syringing with warm water if it is reasonably certain that there is not a perforation of the tympanic membrane behind the wax
- removal under visual guidance with a small curette
- softening with proprietary wax solvents, or ingenious improvisations, such as puncturing a capsule of Colace and emptying the contents into the ear canal

Note that syringing cold water into the ear canal may precipitate vertigo

## **Cauliflower ear**

Cauliflower ear develops when there is separation of the tissue planes of the ear and the subsequent space fills with blood from ruptured capillaries.



This happens as a result of sudden, blunt trauma to the ear when a hand, foot, head or wrestling mat comes in contact with the ear. The underlying cartilage is separated from its supporting medium and will necrose and deform permanently if not treated.

### **Treatment**

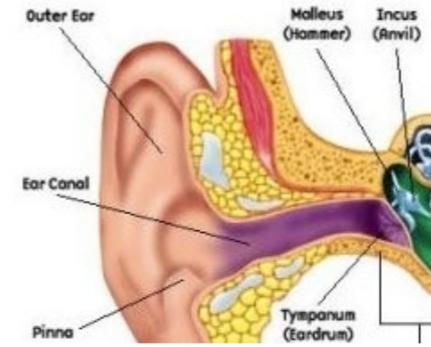
- needle aspiration of blood
- injection of steroid into the evacuated space to further reduce capillary bleeding
- removal of steroid
- clamping to maintain hemostasis
- "Casting" of the ear tightly to prevent re-accumulation of blood into the space
- rechecking until healed with repeat of aspiration as necessary

There are numerous modifications and devices based on the above principles

## Middle ear

The following processes impact the middle ear, singly or in combination.

- Inflammation of ear drum
  - with or without the presence of middle ear fluid
- Perforation/laceration of ear drum
- Loss of compliance of ear drum
- Injury to ossicular chain (stapes, malleus, incus)



## Otitis media

### Definition

Inflammation of the middle ear cleft caused by viral or bacterial infection, or allergic response

### Bacteriae

- Strep pneumonia
- Hemophilus influenza
- Moxarella catarrhalis



# Otitis media

## Presentation

- Pain
- Possible altered hearing
- Possible discharge from ear



## Treatment

- Pain relief if needed
- Antibiotics to cover 3 major organisms
- Antibiotic treatment has become more controversial

Certainly, younger children are treated with symptom relief only in many countries without any discernable change in outcome. Others use a strategy of "delayed discretionary antibiotics"

# Perforation

"Safe" and unsafe perforations should be distinguished. A safe perforation is a hole in the tympanic membrane. The main risk is that it may allow infection to enter the middle ear but rarely any more serious sequelae.



Examples are traumatic perforations (e.g. barotrauma - swimming, diving) which are often posterior and linear, like a tear rather than a round hole. It is possible to make out the posterior margin of this defect. Unsafe perforations are not holes but retractions of the tympanic membrane that may gradually enlarge accumulating keratinous debris which may become infected.

Warnings of serious disease include:

- persistent offensive discharge
- long history of middle ear disease
- significant hearing loss
- prior mastoid or middle ear surgery

# Perforation

## Causes

- force striking ear squarely (puck, poor dive entry)
- skull fracture
- concussion force from explosion
- object (such as a bobby pin, Q-tip, or stick) entering deep into the ear canal

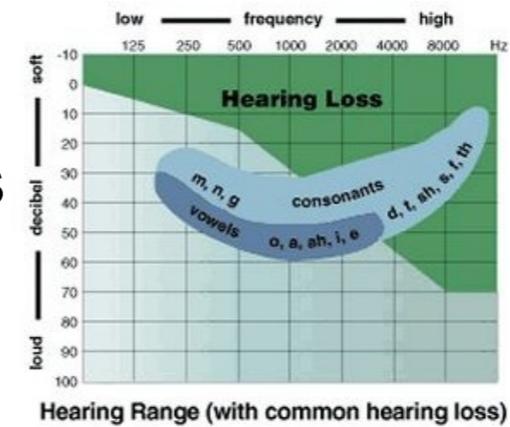


## Outcome

- if the perforated eardrum is due to trauma, loss of hearing and tinnitus may be severe but hearing usually returns partially and tinnitus diminishes, in a few days
- most heal spontaneously within weeks. Some may take several months. The ear must be protected from water and trauma. Those which do not heal spontaneously may require surgery.

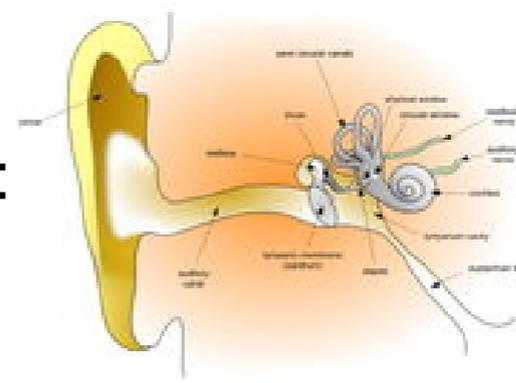
# Hearing

- The tympanic membrane vibrates in response to pressure changes
- This vibration is amplified by the mechanical connection of three small bones known as the ossicles
- The ossicles finally transfer the amplified vibration to the cochlea, the organ of hearing that serves the auditory nerve
- Additional testing, of various complexity, can distinguish tympanic membrane, ossicular chain and cochlear and auditory nerve problems



# Hearing

The basic divisions of hearing are:



## Conductive hearing

- sound travels along the ear canal causing the ear drum to vibrate. Three small bones of the middle ear conduct this vibration to the cochlea of the inner ear

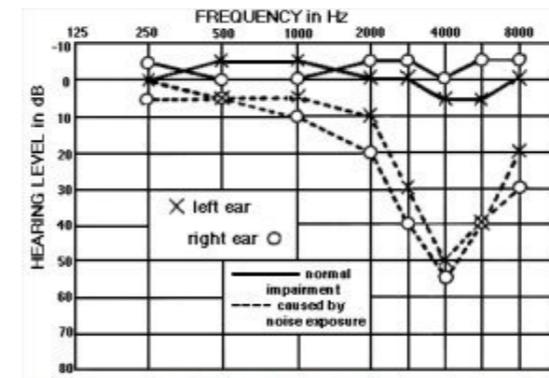
## Sensorineural hearing



- the movement of the ossicles generates waves in the cochlea. These waves stimulate the hair cells which, in turn, generate electrical potentials in the auditory nerve which travels through interconnections to the auditory cortex of the brain

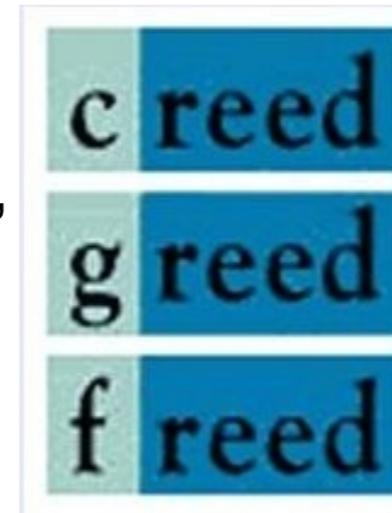
# Normal hearing

Normal hearing is the ability to hear:-



- a whisper, normal speech, and a ticking watch
- the ability to hear a tuning fork through air and bone.
- the ability to hear tones from 250 Hz through 8000 Hz at 25 dB or lower

However, the ability to hear vowels, consonants, and sibilants is affected by different frequencies

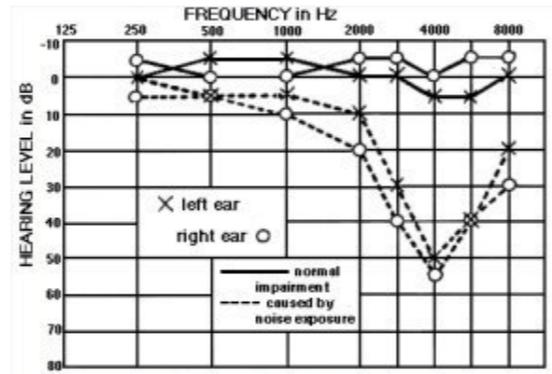


# Noise-induced deafness

Noise induced deafness is of particular importance

because it is:

- preventable
- irreversible



## Major sources:

- industrial
  - compressors, tractors etc
- Recreational
  - loud music, firearms

## Characteristics:

clinical

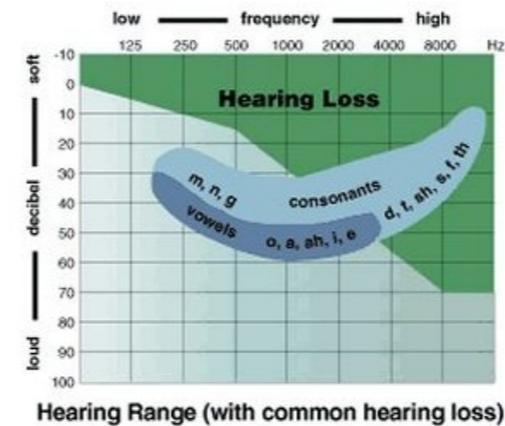
- problems with speech discrimination
- difficulty with competing conversations

- difficulty in noisy environments

- tinnitus

audiogram

- Initial loss at 4000hz slowly spreading up and down the spectrum



**Prevention.** Use applicable hearing protection

# Inner ear

Vertigo is a sense of dysequilibrium with a sense of rotation or movement, often arising in semi-circular canals which are anatomically situated within the petrous temporal bone in the inner ear

## Causes

- Acute viral labyrinthitis
- Benign positional vertigo
- Post-concussive syndrome
- Multiple sclerosis

## Others

- drug induced injury
- vascular injury
- Temporal lobe epilepsy
- Vasculitis

