Microtia and Anotia: They are developmentally small external ears. There are four types 1–4; of which type 4 is anotia. Detailed radiological study of middle ear and inner ear development is necessary before planning for correction. Associated other systemic congenital anomalies should be kept in the mind. Surgical correction is usually done after the age of 4 years.

Aural atresia: It can be congenital or acquired following a trauma or infection. Congenital atresia is due to failed closure of 1st branchial cleft and pouch. It might be associated with a spectrum of other congenital abnormalities. Surgery is preferably done at 5–6 years of age. Till surgery, patient is given hearing aid to help language development.

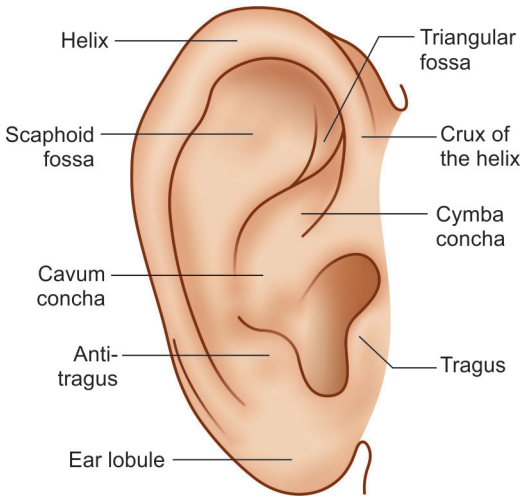
Inner ear congenital malformations: Inner ear development anomalies are classified into membranous and bony. They result in congenital sensorineural hearing loss. Most cases are membranous labyrinth malformation (80%). There will be inner hair cell defect which cannot be detected by CT scans. Patients are managed with hearing aids or cochlear implant based on the severity of hearing loss.

Anatomically Significant Areas

Tragus: It is a cartilaginous projection in front of EAC. This cartilage can be used to harvest graft for ossiculoplasty.

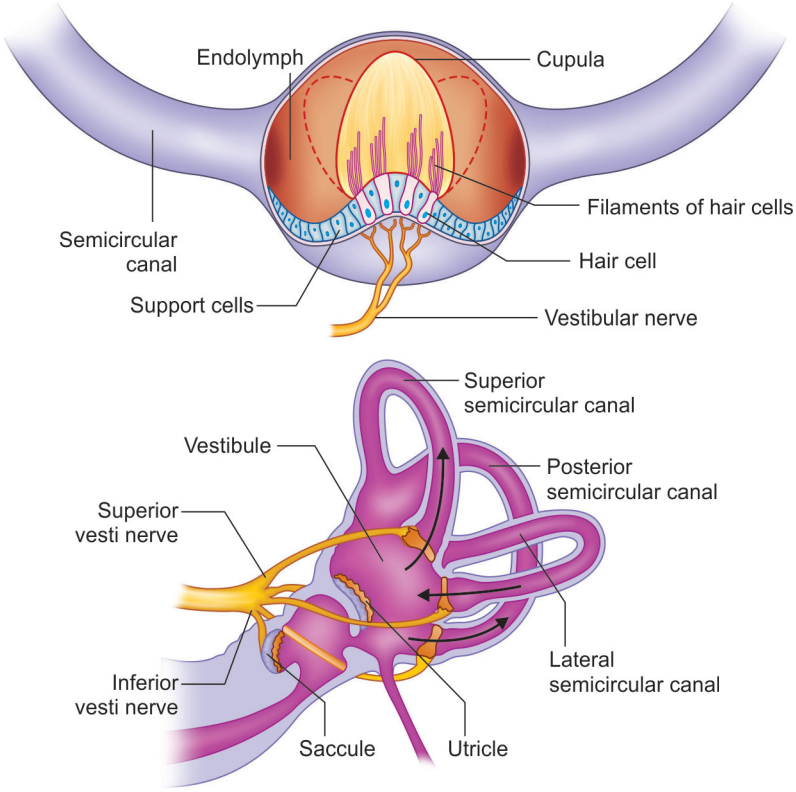
Fissure of Santorini: It is a defect in cartilaginous part of EAC through which infections or tumors can travel from EAC to parotid space and vice versa.

Foramen of Huschke (also called "foramen tympanicum"): It is a defect in bony EAC. It might be communicating with temporomandibular joint space. In most cases this condition is asymptomatic.



Incisura terminalis: This area is between tragus and crux of helix and is devoid of cartilage. This is the site for endaural incision and meatoplasty.

Cymba concha: It is related medially to suprameatal triangle (Macewan's triangle) where mastoid tenderness is palpated. Other sites to palpate mastoid tenderness are mastoid tip (tip cell suppuration) and posterior part of mastoid (mastoid emissary vein thrombophlebitis).



The direction of endolymph movement in vestibule causing depolarization

AUDIOLOGY

Theories of Hearing

1. **Place theory (Helmholtz):** Each pitch has its own loci in basilar membrane.
2. **Telephone theory (Rutherford):** Pitch is differentiated by the difference in individual nerve fiber firing rate.
3. **Volley theory (Wever):** Combination of the above 2 theories.
4. **Travelling wave theory (von Békésy):** (*Nobel Prize*). Amplitude of wave produced by a particular frequency sound at oval window reaches its maximum intensity at a particular point. Higher frequency at base and lower frequencies at apex.

Sound is a form of energy produced by an object possessing both inertia and elasticity. When it vibrates, it causes alternating compression and rarefaction of the surrounding media and sound is transmitted.

Speed of sound: 344 m/s in air. In water, sound travels four times faster. In bone sound travels even faster than in water. Speed of sound varies with media, temperature and pressure.

Frequency: Cycles (1 rarefaction and 1 compression) per second is the frequency of sound. Its SI unit is Hertz (Hz).

Intensity: Loudness of sound.

When there is any disparity between the tuning fork test results and PTA results, it is advised to go with tuning fork tests result rather than PTA result.

Recruitment: It is defined as an abnormally steep perception of loudness of sound which is disproportionate with intensity of sound.

Seen in cochlear pathology, e.g. presbycusis, Meniere's disease.

Tests for recruitment: ABLB (Fowler test), SISI, Metz's recruitment test.

Loudness discomfort level: It is level of sound at which discomfort in the ear is felt.

90–105 dB SL (sensation level).

Dynamic range: The difference (gap) between hearing level and loudness discomfort level. This gap is reduced in cochlear pathologies because of recruitment phenomenon. Patients with recruitment, i.e. poor dynamic ranges, are poor candidates for hearing aid as amplified sound produces discomfort in ear.

Tone decay test: It is slow decline in discharging frequency with time. It measures the nerve fatigue and associated with retro-cochlear lesion, e.g. acoustic neuroma.

Normally person can hear tone up to 60 seconds. However, in retro-cochlear lesions patients cease to hear early.

Speech audiometry: To test a patient's ability to understand the speech. In this spondee words are delivered and patient is asked to repeat these words.

Spondee words: They are phonetically balanced words. Two syllable words that have equal stress on both words, e.g. head-light, foot-ball, sun-light, sun-set, white-wash, arm-chair, ink-pot, air-plane.

Phonetically balanced words: Single syllable word, e.g. as, can, age, dish, din, bin, day.

Speech reception threshold (SRT): It is the intensity at which 50% of the words are repeated.

Speech discrimination score (SDS): In this test phonetically balanced words that are 30–40 dB above the SRT are delivered and percentage of repeated words are calculated. DS markedly reduces (<80%) is SN deafness especially neural type, whereas in conductive deafness and normal hearing DS would be 90–100%.

Impedance: It is the resistance encountered by the acoustic energy (sound) when it passes through the medium (auditory system).

It is due to the mixture of:

1. Stiffness of medium
2. Mass of medium
3. Friction

Compliance: It is the ease by which sound (in test it is 226 Hz) travels through the tympanic membrane and middle ear and is maximum when air pressure (in mm of water commonly –300 to +200) in middle ear and EAC is equal to normal atmospheric pressure. Compliance is measured in cubic cm.

Uses of impedance audiometry: For differential diagnosis of conductive deafness.

To detect the secretory otitis media.

CHAPTER 4

Diseases of External Ear

EAR WAX

Cartilaginous part of EAC has two types of glands:

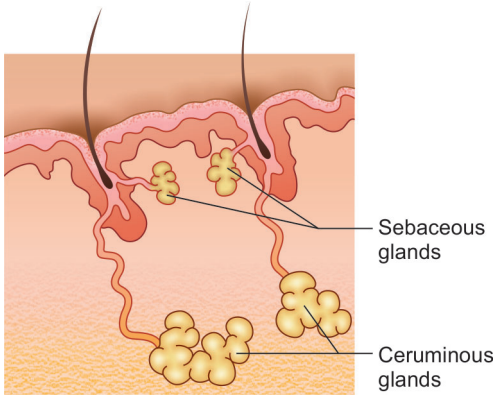
1. Sebaceous gland
2. Ceruminous gland

When the number of sebaceous glands increases more than that of ceruminous gland, it results in hard wax formation.

When the number of ceruminous gland increases more than that of sebaceous gland, it results in no wax formation.

It is autosomal recessive trait.

WW → autosomal dominant → more ceruminous gland and ww (small letter w) → autosomal recessive → more sebaceous glands in EAC.



So WW → excessive ceruminous gland + less sebaceous glands and no wax formation.

Ww → 50% sebaceous gland + 50% ceruminous glands and wet wax formation.

ww → >50% sebaceous glands + <50% ceruminous glands and hard wax formation.

Sebaceous gland secretions are solute and ceruminous gland secretions act as solvent. When the EAC is totally occluded by wax, it can cause hearing loss up to 50 dB.

Keratosis Obturans

Painful condition where there is collection of desquamated cell debris along with wax in deeper part of EAC leading to bone erosion. This condition is more aggressive than cholesteatoma. It is associated with bronchiectasis and sinusitis.

Otitis Externa (Furunculosis)

Seen in cartilaginous EAC because of infection in hair follicles.

Staphylococcus aureus is the most common organism.