

EAR examination

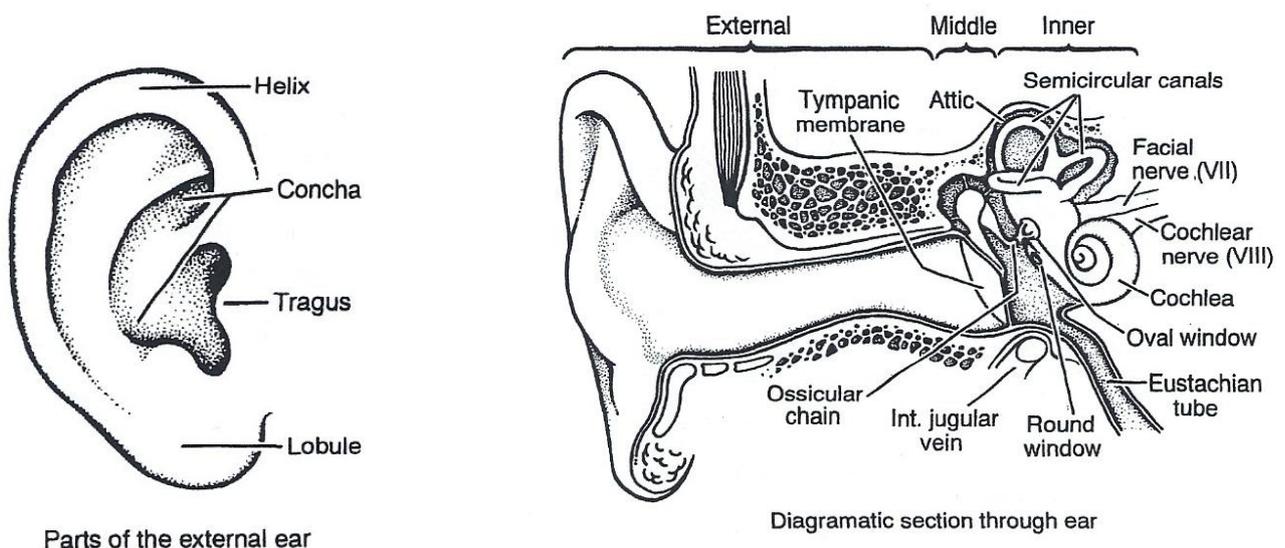
Overview

- Review of the basic anatomy
- Ear examination
- Videos on
 - Normal hearing and the three types of hearing loss
 - How to examine the external ear, ear canal, and tympanic membrane
 - How to do clinical voice tests and tuning fork tests (bedside evaluation of hearing)
- Limitations – what can your ENT do?

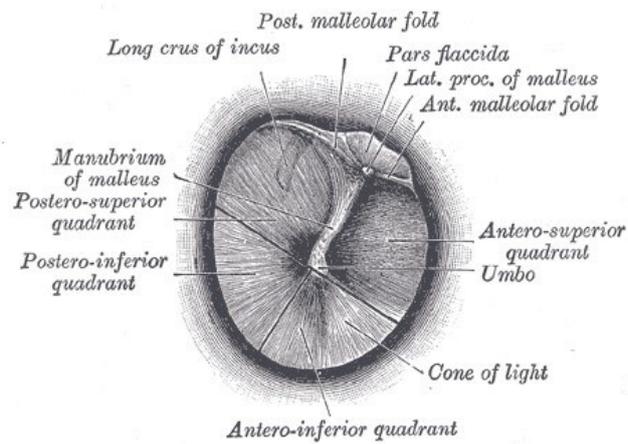
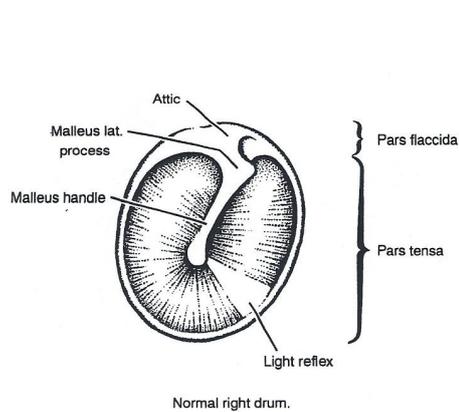
General points

- Personal protective equipment
- Proper light
 - Whether using a head light or otoscope, it should be bright
 - Preferable the ambient light should not be overly bright
- Use two hands
- Be sure to examine all the nooks and crannies
- Be sensitive regarding the position in which you examine a patient
 - Sitting in front or to the side of a patient
- Be sensitive regarding the examination of a child
 - First try to make a bond

Normal anatomy



Normal pinna (left picture) and external, middle and inner ear (right picture)



Normal right tympanic membrane



Right ear



Left ear

Videos (Medel®)

- Hearing - https://youtu.be/_h9FjGTFMFY
- Conductive hearing loss - https://youtu.be/Kn2gX78M_aQ
- Sensori-neural hearing loss - <https://youtu.be/O0CmzXZ1sEo>
- Mixed hearing loss - <https://youtu.be/8SrusMbjEC4>

History

- The initial history is usually kept simple and to the point
- The history is geared to the presenting complaint
- The traditional rule of first history; then physical examination; then special investigation is sometimes bent slightly in the interest of time-efficient examination - e.g.: the identification of wax in the external canal in a patient complaining of hearing impairment may obviate a detailed history
- Certain problems (e.g. vertigo, tinnitus) require extensive history taking
- The important points in history are dealt with under each problem

Examination

You will need to examine the:

- Structure
 - Pinna
 - Inspect and palpate
 - Two mastoids
 - Antrum / Tip

- Skin incisions
 - Pinna
 - Concha
 - Meatal skin
 - Tragus
 - (Percussion)
 - Auscultation
- External ear canal
 - Curve and diameter
- Tympanic membrane and Middle ear
 - Malleus
 - Look at full diameter
 - Remember pars flaccida
 - Assess if it is
 - Normal / Inflamed / Infected
 - Normal position / Retracted / Bulging
 - Normal mobility / Impaired / Hyper
- Inner ear
- Function
 - Hearing
 - Balance
- Special investigations
 - Audiology
 - Tympanometry
 - Pure tone audiometry
 - Speech reception thresholds
 - Speech detection thresholds
 - Speech discrimination
 - Stapes reflex
 - Balance
 - Nystagmography
 - Video / Infra-red / Frenzel glasses
 - Caloric testing
 - MRI / CT
 - Radiology
 - CT
 - MRI
 - Bloods

Structure

Outer Ear:

- Scalp
 - Skin conditions causing periauricular lymphadenopathy, especially skin squamous cell carcinomas
- Pinna
- Mastoid antrum (posterior-superior to pinna helix) and process (inferior-posterior to lobule)
 - Signs of inflammation
 - Abscess presents with:
 - Fluctuant swelling over the mastoid process
 - Loss of auricular crease
 - Pinna displaced anterior-inferiorly

- Rarely the abscess can spread into the zygoma, posterior belly of digastric, or sternocleidomastoid muscle
- Periauricular
 - Pre-auricular pits / sinuses / cysts
 - Lymphadenopathy / abscess formation
- External meatus:
 - Wax
 - Foreign body
 - Narrowing of lumen
 - Otitis externa: Diffuse, Localized e.g. Furunculosis (refer later)
 - Tenderness on manipulation of ear (otitis externa)

Practice removing any wax / pus / foreign body (FB) under supervision in the clinic (also see section “practical tips in otology”).

Remember:

- Use a headlight to be able to work with two hands.
- You will rarely have access to a microscope.
- Make sure you have proper equipment such as a Jobson-Horne, Ear Syringe, Small Tiley’s, and / or Crocodile forceps.
- The only REAL emergency is a corrosive FB, such as a battery, in the external ear canal. This should be referred as an emergency if you are unable to remove it.
- Otherwise, do not risk injuring the ear canal and middle ear structures in an attempt to remove a FB.

Doctors practicing in the public sector will see a high number of children with chronic suppurative otitis media. You will need to be able to do a proper ear mop (toilet) before instilling any drops or powders into the ear. The videos below are links to an ear toilet and boric powder installation:

<https://youtube.com/shorts/SNXWikNz0jE>
<https://youtube.com/shorts/fGeZzGU8oQA>

Middle ear:

- Eardrum (window to middle ear)
 - Pars tensa
 - Light reflex
 - Colour
 - Malleus
 - Pars flaccida (over "attic")
 - Mobility: pneumatization or Valsalva

Make specific notes regarding:

- Suppurative process
- Cholesteatoma
- Perforation / retraction pocket
- Tuning fork tests (Rinne and Weber)
- Hearing tests

Inner ear:

Can't be visualised

See functional: hearing / balance assessment

Function

Hearing:

- During the examination (room testing is limited, but useful).
 - Assess response to your speech
 - Assess patient's speech
 - Assess school progress in relation to child's age
- Adults / Older children can recognize hearing at:
 - Whisper 30dB
 - Speak 60dB
 - Shout 90dB
- Tuning fork tests
 - Rinne
 - Weber
- Young children: Rattle / cup and spoon (distraction) tests

Tuning fork tests:

Differential diagnosis of tuning fork tests

		Weber central	Weber to the left	Weber to the right
Rinne Positive	Right ear	Normal ear	Non-diagnostic Redo	Conductive hearing loss > 5 dB and < 25 dB (mild)
	Left ear	Normal ear	Conductive hearing loss > 5 dB and < 25 dB (mild)	Non-diagnostic Redo
Rinne Negative	Right ear	Non-diagnostic Redo	False negative Rinne – severe / dead ear on the right	Conductive hearing loss >25 dB (moderate – severe)
	Left ear	Non-diagnostic Redo	Conductive hearing loss >25 dB (moderate – severe)	False negative Rinne – severe / dead ear on the left

Balance:

Balance is a complex interplay of inputs from the:

- visual system
- vestibular system
- neck
- proprioceptive system

This information is integrated in the brainstem and analysed by the cerebellum by comparing it to previous inputs. At random interval the cerebrum “checks in” on these two. Balance is therefore mainly an automatic process. Think about running, you can’t “compute” the process, it just happens. Ironically some balance disorders, such as PPPD, are based on over-computing normal bodily movements and wants to willingly correct this.

The ears are responsible for producing quick changes in the position of the eye in relation to space to keep an object focused on the fovea. This process is far quicker than eye movements produced by the cerebrum, also known as neurological eye / oculo-motor movements. These quick movements allow for clear vision. If the system fails, vision becomes blurry, and a patient complains about an imbalance / dizziness. Vestibular disease can be either uni- or bi-lateral and either a hypo- or hyper-function. More details with regards to a differential diagnosis will be discussed later.

Balance examination (please refer to the chapter about vertigo):

- History
 - Classical approach
 - Alternative approach
 - Million-dollar questions
- Examination
 - General
 - One can form an immediate clinico-pathological picture by assessing the patient's posture and walking when coming into the consulting room. The physician should also look for signs of anaemia, lymphadenopathy, weight loss and any other obvious signs.
 - Head and neck
 - Ear, nose and throat (ENT)
 - Neuro-otological
 - Nystagmus
 - Spontaneous / Induced
 - Fixation – Gaze straight
 - Fixation – gaze in different positions
 - Without fixation (ideal in dim room with Frenzel lenses)
 - Central oculo-motor signs
 - Smooth pursuit
 - Saccades
 - Vergence
 - Visual fixation / gaze holding
 - Optokinetic nystagmus
 - VOR battery
 - Dix Hallpike and Lateral semi-circular canal testing
 - Dynamic visual acuity test (DVAT)
 - Head thrust / Head impulse test
 - Head shake
 - Caloric test
 - Rotation testing
 - Fistula test
 - Fixation suppression test
 - Subjective visual vertical
 - CNS
 - Higher functions
 - GCS
 - Orientation
 - Intellect
 - Communication
 - Emotional status
 - Cranial nerves
 - Cerebellum
 - Fast tongue movements
 - Ataxia
 - Dysmetria
 - Finger-nose test
 - Dysdiadochokinesia
 - Romberg
 - Heel-shin test
 - Pendular reflexes
 - Nystagmus

- Motor
 - Inspection
 - Palpation
 - Strength
- Sensory
 - Pain, temperature and general sensation
 - Light touch, position and vibration
 - Stereognosis
- Reflexes
- Gait
- Coordination
- Posture
- It is important to also examine the following systems
 - CVS
 - Arrhythmias
 - Reduced cardiac output
 - Hypovolemia
 - Pericarditis
 - Orthostatic hypotension
 - Autonomic dysfunction
 - Vasovagal syncope
 - Hyperventilation
 - Hypoglycaemia
- Special examinations
 - VNG
 - VEMP's
 - Posturography
 - Scans
 - Neurologist / Cardiologist / Physician / GP
 - Audiology / audiologist
 - Physiotherapist
 - Bloods

Special investigations

Ordering these tests is usually (not always) in the realms of an ENT specialist, but often GPs will receive the results of the tests described below.

Audiology:

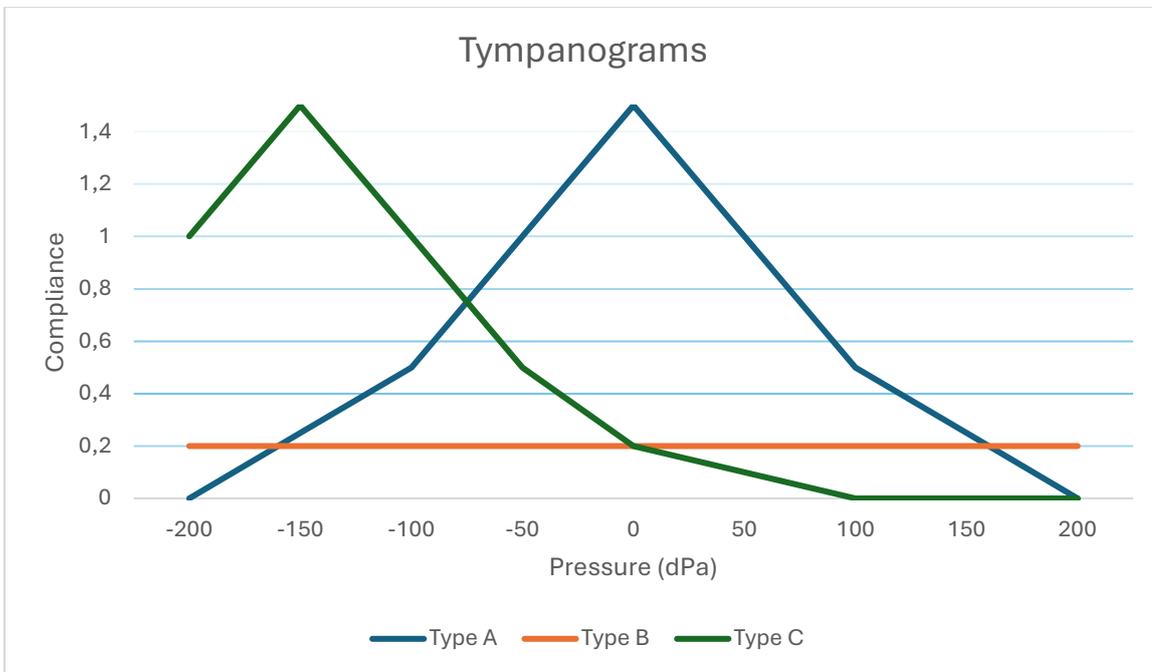
- Tympanometry
- Pure tone audiometry
- Speech reception thresholds
- Speech detection thresholds
- Speech discrimination
- Stapes reflex

Tympanometry

- A probe is placed into the external ear canal and seals it off. The probe sends a sound wave into the external ear canal and measures the amount of sound energy that is reflected back. This all happens while manipulating the pressure in the external ear canal between positive and negative. In a normal ear, the maximal sound should be admitted through to the middle ear when ear canal and middle ear

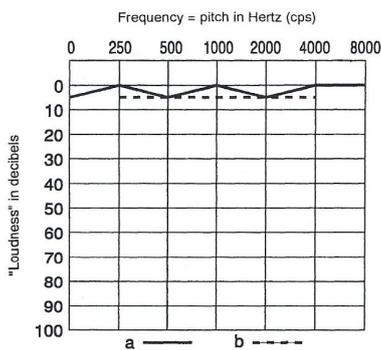
pressures are equal and at atmospheric pressure. Therefore, implying a pressure whereby the least amount of sound energy is reflected back to the probe. By definition this is at zero (atmospheric pressure) and is called a type A tympanogram. A graph is printed and shows a peak at zero, and frequently this is explained as the “movement” of the tympanic membrane. In reality, it is also an indication of the ossicular chain, middle ear pressure, and function of the Eustachian tube

- Before interpreting a tympanogram, one should first look at the external ear canal volume. The normal ranges are 0.5 – 2.0 ml
- A tympanogram with a low volume and type B curve (explained below) points to the probe pressing against the external ear canal skin and is NOT a reflection of the middle ear system
- Otherwise, a type B tympanogram with a volume larger than normal points to a tympanic membrane perforation. In fact, ENT surgeons can use the volume to indirectly predict the successful outcomes of tympanic membrane reconstructions
- There are three types of tympanograms
 - Type A
 - Peaks at between -100 and +100 daPa
 - Implies middle ear pressures reflect atmospheric pressures
 - Two variations are
 - As (“stiff”)
 - Has a low peak (compliance)
 - Seen in
 - Otosclerosis
 - Malleus fixation
 - Tympanosclerosis
 - Ad (hypermobile)
 - High compliance
 - Seen with
 - Ossicular chain dislocations
 - Type B
 - The graph shows that no peak is produced. Therefore, despite varying the pressure of the external ear canal, at no point is there an absolute “sweet spot” where sound energy is admitted through to the middle ear system. This is almost exclusively seen when the middle ear cavity is filled with fluid or a mass. Depending on the type of fluid / mass one might see a dull / yellow / red appearance behind the tympanic membrane
 - Type C
 - The graph shows a peak in the negative pressure range, usually at -150 daPa and more. It implies that the middle ear is at a negative pressure and points to a Eustachian tube that cannot compensate for the loss of middle ear gases (remember there is a constant loss of middle ear gases absorbed by the middle ear mucosa). Clinically one will see retractions for the pars flaccida and / or pars tensa and in severe cases this may lead to adhesive middle ear diseases. Type C tympanograms point to Eustachian tube dysfunction
- Lastly, compliance of TM is 0.39 – 1.3 ml. As explained above this inherently implies the stiffness / laxity of the TM

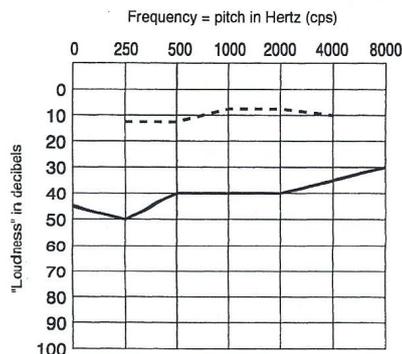


Pure tone audiometry

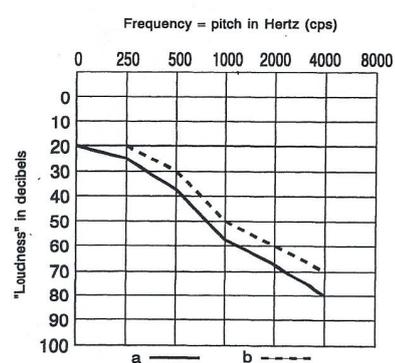
- Pure Tone Audiometry (PTA) is a common hearing test used to assess a person's hearing sensitivity. It's one of the most basic and essential tests in audiology and measures the softest sounds (dB) a person can hear at various frequencies (itches)
- The test is usually done in a soundproof booth and test both the air and bone conduction
- The patient wear headphones or ear inserts, and a machine called an audiometer plays pure tones (beeps) at different pitches (frequency) and volumes (dB)
- The patient indicates (usually by pressing a button or raising your hand) whenever they hear a sound, even if it's very faint. The audiologists usually start loud and then decreases the loudness by 5 dB increments until the tester responds correctly 50% or more. Patients that consistently respond incorrectly may be malingering
- Frequencies tested are typically between 250 Hz and 8000 Hz
- The results are plotted on a graph called an audiogram, showing the quietest level of sound you can hear at each frequency
- It is used to determine the type (conductive, sensorineural, or mixed) and severity (normal, mild, moderate, severe) hearing loss



Normal pure-tone audiogram, indicating the threshold of hearing for: a) Air conduction, b) Bone conduction. The loudness of the test sound is recorded in decibels on the left. The pitch or frequencies are shown on the horizontal axis in cycles per second or hertz.



Here bone conduction remains at a normal level, but there is a loss of air conduction. This is conductive type hearing loss.



Here there is a falloff of both air and bone conduction, especially in the higher frequencies. This is a sensorineural hearing loss, typical of presbycusis

Speech reception threshold (SRT)

- Lowest dB where pt can repeat 50% of spondee words – Uses voice but is also measured in SPL dB
- Spondee is bi-syllable words, with equal weight like “railroad”

- Can be used to confirm PTA
- Should be within 10 dB of average of PTA at 0.5, 1, 2 kHz (REMEMBER an audiometer uses Hearing level dB)
- Tested in groups of 6 words
- If the subject has more than 3 incorrect, then increase dB by 10

Speech detection threshold

- Also uses sound pressure level as reference
- Lowest dB where a subject responded to sound
- Commonly used in children when unable to perform SRT

Speech discrimination (SD)

- Percentage “phonetically balanced” words that a subject can repeat
- Single syllable words
- Output is SPL dB, but remember it is measured for the subject’s ear, therefore SENSATION LEVEL for him
- Start at 30-40 dB SL (which with normal hearing = SPL dB)
 - Groups of 25 words. If you get 3 wrong, then increase the dB with 5
 - Test at least 3 frequencies
 - Normal is 100% SD 40 dB above the average of the PTA thresholds
 - 50% at 25 dB above average of PTA thresholds
- Interpretation
 - 90-100% - normal
 - 76-89% - Slightly abnormal
 - 60-74% - Moderate
 - 40-59% - Severe
 - < 40% - Very severe
- Remember it tests for sensation level, so if you already have a 25 dB hearing loss, and your 100% SD is at 40dB, the PTA value would be at 65 dB

Balance:

- Nystagmography
 - Video / Infra-red / Frenzel glasses
- Caloric testing
- MRI / CT
- Bloods

Radiology:

- CT (high resolution)
- MRI

Bloods:

Many auto-immune conditions can affect the ears. Of the well-known ones include Granulomatosis with Polyangiitis (GPA) (previously known as Wegener’s), Cogan syndrome, Rheumatoid arthritis, SLE etc.

Syphilis remains something we see in the public sector in the Western Cape, but it will be exceedingly rare to see in most settings.

HIV is another infective pathogen known to cause hearing loss and for which patients should be tested.