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Treatment Updates

Hearing

INTRODUCTION

Hearing is one of the five major senses. Although vision is generally considered to be the major sense hearing is of fundamental importance in terms of one's ability to enjoy life. The sensitivity and sophistication of the hearing organ is such that if vision were as complex and evolved one would be able to see a blade of grass on Mars.

Hearing tests are conducted to ascertain whether hearing is normal or not and if there is a problem with hearing where that problem lies anatomically. This, combined with physical examination, enables the ear, nose and throat surgeon to formulate strategies to treat and/or refer on for appropriate hearing aid rehabilitation. Essentially hearing tests are done for two main reasons. One is to diagnose the cause of hearing loss and secondly to help in the fitting of appropriate amplification devices such as hearing aids in those patients with documented hearing loss.

WHERE

Hearing tests are conducted in acoustically-insulated testing booths which are calibrated to an international standard using audiometers (hearing testing devices) which are also calibrated to international standards. Hearing tests that are not done in a hearing booth are by and large less reliable than those done in optimal circumstances.

Testing protocols have been established to ensure a standardised set of guidelines to enable optimal test, re-test reliability and to facilitate hearing tests being compared from clinic to clinic, from state to state or even from country to country.

WHO

In Australia there is no standardised law specifying qualifications for the performance of a hearing test. Therefore it is important that you know the qualifications of the person performing your hearing test. They fall into several categories.

Audiologist

An Audiologist is a person who has had at least four years of university training, with the current qualification in New South Wales being a postgraduate masters degree in audiology. Members of the Audiological Society of Australia have their qualifications checked and verified by the Society and undertake continuing professional development to maintain a current clinical certificate. This ensures that they are of the highest calibre of training and they are up to date with the latest in terms of audiological developments.

Audiometrist

An Audiometrist is someone who has undertaken a six-month TAFE course in basic hearing testing and hearing aid fittings. They have less formal training than audiologists and are able to perform standard audiograms and fit hearing aids in the adult population. For more complex adult problems and for the testing or fitting of hearing aids in children an audiologist qualification is essential.

Nurse Audiometrists

Nurse Audiometrists usually have a degree in nursing and rudimentary training in screening audiometry. They are essentially used for the screening of children's hearing in childcare centres and in a community health setting. Nurse audiometrists usually work under the supervision of an audiologist, or an otolaryngologist, be that in a private practice or in a public health setting.

SWIS-H
(State-Wide Infant Screening – Hearing)

A specialist sub-group of audiologists are those involved in the SWIS-H (State-Wide Infant Screening – Hearing) programme. These audiologists have specific training to undertake the testing of every newborn in New South Wales. This is a statewide programme to test the hearing of all newborn babies to ensure that their hearing is normal or near normal, to facilitate the development of normal speech and language. In the first six months of life our hearing system

develops remarkably quickly with specific parts of the brain developing to allow the "switching on" of brain activity specific for language development. Hearing loss during this time of life can have profound effects on the development of speech and language.

WHEN

Hearing assessment, preferably under medical supervision, should be undertaken whenever a change in hearing is noticed. This could be in one or both ears. It may involve a sensation of fullness or blockage in the ear, a deterioration in the clarity of the spoken word, differential hearing in one ear compared to the other or the development of noises in the ear (tinnitus). If these changes are sudden it is important to get a prompt assessment and hearing test conducted because some of the causes of damage to the inner ear have to be treated within the first 72 hours for the best chance of them responding to treatment.

HOW

Hearing tests vary according to the age of the individual to be tested, the capacity of the individual to co-operate with testing procedure and the reason for the test being done.

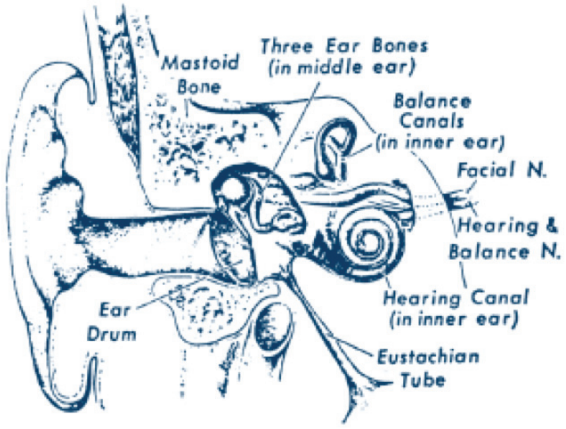
A basic adult hearing test comprises three components. An **audiogram** is a measurement of the threshold of hearing, that is to say the softest level of sound audible across a range of pitch, presented to the right and left ear independently. **Speech discrimination** is a test to detect the ability of the ear to unravel sounds which sound similar such as hat, cat, bat and rat. Finally, **tympanometry** is a measure of middle ear pressure and compliance. These three tests, together with clinical examination, provide a picture of how the outer, middle and inner ear are functioning.

For young children (3-5 year olds) a modified version of the audiogram is performed, something called **play audiometry** where threshold levels (or near threshold levels) can be reliably established by creating a game out of the test. The child is instructed to place a block in a stack or something similar each time they hear a sound. For most children of this age group a reliable audiogram including masking can be undertaken.

For children under the age of three a **behavioural screening test** is used – visual reinforcement operant audiometry (VROA). This is usually undertaken by two test audiologists and involves the child playing quietly in a room with a speaker. A sound is presented through the speaker (loud enough to be easily heard) and when the child turns to the sound a reward (usually a friendly puppet) is seen. This is repeated until the child learns to associate the sound with the reward and then the volume of the sound is reduced to establish hearing thresholds.

For babies and for people not able to undertake the behavioural testing described above, technology has allowed for electrophysiological measures of hearing to be undertaken. The SWIS-H programme, already mentioned, uses an Auditory Brainstem Evoked Response protocol which records electrical activity from the brainstem in response to sounds of varying frequency introduced into the ear. Similarly Cortical Evoked Potentials can be recorded from adults unwilling or unable to undertake behavioural audiometry as described above.

EAR ANATOMY



The ear has three parts, the outer, middle and inner ear. The outer ear comprises the pinna (ear lobe) and the ear canal. The middle ear is the air filled space behind the drum with three little bones (ossicles) and a vent pipe (Eustachian tube) to the back of the nose throat (nasopharynx). The ossicles form a bridge between the drum and the inner ear and the configuration of these bones (the malleus, incus and stapes, or commonly known as hammer, anvil and stirrup) create a significant mechanical advantage by concentrating the sound from the eardrum (about 12 mm diameter) to the plate of the stirrup (about 2 mm diameter). This delicate yet robust anatomy gives us the ability to hear softer sounds. Without this structure our ability to hear is effectively halved.

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The inner ear comprises the cochlea (snail looking structure) and semi-circular canals (part of our balance system). The cochlea contains an amazingly complex array of some 30,000 inner and outer hair cells (or nerve endings) which establish an ear/brain interaction to enable us to decipher speech sounds in adverse situations – for example being able to have a conversation in a noisy café, where speech sounds are embedded in other speech sounds. The nerve transmitting to the brain is the eighth of twelve cranial nerves which allow our brain to interact with our sensory input/output system.

CAUSES OF HEARING LOSS

Outer ear

Blockage of the ear canal by wax, keratin, foreign body, swelling of the skin associated with infection, bony humps caused by exostoses or infection in the ear canal can cause a decrease in both hearing volume and acuity.

Middle ear

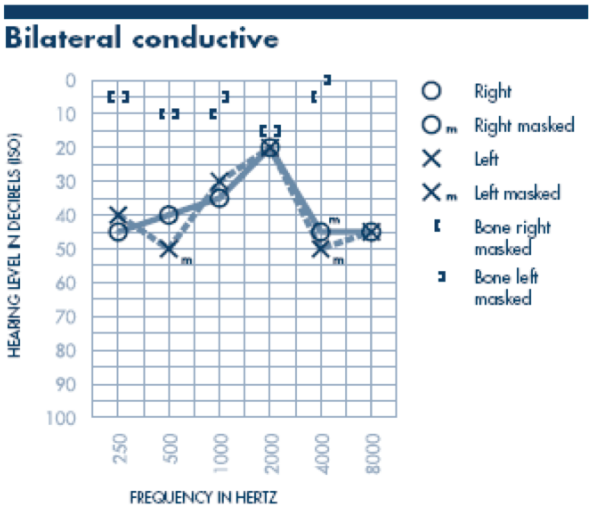
Perforations (holes) of the eardrum caused by infection or injury, tympanosclerosis or infections of the eardrum. The bones of the middle ear can be damaged through trauma, repeated or prolonged middle ear effusion, infection, otosclerosis or cholesteatoma. The middle ear space can be compromised by Eustachian tube dysfunction leading to otitis media with effusion and if left untreated may lead to problems with the eardrum, the three little bones or the ligaments between the three little bones causing permanent conductive hearing loss.

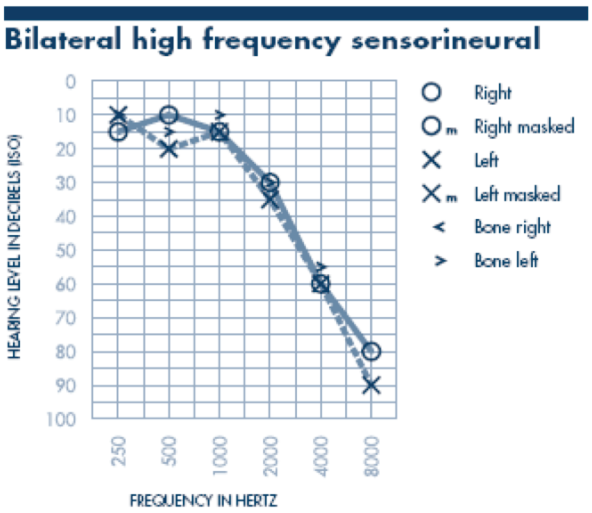
Inner ear

The most common cause of inner ear hearing loss is presbycusis or age related hearing loss. This is exacerbated by excessive noise exposure and is the main cause of hearing loss in the adult population. Both presbycusis and noise induced hearing loss tend to be bilateral and symmetrical. Genetic abnormalities can lead to congenital or progressive sensorineural (inner ear) hearing loss of varying degrees. Specific diseases of the inner ear such as Meniere's disease and autoimmune disorders, viral infections leading to sudden unilateral sensorineural hearing loss, head injury, otosclerosis, Paget's disease and a variety of other illnesses and infections can cause damage to the inner ear or the nerve of hearing.

The most common tumour affecting the nerve of hearing/ balance is an acoustic neuroma, which is a benign slowly growing tumour of the nerve sheaths. This usually presents as one-sided progressive hearing loss with or without dizziness but is slowly progressive. Disorders affecting the brainstem or the auditory cortex can cause hearing loss but in the absence of large brain tumours or strokes are uncommon.

Hearing loss is divided into **conductive** where the sound wave is impaired getting from the outside world through the ear canal and middle ear to the inner ear; and **sensorineural** where there is a problem at the level of the cochlea or along the nerve of hearing. Presented at right are typical audiograms of a conductive hearing loss, a bilateral sensorineural hearing loss and a right-sided unilateral sensorineural hearing loss. The diagnosis of hearing loss and its cause is a collaborative affair with the otolaryngologist relying on accurate testing of hearing function performed by suitably qualified audiologists.





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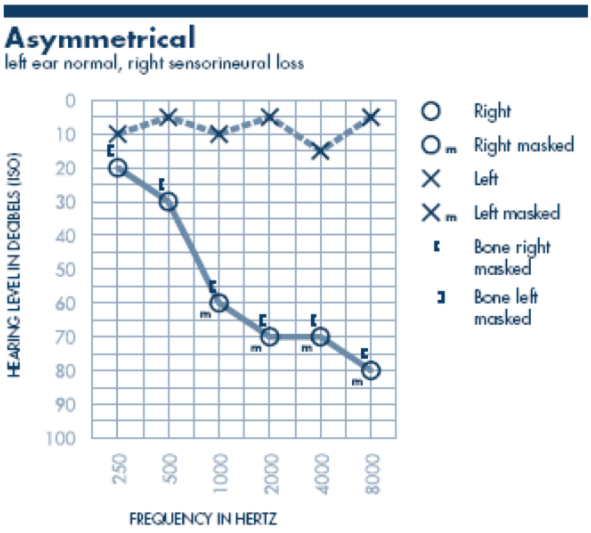

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