

Lecture 3

Types of Hearing Aids

Facts on Hearing Loss in Adults:

- One in every ten Adults has hearing loss and the prevalence of hearing loss increases with age.
- While hearing aids can help about 95% of them, only 25% use hearing aids.

WHY?

- Stigma associated with wearing a Hearing Aid (HA)
- Denial about one's Hearing Loss (HL)
- Exorbitant cost (eg. A pair of Widex Senso Diva BTEs cost around \$11,000)
- Current HAs do not meet user expectations

Definition of a hearing aid:

- Is a device that processes sound in such a way as to make the information it conveys more accessible to the user.
- It is an integral part of the receptive communication chain, which includes the signal source and listener.
- It should be seen as only one important part of a programme to minimize disability and handicap arising from hearing impairment by optimizing the partially hearing or deaf user's access to acoustical information.
- (Barry McCormick-Paediatric Audiology 0-5 years)

Reasons for fitting a hearing aid:

- Significant hearing impairment (monaural/binaural)- both permanent or temporary-SNHL/Conductive/ and Mixed types of loss.

ADVANTAGES of Hearing Aids

- Habilitates/ Rehabilitates
- Improves communication
- Aids speech development
- Social & education

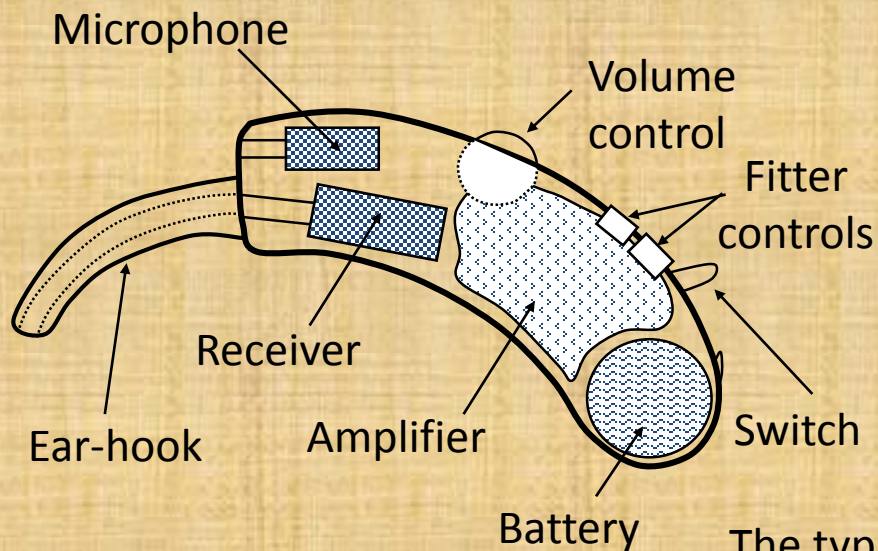
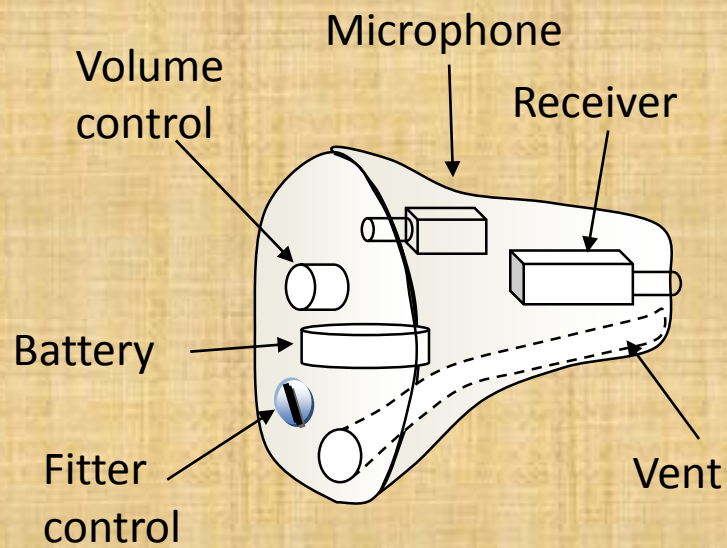
Styles of Hearing Aids



Hearing Aids

- There are many types of hearing aids available today. All air conduction hearing aids have the same basic components, which include a microphone that transduces sound to electrical energy, and amplification stage, an output transducer called a receiver, and a battery to power the electronics.

Component location



The typical location of components in an ITC and a BTE hearing aid.

Glossary:

Acoustic feedback

- Acoustic feedback refers to the whistling sound that occurs when amplified sound escapes from any part of the hearing aid and re-enters the hearing aid microphone. This sets up a cycle of reamplification and leads to the unpleasant whistling or squealing sound.

Glossary:

Concha bowl

- This is the name given to the recessed portion of the outer ear that surrounds the entrance to the ear canal.

Electroacoustic

- This refers to the characteristics of the hearing aid that are determined by electrical rather than physical or mechanical boundaries. The amplifier, microphone and ear phone are the main electroacoustic components of the hearing aid.

Glossary:

Frequency response

- Frequency response refers to the gain of the hearing aid at each of the different frequencies being amplified. Different amounts of gain are usually required at different frequencies and the audiologist adjusts the frequency response to ensure a fitting that is not only comfortable but gives the best listening assistance.

Glossary:

Gain

- Gain refers to the additional amount of sound that the hearing aid provides and is expressed in decibels (dB). Gain refers to how much amplification the hearing aid is providing.

Power

- Power is a shortened form of the term 'maximum power output' (MPO). It refers to the loudest sounds that the hearing aid can produce. The power characteristics are set so that the hearing aid, even if it is attempting to amplify loud sounds, will not cause discomfort by presenting overly loud sounds to the ear.

Glossary:

Sound bore

- The sound bore is the passage through the earmold or tubing that sound travels through.

Types of Hearing Aids:

- The first type is the behind the ear or BTE hearing aid. This device consists of an ear mold that sits in the concha connected to the unit that is worn behind the ear. This is the most common type for children.

BTEs are very popular because:

- they can be fitted to any loss from mild to profound
- they can easily be connected with an FM system
- a range of modifications to improve the aid's performance can be made to the ear mould, tubing or the ear hook as well as to the aid itself.

Advantages of BTE

- The larger the device the greater the number of circuitry options available,
- fewer repair problems
- ability to produce more powerful amplification
- ability to use open ear molds which can benefit those in whom moisture buildup is a problem and in those with chronic otitis externa because of the ease of cleaning the ear mold, and less manual dexterity needed to insert them.

BTE

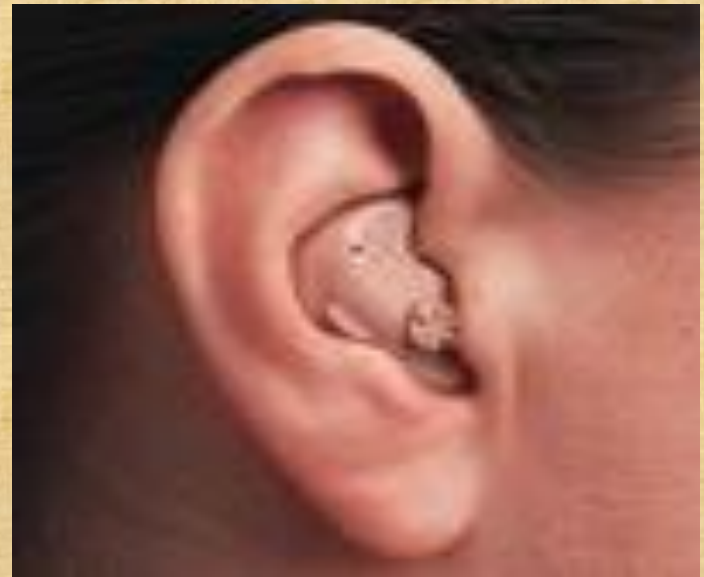
- Disadvantages include large size, more noticeable, microphone in poor location for localization of sound it is above the pinna, and loss of the benefit of using the acoustic properties of the pinna and concha, and vulnerable to scalp perspiration.
- As smaller hearing aids have begun to offer more options this type has become less popular.

BTE



ITE

- The second type is the in the ear or ITE hearing aid. This type of aid fits into the concha.



Advantages of ITE

- This device is smaller than the BTE, without the unit behind the ear
- generally still offers many circuitry and venting options.
- The microphone is at the level of the ear canal
- This is one of the most popular hearing aid choices.

Disadvantages of ITE

- advantages of using the pinna and concha are lost
- it is still visible.

ITC

- A third type of hearing aid is the canal or ITC type. This device fits almost completely in the external auditory canal with a small protrusion lateral to the meatus.



Advantages of ITC

- This type provides better cosmetics than the types mentioned above
- It is able to take advantage of the natural influences of the pinna and concha.

Disadvantage of ITC

- It requires more dexterity to use
- some circuitry and venting options are not available with this type of aid.

CIC

- A fourth type of hearing aid is the completely in the canal or CIC type.
- This relatively new type takes advantage of micro circuitry to fit all of the hearing aid components into a device that fits into the external auditory canal just lateral to the tympanic membrane.
- It is removed by grasping a small plastic string or wire attached to its lateral aspect.

CIC





NEW IIC

Old CIC

Advantages of CIC

- This type of aid obviously provides the best cosmetics of any type.
- It also is able to fully use the benefits of the pinna and concha.
- The medial end is within 2mm of the tympanic membrane so gain requirements are lower.

Disadvantages of CIC

- Include the need for manual dexterity to handle
- some limitation in circuitry available (although this is rapidly changing)
- the proximity of the microphone to the receiver making feedback a problem
- easily lost due to its small size.

- Many people report that ITE and ITC and CIC aids have a very clear sound and this is thought to be because the microphone is actually in the ear itself.
- Due to problems with feedback, only mild and moderate hearing losses can be easily fitted with an ITE or ITC or CIC aids. The fitting of more severe losses with these types of aids is currently being explored.

- For children, ITE and ITC fittings are also limited by:
- the size of the child's ear canal
- the need for frequent refitting due to growth
- difficulties involved with attaching an FM system.

RITE or RIC

- Within the behind-the-ear (BTE) hearing aid category, hearing aids can be further subdivided into Receiver-in-the-Aid (“RITA” or “traditional”) and Receiver-in-the-Canal (“RIC”).
- The receiver – or speaker – amplifies sound, which must pass through a tube to the ear canal (in an RITA) or is simply projected directly from a speaker in the canal (in an “RIC”).

Behind-the ear (“BTE”) hearing aids



Receiver in the aid (RITA)



Receiver in the canal (RIC)

- A [2010 paper for the Journal of American Audiology](#) that compared RITA to RIC hearing aids found that RIC models were equal or superior in all measured respects. Specifically:
 - RIC hearing aids reduced feedback. They were able to produce higher gain (louder amplification), without feedback.
 - 76% of study participants preferred RIC hearing aids to RITA
 - This preference held both for new hearing aid users (74%) and experienced hearing aid users (80%)
- In short, the study strongly suggested the superiority of RIC hearing aids for mild to moderate hearing aids.

Candidate

- Bilateral hearing thresholds better than 40 dBHL at 250 and 500 Hz, and no worse than 70 dBHL from 2 kHz and above

The following types of hearing aids are used in patients with special situations:

- The first type is BW-Body Worn Hearing Aids. These were the original electrical (electronic) hearing aids fitted.
- They consist of a box which contains an amplifier, microphone and battery.
- This box may be worn in a pocket, in a harness on the body, or clipped onto a belt.
- A cord connects the amplifier to the ear mould which is inserted into the ear.

- Body worn aids are no longer commonly fitted to children but for some profoundly deaf children they provide the best amplification with the least amount of acoustic feedback.
- Advantages High Powered aid for profound hearing losses and it is very robust.
- Disadvantages: Cosmetically poor, heavy/cumbersome/ cord, 'Body Baffle' or Clothing rub.
- This is Fitted in exceptional circumstances.

Body Worn Hearing Aid



CROS

- Second type is a contra lateral routing of signal or CROS aid. CROS hearing aids are for people who are **deaf** in one ear and have **normal**, or near normal, hearing in the other ear.
- They consist of two parts. The person wears what looks like two hearing aids in one of two styles—either a behind-the-ear (BTE) aid, or a in-the-ear (ITE) aid.

CROS

- The “hearing aid” on the deaf ear basically consists of a microphone (to pick up sounds on the deaf side) and a transmitter.
- The transmitter sends these sounds (either via a cord joining the two “aids,” or more commonly, via radio waves) to the “hearing aid” on the good ear.

CROS

- This second part of a CROS aid system basically consists of a (radio) receiver (if using the wireless system) and an amplifier.
- It amplifies the sounds it receives from the deaf side, and then feeds these sounds into the good ear via a plastic tube (if a BTE style), or directly into the ear canal (if an ITE style).
- CROS ear molds are of an open fit design so they don't block the sounds the good ear hears naturally.

CROS



Wireless CROSS



ITE Receiver



CRX BTE Receiver
(attaches to audio shoe)



CTX Transmitter

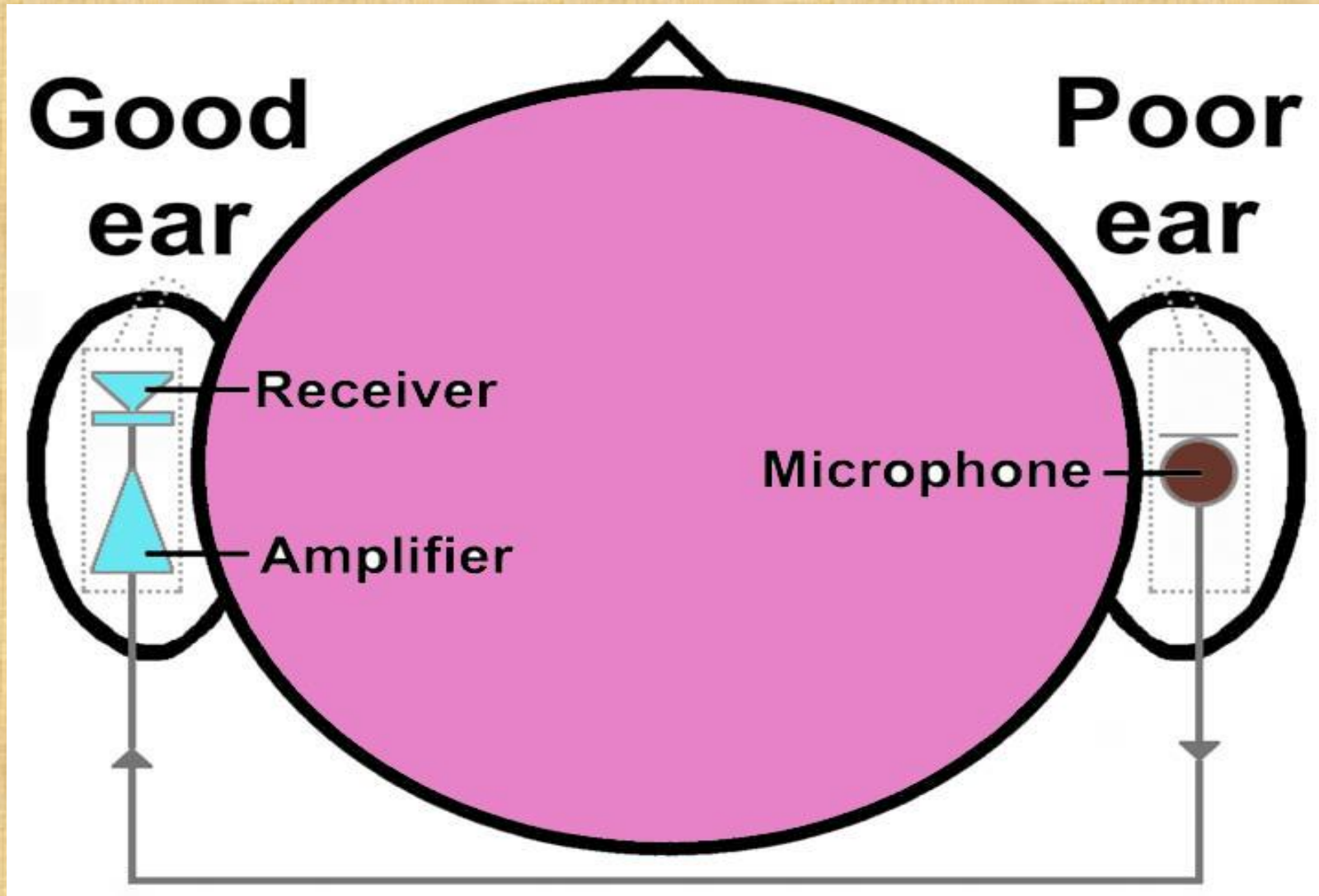
CROS

- Incidentally, you don't need a tightly-fitting ear mold as feedback isn't an issue with CROS aids since the microphone is on the opposite side of your headwell away from the "ear mold."
- Since the person has normal or near normal hearing, the sound doesn't have to be amplified much.

CROS

- This allows the hearing ear to receive signals from the other side.
- That is the microphone at the bad ear sends the signal to the good ear.
- This device prevents the head shadow effect which is the decrease in signal presented to one side of the head when it is measured on the opposite side of the head.

CROS



Bi-CROS

- A third type is used for a patient with hearing loss in both ears but worse on one side may benefit from a Bi-CROS aid.
- Bi-CROS hearing aids are similar in many respects to CROS aids, but have this one major difference.
- They are for people who are **deaf** in one ear and are **hard of hearing** in their other ear.

Bi-CROS

- The part that is worn on the deaf ear is identical to the CROS aid.
- The difference is on the side of the ear with the hearing loss.
- This part of the Bi-CROS system does the same thing as the CROS system did, but, in addition, it also includes a “regular” hearing aid for the hard of hearing ear.

Bi-CROS

- The Bi-CROS unit combines the signals from both ears and then feeds them into the hard of hearing ear via a normal tightly-fitting ear mold, as otherwise there could be problems with feedback.
- This provides amplification to the better ear as well as routing the signal from the poorer hearing ear.

Why do we hear our voice quality different when we hear it on tape?



Bone Conduction Hearing Aids

- A fourth type is Bone Conduction Hearing Aids. Fitted on a headband with a BTE or BW aid adaptation.
- It is used for a Conductive type hearing losses. Fitted to congenital abnormalities/atresia or discharging ears.
- Disadvantages: Often too large for paediatrics, Limited output, Distorted sound, Poor cosmetic appeal.

Bone Conduction Hearing Aids



Soft bands reduces pressure to one part of head



BAHA

- A fifth type is Bone Anchored Hearing Aid-BAHA. Surgical Intervention is required for this type of hearing aid.
- It is used for patients who need permanent bone conduction amplification. Used with children with Downs Syndrome.

Definition BAHA

- A hearing aid attached to an implanted abutment that transmits sound through Bone Conduction to the cochlea, bypassing the outer and middle ear structures .

BAHA

BAHA system is comprised of three parts:

- Titanium fixture
- Connecting abutment
- Detachable sound processor

BAHA



BAHA

Here are some facts about it:

- The device takes sounds and converts them to vibrational energy, sending them *through* the skull to the good ear, without involving the ear canal on either side.
- BAHA is made with Titanium, a metal which actually bonds with bone tissue at the molecular level (this is termed *osseointegration*), and the bone then acts as a pathway for sounds to travel.

BAHA

- It requires a 30-60 minute surgery with a local anaesthetic, comparable to a dental procedure; the patient can go home immediately afterwards.
- During this surgery, 3mm or 4mm titanium implant (a stud) is mounted on the skull behind the deaf ear. It takes about three months for the implant to bond to bone tissue, after which it is connected to the sound processing device.

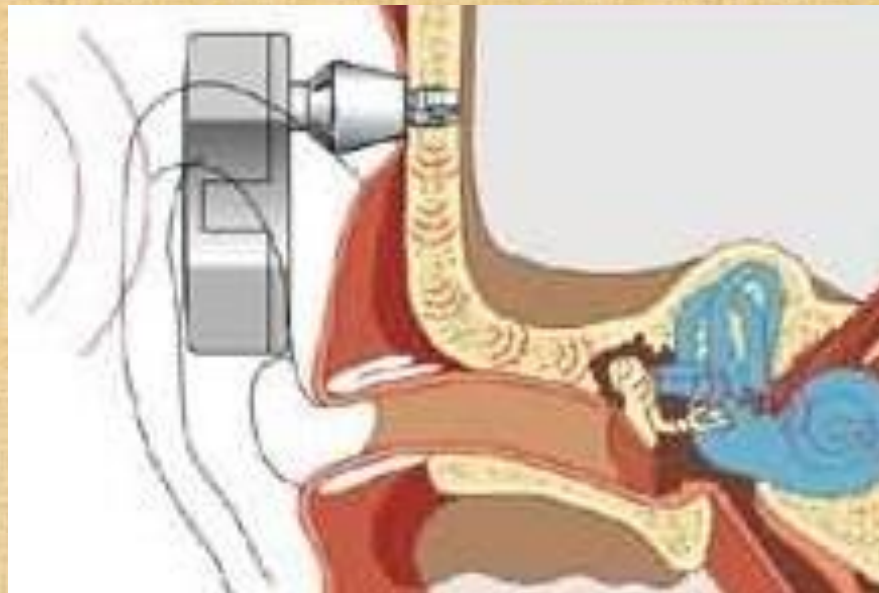
BAHA

- This is a small digital device (about 5/8 inch by 1/2 inch by 1/4 thick). It just press fits onto the stud, and can be unclipped when the patients does not want to wear it. There are no devices in or around the good ear. If a person is dissatisfied it can be removed.

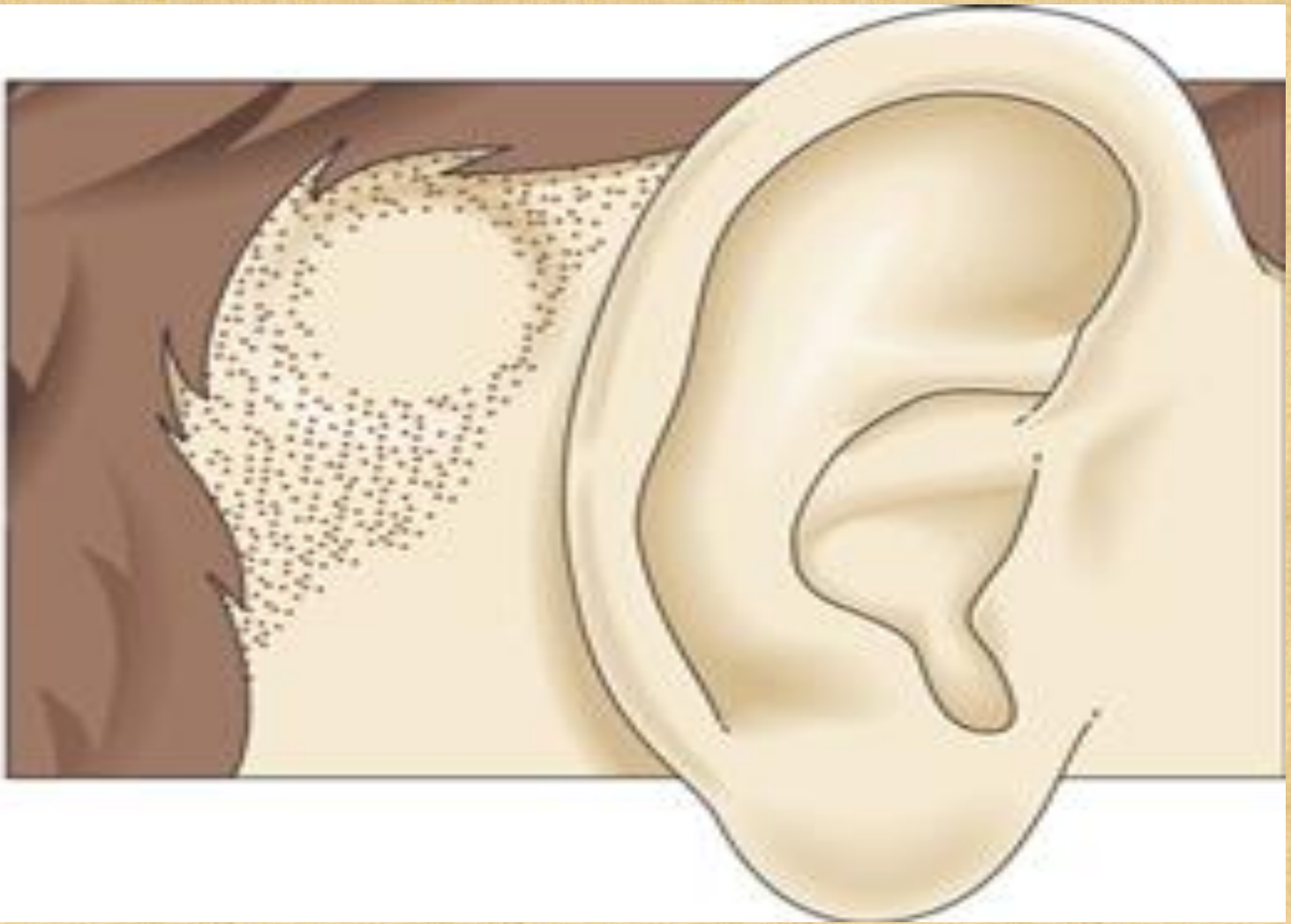
BAHA

- The ability to hear seems to improve with time. That is, hearing is typically better at one year post placement than at 6 months post placement.
- Advantages more reliable than conventional BC Aids, and better sound quality.

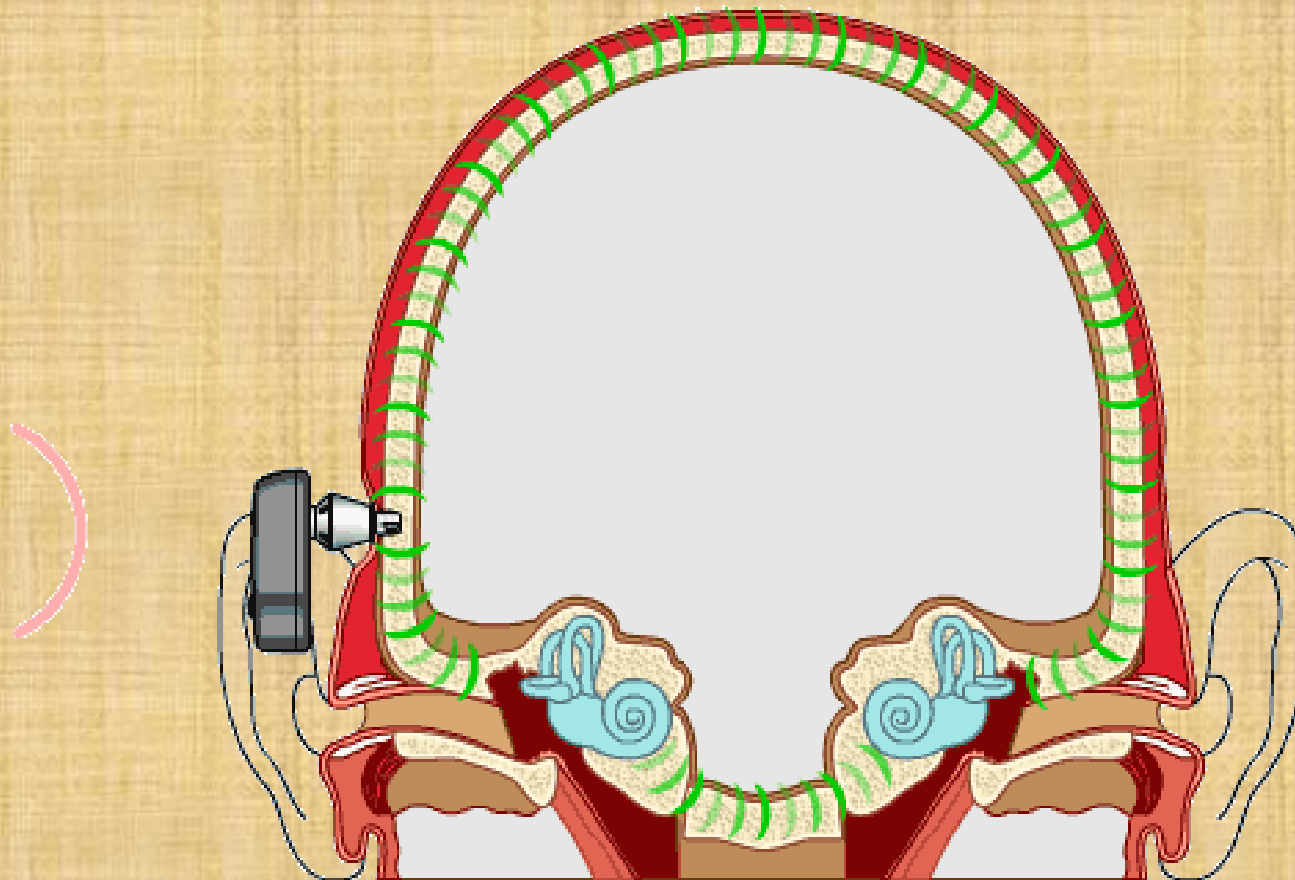
BAHA



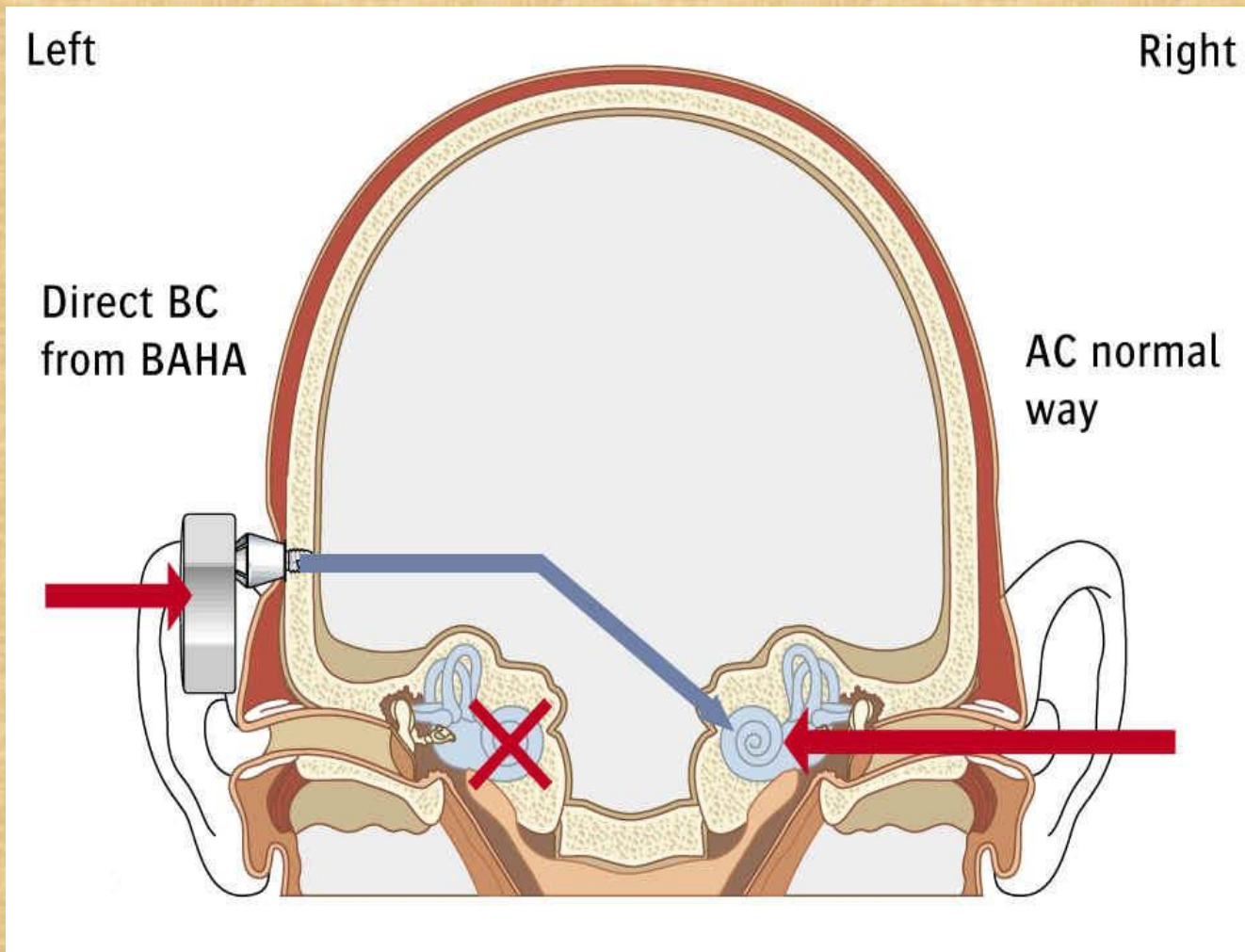
BAHA



BAHA



BAHA



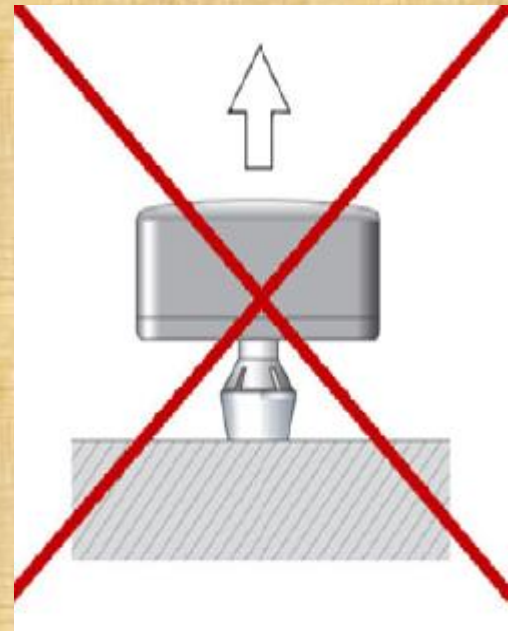
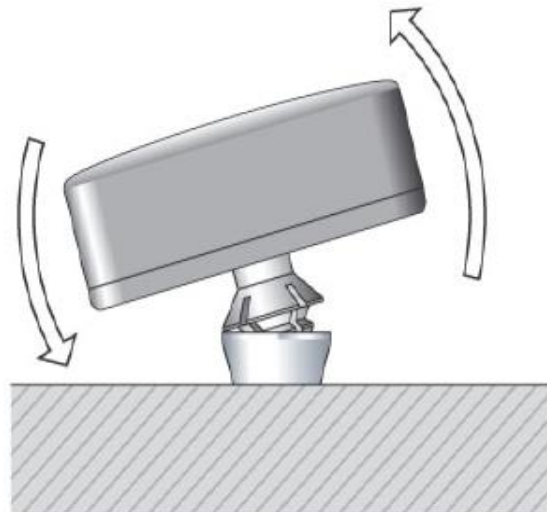
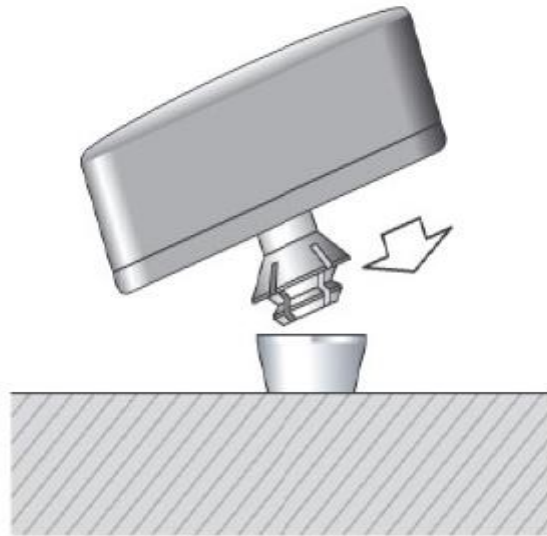
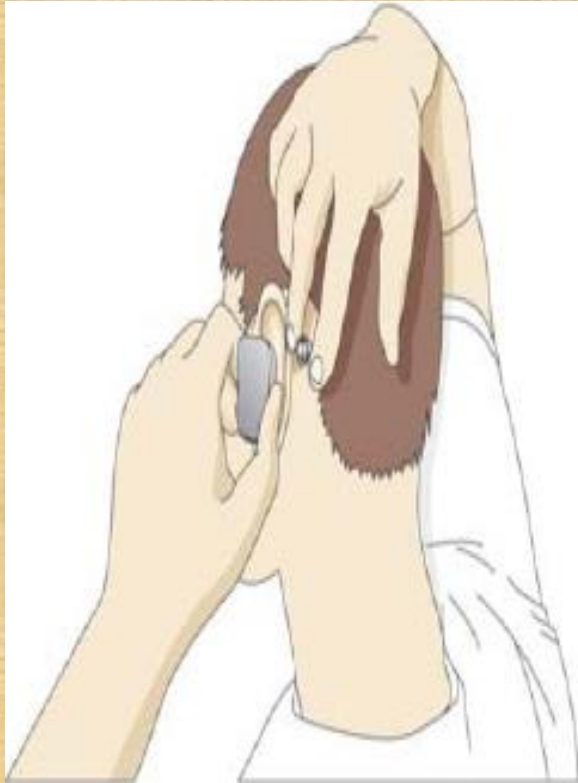
Indications:

- > 5 years old
- Mixed or conductive hearing loss
- Bone conduction pure-tone average in the indicated ear is greater than or equal to 45 dB HL measured at 0.5, 1, 2, 3 kHz
- Monosyllabic word discrimination score $\geq 60\%$
- For bilateral fittings – candidates must have symmetrical bone conduction pure-tone averages between ears. No greater than 10dB difference.
- For single sided Deafness, candidates must have normal hearing in one ear (AC PTA < 20 dB HL) and profound hearing loss in contralateral ear.

Candidates:

- Chronic otitis media
- Congenital aural atresia
- Microtia
- Cholesteatoma
- Middle ear dysfunction or disease
- Acoustic neuroma tumors
- Tumor removal surgery
- Sudden deafness
- Neurologic degenerative disease
- Meniere's disease
- Viral infection
- Trauma

Fitting



Spectacle Aids

- Sixth type is Spectacle Aids for AC or BC. They are rarely fitted to paediatrics. They are expensive.



- <http://www.cochlear.com/wps/wcm/connect/us/home/treatment-options-for-hearing-loss/bone-conduction-implants/baha-softband>