TECHNOLOGY AND DISABILITY

COURSE CODE: C 15

UNIT 1: LISTENINING DEVICES AND CLASSROOM ACOUSTICS

SUBMITTED BY- MINAKSHI KUSARI

Introduction

Hearing impairment has a large impact on overall development and well being of the individual. Most importantly it impairs communication and makes the individual socially isolated. It is mandatory to reduce hearing problems in order to improve communication in individuals with hearing loss. Listening devices are instruments which provide the desired amplification for these individuals. The use of appropriate amplification device improves quality of life as the communication skills, academic performance, social life and mental well being of the hearing impaired individuals are positively enhanced. They become better integrated to the normal hearing world.

Objective

1. In this unit we will learn about various **Listening Devices**, their functioning, and utility.
2. In this unit we will learn about basic components and functioning of hearing aid, different types of hearing aid and different technologies used in hearing aid.
3. In this unit we will learn about the various outcome measures used in hearing impaired individuals
4. In this unit we will learn about various classroom amplification devices available. Individual and group systems will be discussed.
5. In this unit we will learn about the various implantable devices, their components, functioning and importance.
6. In this unit we will learn about recent updates in ADIP scheme (2014) and how it is important for hearing impaired individuals.
7. In this unit we will learn about care and maintenance of individual hearing aids, group hearing aids and cochlear implants.

LISTENING DEVICES: TYPES

What are Listening Devices?

Listening devices are used for hearing impaired individuals to compensate for their hearing loss. These devices aim at making all sounds available in the environment as well as speech of others, audible and clear for hearing impaired individuals. These devices are available in a variety of types depending on style, size, capacity (power) and technology. There are many makes/brands available commercially which vary in price range again depending on the above mentioned types.

In some situations amplification device (such as hearing aids, Cochlear implants etc) is not sufficient alone. In such cases these devices are paired with Assistive Listening Devices. Assistive Listening Devices (ALD) can be worn separately or paired with the amplification device. E.g FM system, Loop induction system etc

Another very important classification is based on the place of stimulation done by the respective devices. The device can deliver amplified sounds directly to the external ear, or directly to the hearing nerve, or directly to the mastoid bone (bone behind external ear).

Listening devices again can be broadly classified as

1) Hearing Aids
2) Cochlear Implants
3) Middle Ear Implants
4) Bone Anchored Hearing Aids
5) Auditory Brainstem Implants.

TYPES

INDIVIDUAL VS GROUP LISTENING DEVICE

INDIVIDUAL LISTENING DEVICE – This type is useful for one individual at a time. It is a called a personalized device. The speech and other sounds are picked up by the device and delivered to the individual wearing it. The amplification device (hearing aid or cochlear implant) has a microphone on its surface to pick up sounds/speech, which is amplified inside the device and then delivered directly to the individual's hearing system. The individual can carry it with him/her. It is totally wearable and portable. Assistive listening device also can be individual in nature e.g FM system which can be paired with individual hearing aid.

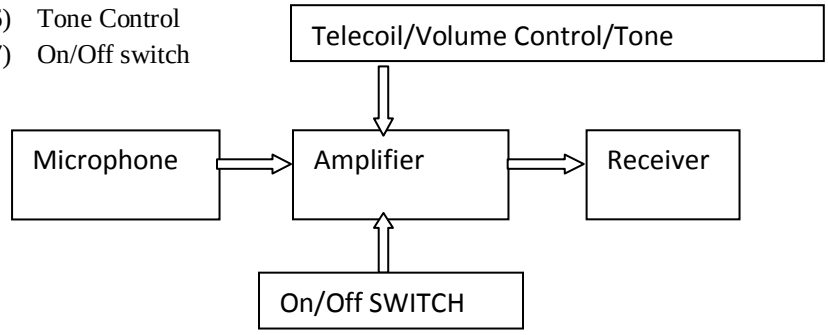
GROUP LISTENING DEVICE - As the name suggests this system aims to help a group of hearing impaired individuals at the same time with a common device. This arrangement is usually used in a special classroom. The teacher has a microphone which picks up the teacher's voice, which is then amplified and sent to headphones/receivers worn by multiple students. So the teacher's voice is heard clearly by a group of students.

Assistive Listening Devices such as loop induction system can also be installed in large areas like classrooms where a loop is installed across the room. The sounds picked up by the microphone are transformed and run through the loop. The telecoil of the hearing aids worn by individuals picks up the signal and it is heard by the individual.

Functioning of Hearing Aids

Before understanding the basic working of a hearing aid, it is essential to know the parts of a hearing aid. The basic parts are as follows:

1) Microphone
2) Amplifier
3) Receiver
4) Telecoil
5) Volume Control
6) Tone Control
7) On/Off switch



Block Diagram of a Hearing Aid

The microphone picks up sounds around it and sends to the amplifier, where the sounds are amplified and filtered in many ways and then finally sent to the receiver which is worn by the hearing impaired individual in his external ear. The hearing aid is powered by a battery. The electronic components consist of transducers, capacitors, resistors, transistors, printed circuit boards are used. An electromagnetic coil system is used to make the telecoil , which helps to hear telephone conversation, speech in induction loop systems etc.

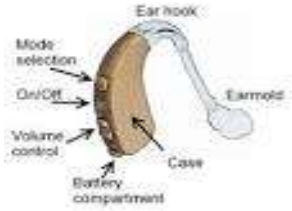
CLASSIFICATION OF HEARING AIDS

BASED ON STYLE

The earliest of amplification system were very basic, non electronic models like ear horns, trumpets etc. Research and development led to the first electric hearing aids which gradually improvised in style and size in order to satisfy the technological advancements as well as cosmetic preference of users. Hearing impaired individuals mostly wanted hidden hearing aids so the miniaturization of size was gradually developed in hearing aid industry.

1) **Body level hearing aids** – As the name suggests the hearing aid is worn on the body of the hearing impaired person(e.g. in the pocket/blouse). The body of the hearing aid has a cord which connects to a receiver, which looks like a button and worn in the ear of the hearing impaired person.

2) **Behind the ear type** – These hearing aids are wearable over the pinna or behind the external ear. The basic parts inside the hearing aid are similar to body level hearing aid only miniaturized in size and advanced technology. The whole hearing aid fits behind the ear, the receiver is also housed in the hearing aid case. The amplified sound reaches the ear via a ear mould or ear tip.



3) **In the ear hearing aids** – These hearing aids are wearable inside the ear, the body of the hearing aid sits in the ear canal with its external part/faceplate sits at the start point of ear canal i.e. concha. As these hearing aids are smaller than the previous two styles, the internal parts are yet more miniaturized and placed closer to each other in the hearing aid case. As a result these hearing aids come with a lower output or capacity as compared with the previous two styles.

4) **Completely in the canal hearing aid -** This type is even smaller than the previous type and sits deeper inside the ear canal. It's almost invisible from outside. As it is even smaller, it has the lowest output/capacity among all styles. This type is customized and made according to the shape and size of the ear to be fitted.

5) **Receiver in the canal**- It looks similar to a miniaturized behind the ear hearing aid. The receiver of the hearing aid sits in the ear canal in a separate case/tip and connected via a slim tube with the rest of the hearing aid. The capacity of the receiver can be changed depending on the hearing loss of the person.

6) **Bone Conduction Hearing aid** – In some hearing impaired persons conventional hearing aids cannot be fitted. The reason can be malformation of external ear, absence of external ear or a actively discharging ear (presence of pus discharge most of the time due to some active infection in the ear). In these cases a body type hearing aid/behind the ear hearing aid is fitted with a bone conduction receiver, which resembles the one used for bone conduction testing. The bone conduction receiver is placed on the mastoid bone behind the external ear. The amplified sound is transformed into vibrational energy and then delivered to the mastoid bone.

CLASSIFICATION BASED ON TECHNOLOGY

In earlier days the basic technology used in a hearing aid was quiet simple. All the signal/sound picked up by the microphone of the hearing aid was amplified by a common factor without any other alteration. The final sound delivered was just an amplified version of the input sound. However due to limitations of the components inside the hearing aid, the sound was degraded and distorted in most of the cases as it reached the user's ears. The problem increased when the loudness of the outside sound increased or when the signal was a speech in presence of a background noise. But with the advent of technology the hearing aid industry witnessed a lot of progress within a

short span of time. As computer technology advanced, processing speed increased, it was possible to incorporate many features in the hearing aid with less power consumption. Also circuit size could be reduced dramatically.

The technology followed the development path:

Analog- Analog programmable- digital- digitally programmable

ANALOG HEARING AID

These hearing aids continuously make the incoming signal louder. The circuits treat all incoming signal similarly. As the incoming signal becomes louder the analog hearing aid makes it even louder. Some sort of limiting circuits are implemented in the analog circuit, where in the amplifier stops after the incoming signal crosses a particular level of loudness. It is used in body type, behind the ear and even In the ear hearing aids. This technology seems to be helpful for severe to profound losses as compared to lower degrees. Moreover this technology works best for quiet environment. In noisy situations, speech is not clear, as speech and noise are amplified in a similar fashion. This technology will also be helpful for flat hearing losses as compared to sloping hearing losses. Usually the hearing aids using this technology come with simple controls. Other than volume control, there are certain trimmer control options (H N L). Wherein depending upon the slope of hearing loss, low/high frequencies can be emphasized. For flat hearing loss, N (normal) position is the best. Moreover the maximum power output (MPO) can also be adjusted wherein the overall output from the hearing aid can be reduced/increased according to patient's need. This technology comes with fixed gain and maximum output with minimum adjustments possible.

ANALOG PROGRAMMABLE

With the development in computer technology, hearing aids could be designed with a memory. The hearing aids could be programmed in different ways and the two or three programs could be stored and retrieved from memory. The programs can be two different settings in the same hearing aid. e.g one program for indoors and one for outdoors.

DIGITAL HEARING AIDS

Even more advancements in computer technology led to the advent of digital signal processors. Digital Signal Processors were used in hearing aids. This enabled the hearing aids to convert the input signal/incoming signal, picked by the microphone into digital signals (binary digits). This resulted in faster and much better processing i.e, the output was much better in quality and a better representation of the input signal (original sound). Many studies have shown that in the same group of persons with hearing loss, performance was much better with digital hearing aids than analog hearing aids. Special mention is the performance in challenging situations like in presence of background noise, performance with digital hearing aids is way ahead of analog hearing aids.

With the digital hearing aids, the amount of amplification depended on the level of input signal. So for a soft sound, more amplification was given whereas for a loud sound very little or no amplification was given.

DIGITALLY PROGRAMMABLE HEARING AIDS

This Variety of digital hearing aids could be computer programmed. The hearing aid has multiple memories, in which different programs can be stored. The user can change the programs according to specific needs, either with a tiny switch on the hearing aid or with remote control. These hearing aids can be programmed with the help of certain software, which are unique to various manufacturing houses. The hearing aid is connected to the computer via a programming interface. Special adaptors and cables are used for this purpose. Recently the whole arrangement could be made wireless, reducing the need of cables.

These hearing aids come in a variety of capacities, with minimum features to ample features including noise reduction strategy, feedback cancellation, and special treatment to sudden, loud sounds, enhancement of soft sounds, special treatment to speech sounds etc. The price range differs depending on capacity.

This type of hearing aids is contemporary, with most of the hearing impaired population fitted with this type. These are also available and approved by Govt.of India, under the ADIP scheme.

OUTCOME MEASURES

The performance with hearing aids needs to be evaluated irrespective of style and technology. The post fitting evaluation is done to understand how much actual benefit the user is receiving with the newly fitted aids. From infants to elder hearing impaired individuals, this assessment is mandatory. The fitting process completes after getting the results with hearing aid.

Certain outcome measures are employed to assess the benefit from hearing aids. These can be questionnaires, aided speech perception tests, aided audiogram, aided behavioral assessment. another handy and quick assessment tool is Ling sounds in Ling's 6 sound test.

1) **Ling six sound test**- Ling (1976, 1989) proposed this test where six speech sounds are used to assess the child's hearing with hearing aids. This is a simple tool and can be used by audiologist, speech-language pathologist, teacher and parents. It quickly gives us an idea about the child's hearing on a day to day basis. Infact after listening check, it must be a regular practice to use Ling six sound test in classroom, therapy and at home.
   All the types of auditory response i.e awareness, identification and discrimination can be tested using these sounds.
   These speech sounds /a/,/i/,/u/,/m/,/sh/ ,/s/broadly represent the speech spectrum from 250-8000 Hz. This range is the same range tested by conventional audiometry. Initially the child can be demonstrated the desired response and this test can be administered. The baseline performance may be recorded and further results should be compared to it, any deterioration of response should be a matter of concern. The output of the hearing aid as well the child's hearing should be checked. It is desirable that the child hears all the sounds, but in some cases even in aided condition, certain sounds may not be heard at all, e.g /s/ .
2) **Aided audiogram** – The free field audiometry procedure is carried out in aided condition and the response is plotted on an audiogram. The test should be carried out with 250 Hz to 4KHz. Testing of 8KHz is not important as most hearing aids do not provide amplification in that range. In very young children and infant aided behavioral response may be noted as they cannot be conditioned. The aided performance can then be compared to unaided response to see the amount of benefit. Moreover the aided assessment should be carried out at a regular interval and compared with the baseline measure. Any discrepancy should indicate problem with hearing aid or hearing.
3) **Speech perception Tests** – Many tests use speech material like nonsense syllables, words, sentences to assess the aided performance. The test is again carried out in a free field condition and the speech can be presented live through the audiometer, which the individual can hear via loudspeakers kept at a distance, in aided condition. The speech is presented at around 40 dBHL. Recorded material can also be used. For young children with limited vocabulary, picture identification tests can be used.
4) **Questionnaires** – various standardized questionnaires are used to get information about the benefit of the hearing aid. These questions are constructed for assessing the improvement in auditory/listening skills, communication skills, social life and quality of life. For very young children parental interviews are conducted to get information.

1.2: EARMOULDS

Earmoulds are acoustic modifiers, being an integral part of the hearing aid (though not an actual part).Following are the characteristics of earmould :

1. These are custom made, i.e made according to shape and size of the user's ear. There is a hole made/canal through the ear mould body, which carries the amplified sound and delivers in the ear canal, Correct fitting of earmould ensures no leakage of sound and hence no feedback.

2. These are used with body type hearing aids, behind the ear hearing aids, the In the Ear and completely in the canal hearing aids are housed in shells which are also customized.

3. It also acts as an anchor to hold the hearing aid in place and prevents falling of hearing aid.

4. Earmoulds come in different shape and texture (Hard or soft). The shape and texture of the ear mould is selected based on the type, degree and slope of hearing loss. To a certain extent age of the user and preference is also a deciding factor.

5. In a body type hearing aid the earmould is attached to the receiver. The button type receiver snuggly fits into the earmould. The other end of the ear mould sits in the ear canal and delivers sound. The sounds through earmoulds are much better than a uncustomized rubber tip. The sound is more complete, free from distortions and there is no annoying feedback.This type is called a full concha ear mould.

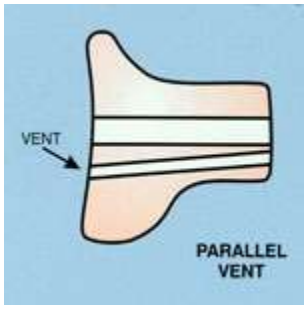

6. In a Behind the ear hearing aid the earmould comes fitted with a tube that is attached to the ear hook of the hearing aid.


7. Hard vs Soft earmould- The decision is mostly made by an audiologist,but it is also important to consider user's preference. Usually the sound passes well through a hard ear mould as the mould material does not sinks under pressure of the moving ear canal. But in some cases,users prefer a soft ear mould for comfort. In case of very high powered hearing aids soft earmoulds are recommended,as they fit more snuggly with the ear canal reducing chances of feedback compared to heard ear moulds.Whereas in cases where hearing loss is moderate or mild,heard ear mould is always recommended.In case of very young children and elderly,whose ear canals are easily collapsable,hard ear moulds are recommended. Hard earmoulds are easier to insert and take out.

8. Venting- In some earmoulds an additional,bore/hole is created through the mould body,which is called a vent. This is done for users with better hearing in the low frequencies(upto 500 Hz),as the vent allows these sounds to

pass naturally through it. This arrangement is done to reduce echo effect i.e patient hears his/her voice more naturally and feels comfortable..Moreover it is also done in users who feel fullness in ear with the hearing aid. There is no sensation of fullness in th ears and the sound clarity is also better However,in cases where the high frequencies have more severe losses,venting is not recommended. As it results in feedback problems.Moreover a vent helps in aeration of the earcanal. This is very helpful for users with a tendency to develop middle ear infections,ear dicarge etc.

The sound bore of the vent can be varied in position,and size to alter the acoustic properties of the amplified sound.e.g parallel vent helps to reduce the low frequency gain without affecting the high frequencies.



TYPES OF EAR MOULDS

1. FULL CONCHA/Shell type -As the name suggests,this type covers the whole of concha and provides a better acoustic seal. This type is recommended for young children and people with more severe hearing losses.

2. HALF CONCHA/Half Shell Type- The top portion of the full concha ear mould is removed for ease of wearing. Elderly people have dexetry issues,they find full concha earmoulds difficult to handle.

3. SKELETON TYPE- A big gap is created in the full concha style for a comfortable, lighter fitting.This type can be used for people needing full concha earmoulds but feel fullness and discomfort with a proper full concha type.So a gap is created in the concha part to ease out the fullness.

4. TIP TYPE- This type is recommended for milder hearing loss. The ear mould only sits in the ear canal part, leaving the concha free. This style is not recommended for people with straighter ear canals and children(children have straighter ear canals compared to adults).As a straight ear canal will allow the earmould to fall out easily. Also not recommended for shorter ear canals.

Care and Maintenance of Earmoulds

As the ear moulds are in direct contact with the ear canal, they are exposed to ear wax, sweat and some discharge (if present). So they need regular cleaning. If not cleaned regularly, the sound tube will get easily blocked with ear wax etc, and the user will not be able to hear clearly. The tubing of the ear mould hardens after an interval of time, so needs to be changed regularly. Following care and maintenance regime can be helpful:

1. After each use, the earmoulds need to be wiped with a clean cloth and kept.
2. The earmould should be washed in water with mild cleanser. The receiver should be carefully removed before putting under water.
3. If wax/any other material gets stuck in the sound pipe, it can be cleaned by using a floss.(Usually audiologist assistance may be needed)
4. Hard moulds are breakable when dropped hardly or crushed under pressure. So care must be taken not to drop it.
5. The tubing bent must be changed regularly. If it gets hardened it may come out of the earmould. It can be reaffixed at an ear mould lab.
6. Soft moulds are tearable, so caution must be taken while inserting and taking out the ear mould. The soft material also hardens after a certain period if time indicating the need a new ear mould.
7. In case of young children, the ear canal shape and size changes with age. So they will need new earmoulds at a regular interval atleast till the age of 18 years.

1.3 CLASSROOM AMPLIFICATION DEVICES

In classrooms, where the area is large, the hearing impaired individual may face difficulties to hear speech of teacher and peers due to distance and effect of other factors such as noise and reverberation. In such situations hearing aids

alone may not be useful; some additional assistive devices may be helpful. These devices can be useful for one individual at a time or can be used in a group of individuals.

INDIVIDUAL DEVICES

Speech Trainer

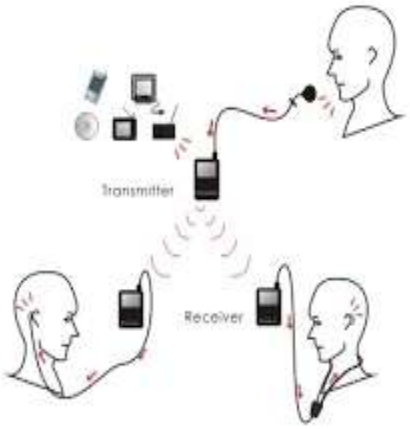
This device comes with a microphone for the speaker, the amplifier and headphones to be worn by the hearing impaired individual. The use of speech trainers have reduced in recent times, though many old schools still use these systems. The speech trainer comes with certain controls, where the output of the signal can be altered. The headset also comes equipped with a microphone, so that the user can hear own voice. This is also used during speech therapy sessions. Usually it is worn separately without the hearing aids.

Advantages

1. The teacher'/trainer's speech reaches the individual's ear easily and is less affected by the noise and reverberation in the room. As the signal is going mostly in the ear canal, hearing becomes much easier.
2. Usually these trainers come with high output capacity, so can be used for severe to profound hearing losses. Limitations
1. Since it's a wired system, the mobility of the student and teacher is affected.
2. Cannot be used in groups.
3. Useful only for one to one teaching.

Personal neck loop system- The speech of teacher is picked up by a microphone worn by the teacher and sent to a loop worn by the student whose hearing aid is at telecoil position. The signal in the loop is picked up by the hearing aid and amplified.

FM System- These based on FM technology. These are typically used in schools. The teacher wears a microphone that is either clipped on to their collar or as a headset. This is connected to a transmitter, which sends out FM signals to the receiver unit worn by the student. It can also be carried around in the pocket everywhere. It helps reduce the background noise and improves speech clarity even at a distance. It can be used by a hearing impaired student in a normal classroom. It can be used as a individual or group device.



GROUP CLASSROOM AMPLIFICATION DEVICES

1. **Hardwire system –** These systems are permanently installed in a classroom. One unit with the microphone is connected to a number of headphones. The teacher's speech can be heard by a group of students at the same time. There are also separate microphones installed on student's desk, so that even their speech is audible to each other.

Induction loop system: One of the oldest and cheaper forms of assistive listening technology still popular in educational set ups. This system consists of microphone, amplifier, a loop of wire and receiver. The teacher's speech is picked up by a microphone and transmitted through a loop of wire. This wire generates magnetic field. This energy is picked by the individual hearing aid's telecoil. The received signal is then amplified by the amplifier of the hearing aid and converted into sound signal.

Advantages:

•This system can be installed in a large area, e.g.classrooms.

•It can be used by an individual, with an induction loop worn around the neck by an individual listener. •Teacher's speech is clearly audible even at a distance

•Use of induction loop improves signal to noise ratio.

•The child can move freely within the loop area

•The system is used with the child's own hearing aids, so the electro- acoustic characteristics selected for a particular child are maintained in the signal received in the input that the child receives.

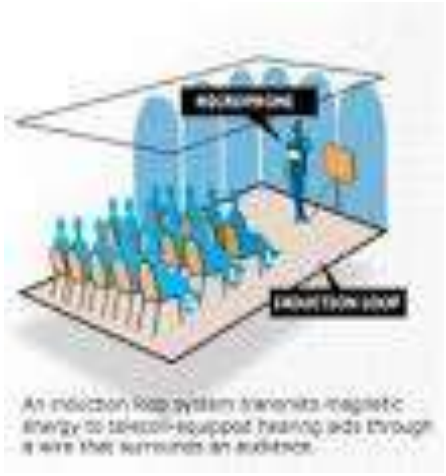
•The hearing aid can be kept on the MT setting, whereby the child can receive the teacher's voice through the telecoil and the other students' voice through the microphone. This promotes interaction between the students.

- Low cost and maintenance.

Disadvantages:

•Spill over: If there is more than one room looped in the same area, magnetic field generated in one room could be picked up by a tele-coil in an adjacent room.

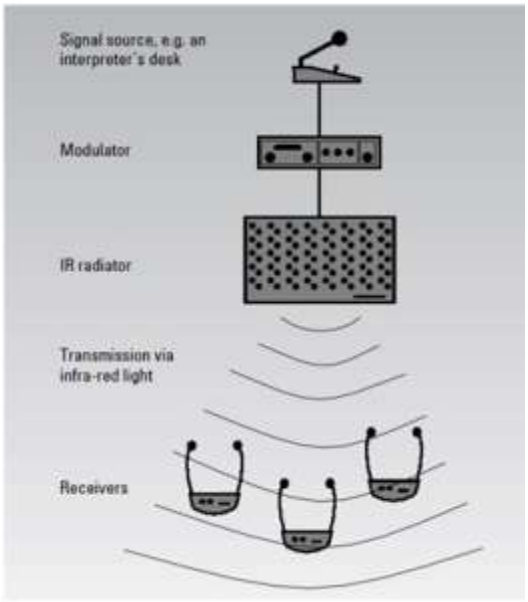
•Fluorescent lights, transformers, electric power wires in the area may cause interference in the induction system, may sound like a hum in the output.



FM System –

This system consists of 2 parts - a **transmitter unit** and a **receiver unit**. The transmitter unit is made up of a microphone and a transmitter. The microphone converts the sound signal to electric signals. The transmitter then transmits sound via Frequency Modulated (FM) radio waves to the receiver unit. The receiver unit converts the FM radio waves into audio signal. The receiver unit is worn by the students with hearing impairment.

Infrared technology: Infrared systems pick-up the speaker's voice through a microphone, which converts sound signals into electrical energy. These signals are then sent to a receiver using invisible light rays. The signal is then changed into sound energy. Infrared is most useful for settings like auditoriums, television, audio-visual classes for children.



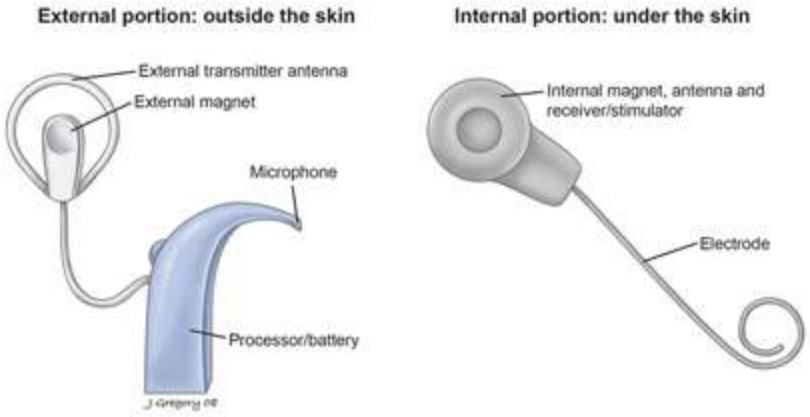
1.4 COCHLEAR IMPLANTS

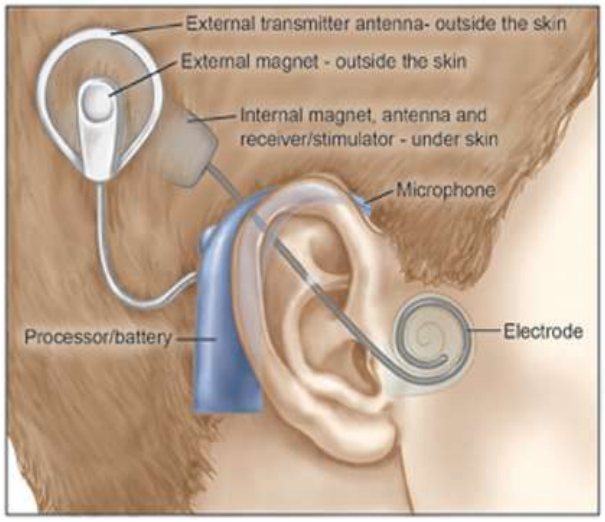
These are amplification devices which are surgically placed inside the inner most part of the ear, i.e.cochlea. the input signal is converted into electrical signal, which stimulates the auditory nerve or the VIIITH nerve.

CANDIDACY

1. Hearing impaired individuals with severe to profound hearing loss.
2. Individuals who do not benefit from hearing aids or get limited benefits.
3. Individuals whose aided performance on speech perception tests is less than 50%.
4. No benefit from hearing aid, 3months post fitting with hearing aids.
5. No other psychological deficits
6. No problems/disorders in higher processing centres.
7. Intact auditory nerve

COMPONENTS AND FUNCTIONING





There are two major parts, external and internal. The external part is worn either on the body or ear of the individual. It mainly comprises of the speech processesor. The internal part is surgically placed inside the ear/head. The components are as follows

External components

1. Microphone `- housed inside the prossessor,it picks up surrounding sounds including speech signal.
2. Speech processor- Can be a body type or Behind the ear type. It modifies the signal and converts into digital signal and sends the digital signal to a transmitting coil via a cable.
3. Transmitting Coil – This part has a magnet in the middle of a disc, this enables this part to adhere to a internal component placed under the skin which also has a magnet. The transmitting coil transmits the entire signal to the internal component via skin in the form of radio waves.

Internal Components

1. Receiver-Stimulator unit- This part receives signal from the external transmitting coil. The part is surgically placed under the skin, behind the ear, on the mastoid bone.
2. The receiver – stimulator unit sends the final signal to selected electrodes (programmed), which are placed inside the cochlea.

The fitting of cochlear implants is a long process and needs intensive speech and language therapy, auditory training and proper educational placement post fitting.
The first part of the fitting procedure is about deciding on candidacy. Once decided, the individual has to undergo certain audiological, radiological, & speech-language evaluations. A thorough medical checkup is done to check suitability for surgery. After the surgery takes place, the cochlear implant is switched on and programmed (mapping). Many follow up visits at regular intervals are required to settle the appropriate map/program. The child is under intense speech – language therapy, AVT, and educational placement.

Importance of Cochlear Implant

This extraordinary technology has given the gift of hearing to many individuals who received limited or no benefits from hearing aids. Once they have better hearing, their social, speech- language, academic and overall development with gets enhanced. Children who are implanted at a very young age (within 3 years) can be easily mainstreamed into normal educational systems.

MIDDLE EAR IMPLANTS

This type of implant is surgically placed in the middle ear of hearing impaired individual. It also has two parts, external and surgically placed internal part. The internal part directly stimulates the inner ear, bypassing the external and is placed in the middle ear. Although intactness of certain middle ear structures is mandatory in one category of middle ear implants. It provides excellent sound quality.

CANDIDACY

- Individuals with mild to severe sensorineural hearing loss (the internal part will be different than in case of conductive or mixed hearing loss)
- Individuals with conductive and mixed hearing losses.
- Individuals who cannot tolerate foreign bodies in the ear canal for medical reasons, e.g., chronic ear canal inflammations or ear canal eczemas.
- Individuals who require a free ear canal for personal or professional reasons, e.g., musicians, singers or physicians.

COMPONENTS AND FUNCTIONING

External Part

1. Audio processor, which is worn on the head of the recipient, with a microphone to pick up external sounds. This part has a disc magnet which attaches to the magnet on the internal receiver part above intact skin.

Internal part

1. Internal prosthesis, consisting receiver unit and a transducer unit. After the receiver unit receives the signal from external audio processor, it sends it to the transducer which delivers vibration/mechanical signal to the middle ear bones.

The implant directly vibrates the small bones in the middle ear. The internal part of the device mechanically vibrates the bones in the middle ear .The tiny transducer, attached to the incus bone in the middle ear, is approximately the size of a grain of rice. It is 100 percent digital and is programmed by an audiologist . The internal prosthesis converts sound into mechanical energy which is directly transmitted to the auditory ossicles. The external audio processor picks up the sound from the environment and transmits it across the skin to the receiver of the prosthesis. The signal is then transmitted to the transducer causing it to vibrate. The transducer mechanically stimulates the ossicles, like the natural process of hearing. The internal part is surgically implanted under the skin behind the ear. The transducer is attached to the long process of the “incus” bone during the surgical process. The ossicular motion creates a movement in the cochlea, stimulating the hair cells. The hair cells provide stimuli to the auditory nerve, which is interpreted as sound by the brain.

Bone Anchored Hearing Aid (BAHA)

This type of device is also implantable. BAHA stimulates the cochlea by transmitting the sound waves through the bones in our skull, or bone conduction, thereby bypassing the outer and middle ear. Once the cochlea receives the sound signals, the information is converted in to neural signals and transferred to the brain.

CANDIDACY

1. Individuals with bilateral canal atresia is an indication for the use of BAHA. This is because canal atresia prevents insertion of an air conduction aid.

2. Individuals with chronic ear infections when insertion of ear moulds is a problem.

3. Individuals with unilateral hearing loss who cannot benefit from use of regular hearing aids. (sensory neural, but good bone conduction hearing)

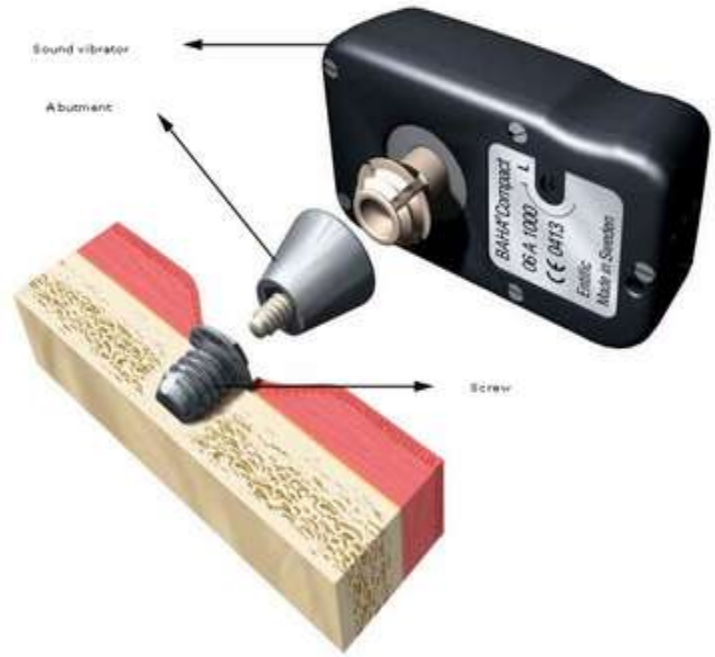
COMPONENTS & FUNCTIONING OF BAHA:

BAHA has 3 components. They are :

1. Titanium screw that becomes integrated with the skull bone behind the ear.

2. Titanium abutment is fitted to the titanium screw which is already integrated to the skull bone.

3. Ear level sound vibrator.



Sound processor coupling to abutment

BAHA implantation is a surgical procedure..The titanium screw is inserted during surgery. Titanium screw integrates with bone in such a fashion that it never comes out easily. Three months post surgery the abutment and sound vibrator/processor are attached. There is a small opening in the skin, which gives anchor for the abutment. The sound vibrator attaches to the abutment. The sound is picked up by the microphone, converted into vibrations, which is transmitted to cochlea through the internal part of BAHA and through bone.

Importance of BAHA

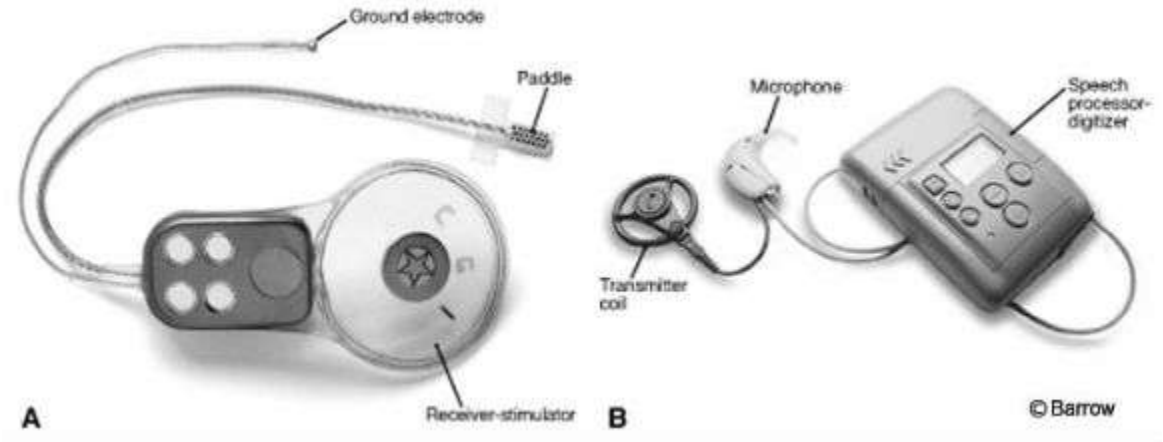
1. It is a device of choice for individuals who cannot be fitted with conventional hearing aids. This can be due to a variety of factors, such absence of external ear, middle ear infections with active ear discharge.

2. It is also useful for individuals with unilateral sensorineural hearing loss(bc upto 55dBHL)**s**

AUDITORY BRAINSTEM IMPLANT(ABI)

As the name suggests this device is fitted in the brainstem, beyond the cochlear or inner ear. The first point or relay station after cochlea is the cochlear nucleus where the ABI is implanted. The decision of ABI implantation is taken in individuals who do not benefit from cochlear implants.

ABIs provide limited benefit for speech understanding. The hearing for environmental sounds and certain speech input is improved. But for better understanding of speech the patient has to use speech reading.



CANDIDACY

1. Individuals of atleast 15 years of age.

2. Individuals with damaged auditory nerve due to conditions like tumour of auditory nerve (NF2), where the auditory nerve(s) are irreversibly damaged.

COMPONENTS AND FUNCTIONING

External Components

Audio processor

Internal Component

The implant consists of an electronics housing and an implantable soft silicone matrix with an electrode array. An additional reference electrode is used for advanced telemetry measurements.

The soft silicone matrix with a 12 contact electrode array is surgically inserted directly onto the brainstem.

The sounds picked up by the microphone in the audio processor are transmitted to the internal part, where the electrode array sends electrical stimulation to the brainstem.

ADIP SCHEME 2014

Scheme of Assistance to Disabled Persons for Purchase/Fitting of Aids/Appliances (ADIP Scheme) by Govt. of India.

The original ADIP scheme came into focus after the implementation of PWD Act 1995,1996. The Scheme was revised w.e.f. 1st April, 2014.It stated:

"Provision for cochlear implant for 500 children per year with Hearing disability under the scheme, with a ceiling of Rs. 6.00 lakh per unit."

There is a provision of online form fill up and submission, for applying for cochlear implant. AYJNIHD(D), Mumbai has the authority to approve the list of benifieries. The surgery will be carried out in one of the empanelled hospitals under the scheme. Post implant rehabilitation,speech-language therapy for 10 weeks with 3hours per week is allotted. Additional sessions can be provided with special permission from competent authority. Post implant the child will be monitored at 3,6,9 and 12 months.

CI Candidacy

Individuals are eligible to claim cochlear implant under ADIP in the following cases:

1.Child will get only unilateral cochlear implant

2. He/She should have Indian citizenship

3. Age of the child

Child with congenital deafness (since birth) upto 5 years as on 31st December in the current year

OR

Upto 12 years for child with post lingual deafness i.e. after development of speech & language

4. Degree of hearing loss - Severe to Profound sensorineural hearing loss in both ears

5. Child should not have any associated developmental delay or Mental Retardation or cognitive deficit etc.

6. Child should have Hearing Disability certificate

7. Child should have used suitable hearing aid for atleast 3 months with no significant improvement in speech and language development

8. Family Income

100% subsidy for income less than 15,000/- per month
OR
50% subsidy for income Rs.15,000 to Rs.20,000 per month
(c) Income Certificate of family is mandatory

9. Have reports of hearing evaluation, speech-language evaluation, psychological evaluation and required medical

valuations.

10. Agreeing to the criteria/condition that Pre implant candidacy evaluation such as Audiological , Radiological(CT Scan/MRI) and vaccination charges are to be borne by the family as not covered under the scheme

11. Agreeing to the criteria that - Caste certificate has to be submitted if SC/ST or will be considered under General quota

1.5 COMPARISON BETWEEN INDIVIDUAL HEARING AIDS,GROUP HEARING AIDS AND COCHLEAR IMPLANTS

Individual hearing aids are fitted to individuals with hearing loss (anywhere between mild to severe). There a variety of options possible in individual hearing aids. Individual hearing aid's performance depends on the technology used. Digitally programmable ones are highly recommended for their better performance. In this category also there are plenty of options available commercially. The advantages of individual hearing aid is it can be used by the individual according to own requirements. The mobility is not restricted. The user can upgrade his/her hearing aid as and when required

There are certain limitations, the cost of a new hearing aid has to be totally born by the individual totally (socially backwards can apply under ADIP scheme. These hearing aids undergo regular wear and tear, so they need to be changed at every 5 years (appx).Hearing aids are electronic devices, may need servicing and repair. The cost of service and repair again has to be born by the individual.

CARE AND MAINTENANCE

1. It should be kept clean and free from moisture. - after every use, should be cleaned with a dry cloth and kept back.
2. The battery should be removed, when not in use. Batteries to be changed regularly.
3. Hearing aid should be removed during bath.
4. It should be sent for regular servicing.
5. It should not be dropped from a height.
6. It should not be exposed to excessive heat and strong electric/magnetic field.
7. Hearing should be checked at a regular interval, hearing aid or settings should be changed in case of change in hearing thresholds.
8. The overall life of a hearing aid is about 5-8 years. It should be changed at that interval.
9. In case of any problem it should be taken to audiologist.
10. In classrooms, teachers can keep a regular check on the functioning of hearing aids worn by the students. The switches, battery, and overall condition of the hearing aid to be checked regularly. Even the sound quality to be checked regularly.

Group Hearing aids-

The onus of care and maintenance of the group hearing aids is usually on the institutional set up, where it is used. The hearing aids are set at a same level, so individual requirements are difficult to address. One to one communication training/teaching is difficult. Mobility of the students get restricted. It is less often used.

However the overall cost of the system and maintenance cost is more economical.

Cochlear Implants

1. This is recommended for individuals who do not benefit from conventional hearing aids.
2. It involves a surgical procedure. The instrument has an implantable part and an external part. As surgery is

involved, a lot of detailed evaluations including a thorough medical evaluation is mandatory.
3. The overall cost of fitting and post fitting rehabilitation is higher than individual or group hearing aids, by a huge amount.
4. The maintenance and repair requirements are quiet less, but repair cost is also higher compared to individual hearing aids.
5. Individuals fitted at the right time, followed by vigorous rehabilitation work-up, perform way ahead than hearing aids. The speech clarity, suprasegmentals are much natural.
6. However due to inherent cost and need for surgery, it is highly recommended for individuals who are performing poorly with hearing aids.
7. There are certain risks involved, with surgery though very limited.

CARE AND MAINTENANCE

1. CI should be kept away from dirt and moisture.
2. Regular charging of batteries is required.
3. Daily use of dehumidifying kits is mandatory.
4. The individual should not pass high thorough magnetic fields with the external component on.
5. The external component should not be dropped.
6. The transmitting cable should be handled with care.

LET'S SUM UP

1. Listening devices are given to individuals with difficulty in hearing, to improve their overall quality of life.
2. There are a large variety of these devices available commercially.
3. A basic hearing aid can have different styles and technology in them.
4. The styles are names Body type, Behind the ear, In the ear, Completely in the canal and receiver in the canal hearing aids. Each one has their own advantage and limitations.
5. The technology in the hearing aids can be a basic analog processing or a more sophisticated digital signal processing. Owing to better technology, the performance of digital hearing aids are way ahead than analog hearing aids. Although some individuals prefer analog hearing aids.
6. The benefits of fitting hearing aids can be measured in users, by various outcome measures such as Ling six sound test, speech recognition measures, aided audiograms,quetionaire etc.
7. Hearing aids are not sufficient in all hearing impaired individuals and also in all listening situations.
8. In difficult listening situations, assistive listening devices are very helpful. These can be used alone or attaché to the hearing aid.
9. Many of the assistive listening devices are used in classrooms for hearing impaired children. Commonly used are FM systems, Loop induction systems
10. In individuals where conventional hearing aids have poor performance, the next level in intervention are with implantable devices

LET'S CHECK YOUR PROGRESS

1. What are the basic components of a hearing aid?
2. What are ling sounds? What is their use?
3. What are digitally programmable hearing aids?
4. List various classroom amplification systems available?
5. What is the difference between full concha and tip size ear mould.
6. List the various implantable devices with highlighting one advantage of each device.
7. Write about care and maintenance of behind the ear hearing aid.

REFERENCES

1. https://sites.google.com/a/asu.edu/secondary-ed-tech-in-the-field/fm-system
2. http://ayjnihh.nic.in/awareness/schemes2.asp
3. Press Information Bureau,Government of India,Ministry of Social Justice & Empowerment
4. Google Images/www.google.com
5. www.microsonic-inc.com
6. Hearing Aids,Dillon.H,2001
7. Rehabilitative Audiology: Children and Adults, Alpiner and McCarthy