Step #2—Getting Hearing Aids

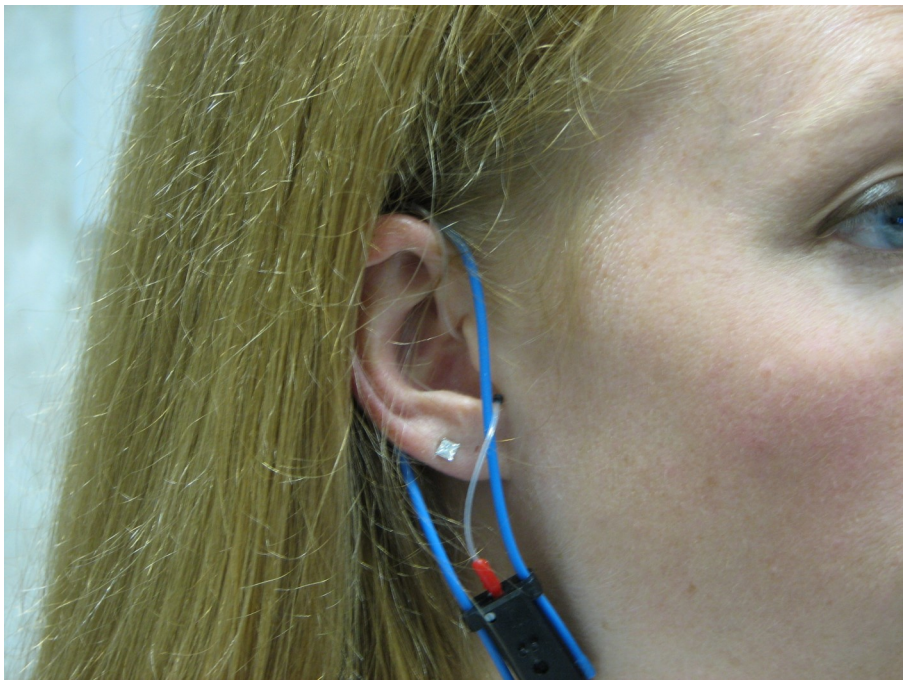
"All generalizations are false, including this one" - Mark Twain

Where

When we fit a hearing aid, its frequency response is adjusted according your residual hearing's frequency response as seen on the audiogram. In other words, if you have normal hearing sensitivity at 500 Hz, we don't want the hearing aid to change sounds in the 500 Hz region. If you have hearing loss at 1000 Hz however, we do want to provide gain to sounds in the 1000 region; the amount of gain, depending on your 1000 Hz threshold and loudness growth.

The way that the hearing aid responds to soft low-frequency sound, to loud low-frequency sound, to soft high-frequency sound, and so on, should be set according to the sound the hearing aid is producing at the eardrum. It doesn't matter what that hearing aid produces in an artificial ear at the manufacturer's location, what matters is what that hearing aid produces in your ear.

The following picture shows a probe microphone used to measure sound at the eardrum.
The piece of blue rubber fitting over and around the ear is simply to hold everything in place. The clear tube with red at its base is the actual probe that ends close to the eardrum and measures the sound close to the eardrum.



There are a variety of ways to accomplish the type of measure we are talking about. One hearing aid manufacturer uses a probe tube that temporarily connects to the hearing aid microphone. In this way the hearing aid is measuring the sound it is producing at the eardrum (the tube is removed after the hearing aid is programmed/adjusted). Some hearing aids test your hearing with the hearing aid in place to more accurately predict its true response in your ear.

The point is that the sound an aid produces in a given ear is not necessarily what the fitting-computer predicts, which is based on an average size ear with average acoustics, and **it is not what that same hearing aid would produce in someone else's ear**. So a method, one of which is probe-microphone measures like the one discussed, to measure the performance of the aid in your actual ear helps make sure that we are making all speech sounds audible and comfortable.

Gain—How much increase in sound, usually as a function of frequency, a hearing aid causes. 25 dB of gain at 1000 Hz in your ear will sound different than 30 dB of gain.

Output— The level of sound in decibels that a hearing aid produces—and what matters is the output in your ear.

Maximum Output—The highest sound level that a given hearing aid will produce. A maximum output at 1000 Hz of 110 dB may be uncomfortable, but a maximum output of 108 dB may result in 'loud but not uncomfortable'.

There are some aided measures done in the test room booth where you had your hearing test that are worthwhile, like seeing how well you hear speech in background noise. However, it is not generally worthwhile to try and test the softest sound you can hear with the hearing aids—like you did for your original hearing test by raising your hand or pressing the button when you heard the tone. That type of behavioral measure under earphones has a 5 dB variation and putting earphones on over a hearing aid does not often work accurately. Probe-microphone, real-ear measures require no response from the hearing aid wearer, are designed to work with the hearing aid on your ear and have a variation much less than 5 dB.

I heard an advertisement from an eyeglass manufacturer about how their lenses were shatterproof, smudge resistant, blocked UV rays, and were responsive to changes in light. Those excellent features would do you little good if the glasses were not appropriate otherwise to your eyesight or didn't fit correctly on your head. There are hearing aids that do not easily feedback, are nearly invisible, can sync with your smartphone, and can tell the difference between speech and noise. Those excellent features would do you little good if the hearing aids were not properly fit to your residual hearing and ear—gh.

"New hearing aid technology is introduced each and every year: there are constant updates to directional microphone algorithms, noise reduction strategies, variations of amplitude and frequency compression, wireless streaming, and audio data transfer between hearing aids, just to name a few. What is sometimes forgotten, however, is the basic programming of the hearing aids' gain and output, which has a significant impact on the patient benefit obtained from these special features. Moreover, while many convenience features have been added to hearing aids in the past few years, *understanding speech* remains the dominant concern of hearing aid users, and for the most part, this is determined by the frequency-specific gain selected for the patient's instruments."

-Sanders and others, 2015

We still don't, however**,** have everything down to perfection. And some things, like how quickly the hearing aid adjusts to changes in softness and loudness, are still a bit unpredictable on an individual basis. For example, ask ten people with perfect hearing to adjust a stereo. Some prefer more bass (low frequencies), some prefer more treble (high frequencies), and some more volume, even though all have perfect hearing.

Ten people with audiograms exactly like yours will have some of these variations. So it is likely that you will need to be seen for follow-up after you have had experience wearing the hearing aids in the real world. It is also possible that you may not want the hearing aids adjusted for maximum benefit (maximum audibility) until you get used to hearing all the little, and big, sounds of life.

Once the hearing aid characteristics have been adjusted to your hearing and peculiar preferences, it is still desirable to be seen at least yearly by the Audiologist, or more often for some. Wax gets in hearing aids, hearing changes, hearing aids break, and even the size and shape of your ear canal changes with time.

The average need for factory repair of hearing aids is roughly 1½ times in a four year period (Harris and others, 1999), and that doesn't include times that the hearing aid can be repaired

Wax, skin and other debris gets in hearing aids, hearing changes, hearing aids break, and even the size and shape of your ear canal changes with time.

in the office without going back to the manufacturer. You may go four years with your hearing aid and never need service, but that would be unusual.

This follow up, re-measurement of your hearing, and repair of your hearing aid can't be done through the mail or Internet in an efficient or effective manner. As big as a nuisance it may be for you to do locally, it would be an even bigger nuisance should you have to drive 100 miles each way when you're hearing aid broke or when you needed routine follow up.

You can be fit with hearing aids by a specialist some distance away and then be seen for yearly checks by someone closer to you. However, this might end up costing you more money because the person fitting the hearing aid may bundle a certain amount of follow-up visits into the price of the hearing aid. So the person closer to you, who wasn't paid for the hearing aid and its associated services, will want to be reimbursed for his or her time also.

For these reasons, you want to try and buy your hearing aids from a person who will know your successes or failures and, ideally, you want to buy them locally.

Who

With some regularity we get a call from a person who is looking to purchase a certain make and model of hearing aid. They may have a friend who has that make and model, and who loves the hearing aid, or perhaps they saw an advertisement for that hearing aid and the advertisement impressed them.

You didn't pick out your glasses or contacts according to who manufactured them and you shouldn't do so with hearing aids. There are more than 6 companies who manufacture hearing aids. There is no data to confirm, and little reason to believe, that the average hearing impaired person with an average garden-variety hearing loss will hear better with one hearing aid company's products over another company.

Each company does have certain niches that can help determine who manufacturers your hearing aid. Some may have hearing aids that don't feedback as easily, some may make waterproof hearing aids, some may have more varied colors of hearing aids. At any point in time a given company may have a particular technological improvement that is confirmed by data, but very often other hearing aid manufacturers will develop that same improvement within the year. By and large this need not enter into your thinking about hearing aids. Find an expert in hearing and hearing aids and he or she will decide which manufacturer works better for them and you.

We would consider the answer to the question, "Who will you get to fit your hearing aids" by analogy: If you needed foot surgery, you first of all need someone who has been trained in, and does, foot surgery. You also want someone whose bedside manner is to your liking.

You will want the person fitting you with hearing aids to be educated in hearing and hearing aids and you want it to be a person who you can work with. Get a referral from a friend or from your family doctor. Then make an appointment for a hearing evaluation and talk with the Audiologist about hearing aids. If you don't think you will be happy with this expert, get a second opinion and decide from there.

You will not be seeing a company, you will not be seeing a hearing aid manufacturer, but you will want to see an individual who understands both hearing and hearing aids.

Patient Advocate

Wearing hearing aids is not as difficult as the size of this book would tend to make you think. Lots of people wear them. Lots of people put them on first thing of the morning, and take them off last thing at night. For first time hearing aid wearers however, rarely is it so easy that you just stick them in your ears and go about your way. And sometimes people are overwhelmed before or during the fitting and forget things about the hearing aid.

It is reasonable that you can be seen for a hearing and hearing aid evaluation and then be fit with hearing aids by yourself. A patient advocate can be an asset, however. It can be useful if there is a family member or friend present during the fitting. They can see how to put the hearing aid in, learn about batteries and how to clean the hearing aids.

Some people have trouble learning to insert the hearing aid initially. If a family member knows how to do it, they can help you when you get home. If you are having trouble with the hearing aid, they can look at them and make sure you have them properly inserted or even if you have them in the correct ear!

It can also be helpful to your family to get an idea of how well you might hear with hearing aids. Sometimes the family expects the hearing-aided person to hear perfect and that they should be able to hear if someone whispers to them from 30 feet away. The Audiologist can give the family realistic expectations based on the patient's residual hearing and remind them that the patient may not hear well from the back seat of the car (who can?).

Audiology is like the military in its use of a lot of abbreviations.

- *BTE—behind the ear*
- *Slim tube BTE—BTE with small diameter tubing*
- *RIC or RIE—Receiver in the canal or receiver in the ear—BTE with the loudspeaker (receiver) residing in the ear canal instead of in the hearing aid*
- *ITE—in the ear*
- *ITC—in the canal (but still an in the ear aid)*
- *MIH—Mic in Helix*
- *CIC—Completely in the canal (but still an in the ear aid)*
- *iIC—invisible in the canal*

As helpful as a patient advocate can be, they can be counterproductive if they try to belittle the patient and/or not let the patient express themselves. There can sometimes be power struggles between the patient and the family member and we've even seen sometimes a patient want to hear better but want to do the opposite of what their "know-it-all" family member wanted them to do.

So if you are going to be a patient advocate, check your personal agenda and ego at the door.

What

There are a variety of styles of hearing aids that will be discussed here. The advantages and disadvantages listed are generalized guidelines. Generalizations don't apply 100% of the time, so talk with your Audiologist about which style might work best for you. Let's first talk about whether or not you should get a hearing aid with a volume control.

Theoretically, the answer is no, you should not have a volume control. People with normal hearing do not have a volume control. If the hearing aid is set perfectly in how it controls the loudness of sound as a function of frequency for your particular hearing: what is soft to a normal hearing person will be soft to you, what is loud to a normal hearing person will be the same loudness to you. But let's look at things practically.

As a practical matter, some people should still not a have a volume control. They may not have the dexterity to manipulate a volume control. They may not be able to tell when the volume control is set at an optimal volume. They may have a tendency to play with the volume control.

Otherwise, it can be handy to have a volume control. If my normal hearing had a volume control I think I could use it, say when my (gh) grandson is screaming. If the initial fitting of your hearing aid is simply found to be overwhelming, you can turn the volume down a bit while you get used to hearing again. If your hearing fluctuates (varies from day to day), a volume control might be mandatory.

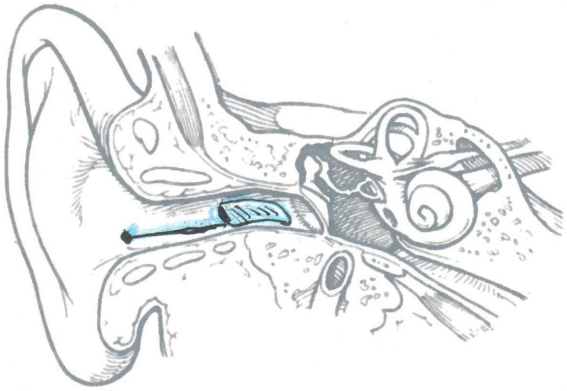
Most hearing aids can be made with volume controls that can be enabled or disabled. Sometimes we may disable the volume control when you first get the hearing aid so that if you have problems with the aid we know that it is not because you had the volume set incorrectly. The volume control can be enabled, or 'turned on', at a later date.

The occlusion effect is an increase in the self-perceived loudness of your own voice caused by something plugging the outer 1/2 of your ear canal.

Some hearing aids can be controlled with a remote control or even controlled with your smartphone.

A few generalizations can also be made about the style of hearing aid. More power can be obtained from a standard behind-the-ear (BTE) hearing aid than from the in-the-ear (ITE) styles. The standard and slim-tube BTE, but not the RIC, is also going to suffer fewer problems from cerumen (earwax). Cerumen can get into the electronics of the ITE styles, but with the standard and slimtube BTE the electronics are not in your ear. The flip-side of this is that ITE styles of hearing aids will suffer fewer problems from perspiration than might a BTE.

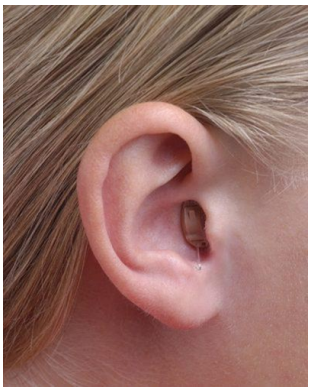
Regardless of the style, the goal of producing the optimal sound at your eardrum is unchanged, so that for the average garden-variety hearing impairment, one style of hearing aid should not necessarily make you hear different than another style.

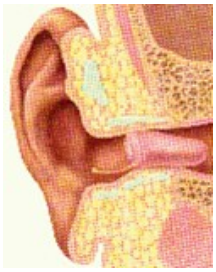


Medial Completely-in-the-Canal (MCIC) or invisible In-the-Canal (iIC)

- This is the smallest style of hearing aid.
- It fits in the inner-half (medial) of the ear canal with its end very close, less than ¼ inch, to the eardrum.
- It may be the most expensive style because of its size, and the time and preparation required to fit it.
- It uses the smallest size of battery, a size 10. The battery is the largest thing in it.
- Some ear canals may not be big enough to accommodate the hearing aid.
- Because it fits in the medial part, or inner 1/2 of the ear canal, there is usually little or no occlusion effect from it.
- It requires a deep impression of the ear, and some patients may find that uncomfortable.
- It has a string (it looks like a piece of fishing line) sticking outward. This is not an anten-

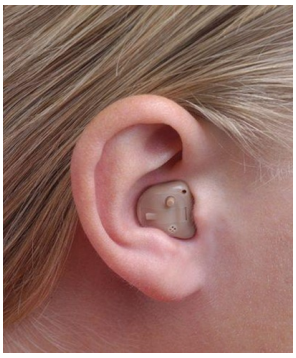
na; it is used to pull the aid out of the ear.
- This may not be the most appropriate aid for someone who needs a lot of power or does not have healthy ear canal skin.





Completely-in-the-Canal (CIC)

- Until the invisible in-the-canal style, this was the smallest style of hearing aid.
- It usually takes a size 10 battery, which doesn't last as long (2-5 days) as larger batteries.
- It usually has a string (it looks like a piece of fishing line) sticking outward. This is not an antenna; it is used to pull the aid out of the ear.
- This may not be the most appropriate aid for someone who needs a lot of power.
- The most common complaint with this hearing aid is that it feels like it plugs the ear and the wearer may hear their own voice "in a barrel" at first (from the occlusion effect).
- If your ear canal is small, this aid may protrude more than what you see in the picture above.
- This aid does not usually have a volume control. It can be made to have a volume control, but that makes it bigger.
- Cerumen from your ear can get in the sound exit (receiver port) of the hearing aid and block it.



In-The-Canal (ITC or Canal)

- This is one of the more common types of in-the-ear hearing aid.
- It usually takes a size 312 battery (3 to 7 days battery life), the next-to-smallest battery.
- These hearing aids are often made with a volume control.
- They can also be made with telephone coils and directional microphones, although this makes the aid bigger.
- The most common complaint with this hearing aid is that it feels like it plugs the ear and the wearer may hear their voice "in a barrel" at first.
- If your ear is small, this aid may protrude more than what you see in the picture above.
- Cerumen from your ear can get in the sound port of the hearing aid and block it.
- Canal aids can also be made with pull strings for removal, but they can removed as follows (and a pull string is not needed).

To remove canal and mic-in-helix aids, push upward on the bottom of your ear with your thumb, as shown.

This exposes enough of the aid that you can grab it with your fingers and remove.

This is the helix of your ear

Mic-In-Helix

- What makes this aid different is that the microphone is placed in the helix of the ear. The rest of the hearing aid is in the canal.
- The microphone connects to the rest of the aid with a wire that runs along the perimeter of the concha.
- These share most other traits with canal hearing aids but vary as follows.
- The 3 advantages to having the microphone in the helix are: protection from wind noise, a slight advantage in directionality (sounds from in front of you arrive at your eardrum different than sounds behind you), and less chance of distortion/interaction between the receiver and microphone (due to their physical separation) when lots of power is used.
- The 2 disadvantages are that the wire connecting the mic to the aid can fail if harshly manipulated and the microphone is subject to getting skin in it. For these reasons, this is usually reserved for someone with the dexterity to carefully remove the aid and clean their helix.

In-The-Ear (ITE or Full Shell)

- Because of its larger size, this is the easiest to manipulate and insert into the ear.
- This aid can be made with or without a volume control.
- It can be made with directional microphones and a telephone coil.
- This hearing aid usually takes a size 13 battery (5 to 10 days), although in some small ears a smaller battery (312 battery) is required. Larger batteries last longer than smaller batteries.

Standard Behind-The-Ear (BTE)

- There are 2 pieces to the BTE, the actual hearing aid that sits on top of your outer ear, and the earmold that attaches to the aid with a tube.
- The BTE is well-suited for children since their ears are small and growing. The earmold is less expensive to replace than the hearing aid if the child's ear grows out of the mold. (Some manufacturers of in-the-ear type hearing aids will "reshell" their hearing aids at no charge during the warranty period to accommodate children who are fit with in-the-ear style hearing aids.)
- It is well-suited for those who require a lot of power.
- The BTE is less prone to feedback than other hearing aids because the microphone is further away from the ear canal. (Feedback is the squealing noise hearing aids can make.)
- It is also well-suited for those with mild hearing loss because the earmold does not have to occlude the ear canal. This can make the wearer's own voice less noticeable to them.
- This hearing aid is more prone than other styles to getting perspiration in it, although some hearing aids like this are being made more water-resistant.
- Since the hearing aid can be separated from the earmold (the plastic piece that actually fits in your ear canal), it is easy to loan a patient a BTE hearing aid if his or her BTE needs sent to the factory for repair.
- For someone with small outer ears, there may not be enough room on the ear for the hearing aid and glasses.
- Wax problems are not as much of an issue with this type of hearing aid since there are no electronics in the earmold.
- The tubing of the earmold needs to be changed periodically because it gets hard and brittle.
- It can be made with any size of battery from 675 to 13 to 312 to 10 (from largest to smallest).

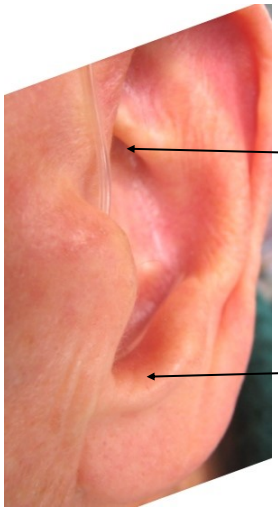

Slim-Tube BTE

- This style is also referred to as an “open fit” BTE since, in its original and typical configuration, the ear canal is not closed off by an earmold or by the hearing aid; that is, the original form of this hearing aid leaves the ear canal “open”. Slim-tube BTE hearing aids can now be provided with an earmold that does close the ear canal off when more gain and output are needed.
- The tubing for this type of BTE is smaller than that used with the standard BTE, and so this type is not as visible as the standard BTE.
- It can sometimes be fit without the need for an ear impression and custom earmold. Several sizes of domes and lengths of tubing are available to accommodate various sizes of ears. The domes are sometimes called earbuds.
- Since the tubing is smaller than that for the standard BTE, it is more prone to getting plugged with wax or condensation. The tubing can be cleaned by the wearer.
- Many slim-tube BTE hearing aids are very small and may not be made with a volume control.
- They are not usually suitable for someone with severe hearing loss and in need of lots of power.

Receiver-In-The-Canal BTE (RIC)

- This is sometimes denoted as an RITE hearing aid, meaning “Receiver in the Ear” and sometimes also called an “open fit” BTE.
- These look almost identical to the slim-tube BTEs. Instead of a hollow tube going from the hearing aid into the ear like the slim-tube however, there is a wire going from the hearing aid down to a receiver (speaker) that is placed in the ear canal.
- The receiver can be placed in the ear canal with a dome/earbud which comes in various sizes, or with a custom earmold.
- Some RIC hearing aids can be made with lots of power, but not without a tight fitting custom earmold.
- The receiver can fail if wax gets in it.

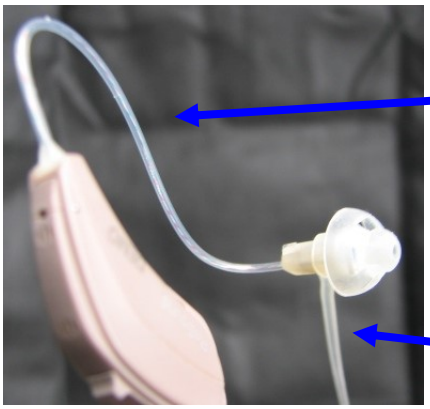
After you have had your hearing evaluated, the audiologist can give you an idea of how much hearing aids might help you, show you these different styles (and other styles that might be available), and give recommendations about what might be appropriate for you. See if you can handle the batteries and make sure that you can change the battery in the smaller hearing aids if that is what you want.



slim tube or RIC wire

slim tube and RIC hearing aids often have an “anchor’ or “sports lok” or “pigtail” to help secure the dome in place

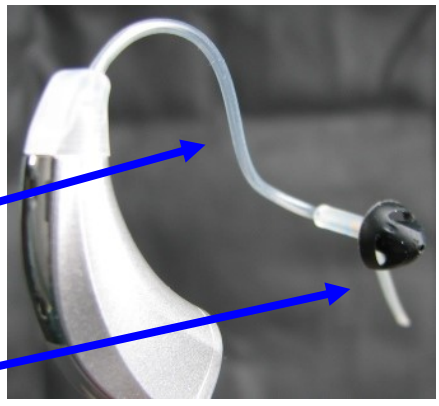
RICs (left) and slim tube (right) aids look almost identical



This is the wire leading to the receiver and dome

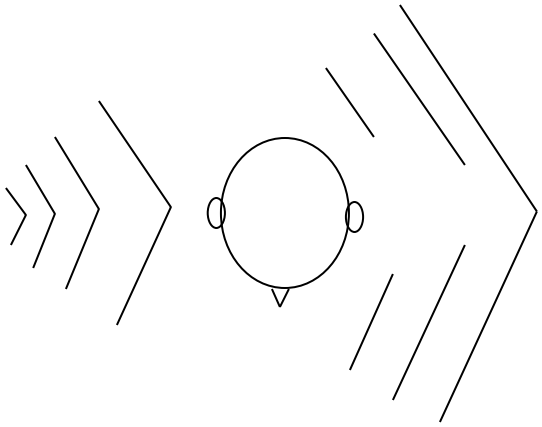
This is the hollow tube leading to the dome

This is the plastic anchor that fits in the bowl (concha) of the ear



CROS and other Variations

The above examples are by far the most common styles but there are lots of variations on these themes. One variation is CROS hearing aids. CROS stands for Contralateral Routing of Signals. It means that sound from one side of your head is routed to the ear on the other side of your head. It is a type of hearing aid that is used when one ear is unusable and the other ear is ok. This is sometimes called single-sided deafness.



Your head casts a small, but significant sound shadow. This is obvious if you consider someone trying to whisper into a right deaf ear - the left ear can't hear that whisper. But if the right ear is deaf, and the left ear is ok, then a CROS hearing aid will allow the person to hear that whisper. They hear it in the good ear, but they hear it. CROS hearing aids eliminate the sound shadow cast by the head.

The most common way that a CROS hearing aid works is by placing a microphone and radio transmitter (which looks like a regular hearing aid) on the bad ear and then placing a radio receiver and the rest of the hearing aid on the good ear. In this way the good ear hears sound (even from a telephone receiver) from the side of the head with the bad ear.

This goal of eliminating the head shadow in cases of single-sided deafness, can also be accomplished with bone conduction hearing aids. One type of bone conduction hearing aid is partially implanted into the bone behind the bad ear. Since it vibrates that bone and since that bone is ultimately connected to the bone in which the good ear is housed, the result is that the good ear hears sound from the bad side.

The mastoid area of the temporal bone is a common area for placement of a bone conduction hearing aid. The mastoid is the raised area behind your outer ear. Other sites can be used however. Even the teeth can transmit bone conducted sound throughout the skull.

A bone conduction aid can also be made without the need of implanting part of it. Another way of coupling a bone conduction aid is by a special earmold that vibrates the bones from within the ear canal. This is usually called a transcranial CROS hearing aid.

Impressioning

There are a few hearing aids where an impression of your ear is not taken. If you have a mild loss and the shape of your ear is not too different from average, you may wear a slim-tube or RIC BTE where a standard ear piece is used. Your ear is measured for tubing or wire length and

dome size, and no impression is taken.

In most cases however, an impression is taken of your ear. This is done by first inserting an ear-dam made of cotton or foam into your ear canal. The ear-dam serves as a block so that the impression material will not go all the way to the eardrum. It is not unusual that placement of the ear-dam makes you cough. A branch of the Vagus Nerve that serves your throat passes close to the ear canal, very close in some people, and moving the ear-dam through the ear canal can cause your throat to tickle, making you cough.

Once the ear-dam is in place, an impression material, usually made of silicone, is squirted into your ear canal. The impression material feels cold in your ear because the impression material is room temperature and your ear canal is about 98 degrees.

The ear canal is about an inch long from its entrance to the eardrum. The outer half of the canal is cartilage covered with thin skin. The inner half of the canal is bone covered with even thinner skin.

The outer portion of most people's ear canal is pliable, as is the pinna (that easily-visible, funny-shaped flap of skin and cartilage most people call their ear). The person making the impression will take care not to distend your ear when he or she injects it with impression material.

The shape of your ear canal is also influenced by your jaw. The temporomandibular joint (TMJ) is located just beneath the ear canal. If you put your finger in your ear canal and move your jaw you can feel the ear canal changing shape.

Most ear canals expand when the jaw is open and some experts have you hold your jaw open while taking an impression, especially if the hearing aid needs to fit snugly in your ear. Some may even take one impression with your jaw open and then another with your jaw closed to show the hearing aid factory the amount of movement in your canal.

Some people find removal of the impression material uncomfortable because their ear canal is very sensitive. It can also be uncomfortable if there is a sharp bend in your canal that the impression material is pulling against, or if the impression material is sitting on the tympanic membrane. If the impression material is deeply seated in the canal, it is helpful to break the seal so that there is no vacuum when the impression is removed.

Monaural, Binaural

People hear better with two ears that cooperate with each other, including people who wear

hearing aids. Let us give you an example. Our old fitting room was about 12 X 10 feet and had a ventilation register in the ceiling. Because this room was located in the center of the rest of the office area, it didn't' get much air circulation unless the central fan was running. For this reason, we left the fan running all day to keep the fitting room from getting too hot and stuffy.

Most people who need hearing aids do not hear the sound from the air exiting the register above them… until a hearing aid is placed on them. When we put one hearing aid on (a monaural fitting) they may hear the ventilation sound and comment that the *hearing aid* is making a noise; that there is a soft rushing sound in the hearing aid. When we put a hearing aid on the other ear, so that they are wearing two hearing aids (a binaural fitting) they say, "Oh, it's not the hearing aids making that noise, I can hear that it's your air conditioner" and point to the air register above them because now they can tell where the sound is coming from.

Many people with good hearing in only one ear do very well, but normal hearing is hearing from two ears. You cannot find a hearing animal in the world that has only one ear.

Having said that, there are some reasons for a monaural fitting, that is, having a hearing aid for only one ear. If only one ear is impaired you don't want the normal ear fit of course (unless you decide on a CROS hearing aid). If you can hear nothing from one ear, I mean nothing, fitting a deaf ear with a standard hearing aid may do no good. Some people's hearing is such that both ears do not work together and this person actually does better with a monaural fitting. This is an unusual situation and a sign of impairment in the central auditory pathways beyond the inner ear.

Someone who has worn a hearing aid in only one ear for a long time can have a very hard time getting the unaided ear to handle sound again because of Auditory Deprivation.

A binaural fitting costs more and can actually make your voice sound a little odder to you at first than a monaural fitting, but is closer to normal hearing than is a monaural fitting.

We'll mention one other thing about this that comes up frequently in our practice. Most people assume that the worse your hearing, the greater the need for a binaural fitting and conversely, the closer your hearing is to normal, the easier it will be to get away with a monaural fitting. It is just the opposite.

For someone with a severe hearing loss, they are hearing very little without hearing aids. If we fit them monaurally, they hear conversation and hear so much better in so many situations that they are very happy. They may not hear as well as they would with a binaural fitting, but the difference between no hearing aid and a monaural hearing aid is so much that the difference is very noticeable to them.

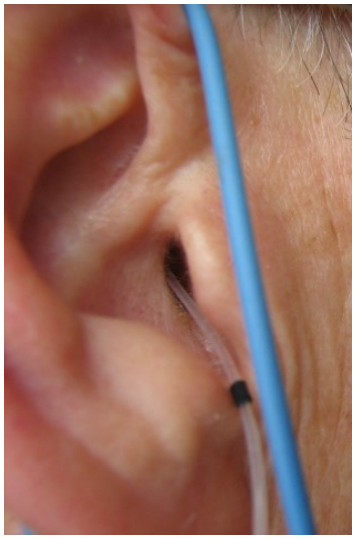
For someone with a very mild binaural hearing loss, a monaural fitting may be as bad as going without hearing aids. The person with a mild hearing loss in both ears usually has noticeable

hearing impairment only in difficult listening situations, situations where there is background noise, high reverberation, or a large distance over which he or she is trying to listen. It is important to have two equally responding, or two balanced, ears in difficult listening situations. They need binaural hearing to hear better in difficult listening situations.

Probe-Microphone Real-Ear Measures

A few decibels louder or softer can make a big difference in some fittings. We could try to test a person with the hearing aids in place just as we did when we tested without the hearing aids, but it would take a lot of time and is not as precise as probe-microphone measures.

The science of fitting hearing aid acoustic characteristics to the particular specifics of your residual hearing has advanced tremendously since I (gh) started fitting hearing aids 40 years ago, with probe-microphone measures being one example of that improvement. Probe-microphone measures began in the early 1980s (Harford, 1981; Nielson, 1985), and have gradually won wide acceptance and usage.



The picture here (and at the beginning of this chapter) shows a probe-microphone assembly. Basically, a hollow tube (the probe) is placed close to the ear drum and connected at its other end to a microphone. A hearing aid can be placed in the ear and now the probe-microphone measures the sound the hearing aid is producing at the eardrum. This can be compared back to your audiogram to see if the sound produced by the hearing aid is set to "target" or set to what most would "prescribe" for your residual hearing.

Being able to place a microphone in the ear canal and measure the sound produced by the hearing aid at your eardrum was a big advance in the science of hearing aid fitting. It is fast, and it is reliable.

How Long Does a Hearing Aid Last?

I once fit a lady who used her hearing aid every day for 13 years without a problem. But this is rare!

I do not know statistics for how often patients end up replacing hearing aids, but I usually tell people that roughly five years is about average for replacement of hearing aids and that it would be unusual to try and have a hearing aid over ten years old repaired instead of replaced. Here are some of the factors that enter into the decision whether to repair a hearing aid or replace it.

The shape of your ear canal changes with time, even without a hearing aid in it. Plus, when you wear a hearing aid it will often wallow-out your ear, much like the ring on your finger will indent your finger. If you have an old aid that no longer fits properly, it will in most cases be better to replace it.

The plastic of the hearing aid also deteriorates over time, faster for some wearers than others. The amount of sunlight exposure, the skin oils and perspiration to which the aid is exposed, and other factors help determine how quickly the plastic will deteriorate. The plastic can harden and crack and discolor with time. We've seen hearing aids so yellow that they look dirty, even though they might not be.

We've also seen the insides of a hearing aid get so corroded that the entire hearing aid needs to be replaced. Manufacturers have a limited time that they will carry replacement parts, especially amplifiers. So if the amplifier of your ten year old hearing aid goes bad, the part may no longer be available from the manufacturer, although you might be able to find a hearing repair firm who stockpiles old hearing aids and can get an amplifier that way.

It is likely that your hearing will change over time, maybe not a lot, but a little can make a big difference. If your hearing has changed significantly and the hearing aid cannot be programmed (readjusted) to match targets for your new hearing, it might be time to replace the hearing aid. While I'm on the subject, there is usually no way to know how stable your hearing loss might be. Some people might have been told that they would be deaf by the time they were some particular age, but that was a guess. It is reasonable to have your hearing checked every one to two years, sooner for hearing impaired children.

Technology changes. If there is a hearing aid that will provide you better hearing than your old hearing aid, it might be time to replace the aid. Hearing aids are getting smarter in how they respond to sound and communicate with other devices. Sometimes people just want a smaller hearing aid. Sometimes dogs eat hearing aids and the aid has to be replaced.

Hearing Aid Warranties

Hearing aids usually come with a one or two year warranty, sometimes longer. There are some variations in exactly what this means.

It almost always means that if the hearing aid breaks and needs to be returned to the factory for repair during the warranty period, that the factory will repair it at no charge. Some manufacturers may make an exception when it comes to the shell of the hearing aid.

In-the-ear type hearing aids have a faceplate and shell. The shell is the part of the aid that touches the skin of the ear and is not seen when the hearing aid is in place. If you step on the hearing aid and break the shell, some audiologists and manufacturers will charge to have the

shell repaired or replaced even if the aid is in warranty.

With behind-the-ear hearing aids you might have an earmold that is not made by the same company as your hearing aid. The warranty on the earmold is probably different than the warranty on your hearing aid.

If your hearing aid breaks during the warranty period and you return to the audiologist from whom you purchased your hearing aid, there *may* be no charge from the Audiologist during the warranty period. There are some exceptions. Some Audiologists include or "bundle" the likely cost of their services for a year into the purchase price of your hearing aid, but some do not and may charge you for service on an "as seen" basis.

If you have an Audiologist troubleshoot a hearing aid that you did not purchase from him or her, you might pay for the Audiologist's service even if the hearing aid is under warranty.

We have seen one Internet seller of hearing aids give a three year warranty, but only the first year was a manufacturer warranty; the second and third years were self-warranted by the Internet seller. In one instance the Internet seller covered the second year warranty but made an exception if the hearing aid broke because of ear wax; that is, they charged for the repair if wax was the problem, and we estimate that 80% of the time it is wax.

If you lose your hearing aid or it is damaged beyond repair, many manufacturers have a loss and damage warranty and will remake, usually for a deductable, the hearing aid one time under this warranty.