HEARING LOSS

What you should know

WHAT DOES BETTER HEARING MEAN TO YOU?

Why you should be proactive with your hearing health

Self-check:

What is your hearing like?

Profession:

Audiologist

Interview with Anna Berger

HEARING LOSS HAPPENS TO ALL OF US

What to know about hearing loss and modern hearing aids

What can you expect from hearing aids?

Hearing aids today are tiny but powerful computers. Their sophisticated digital technology sets them a world apart from the hearing aids of the past. So the answer as to what can you expect from your hearing aids is: A lot!

Modern hearing aids work with digital technology. They can be individually adjusted to suit specific hearing loss, have automatic programs for every environment (speech is amplified while ambient noise is dampened) and a function to suppress acoustic feedback. If required, they can transmit sound directly from a television or cell phone. This all makes life so much easier for people with hearing loss, and gives them improved quality of life.

Hearing aids nowadays are miniature, technical miracle workers, which can have a significant positive impact on quality of life.

Photos: Resch (1), Fotolia (2)

But there is one thing you need to bear in mind: Hearing aids cannot replace natural hearing in all situations – regardless of the brand, type or technology. Even the very latest and best hearing aids are still prostheses and have their limits, depending on the type and severity of hearing loss. And such unrealistically high expectations of the hearing aids will inevitably leave you feeling frustrated and dissatisfied. If, however, you are aware of the limits and of what you can realistically expect, you will be amazed at how hearing aids can make things easier and improve your quality of life.

How to be proactive with your hearing health:

Perhaps the most compelling argument to take care of one's hearing is the "use it or lose it" principle. With any level of hearing loss, a person is missing certain sounds, meaning their hearing nerve and the part of the brain that processes sound are not being stimulated. This can lead to a decreased ability to recognize speech, even when hearing is restored. Being proactive with your hearing health before you notice a change in your hearing is easy:

1 PROTECT YOUR HEARING. An exposure of only 10 minutes to loud noise is enough to damage your hearing, the good news is prevention works. Carry hearing protection to use while travelling or at events - even the noise at the average hockey game can reach 120 decibels, that's as loud as a jet engine during take-off!

2 GET A BASELINE HEARING TEST. A basic hearing test is used to determine how well you hear at various frequencies. Once you have that first hearing test to compare to, your hearing care practitioner can pick out changes more easily. Then, get your hearing checked annually, just as you would your eyes and teeth.

Wearing hearing aids:

Positive effects on all aspects of life!

An international study, "Hear the World Study, 2011", asked people around the globe to what extent their hearing aids had improved important aspects of their lives. The data speaks for itself.

Source: Hear the World Study, 2011

Don't leave it too long!

While glasses are seen as a smart and fashionable accessory, many people still see hearing aids as a stigma and are afraid that wearing them will make them appear old and disabled. **Serious consequences of this fear of wearing hearing aids: many people with hearing loss put off going to see a Hearing Care Professional - and some even leave it too late.** Studies show that people who realize they are losing their hearing generally wait seven to eight years (!) until they take the step of going to see a Hearing Care Professional.

But this wait is a major problem - research has shown that the brain actually "unlearns" certain sounds after about seven years. If these sounds are made audible again with the help of hearing aids, the brain is no longer able to make them out properly and they are often perceived as being much too loud or unpleasant - even if they are something as harmless as the leaves rustling or voices from next door's garden. **The problem is: hearing is almost always lost gradually.** If you suffer from hearing loss, you gradually get used to it and do not notice it until you suddenly realize you cannot follow an everyday conversation.

The following points can help you to define realistic expectations for your future hearing aids:

WHERE I AM NOW IN TERMS OF MY HEARING?

The extent to which hearing can be improved with hearing aids depends very much on how severe the hearing loss is and how long it has lasted. The greater the hearing loss, the greater the demands on the hearing aids.

IN WHAT SITUATIONS DO I NEED HELP?

Deteriorating hearing is most evident in noisy environments where there are many different voices, e.g. in a restaurant or on a bus. The Hearing Care Professional aims to find a device that will help you hear as clearly as possible in the situations that are most important to you, and in particular to allow you to understand speech clearly.

AM I READY TO INVEST A LITTLE TIME?

Only custom hearing aids can deliver the greatest benefit. Selecting and adjusting a hearing aid is, however, a lengthy and time-consuming process. To find the best device for you and the ideal settings, you will need to visit your Hearing Care Professional several times (see also page 14 "The route to a hearing aid").

In which situations is the deterioration in my hearing most evident?

Hearing well means

enjoying dinner conversation again.

With hearing aids that automatically filter out background noise, a busy dinner table means enjoying lively conversation, not mumbling.

It starts at Connect Hearing.

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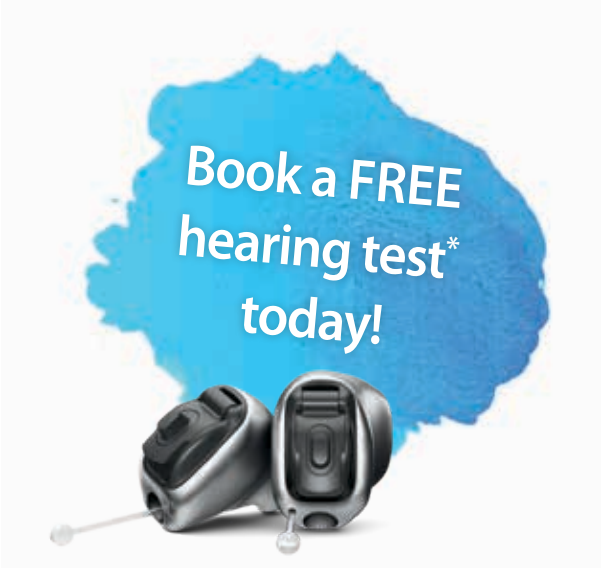

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Connect Hearing
YOUR HEARING PROFESSIONALS

VAC, WCB, WSIB, WorkSafeBC, ADP & ODSP accepted. Registered under the College of Speech and Hearing Health Professionals of BC. *Free hearing tests are only applicable for customers over 50 years of age. No purchase required. Some conditions may apply. †Based on national physician referrals over the tenure of the corporation's Canadian business operations compared to the disclosed referral count of leading competitors.

Constant strain on the ears: It is not just loud music in discos and rock concerts that has taken its toll on the babyboomer generation, but also the continuously increasing day-to-day noise.

Photos: Fotolia (7)

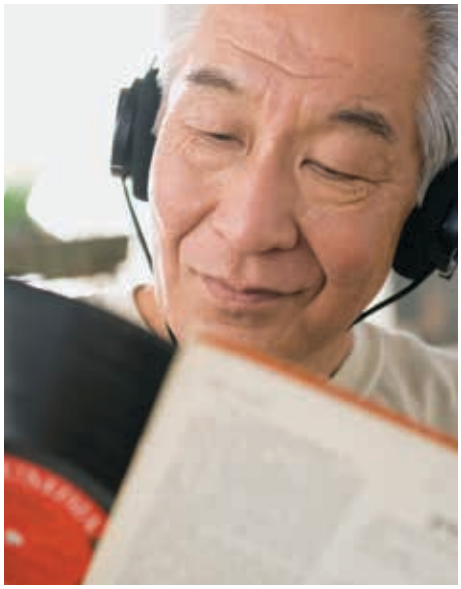
Baby Boomer generation particularly hard hit by hearing loss

As hearing loss increases with rising age, we should assume that most people suffering from hearing loss are seniors. And, until a few decades ago, this assumption was correct. But now it is not the oldest among us who make up the largest group of people with hearing loss, but the active babyboomer generation (born in the babyboom years in the 50s and 60s).

In the USA, for instance, there are some 10 million babyboomers with mild to severe hearing loss, while this figure in the over 65s stands at only 9 million.

Constant stress from noise and loud music

Experts agree that this development is the result of an ever increasing constant exposure to noise, the result of lifestyle and environment. This babyboomer generation has listened to loud music in discos and rock concerts since adolescence, and have also been exposed to increasing noise pollution in the day-to-day environment, from traffic, for instance.



Preprogrammed hearing problems: Many people regularly listen to music that is too loud.

The situation is worse for children

An alarming fact: This trend is even more evident in the children of the babyboomer generation. The main reasons for this are excessive environmental noise and regularly listening to music that is too loud, especially with headphones.

Hearing loss is a wide-scale problem

The World Health Organization (WHO) estimates that in 2015 1.1 billion people the world over will be affected by hearing loss - a figure equating to about 16% of the population. 65% of them will have slight, 30% moderate and 5% severe to profound hearing loss. A hearing system would benefit most of them, but only one in five of those affected makes use of this option.

49% of people who wear hearing aids say: "I should have got a hearing aid much sooner!"

70% of people who wear hearing aids say: "It's no problem to wear a hearing aid during exercise."

81% of partners and spouses say: "I am pleased that my partner wears a hearing aid."

78% of people who wear hearing aids have come to enjoy activities with friends again

68% of people who wear hearing aids wear them every day or almost every day.

52% of hearing aid wearers say it is easier for them to get to know new people - exactly the same as in the population at large.

Source:
Hear the World Study, 2011

What's the difference?

In-clinic hearing evaluation vs. online hearing test.

Online hearing tests can be seen as a stepping stone on the road to better hearing health. An online hearing test typically consists of a short survey of your current perceptions of your hearing and may also include a series of tones heard through personal headphones. Results from online hearing tests can help identify a potential hearing loss and empower you to approach an in-clinic hearing evaluation with a basic knowledge of your current hearing health.

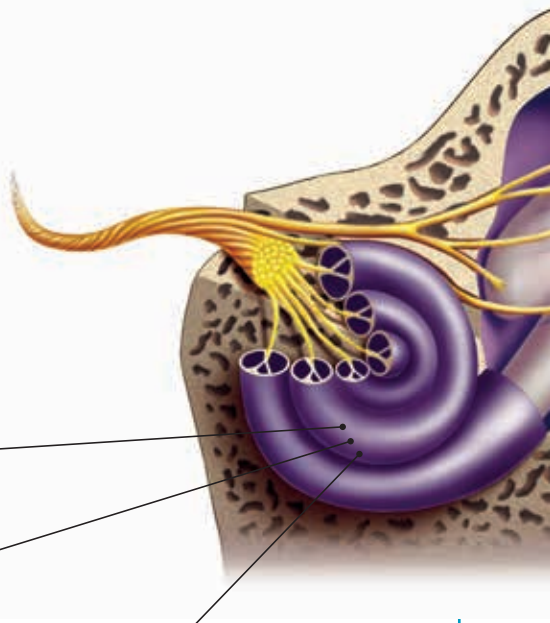
In-clinic hearing evaluations take place with a qualified hearing care professional who will review your hearing and related medical history and inspect your ear canals and middle ears. They will then perform a hearing test in a calibrated sound treated booth where they'll share a range of tones to test the frequencies you can hear and ask you to repeat certain words to check word recognition a how you hear speech in quiet and noisy situations. The hearing care professional will then create an audiogram, which is like a perscription for your hearing, and recommend a treatment plan based on your individual hearing loss and lifestyle.

What causes hearing loss?

The ear is a sensitive and complicated organ. It helps us to perceive sounds and to orientate ourselves in space. So deteriorating hearing ability has a detrimental impact.

The part of the ear with the hearing loss can vary. There is a wide range of possible causes: hearing loss is not always related to old age. It can be triggered by a very loud noise, infections, toxicity, injuries or hereditary factors.

The cause of hearing loss can manifest in different parts of our auditory organs: in the **outer ear,** the **middle ear,** the **inner ear** or even the auditory nerve. Depending on the type of hearing loss, this may be accompanied by other symptoms, such as tinnitus (see our glossary page 31), noise sensitivity or dizziness. Hearing loss is permanent in almost all cases and it is often difficult to predict how it will develop. The possible treatments and the option of rectifying or at least reducing the hearing loss with technical devices depend very much on the cause.



POSSIBLE CAUSES IN THE INNER EAR

Age-related hearing loss (presbyacusis)

This usually begins at the age of 45 to 65 and can also be affected by external factors (e.g. exposure to noise). Age-related hearing loss affects the higher frequencies in particular, and usually affects both ears. It is caused by damage to the fragile hair cells in the cochlea, leading to reduced signal transmission to the auditory nerve.

REMEDY: Drug treatment or surgery are not possible. **HEARING AIDS** may, however, be a great support for this type of hearing loss.

Toxicity of the nerve cells (ototoxicity)

The medical term ototoxicity describes the harmful effect of substances (such as certain medicines) on the inner ear, particularly on the sensory cells in the hearing and balance organs or the corresponding nerves in the brain.

REMEDY: As nerve cells are affected, the damage is usually permanent. **HEARING AIDS** may, however, be a great support for this type of hearing loss.

Acoustic trauma

Damage to the inner ear caused by a very loud noise, such as a shot or an explosion. This results in a feeling that the ears are blocked, hearing loss and/or tinnitus.

REMEDY: Usually, hearing will improve within hours or days. Permanent damage is, however, possible. Properly fit **HEARING AIDS** can be helpful in these cases.

The different forms of hearing loss

POSSIBLE CAUSES IN THE OUTER EAR

Foreign body in the ear canal

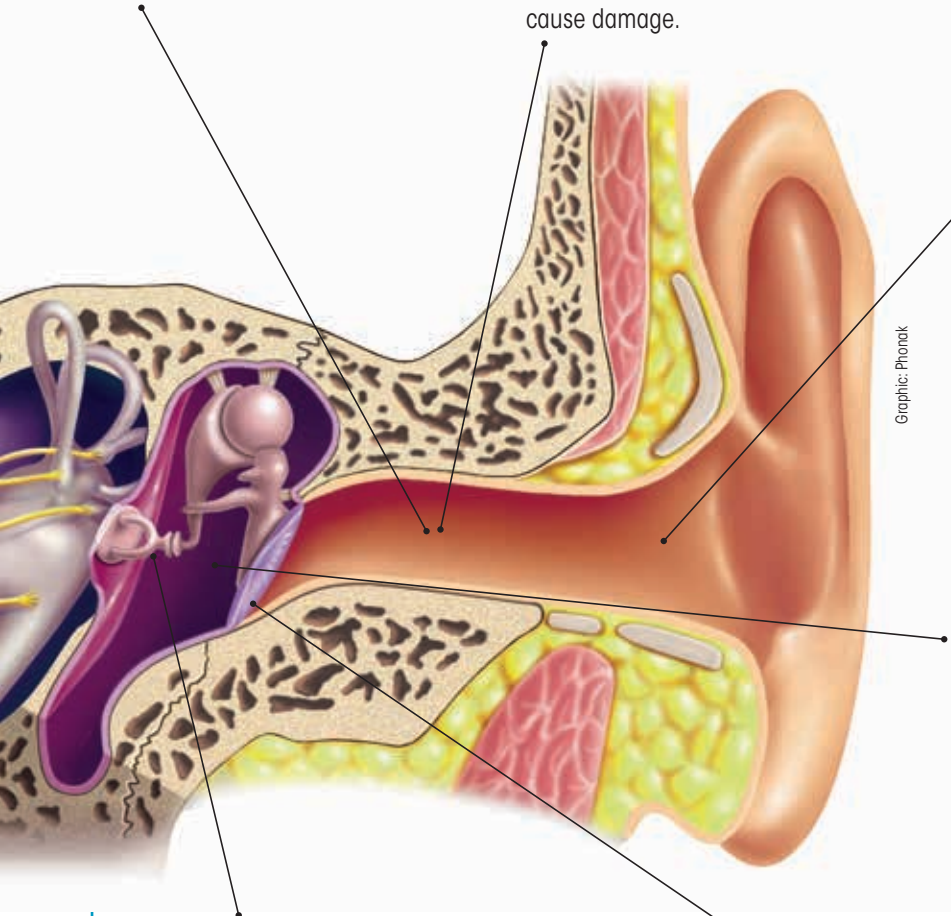
An injury to the outer ear or a blockage in the ear canal can also be caused by a foreign body.
REMEDY: A doctor can remove the foreign body.

Excess ear wax

The ear canal can be blocked as a result of incorrect cleaning or an over-production of ear wax, which can result in greatly reduced hearing.
REMEDY: A doctor can expertly clean the blocked ear. **CAUTION:** Do not use ear buds, as they can push the ear wax deeper down into the ear and cause damage.

Outer ear infection (otitis externa)

An infection in the outer ear affects the outer ear canal and sometimes also the auricle. A bacterial infection is usually caused by contaminated water (e.g. in swimming pools). This is why it is also known as "swimmer's ear". It can cause pain, itching and reduced hearing.
REMEDY: Your GP or ENT doctor can prescribe drug treatment.



Graphic: Phonak

POSSIBLE CAUSES IN THE MIDDLE EAR

Middle ear infection (Otitis media)

A middle ear infection caused by a virus or by bacteria is usually very painful. The pathogens make their way to the ear via the blood stream or through the nasal cavity to the eustachian tubes. While the infection persists, hearing is severely affected.
REMEDY: Your GP or ENT doctor can prescribe drug treatment.

Otosclerosis

A disease affecting the bone surrounding the inner ear. Otosclerosis is an inflammatory process that causes abnormal bone to form and impacts on the mobility of the stirrup bone (the smallest bone in the human body). This results in a slowly progressive loss of hearing, often accompanied by ringing in the ears (tinnitus).
REMEDY: Cannot be treated with drugs. Sometimes surgery can reduce the hearing loss.

Ear drum perforation (burst ear drum)

The sensitive ear drum can be damaged by foreign bodies, an infection (e.g. middle ear inflammation) or severe pressure (e.g. when diving). Sometimes it can burst as a result of a punch to the ear or a loud noise. A perforated ear drum leads to hearing loss.
REMEDY: The good news is that an injured ear drum can often heal itself. For this to happen it is essential to keep the ear dry, even when washing your hair. If the ear drum doesn't heal itself, the perforation has to be rectified with surgery.

Every hearing situation is different

On a day-to-day basis, we experience a range of different hearing situations. The more active we are, the rarer it is for us to have moments of quiet. Situations where we are immersed in all kinds of background noise are, however, much more common.

Outdoors, this is usually wind or traffic. But indoors the moment people get together it is rarely quiet. In open plan offices, for example, there is a constant and high level of noise: telephones ring, printers and photocopiers clatter, staff chat.

Not quieter, but "more blurred"

The problem: The more densely woven the carpet of sound the more difficult it is for us to hear, and especially to understand speech - particularly if we suffer from hearing loss. Because, contrary to popular belief, hearing loss does not just make everything quieter, but causes sounds to "blur". We can compare it to a mixture of sounds in which it becomes increasingly difficult to decipher the more ingredients (background noises) are added. It is also some of the most important consonants that gradually disappear from our hearing range when we suffer from hearing loss: P, K, F, H and also all T, sh- and s- sounds. This all has a direct affect on our speech comprehension.

Self-check:

What is your hearing like?

What makes hearing loss so insidious is the way it gradually creeps up on us. This way, many of us do not realize for a long time that we are suffering from hearing loss. And little by little it gnaws away at our quality of life. The longer you go without doing something about hearing loss, the more sounds and voices will disappear from your life - in a worst case scenario, forever.

The more questions you have answered with "yes" in our checklist, the greater the probability that you are suffering from hearing loss and would benefit from hearing aids:

- ☐ Do you often find it difficult to follow a conversation with more than two people? Or do you find conversations like this a strain?
- ☐ Do you find it difficult to understand what people are saying in loud environments, such as restaurants or shopping centers?
- ☐ Do you often need to ask people to repeat what they have said?
- ☐ Have you missed visitors or telephone calls because you didn't hear the phone or the door bell?
- ☐ Have you ever got yourself into an embarrassing situation because you have not understood something properly?
- ☐ Does your family or your neighbors complain that you have the TV on too loud?
- ☐ Do you find it more difficult to understand what women or children are saying?
- ☐ Do people sometimes tell you that you are talking too loud?
- ☐ Can you still hear quiet everyday sounds? Such as a dripping tap, a humming fridge or a purring cat?
- ☐ Are you increasingly wary of contact with strangers because you are worried you will not be able to understand what they are saying?
- ☐ Do you suffer from ringing ears (see box "Tinnitus")?
- ☐ Are or were your parents or grandparents hard of hearing?

If you have answered one or more of these questions with **"yes"**, you should visit a Hearing Care Professional.

Where is the limit of good comprehension?

We have come up with six classic hearing situations which are increasing complex.

Hearing situation 1

Simple conversation without background noise

Hearing situation 2

Simple conversation with background noise (children's voices, radio or TV)

Hearing situation 3

Wind and other sounds of nature

Hearing situation 4

In a restaurant - classic difficult hearing situation

Several people talking from different directions, with a humdrum of voices, cutlery, etc.

Illustrations: Area Media Group

Hearing situation 5

Listening to music in a concert or at home

Hearing situation 6

The classic work situation: The meeting

Lots of people talking at varying distances and from different directions

Do these situations sound familiar? In which situations do you still feel comfortable? And at what point is listening a strain or even unpleasant? Make a note of your answers - they provide important information for your Hearing Care Professional!

The different types of hearing aids

The principle of a hearing aid is simple: It takes sound waves from the environment and transmits them amplified - and, if necessary, modulated - to the ear. This then compensates for the wearer's hearing loss.

Various types of hearing aids can be used nowadays, depending on the hearing loss and personal requirements

Most hearing aids are basically built in a very similar way: They have one or two microphones, an amplifier and a loudspeaker (or what professionals call a "receiver"). The microphones take in surrounding sound, which is processed in the form of electrical impulses and then transmitted to the ear amplified.

At the core of the hearing aid is a tiny computer.
The trick: Modern hearing aids constantly optimize the sounds to be amplified using sophisticated control and filter programs, which are precision adjusted to the wearer's hearing loss and the current hearing situation (see also page 10). This is all powered by a miniature computer which, depending on the manufacturer, can carry out up to 200 million calculations per second with up to 16 million transistors - equivalent to the performance of a sophisticated office computer.

Photos: Phonak (4), Resch, Graphics Lötscher

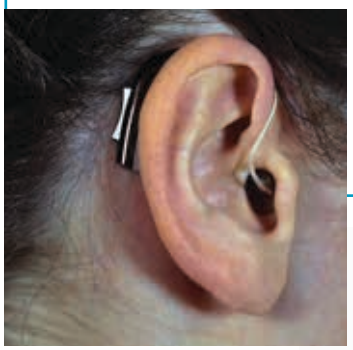
Behind-the-ear devices (BTE)

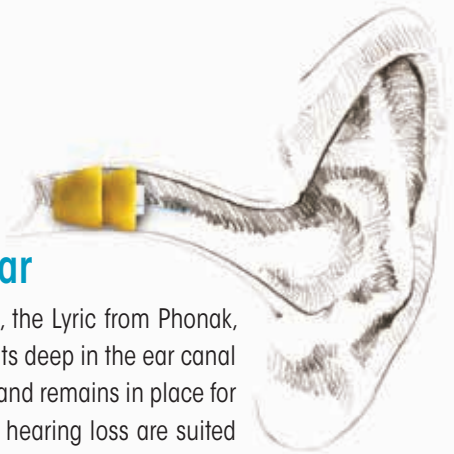
Behind-the-ear devices are suitable for all degrees of hearing loss. They are worn comfortably behind the ear and are available in various sizes. The smaller options are virtually "invisible" as they disappear completely behind the ear. Sound is transmitted into the ear through a very discrete and fine tube, which leads into a customized earmold.

Since BTE devices have more space for the electronics than other designs, they are suitable for a wide range of technical options and deliver increased amplification performance.

Receiver in Canal (RIC)

These devices are smaller than normal BTE models and are available for mild to severe hearing loss. They can also be worn comfortably behind the ear. What differentiates them from BTE devices is a loudspeaker or "receiver" outside the housing. This is positioned at the end of a thin earwire which is placed near the ear drum instead of the thin tube placed in the ear canal in the BTE model. The sound generated only has to travel a very short distance with lower transmission loss, requiring much less sound energy (longer battery times).





"Contact lens" for the ear

The first completely invisible hearing aid, the Lyric from Phonak, was only launched a few years ago. This fits deep in the ear canal - up to just 4 mm in front of the ear drum and remains in place for several months. However, not all types of hearing loss are suited for this, and neither is everybody's ear canal.

In-the-ear (ITE) hearing aids

In-the-ear hearing aids are worn fully inside the ear or in the ear canal. The electronics are fitted into the individually crafted hollow shell. This allows ITE devices to exploit the anatomical advantages of the outer ear (the pinna). An ITE device is, however, only suitable for mild to severe hearing loss.

In-the-ear systems can be divided into the following categories:

- **ITE: "In-The-Ear"**
  The casing for this hearing system completely fills the external part of your ear (full shell).
  Advantages: longer battery life, greater amplification, better user comfort.
- **ITC: "In-The-Canal"**
  The auricle remains free because the housing for this hearing system is in the ear canal, sealing it off.
- **CIC: "Complete-In-Canal"**
  The hearing aid is so small that it can be sunk completely into the ear canal and is barely visible from the outside. These devices usually have a nylon thread to pull them out of the ear canal.

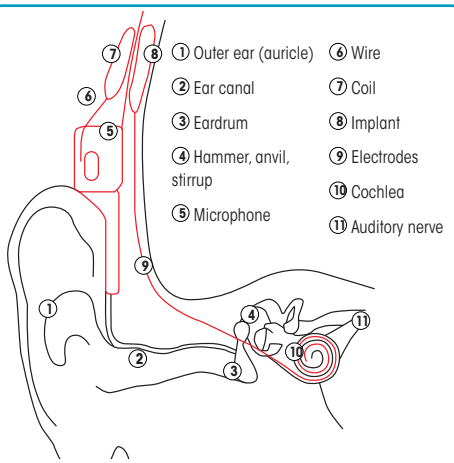
Bone conduction hearing aids

There are some specific diseases affecting the ear that mean that sound cannot be transmitted through the air into the ear canal, but has to be transmitted by vibrations on the skull into the inner ear. Usually bone conduction hearing aids are integrated into the arms on a pair of glasses (spectacle hearing aids). The composer Ludwig van Beethoven invented what must have been the first form of bone conduction hearing aid out of necessity back in 1814. So that he could hear at least a little of his piano sounds when he was composing, despite the fact that he was almost completely deaf (as a result of otosclerosis, see page 9), he secured a wooden rod to his grand piano which he held between his teeth as he played. This way the music from the piano was transmitted through Beethoven's teeth and skull into his inner ear.

Hightech options

Here are some of the latest advances that have made their way into your hearing aids

- **Rechargeable batteries**
  Hearing aids now have the capability of holding built-in lithium-ion zinc rechargeable batteries with silver-zinc technology to provide longer lasting wear.
- **Connectivity**
  Blutooth compatible hearing aids let you connect to your favourite devices with ease - control your hearing aids with an app, use them as a wireless headset for hands-free calls or enjoy surround sound on your tv.
- **Hyper-customization**
  Precision-fit in-the-ear hearing devices are often custom made using a 3-D printer. Advances in 3-D printing have allowed new mediums such as titanium to be used to create thin, durable casings.



Cochlear Implant (CI)

"Cochlea" means literally snail shell. The cochlear implant is a hearing prosthesis for the deaf and profoundly hard of hearing, who derive either no or very little benefit from conventional hearing aids, but whose auditory nerves are still intact. This is how it works: a speech processor takes in sound from the environment via a microphone and converts it into electrical signals. These are then converted into an electrical pulse pattern and passed through the skin to the implant carried as a coded signal by radio waves. The implant then decodes the signals and passes them on to special electrodes in the cochlea. The auditory nerve is stimulated by the electrical impulses and the brain recognizes the signals as sound.

Small, easy to use and comfortable

Hearing aid technology has been forging ahead in recent years. Gone are the days of chunky, unsightly and uncomfortable systems. Modern hearing aids are technological marvels that offer extreme performance in a tiny device - and are so discrete you hardly notice them.

The key advantages of modern hearing systems at a glance:

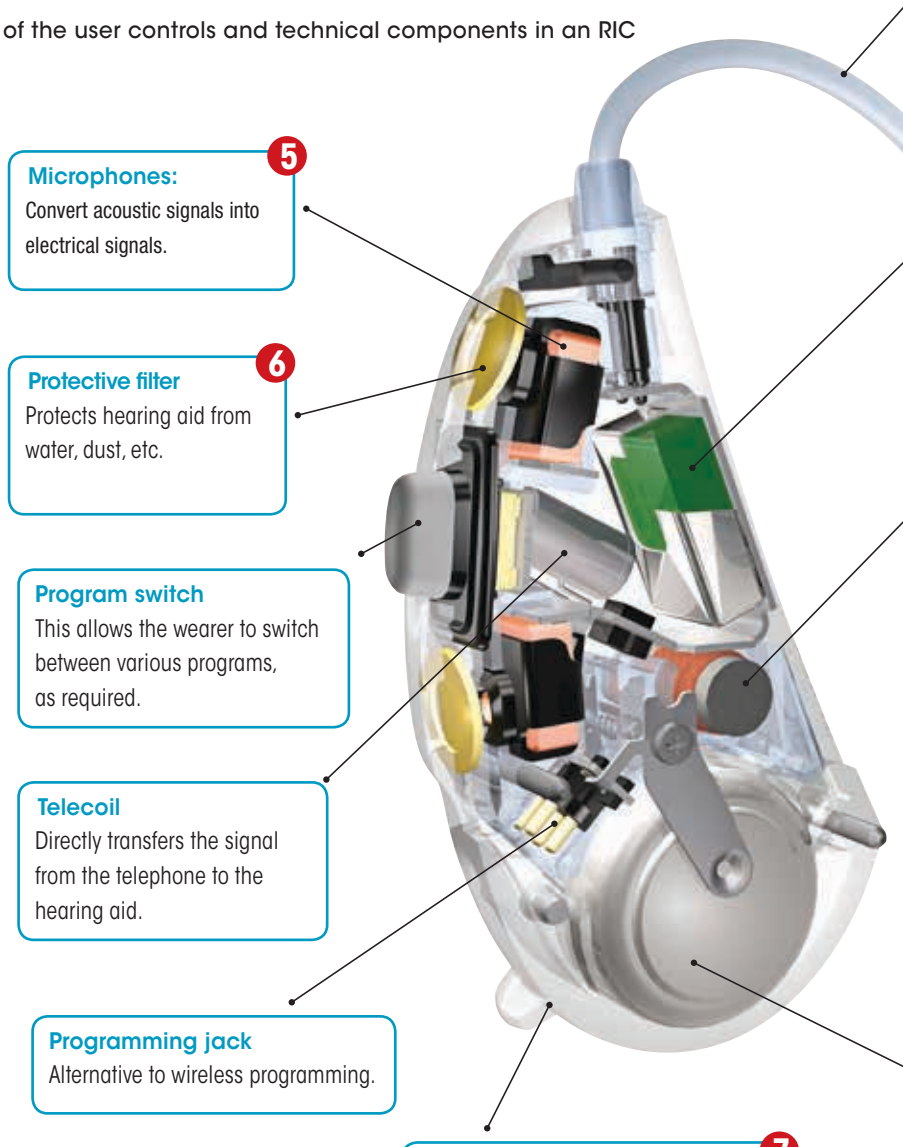
- small and discrete to virtually invisible
- easy to use despite complex technology
- very comfortable to wear, as they are small & light
- sophisticated programs and filters ensure improved speech comprehension
- no acoustic feedback
- wireless transmission from the television, cell phone, etc.
- much better battery life than a few years ago with optimized, energy saving technology (significant differences between models, as various battery sizes are used)

In tune with your environment

Accessories are available for digital hearing devices to be connected wirelessly to multimedia devices by FM or bluetooth.
This allows sound signals from the television or the sound of a caller to be transmitted directly to the hearing system. While just a few years ago simply phoning often posed a problem with a hearing aid, nowadays they can be connected to all devices with bluetooth technology or an FM adapter.
This works by small add-on devices linked to the signal source transmitting the audio signal directly to the hearing device. The hearing device therefore also acts as multifunctional headphones.

Design of a BTE hearing aid

Design of the user controls and technical components in an RIC device



Graphics: Flach (2), Lötscher (1)

Two ears hear better than one

Aspect 1: Directional hearing

When our ears hear sounds, we usually know which direction they came from. We can do this because sound reaches one ear microseconds before it reaches the other. The auditory response area in our brain uses this information to calculate the direction the sound came from. This ability - known as binaural hearing - is an important safety skill, because it can warn us, for example, if a car or bus is approaching when we cross the road.

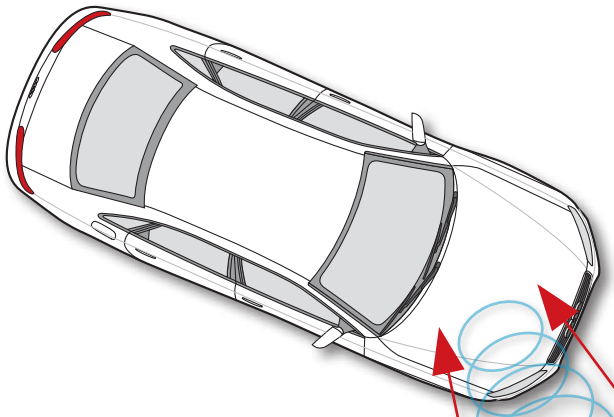
Aspect 2: Sound quality

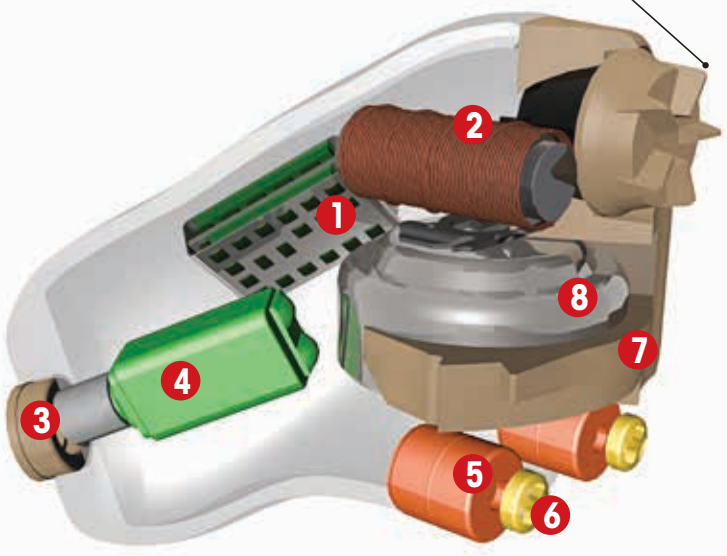
Another factor that is of equal importance is that the sound quality is much better when we hear with both ears. Speech we listen to with just one ear sounds flat and dull.

This is the reason why hearing systems are fitted for both ears if hearing loss is bilateral.

Aspect 3: Sensory deprivation

Over time, the ability of the unaided ear to interpret sound will deteriorate.





Design of an in-the-ear hearing aid

Cable with plug
Anatomically optimized curve.
Available in various lengths.
Replaceable

1 Signal processor
Adjusts the hearing aid to the individual's hearing loss.

2 Antennae
Wireless communication for accessories

4 Loudspeaker
Emits frequency-optimized signals

Earmold
Available in a range of sizes for optimized comfort. Individually customized solutions are also available.

Volume adjuster
Louder / softer

3 Wax protector
Replaceable
Protects receiver from ear wax

8 Battery
Supplies the hearing system with sufficient power.

What should I expect at a hearing care appointment?

If you suspect that you are suffering from hearing loss, you should not wait too long. The first step towards improved quality of life is to go to a Hearing Care Professional who can establish whether you have actually lost hearing and can show which options could help you.

1 Consultation

Every hearing consultation includes a lifestyle analysis. By asking you specific questions in a one-to-one meeting, the hearing aid acoustician can find out what your exact hearing needs are. So, for example, what hearing environment you are in most, and in which situations you would like to hear and understand better. The Hearing Care Professional will work with you to establish your individual criteria, based on your hearing experience to date and your specific wishes. This is an important step because the Hearing Care Professional cannot select the ideal solution for you until he/she understands your lifestyle.

Photos: Resch (3)

2 Otoscopy

In this completely painless examination, the Hearing Care Professional looks into your ears to cast an expert eye on the ear canal and ear drum and ensure that they are intact. This also establishes whether there is a blockage in the ear canal (from a foreign body, for instance) and if excess ear wax needs to be removed. The special magnifying glass the Hearing Care Professional uses for this is called an otoscope (meaning in Greek, "device to look at ears"), which is why the examination is called an otoscopy.

3 Comprehensive hearing tests

To measure hearing threshold loss accurately, the Hearing Care Professional carries out a two-part test (called audiometry). The test results are an important factor when it comes to choosing suitable hearing aids. First the Hearing Care Professional plays sounds at a certain frequency and volume through a set of headphones; the client presses a button whenever he or she hears a sound. This procedure is repeated for various frequencies until the hearing threshold is clearly established. This is then followed by the speech comprehension test. In this test, spoken words are played at a defined volume over the headphones. The client repeats each word as he understands it. The discrepancy between this and the text that is actually played provides further feedback on the hearing ability.

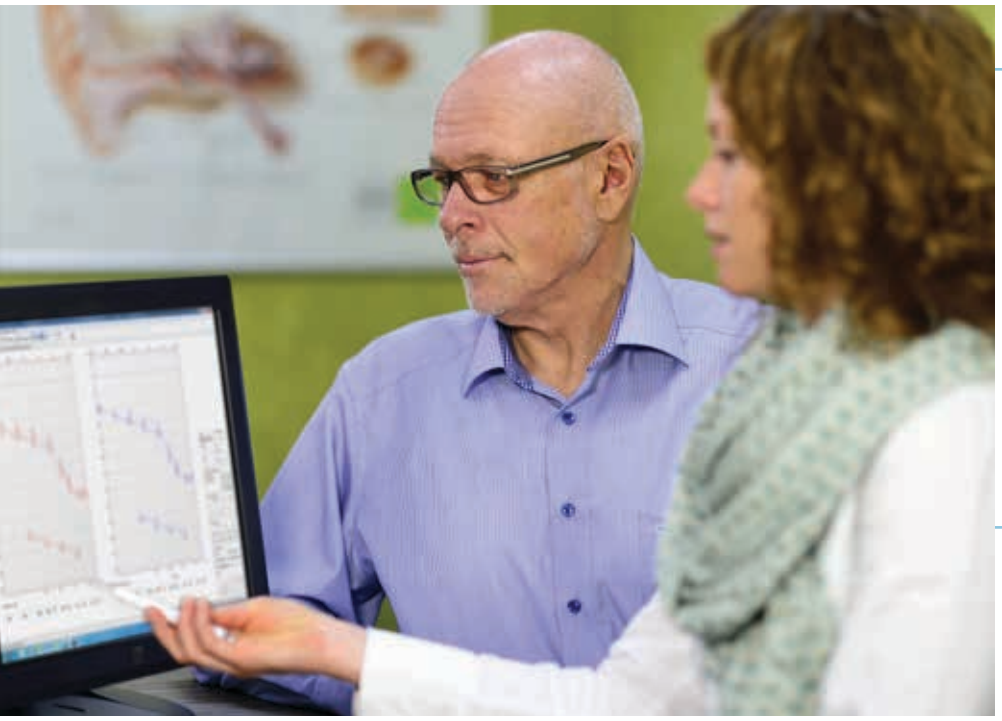
Do I need hearing aids? And if so, which hearing aids are right for me? To answer this question in earnest and productively, the Hearing Care Professional needs to get an accurate picture of you and your hearing in a personal discussion.

Not only the results from the hearing test, but a whole host of other factors have to be taken into account. These include the shape of your ear canals, for example, your personal requirements, your lifestyle, your hearing habits and your budget. There are a wide range of hearing aids available from different manufacturers, all of which have their unique features and special qualities.

We can basically differentiate between in-the-ear and behind-the-ear models, and these two categories then have countless subgroups depending on design and technical possibilities. There are digital and analog models, with or without remote control and with extra functions as required, such as wireless transmission technology for better connection with the telephone and television (for details, see page 12).

Which hearing aids are right for me?

Read everything you need to know about the key steps your Hearing Care Professional will take to ensure you have optimal, customized hearing aids.



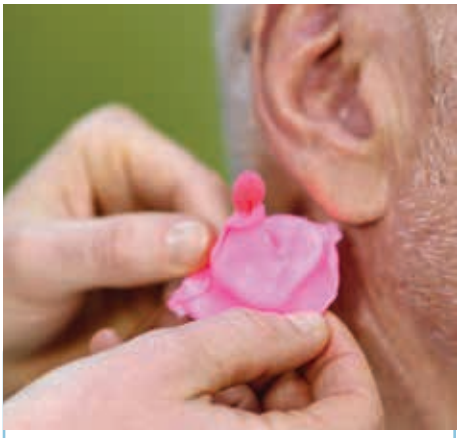
4 Analysis

The results of the hearing test are shown as a graph on the screen. The Hearing Care Professional uses these results as a criterion to select suitable devices. The readings from the audiogram are also an important tool, as the audiogram provides key information on the symptoms and sometimes even about the possible cause of the hearing loss.

5 Recommendation

The next step is the hearing aid recommendation. The Hearing Care Professional will recommend suitable hearing aids based on the lifestyle analysis, the otoscopy (examination of the ear canal and ear drum), the hearing test and the wishes you expressed in your meeting. You then decide together which hearing aids are most appropriate based on your requirements.

Photos: Resch (5)



6 Ear impression

Some hearing aids have what is known as an earmold, an individually formed part that has to fit perfectly into the ear or the ear canal. If this type of hearing aid is an option for you, the Hearing Care Professional will take an exact impression of your ear.

This is how it works: The silicone impression material is pressed into the ear canal and the outer ear with a special injection. It takes about five minutes to harden. But it still remains flexible enough to be taken out of the ear easily and painlessly.

7 The Fitting

The Hearing Care Professional individually programs the hearing aids to suit your hearing needs. Then the last phase starts - the "field test". You can try the hearing aids for a while to get used to them, to test them, to see if they suit your needs. Sometimes it takes a few appointments with the Hearing Care Professional to find the right hearing aids and the best settings.

"Precision is the cornerstone of our everyday work"

The professional who fits people with hearing loss with a customized hearing aids is called a hearing aid acoustician. He/she uses standardized tests to establish the customer's hearing loss and provides advice and support.

We discussed the highlights and challenges of the job with Anna Berger (26), a Hearing Care Professional.

Photos: Resch (2), Phonak (1)

What appeals to you most about your job as a Hearing Care Professional

Anna Berger: That there are so many different aspects that come together in this job. First, there is the medical side of it, since hearing is all about anatomy. And then there is physics, or technology to be more precise, since hearing aids are technical aids. And then there is, of course, the psychological component. Loss of hearing is not something that people just accept. As a Hearing Care Professional, you therefore need a certain degree of social skill so that you can approach people properly.

What is a typical day at work?

The work of a Hearing Care Professional is very varied, because you come across a wide range of different people, and you have to approach them all individually. Really, our everyday work is all about customizing. Then there is also the fact that hearing devices are constantly changing and developing. You have to make sure you always keep up.

How do you work with the client to find the right hearing aid?

This is a lengthy process based on the hearing test (for details on the hearing test, see page 16). As a Hearing Care Professional, I talk to the clients to find out what direction they want to go in. Of course, the type of hearing damage basically defines what they can or cannot use. There are so many different

technologies nowadays with different performance levels and a whole range of features. It can be quite a challenge to find out what the affected person needs exactly - but then again, that is also the appeal of this profession.

Do you also sometimes have to disappoint people because they have unrealistic expectations of a hearing aid?

The moment someone crosses the threshold to see a Hearing Care Professional, they have overcome the greatest hurdle. Because that person has reached a decision in the course of a generally lengthy process. Something is wrong, I have to do something about it. Once I have then established the extent of the customer's hearing loss, it is then my job to give them realistic information on their hearing loss. When the hearing aids are fitted and he/she can hear everything again for the first time, satisfaction takes over.

Unfortunately it's not that simple - you can't just fit hearing aids and then hope everything will be great. This point is precisely where the psychological work with the customer begins. You have to support them and explain everything well to them. Because when you have a hearing aid your hearing and your brain have to get used to the new situation. That can take weeks or months. What is important is that the client accepts that he is going to have to come to terms with this over a long period of time.

Modern hearing aids are technical marvels. Are some clients not overwhelmed by all those different functions?

This is an important point when you are developing new devices. We always ask the question - is the device even manageable? Of course, nowadays we try to make everything as small as possible, ideally invisible. But this makes them much more fiddly, which renders them impractical for older people in particular. And so the smallest device is not always the best option.

Anna Berger
Hearing Care Professional
and Audiologist

The 26-year-old Austrian is a trained Hearing Care Professional and has been working in the field for several years. She opted to study audiology because the subject fascinated her. Anna Berger has had hearing loss since birth and therefore knows from her own experience what people with hearing loss actually need.

Professional profile - Hearing Care Professional

Hearing Care Professionals advise their clients in the choice of hearing aids and adjust the devices to meet their needs. They test the patient's hearing and adjust the hearing aid to the results. As well as medical knowledge, they need a good social interaction with the client, and also have technical and business skills.

Audiology

If you want to delve deeper into the subject and have your Bachelor's degree, you can study Audiology at university. Audiology is a science in its own right, and covers all aspects of auditory perception, processing and rehabilitation.

Even in state-of-the-art hearing aid factories, some steps have to be made by hand. Like here, where the hearing aid electronics are being adjusted.

Photos: Phonak (4)

How modern hearing technology is built

Modern hearing aids are only the size of a cashew nut - or even smaller. But inside they have the performance of a sophisticated office computer. They also hold tiny microphones, a loudspeaker, adjusters, receivers/transmitters and batteries. This makes the production process complex and time-consuming.

The days of simple sound amplifiers are long gone. Today's hearing aids are feats of technology. The modern miniature devices contain chips with the processing power of an office PC. Analog devices are seldom used now, as the use of digital technology means that so much more performance is compacted into a tiny space.

High tech and handmade:
The production of a modern hearing aid is therefore also a highly specialized procedure. The production sites are like computer production plants. With one small difference: As a perfect individual fit to the wearer's anatomy is essential for certain types of hearing devices, some steps still need to be carried out by hand by specially trained staff.

The most important production steps

In the plastic injection molding, the housing for hearing aids is injection molded in a fully automated process, and sorted for further processing by a robot arm.

The housing

Preparing for the plasma coating process: Exposed parts of the housing are nano-coated to makes them permanently resistant to moisture and dirt.

The moisture resistant housing for the hearing aid is made in the plastic injection molding and is precision adjusted to the inside fittings. Melted plastic granulate is pressed into hearing aid shells in a fully automated process and other plastic parts are pressed into injection molding machines. This often involves dual component injection molding, where two different types of plastic (thermoplastic and thermoplastic elastomers) are used. Then the housing is printed with logos, article names and symbols. To ensure long-term protection against moisture and dirt, exposed parts are nano-coated.

The electronics

The electronic chip known as a "Hybrid" among experts, is the heart of the hearing aid. It is made of 16 million transistors packed together in a tiny space (1.5 x 5.5 x 1.5 mm) and can carry out some 200 million calculations per second (the calculating performance of a modern office PC). Its second feature (which is why it is called a "Hybrid") is a transmitter / receiver for wireless connections (wireless link). After production, a hybrid looks like a little strip. As there is not very much room in a hearing aid, it is machine folded into a tiny little cube.

For a hearing aid to work, it needs a series of other complex electronic components alongside the hybrid. These are added in several layers - fully automatically or partially manually, depending on the type and manufacturer of the hearing aid. At the end everything is assembled and fitted together to form a hearing aid.

Before it leaves the factory, it is thoroughly tested and inspected.

Precision work in detail: checking an in-the-ear hearing aid that has been custom made to the wearer's anatomy.

Production of in-the-ear devices (ITE)

Unlike the automated mass production of the behind-the-ear devices described above, all in-the-ear hearing aids are custom made and individually produced - exactly tailored to the individual shape of the ear canal of each and every client. This ensures maximum benefit and supreme comfort.

The craftsmanship for the miniature high tech devices (the smallest of them disappear in the ear canal) is so sophisticated that the responsible staff are specially selected and undertake lengthy training.

Even though their production is a complex process involving craftsmanship, ITE devices are very popular.

Key terms
glossary of hearing terms

Acoustic feedback – Loud whistling sounds that occur when sound from the receiver (loudspeaker) is received by the microphone, amplified further, and then passed out through the loudspeaker again.

Audiogram – Presents specific parameters to define hearing function.

Audiometer – Devices to determine hearing function, e.g. the hearing threshold and speech comprehension using tones, sounds or language.

Audiology – Science covering all aspects of hearing. This also includes the diagnosis, treatment and prevention of loss of hearing.

Automatic situation detection - Ability of the hearing aid to differentiate between different hearing situations (e.g. wind sounds or background talking in a restaurant) and to independently select the right setting.

Automatic telephone detection – The hearing aid automatically detects if a telephone receiver is held against the ear and optimizes the settings of the hearing aid to telephone mode. Transmission from the telephone to the hearing aid is acoustic or inductive. Modern hearing systems allow wireless transmission of the telephone signal in both ears when used with suitable telephones.

Binaural directionality – Based on the principle of "directionality", this uses the wireless exchange of real audio data between the hearing aids for "binaural processing". This reinforces the directional effect so that it is easier to focus on the person you are talking to.

Binaural processing – Processing with two hearing aids - one in each ear.

Binaural synchronization – Ability of the hearing aid to activate different automatic functions, such as noise suppression, in two devices at the same time. This ensures that the left and right hearing aids are synchronized with each other and react in unison. This gives a harmonious and comfortable hearing impression.

Bluetooth – Wireless technology, especially in combination with modern multimedia devices (e.g. smart phones, tablets). Allows the wearer to listen to music wirelessly, and also ensures premium quality telephoning for both ears. With bluetooth technology, the hearing aids act as top quality headphones.

BTE – Behind-the-ear hearing aid (see also page 12).

CIC ("Complete-In-Canal") – hearing aids positioned inside the ear canal (see also page 13).

Connectivity – the capacity for the interconnection of platforms, systems or applications. For example, wirelessley connecting your hearing aids to your smartphone to control your hearing experience. (see also page 13).

Decibel (dB) – Unit for the volume of an acoustic signal.

Digital hearing technology – Most hearing aids are now digital. The principle: The sounds registered by the microphone are converted into a signal the computer can process (analog to digital) The computer can then amplify the signal, filter out background noise, and so on. The computer data is then converted back into an acoustic signal and passed into the ear.

Directionality – Ensures much better understanding and easy communication, even in difficult hearing situations. The trick: Directional microphone characteristics are at the forefront, to focus specifically on the individual voice in the crowd.

Directional microphone – a microphone that is more sensitive to sound from one direction (generally from in front) than from another. The opposite: Omnidirectional microphone. See also: binaural directionality.

Discrimination loss – This defines the percentage by which the speech comprehension of a person with hearing loss is below that of a person with normal hearing. Basis: a test with 20 single syllable words.

Frequency earmold vent – This vent runs parallel to the earmold tubing and reduces the perception of low sounds. This reduces or eliminates the occlusion effect, where the wearer's own voice sounds amplified and hollow.

Frequency range – Transmission range of a hearing aid; ranges from

approximately 199 Hz to 7,000 Hz in a good hearing aid.

Frequency reduction – Digital function which reduces tones which a hearing aid wearer can no longer hear, down to lower frequencies, making them audible again.

FM system – Accessory for a hearing aid, consisting of an FM microphone (transmitter) worn by the speaker (or connected to an audio source), which sends wireless signals by frequency modulation (FM) to the hearing aid wearer's receiver. Purpose: Improves communication in situations where it is difficult to hear.

Hearing range – Dynamic audible range from the hearing threshold (quiet) to the discomfort level (very loud) through the entire range of frequencies.

Hearing threshold – The acoustic pressure (sound level) at which the human ear can still hear sounds or noise. The hearing threshold depends on the frequency (pitch) and on age and general health. The hearing threshold generally rises with age, especially at higher frequencies.

IIC ("Invisible-In-Canal") – hearing aid that is positioned out of sight into the ear canal (see also page 13).

ITE or IE – in-ear or in-the-ear hearing aids, for details see page 13.

Ear impression, ear cast – impression of the outer ear to custom-fit an earmold or the housing for an in-the-ear hearing aid.

Earmold – A customized plastic insert to connect a BTE hearing aid to the ear canal.

MFA (Made For All) – Technology allowing bluetooth or wireless connection to multiple smartphone or device platfroms. For example, connect the same hearing device to both an iPhone for work and a Windows tablet for videos. (see also connectivity pg. 30 and Hightech options page 13)

Monaural hearing aid – A hearing aid is only placed in one ear.

Omnidirectional microphone– A microphone that picks up sounds at equal volume from all directions. The opposite: Directional microphone.

Credits

Otoscope – Magnifying-glass style device with a light source, used to visually examine the ear canal and the ear drum.

Pinna effect – The pinna (the auricle) plays an important role in determining where a sound comes from. This does not work, however, in BTE hearing aids, as the microphone is outside the pinna. Modern hearing systems are able to technically compensate for this effect.

Receiver – Acts as a mini speaker in a hearing aid. The receiver sends the sound signal from the hearing aid into the ear.

Rechargeable hearing aids – utilizes lithium-ion or silver-zinc rechargeable batteries for up to 24-30 hours of long lasting wear with one charge.

RIC, Receiver in Canal – Like a BTE device, but where the sound transducer is on the outside (see also page 12).

Tinnitus – From the Latin "Ringing in the ears", tinnitus is the perception of sounds in the ear that do not have an external source. Tinnitus usually manifests as a more or less loud whistling, whooshing or ringing sound in one or both ears. The sound can be monotone or it can vary in pitch, tone and intensity. It is rare for tinnitus to be a concomitant symptom of hearing loss. Tinnitus is generally difficult to cure.

Tinnitus masker – Technical anti-tinnitus system. Designed similarly to a hearing aid, this has a sound generator instead of a microphone. The principle: The sound signal in the ear is classed as unimportant by the brain and is blanked out - and the tinnitus often becomes quieter as a result.

Windblock – Sometimes gusts of wind can sound as if someone is blowing hard into your ear when you wear a hearing aid. This may be very irritating in certain situations. Special systems, such as "WindBlock Management", eliminate this effect.

Wireless solutions – See **FM system** and **Bluetooth.**

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