

The importance of ensuring access to quality sound

Allowing children to reach their full potential through Softband fittings

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Because
sound matters

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Learning goals

After this course, participants will be able to

- After this course participants will be able to
 - List the most important reasons for why access to sound is paramount for children with a hearing loss
 - Know why temporary hearing loss in children should be noticed and timely remedied
 - Explain why Softband 5 is so much more than just an elastic band
 - List the central aspects of fitting bone conduction sound



**The importance of providing
amplification early in life**

Speech and communication

- Hearing loss can significantly affect a child's ability to perceive and distinguish speech sounds
- Hearing Loss leads to worse than normal outcomes in
 - speech
 - language
 - grammar skills
 - overall comprehension
- Social environments with background noise are most critical
 - Perception of multiple auditory cues can be hindered
 - Requires significant listening effort,
 - Which may lead to fatigue
- In turn potentially leading to
 - A mismatch in communication strategies.
 - communication resignation

Tjeerd J. de Jong, Marc P. van der Schroeff, Luuk Stapersma & Jantien L. Vroegop (27 Oct 2023): A systematic review on the impact of auditory functioning and language proficiency on psychosocial difficulties in children and adolescents with hearing loss, International Journal of Audiology, DOI: 10.1080/14992027.2023.2261074
Judith E. C. Lieu, Margaret Kenna, Samantha Anne, et al (2020): Hearing Loss in Children - A Review. JAMA. 2020;324(21):2195-2205.

Psychosocial aspects

- Children with hearing loss have a twofold risk of experiencing psychosocial difficulties compared to normal hearing peers.
- Difficulties broadly classified into
 - emotional and behavioral problems (anxiety, depression, aggression, hyperactivity)
 - social difficulties (poor peer relationship, low assertiveness in social interactions)
- Especially delays in the development of prosocial behavior have been seen
- There may be a developmental gap between children with hearing loss and those without

On a wider perspective..

- Hearing Loss leads to worse outcomes in
 - cognitive abilities,
 - education,
 - quality of life
- Likely that psychosocial outcomes are related to better auditory functioning.
- It is evident that better language skills are associated with better psychosocial outcomes
- Estimates for functioning in social interactions (speech perception, language proficiency), are more adequate predictors for psychosocial difficulties than degree of hearing loss.
- Communication abilities optimized through
 - hearing device fitting,
 - auditory rehabilitation
 - speech/- language therapy to optimize the acquisition of language

The importance of providing amplification early in life

Considerations for paediatrics

- Age at fitting of amplification is predictive for speech perception, speech production, and spoken language skills¹
- Auditory system development, and particularly development of speech perception, is guided by access to relevant acoustic and linguistic information early in life²



1. Sininger et al (2010) Auditory development in early amplified children: Factors influencing Auditory-based communication outcomes in children with hearing loss. *Ear and Hearing* 2010, 31(2), pp166-185.

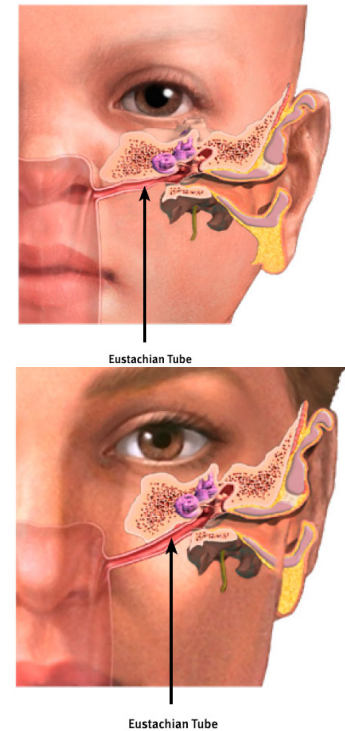
2. Kuhl, P. K. (2000). A new view of language acquisition. *Proc Natl Acad Sci*, 97, 11850–11857.



Temporary hearing loss – Tickety-tock

Prevalence of Otitis Media with Effusion (OME)

- Defined as the presence of fluid in the middle ear without signs or symptoms of acute infection
- 20% at the age of two years
- 90% of children have OME before school age,
- 80% of cases resolve spontaneously within 3 months



Simpson, S.A., Thomas, C.L., van der Linden, M., et al. (2007) Identification of children in the first four years of life for early treatment for otitis media with effusion (Cochrane Review). The Cochrane Library. John Wiley & Sons, Ltd.

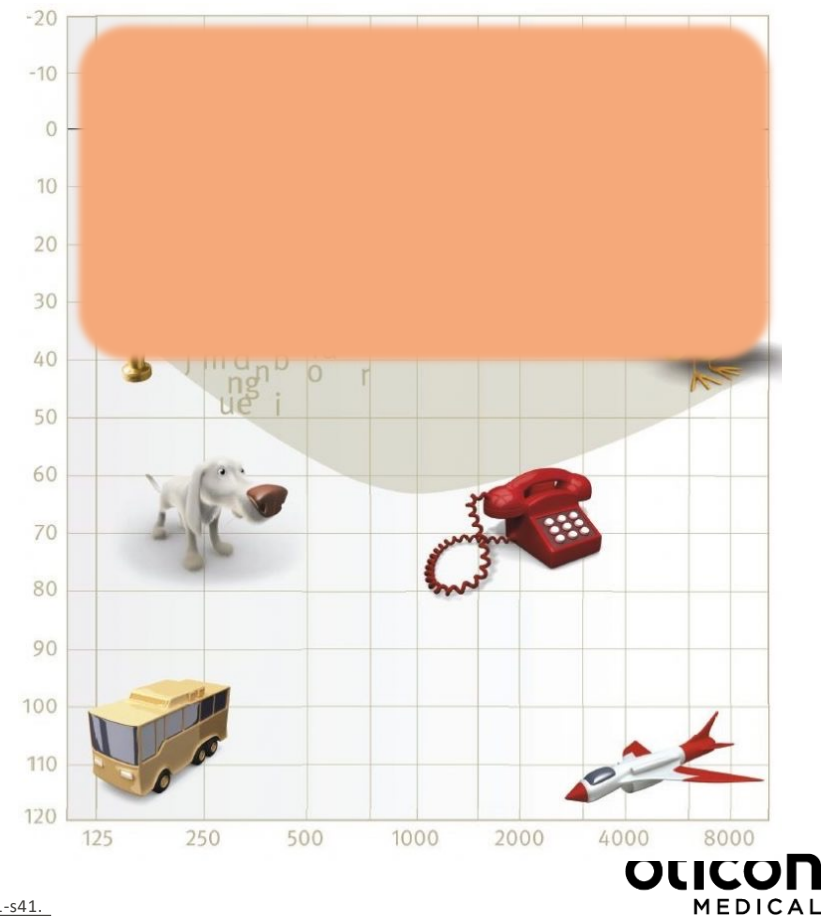
Rosenfeld, R. M., et al. (2016). "Clinical Practice Guideline: Otitis Media with Effusion (Update)." Otolaryngol Head Neck Surg **154**(1 Suppl): S1-s41.

Tos, M. (1984). "Epidemiology and natural history of secretory otitis." Am J Otol **5**(6): 459-462.

Mandel, E. M., et al. (2008). "The incidence, prevalence and burden of OM in unselected children aged 1-8 years followed by weekly otoscopy through the "common cold" season." Int J Pediatr Otorhinolaryngol **72**(4): 491-499.

Otitis Media with Effusion (OME)

- 20% of OME episodes in children persist over 3 months,
- Classified as chronic OME
- Can last up to 24 months
- Persistent middle ear fluid from OME can cause
 - a temporary conductive hearing loss
 - of up to 40 dB HL
 - Fluctuating AC hearing loss



Growing Body of Evidence

OME specifically

- OME can interfere with this process of binaural integration
 - Critical periods of development
 - Need of on average a 4dB increase in SNR in classroom listening conditions.
 - This need linked to poorer academic performance
- Abnormal physiology of the auditory brainstem consistently observed in children with chronic OM years after it has resolved:
 - Absolute and interpeak wave latencies delayed in ABR suggesting immaturity in neural conduction
 - Children with a history of OM, have a delayed P300 response which has been associated with children with learning or attention difficulties

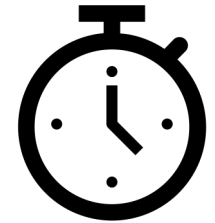
Borges, L. R., et al. (2020). "Long-term effect of middle ear disease on temporal processing and P300 in two different populations of children." PLoS One 15(5): e0232839.

Graydon, K., et al. (2017). "Consequences of Early Conductive Hearing Loss on Long-Term Binaural Processing." Ear and Hearing 38(5).

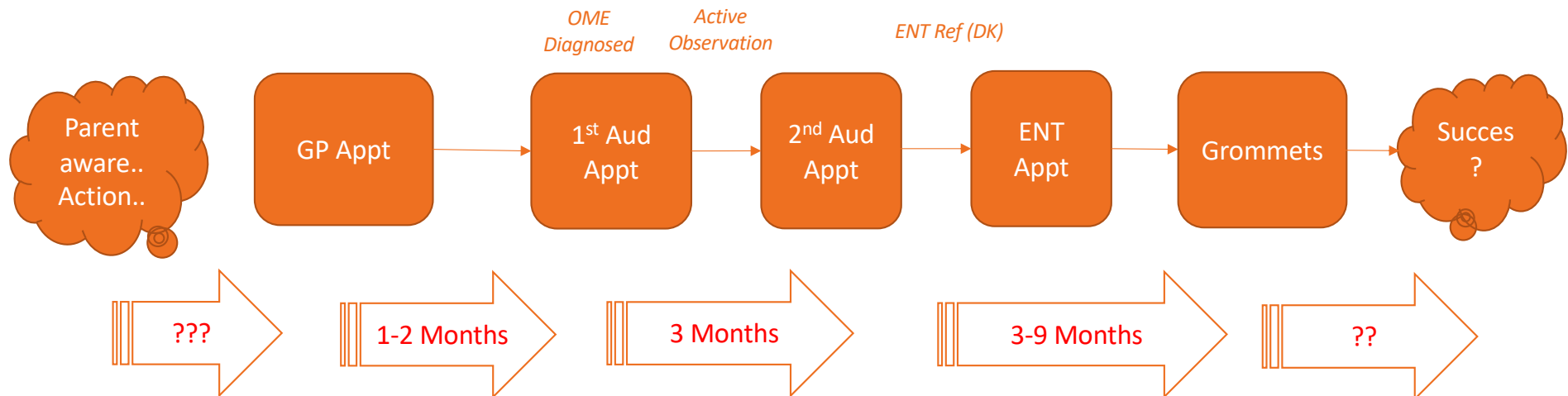
Gravel, J. S., et al. (2006). "Early otitis media with effusion, hearing loss, and auditory processes at school age." Ear Hear 27(4): 353-368.

The clock is ticking

Example case



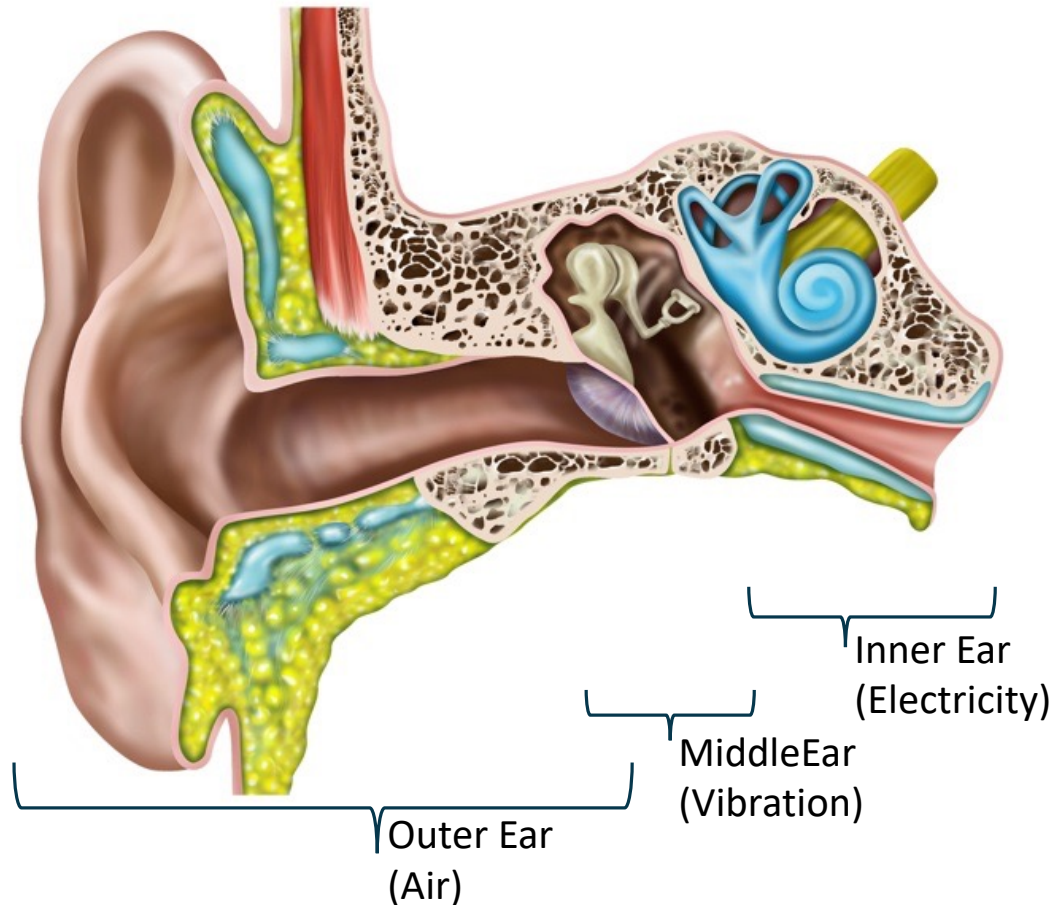
- No clear signs, but they be
 - not responding, parents must call twice, TV louder than normal.
 - change in behavior, tiredness, lack of concentration, less playing with friends



Softband 5 – Safe, flexible and non-invasive



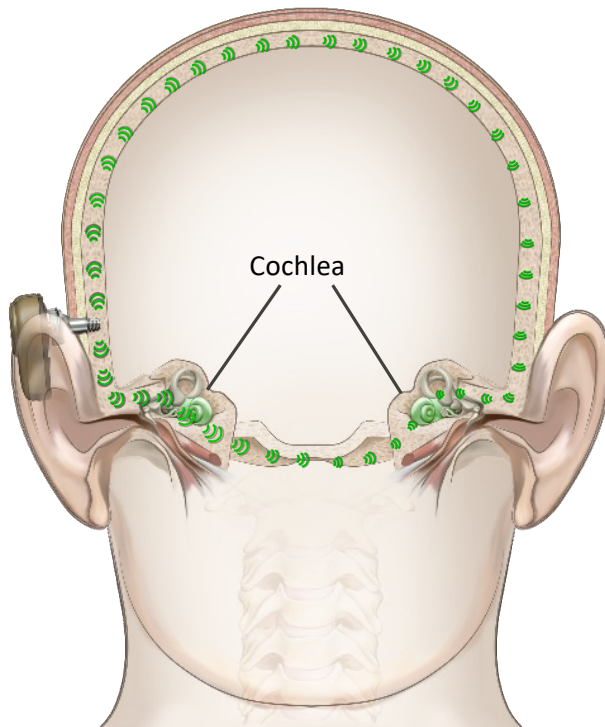
Hearing system – Conductive/mixed loss



Diagnosis/history

- Closed ear canal – *atresia/microtia*
- Outer ear infection – *otitis externa*
- Growths invading middle ear space – *Cholesteatoma*
- Traumatic injury to middle ear structures
- Ossicular disease – *Otosclerosis*
- Surgical removal of middle ear structures – *mastoidectomy*
- **Chronic middle ear infection – *otitis media w/wo effusion***

BAHS - Bone Anchored Hearing System



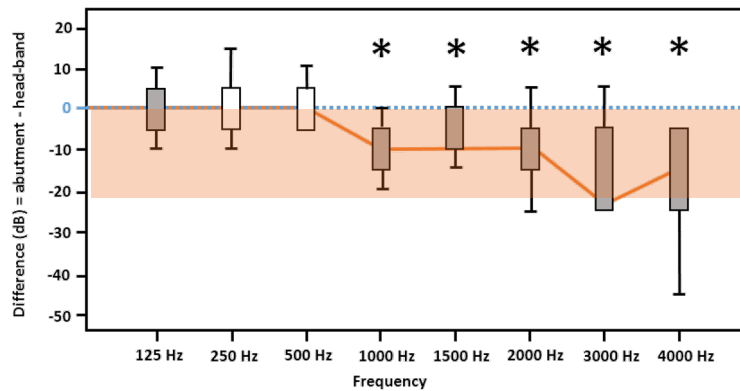
- Sounds are converted to vibrations
- Vibrations allow direct transmission to inner ear(s)
- 'Bridging' the middle ear (Ponto - Bridge in Latin)



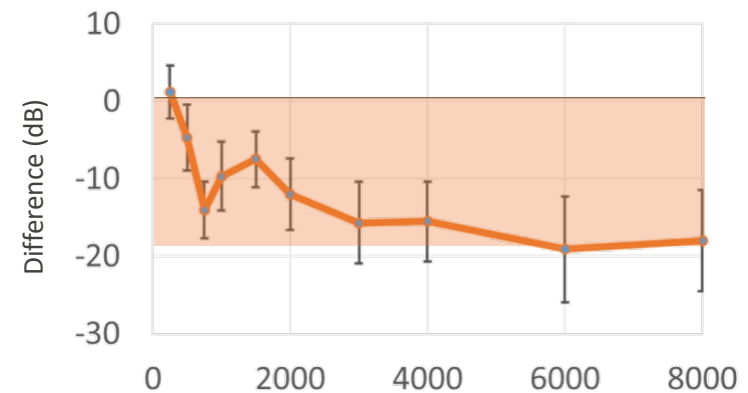
- Oticon Medical uses the term BAHS - Bone anchored Hearing Systems
- BAHA® term owned by Cochlear

Direct drive versus softband

Difference in hearing threshold obtain with headband vs abutment



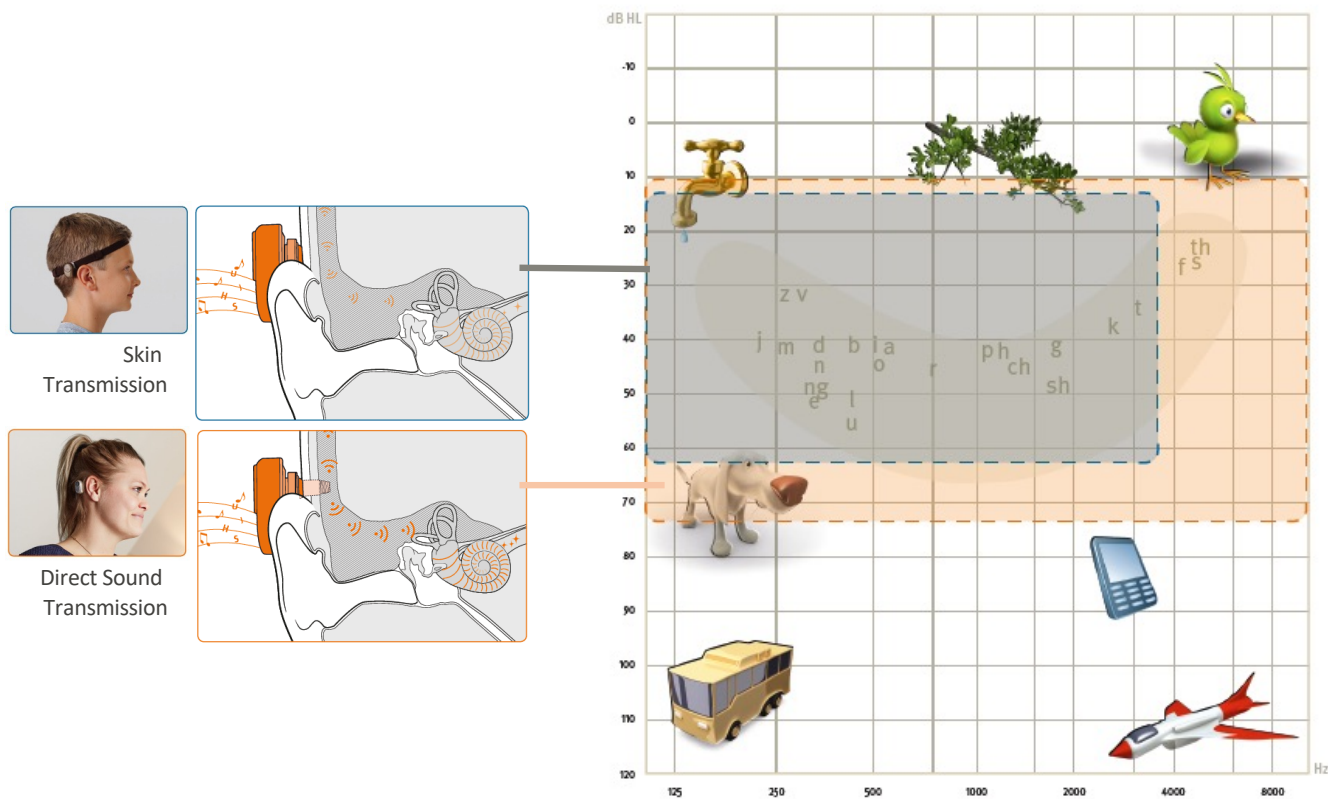
Difference in hearing threshold (Abutment – test band)



- ✓ Soft tissue adds 10-20 dB sound attenuation in the mid- to high frequency region¹
- ✓ The additional full-on gain and maximum force output of a Ponto 5 SuperPower can better address that
- ✓ This offers a better mimicking of the result after implantation

¹ Verstraeten et al (2008) Otolology & Neurotology 30: 70-75

Direct versus skin drive sound Transmission



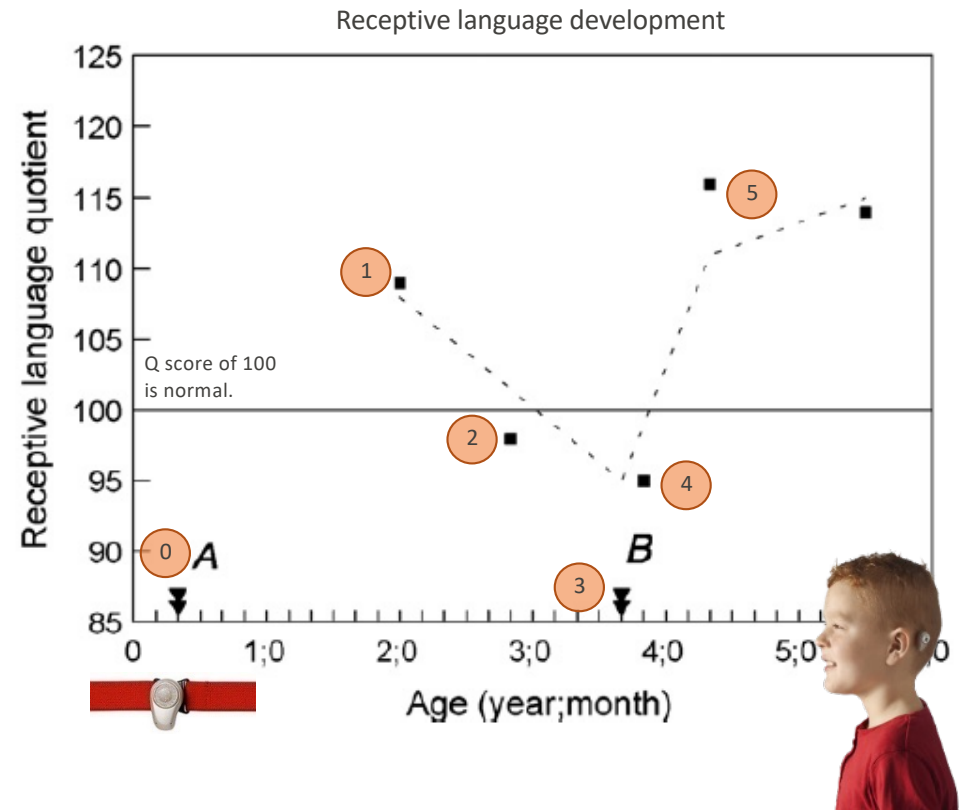
Maintaining normal language development

Paediatric case

Pos.	Age; years/months	Language development
0; A	0y 4 m	Fitting on soft band
1	2y	Above normal
2	3y	Below normal
3; B	3y 8m	Fitting on abutments*
4	3y 9m	Further below normal
5	4y 4m	Well above normal

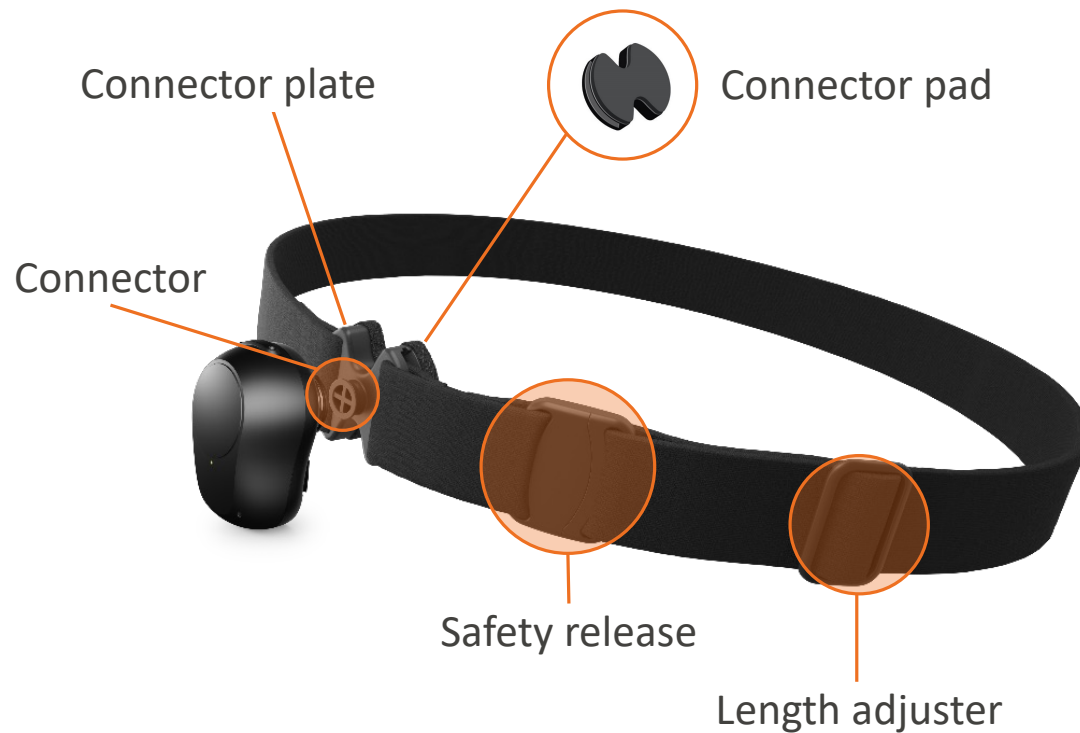
*In the US and Canada, the placement of a bone anchored implant is contraindicated in children below the age of five.

- Transition to direct sound transmission was necessary to maintain normal language development
- "Language development testing showed an accelerated improvement in speech development after implantation"¹



1. Verhagen et al (2008) The Baha Softband a new treatment for young children with bilateral congenital aural atresia. *International Journal of Pediatric Otorhinolaryngology* 72, 1455-1459

Softband 5 features



- ✓ High quality material
- ✓ Two adjustable sizes
 - XS/S (380-500mm)
 - M/L (500-600)
- ✓ Unilateral and bilateral version
- ✓ In 8 different colours
- ✓ Plastic parts in dark or transparent
- ✓ Combine with skins



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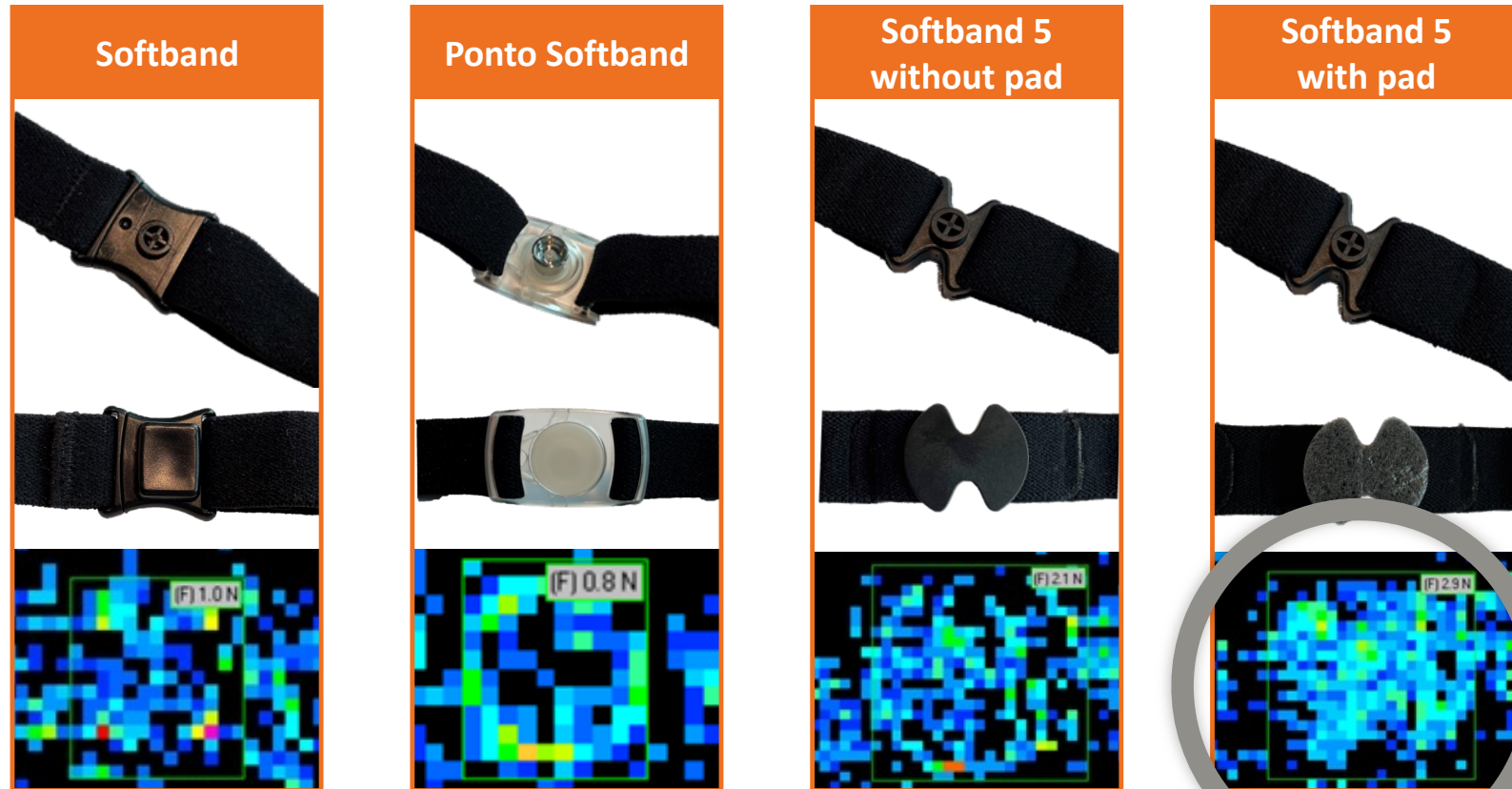
Sound transmission through the Connector Plate

- ✓ Design aim: **Focused force** onto the connector plate
- ✓ Sound Transmission is affected by the weight, stiffness and force of the **connector plate**
- ✓ A **decoupled design** ensures sound processor vibrates plate only
- ✓ **Size & Shape**
- ✓ The user can **open & close battery drawer** while the sound processor is mounted on the softband
- ✓ Connector pad acts **stiff** in the **higher frequencies**
- ✓ Foam adjusts to **increase surface area**



Impressive sound transmission

due to new connector plate and Connector Pad design

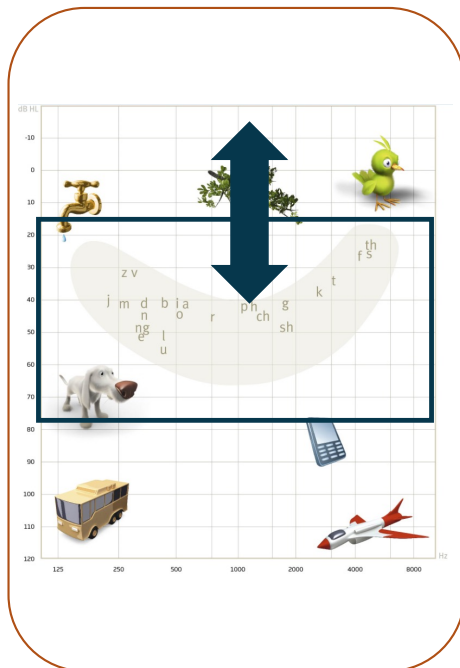




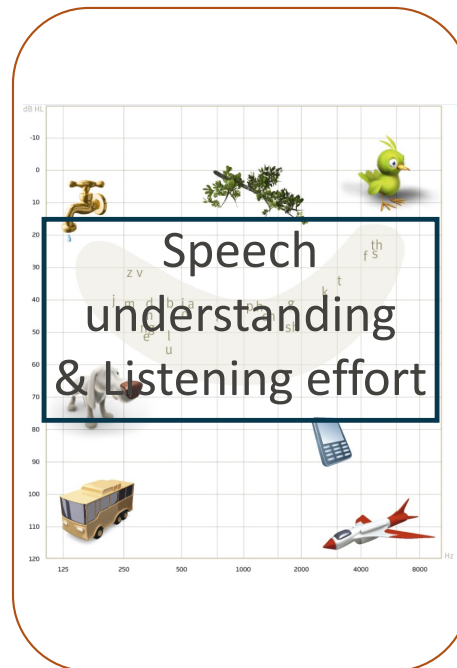
The key elements of bone conduction sound

The key elements of bone conduction sound

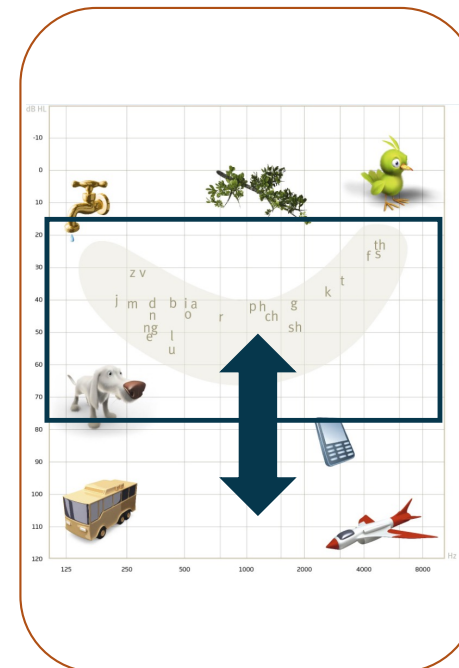
Audibility



Signal processing

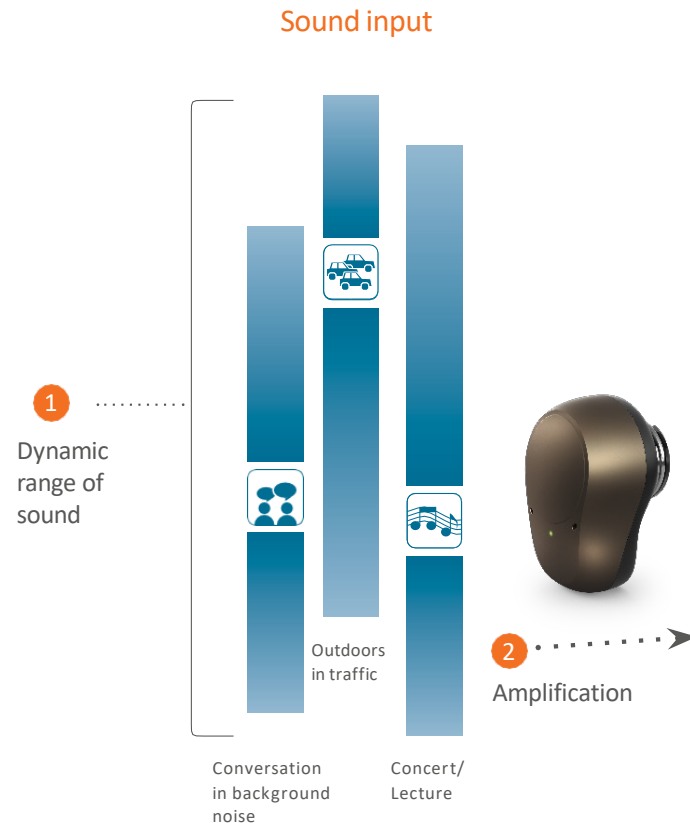


Maximum force output



Audibility is the primary purpose of a hearing device

Without audibility, nothing else matters

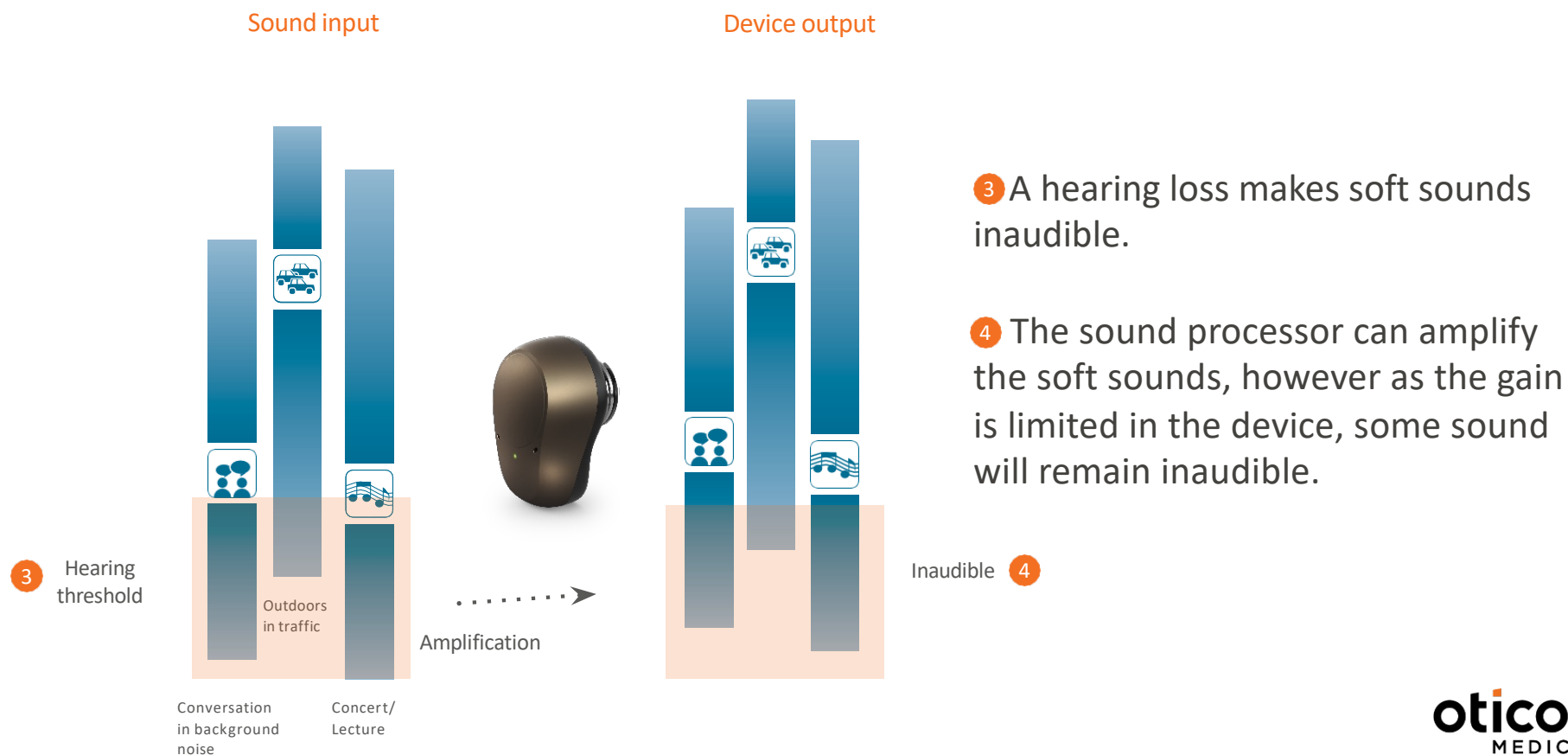


1 Some situations are on average softer or louder than others and there are natural variations in the sound level in all environments.

2 All sound processors continuously need to transfer or amplify sounds to match the hearing profile of the user.

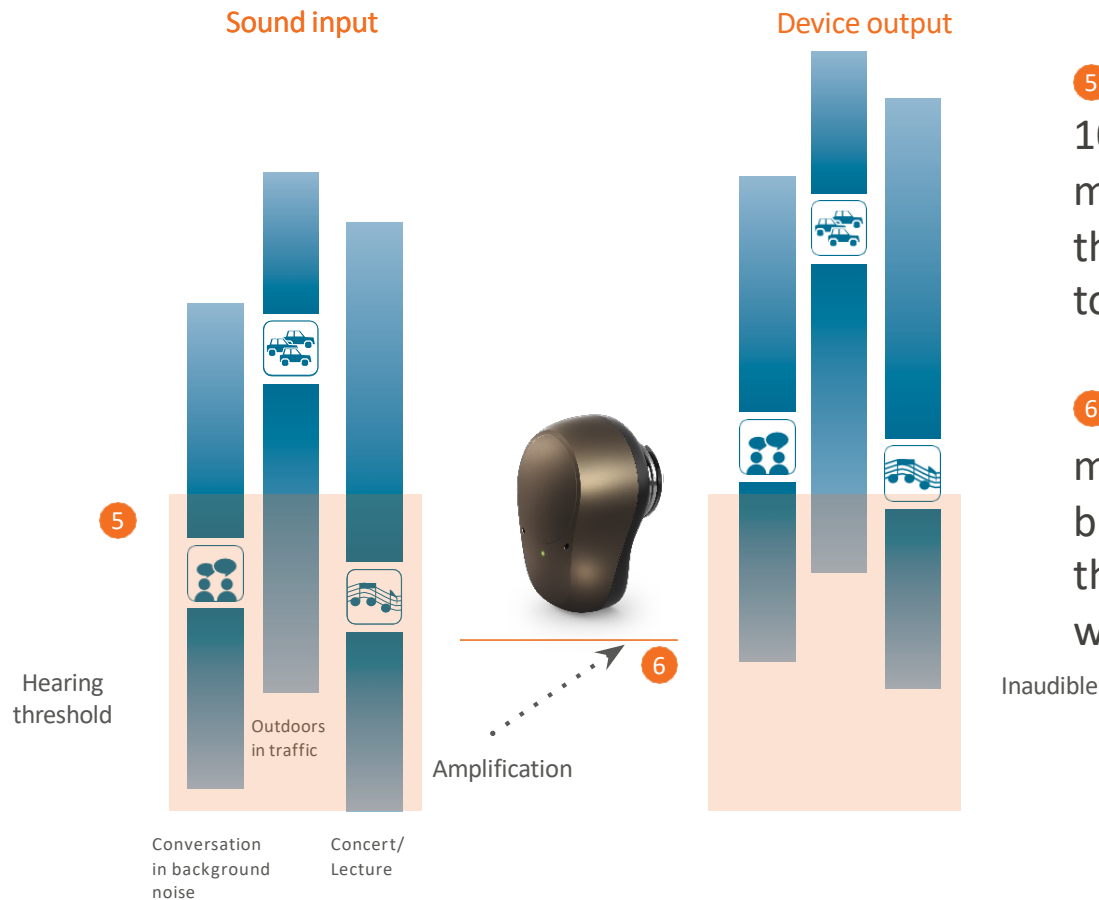
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Audibility and maximum gain



Audibility is the primary purpose of a hearing device

Audibility and maximum gain

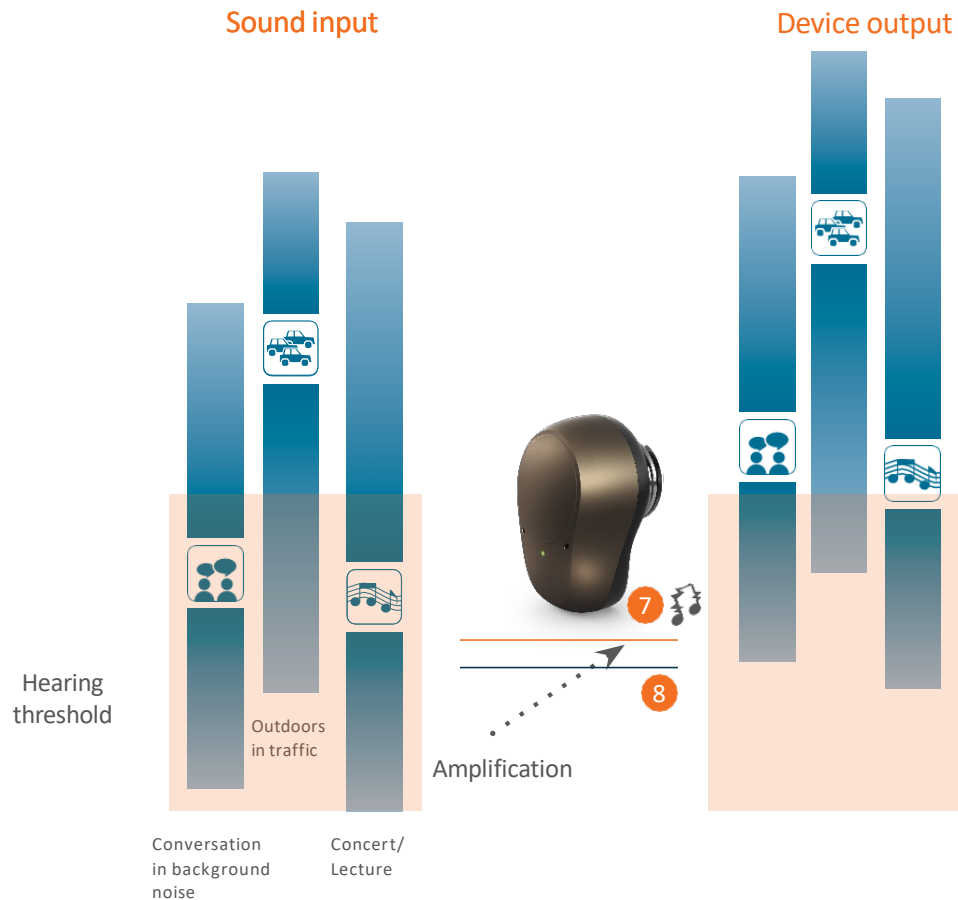


5 In softband fittings, soft tissue adds 10-20 dB sound attenuation in the mid- to high frequency. More gain is therefore needed in softband fittings to make sounds audible.

6 A sound processor has a technical maximum gain it can provide. It can be found on data sheets. The lower the maximum gain, the more sound will remain inaudible.

Audibility is the primary purpose of a hearing device

Audibility and feedback limit

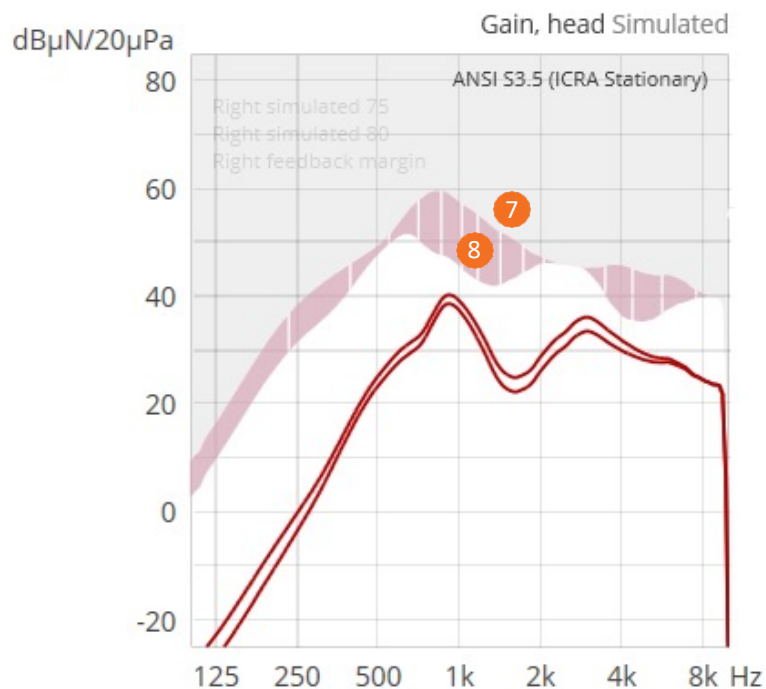


7 In many cases, not least on softband, you cannot use the technical maximum gain of the device, because it causes feedback

8 The feedback limit of the device is in these cases *below* the maximum gain. Hence, the audibility is decided by the feedback limit and the effectiveness of the feedback management system

Feedback limit below the maximum gain

How does it look in the fitting software

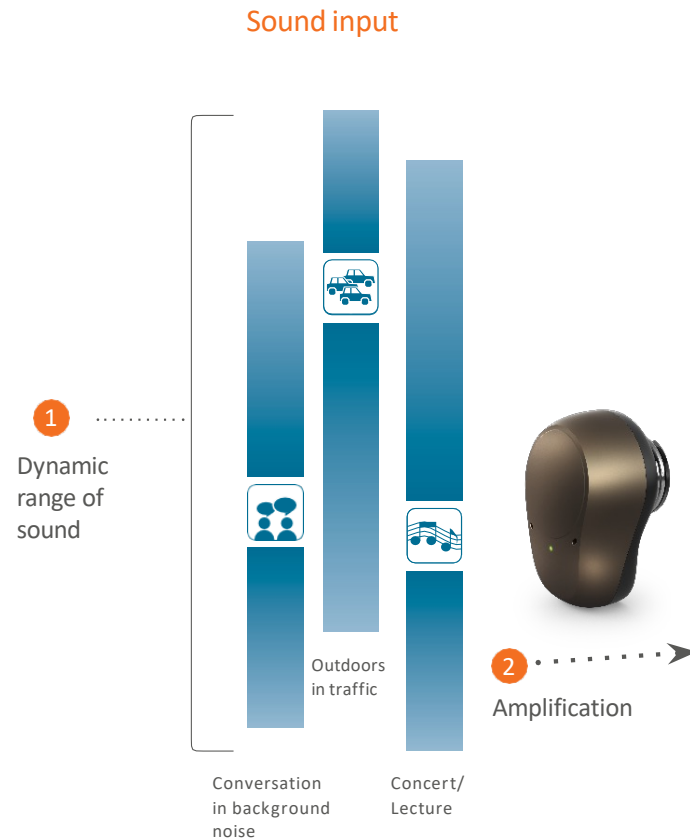


7 In many cases, in particular mixed losses, you cannot use the technical maximum gain of the device, because it causes feedback

8 The feedback limit of the device is in these cases *below* the maximum gain. Hence, the audibility is decided by the feedback limit and the effectiveness of the feedback management system

Maximum force output affects loud sounds

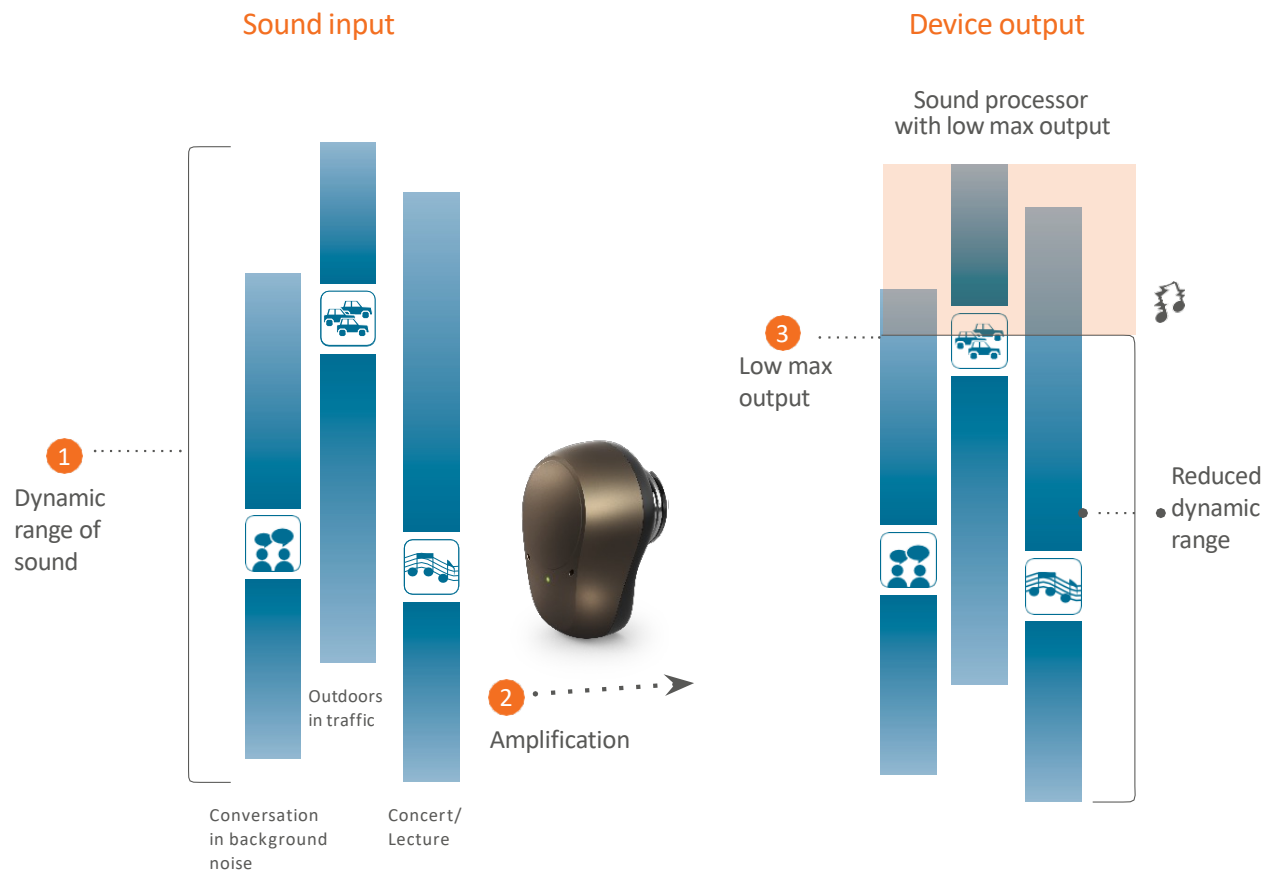
Audibility and signal processing are prerequisites



- 1 Some situations are on average softer or louder than others and there are natural variations in the sound level in all environments.
- 2 All sound processors continuously need to transfer or amplify sounds to match the hearing profile of the user.

Maximum force output affects loud sounds

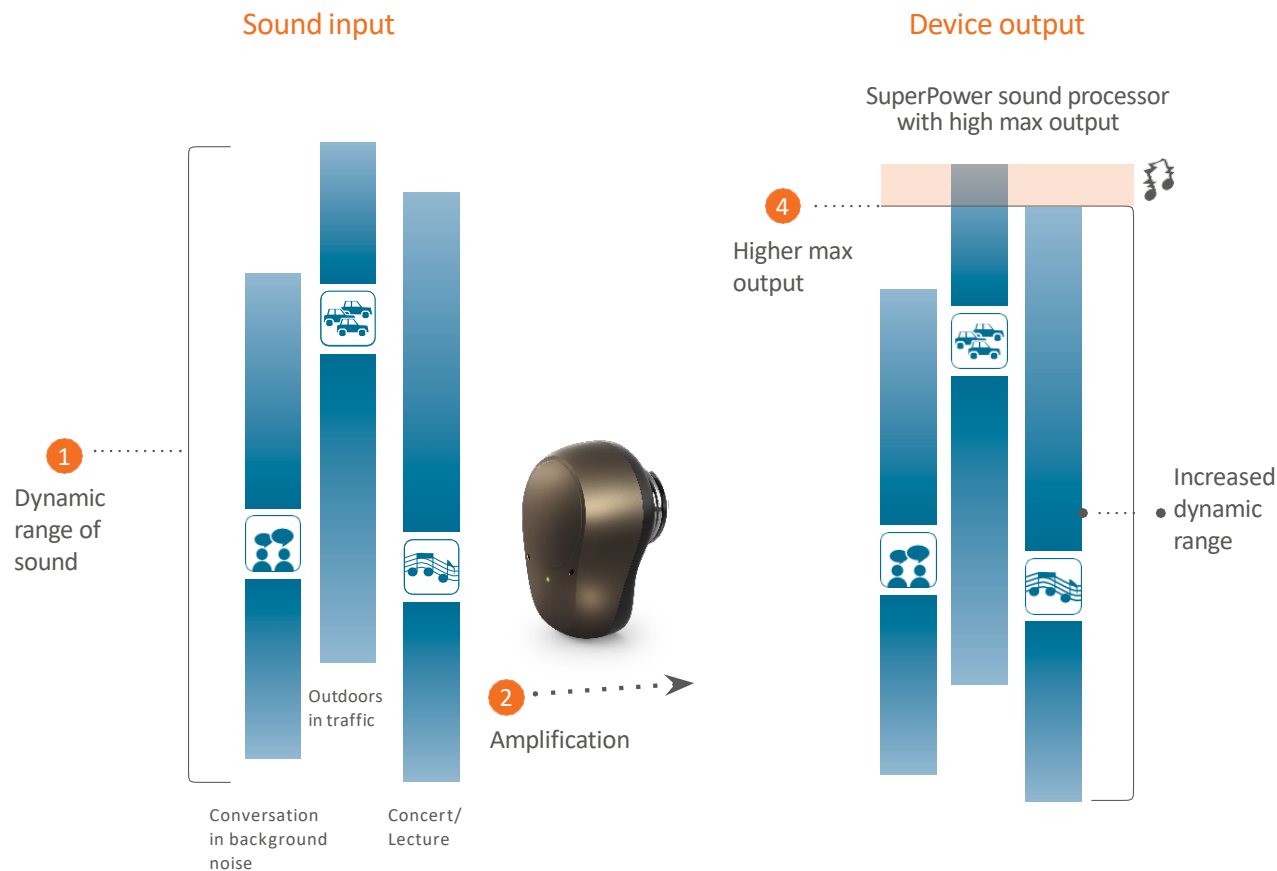
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3 The sound processor can replicate some of the dynamic range. However, it has a limited maximum output and once this is reached, loud sounds will be distorted.

Maximum force output affects loud sounds

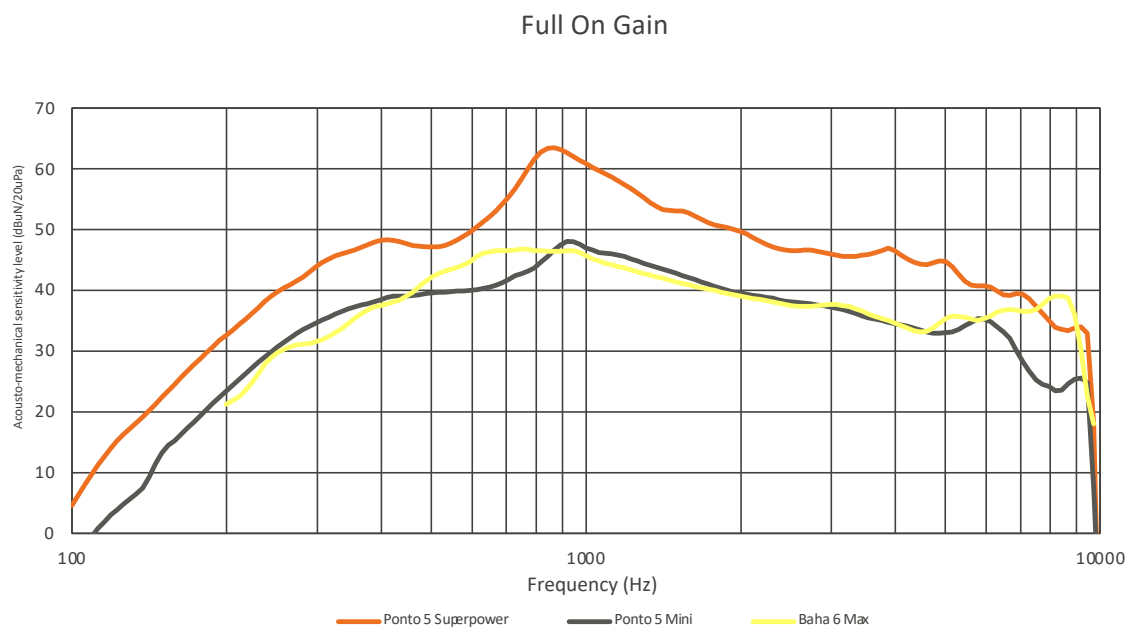
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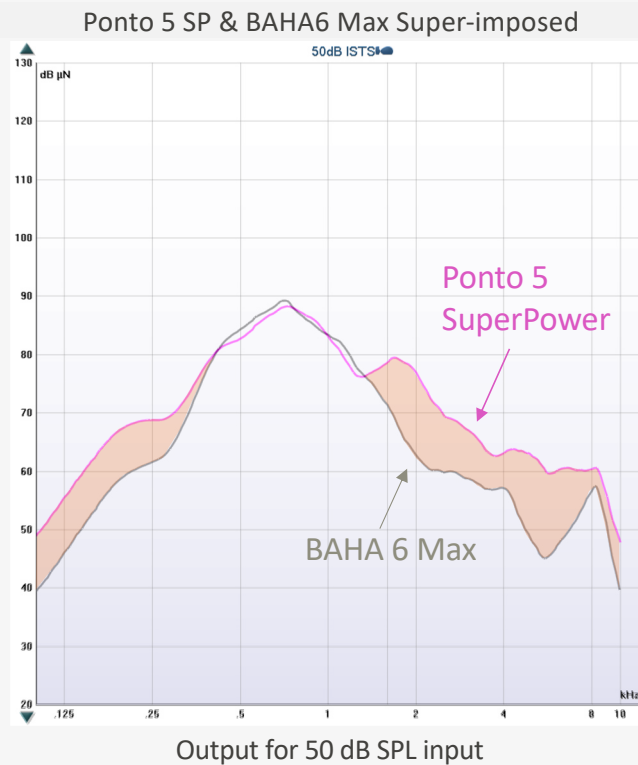
4 A more powerful sound processor, with a higher maximum output level, provides access to larger dynamic range of sound, keeping more of the loud sounds undistorted. Maximum output of the device can be linked to the perceived sound quality – but only in loud situations.

When talking about maximum gain there is only one SuperPower



Audibility with a softband fitting?

The 'real-life' maximum gain – taken feedback measurements into account



Ponto 5 SuperPower

Based on feedback limit measured on softband



BAHA 6 Max

Based on feedback limit measured on softband

Ponto 5 SuperPower on softband
can provide more HF gain than any
other bone anchored product*

- Output measured on skull simulator.
- Input signal: ISTS
- Output for 50 dB SPL input

* In similar form factor

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