

## Hörgeräte und Implantate

### Appareillage acoustique conventionnel- implants

Dorothe Veraguth, Alex Huber  
ORL-Klinik Zürich

Sommerschule SGORL  
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### Hearing aids: Indications

- Communication problems with several persons
  - Communication problems in noise
- »handicap«
- medical treatment not possible/requested
  - Surgery not possible/requested
- Contraindication:
    - retrocochlear tumor
    - central hearing disorders



09.08.2011 Seite 1

### Hearing Handicap Inventory for the Elderly (HHIE-S)

#### Screening Version

- Does a hearing problem cause you to feel embarrassed when you meet new people?
- Does a hearing problem cause you to feel frustrated when talking to members of your family?
- Do you have difficulty hearing when someone speaks in a whisper?
- Do you feel handicapped by a hearing problem?
- Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?
- Does a hearing problem cause you to attend religious services less often than you would like?
- Does a hearing problem cause you to have arguments with family members?
- Does a hearing problem cause you difficulty when listening to TV or radio?
- Do you feel that any difficulty with your hearing limits or hampers your personal or social life?
- Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?

RAW SCORE \_\_\_\_\_ (sum of the points assigned each of the items)

YES (4pts) SOMETIMES(2pts) No (0pts)

#### INTERPRETING THE RAW SCORE

0 to 8 = 13% probability of hearing impairment (no handicap/no referral)  
10 to 24 = 50% probability of hearing impairment (mild-moderate handicap/refer)  
26 to 40 = 84% probability of hearing impairment (severe handicap/refer)

Ventry, J. Weinstein B. (1983). Identification of elderly people with hearing problems. ©American Speech-Language-Hearing Association, July, 37-42.



09.08.2011 Seite 2

## Diagnostic tests

- Pure tone audiometry
- Speech audiometry (in noise)
- Uncomfortable level (UCL)
- in special cases:
  - Tympanometrie, reflexes
  - Otoacoustic emissions
  - BERA

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## Prescription

- Medical indications  
hearing loss in 2 frequencies  
 $\geq 30\text{dB}$  in the better ear
- Guidelines of insurances



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## Guidelines

### Bundesamt für Sozialversicherungen BSV

#### Richtlinien für ORL- Expertenärzte zum Abklärungsauftrag zur Vergütung von Hörgeräten durch die Sozialversicherungen IV und AHV

Gültig ab 1.7.2011, erstellt zusammen mit der Kommission für Audiologie und Expertenwesen der Schweizerischen Gesellschaft für Oto-Rhino-Laryngologie, Hals- und Gesichtschirurgie im Auftrag des BSV.

### Office fédéral des assurances sociales OFAS

#### Directives à l'intention des médecins-experts ORL pour l'examen de la prise en charge d'appareils auditifs par les assurances sociales (AI et AVS)

Valables dès le 1.7.2011, élaborées avec la Société suisse d'oto-rhino-laryngologie et de chirurgie cervico-faciale (SSORL) pour le compte de l'OFAS.

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## Guidelines AI/AVS (IV/AHV)

L'**AI** peut contribuer par un montant forfaitaire à la remise d'appareils auditifs lorsque la perte auditive binaurale totale est d'au moins **20 %**.

L'**AVS** peut contribuer par un montant forfaitaire à la remise d'appareils auditifs lorsque la perte auditive binaurale totale est d'au moins **35 %**.

La perte auditive binaurale totale est calculée à partir des audiogrammes tonal et vocal.

### Méthodes de calcul de la perte auditive totale

Pour l'audiogramme tonal, le pourcentage de perte auditive est calculé pour chaque oreille selon la table CPT-AMA.

Pour l'audiogramme vocal dans le calme, le pourcentage de perte auditive est calculé pour chaque oreille selon l'indice social ou les tests de Fournier

$$\frac{(PA \text{ CPT-AMA re} + CPT-AMA li) + (PA \text{ Sozialindex/Fournier re} + Sozialindex/Fournier li)}{4}$$

## Guidelines : Adaptation binaurale par l'AI

Une adaptation binaurale ne peut être réalisée aux frais de l'assurance qu'avant l'âge AVS ou dans le cadre de la garantie des droits acquis à l'AI, si deux des conditions suivantes sont remplies :

- la différence interaurale de la perte auditive selon la table CPT-AMA est inférieure à 30 % ;
- la différence interaurale de la discrimination maximale (audiométrie vocale au calme) est inférieure à 50 % ;
- la différence interaurale du seuil d'intelligibilité (50 % d'intelligibilité sur les chiffres, dissyllabes ou monosyllabes) est inférieure à 50 dB.

## Guidelines: binaurale Versorgung IV-Alter

.....Es müssen zwei der folgenden drei Bedingungen erfüllt sein:

- Der Unterschied des Hörverlustes nach CPT-AMA zwischen rechts und links beträgt weniger als 30%.
- Der Unterschied des Diskriminationsverlustes im Sprachtest in Ruhe zwischen rechts und links beträgt weniger als 50%.
- Der Unterschied der Sprachhörschwelle (50%ige Verständlichkeit für Zahlen, Zweisilber oder Einsilber) zwischen links und rechts beträgt weniger als 50 dB.

## Counseling

- Fixed amount IV/AHV
- Additional payment
- Acoustician /other careers for fitting
- Comparison of different hearing aids
- Quality control of fitting (Schlussexpertise / expertise finale)

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## Quality of hearing aids fitting

### *Gain subjective*

- gain in quiet / in noise
- naturalness of sounds (speech, music, voice)

### *Handicap*

- regular use
- communication
- social relations
- sensitivity to noise

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### *manipulation and technical criteria*

- handling
- technical knowledge
- correct placement
- whistling problems

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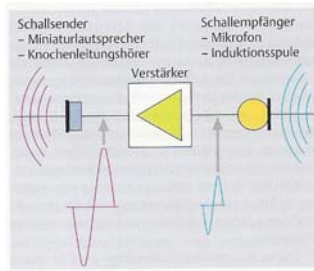
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## Principles of hearing aids



**Bauartunabhängige Hörgerätekomponenten.**  
Schallempfänger, Verstärker und Schallsender. Darüber hinaus werden Bedienelemente und eine Energieversorgung benötigt (nicht dargestellt).

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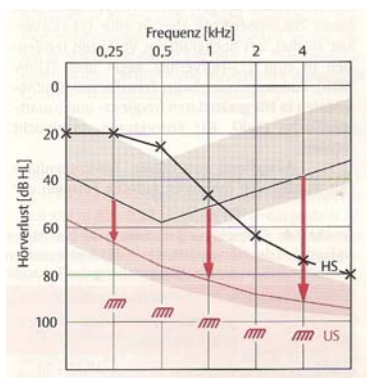
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## Technical features

- Digital, multichannel signal processing
- Microphones: omnidirectional, fixed directional, adaptive directional
- Speech recognition
- Noise suppression
- Feedback suppression
- Binaural coordination/processing
- Dataloggin
- Bluetooth connection

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## Behind-the-ear hearing aids (BTE)



- severe hearing loss or for very small ear canals, which makes it difficult to fit an entire hearing aid
- All the electronic components of a classic BTE model are located in a housing placed behind the ear.

- A slim plastic tube with an earmould in the end directs the amplified sound from the hearing aid into the ear.
- Manual controls for volume and program change are placed on the top side of the hearing aid for easy user access.
- Depending on the model, BTE hearing aids can moreover often be fitted with an open fit solution to optimize the sound processing

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## In-the-ear hearing aids (ITE)



- mild to severe hearing loss
- all its electronic components contained within a plastic shell moulded to fit the ear.
- placed in the ear canal, but with the faceplate still visible in the concha of the ear.
- the size - as well as the visibility - of the ITE depends on the degree of hearing loss and the shape of the ear canals.

## Completely-in-canal hearing aids (CIC)



- mild to moderate hearing loss
- custom made shell that contains all the electronic components
- for easy everyday removal, the CIC has a small extension cord attached to the outside
- CIC model works fully automatically

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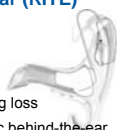
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## Receiver-in-canal (RIC)



- mild to severe hearing loss
- the receiver of the RIC (the loudspeaker) is placed in the ear-tip instead of in the housing, thereby reducing its size.
- the RIC model consists of three parts: The housing, which sits behind the ear, and a thin earwire connecting the housing to the receiver. The receiver goes directly into the ear canal.
- works fully automatically.

## Receiver-in-the-ear (RITE)



- mild to severe hearing loss
- compared to a classic behind-the-ear (BTE) hearing aid, the receiver of the RITE (the loudspeaker) is placed in the ear-tip instead of in the housing, thereby reducing its size.
- the RITE model consists of three parts: The housing, which sits behind the ear, and a thin earwire connecting the housing to the receiver. The receiver is placed in the concha of the ear.
- powerful hearing aid, which works fully automatically.

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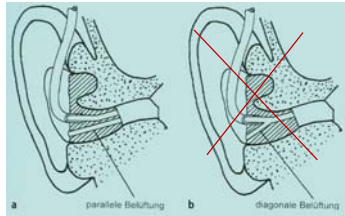
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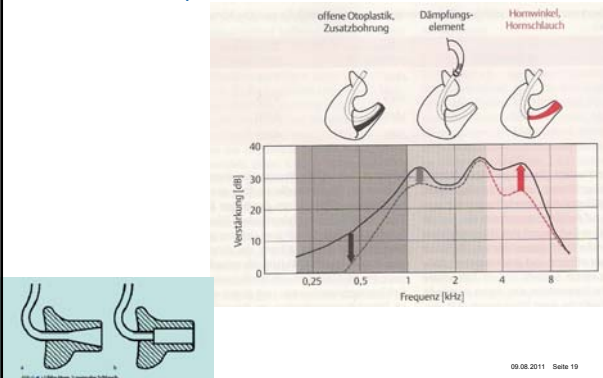
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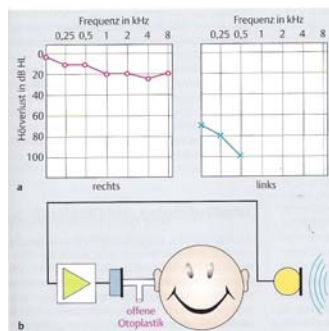
## Otoplastic and boring: open as possible



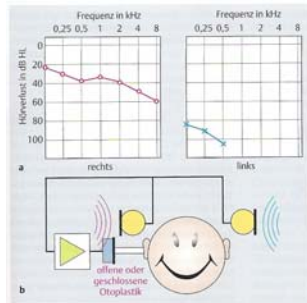
## Models of Otoplastic



## CROS (contralateral routing of signals)



## BiCROS (binaural CROS)



## Additional procedures

- Auditory speech training
- Lip reading
- Technical devices: telephone, light alarm clock
- FM communication
- Induction (churches, theatre,...)



## Communication with hearing impaired persons

- room acoustic
- good light
- arrangements of seats
- clear articulation
- written information



## Implantable Hearing Devices

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## General Indication Considerations

Patients that need hearing rehabilitation  
but  
can not wear a conventional hearing aid

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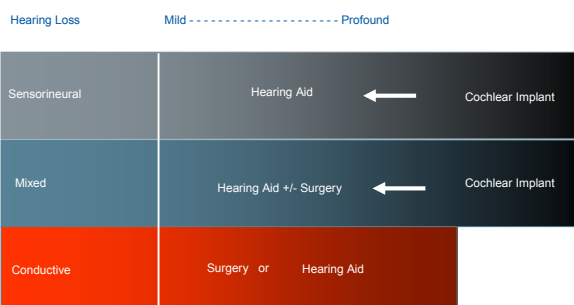
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## Common Therapy for Hearing Loss



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## Limitations of Hearing Aids

Medical:	Recurrent infection of external auditory canal Skin irritation due to the ear mold / tubing
Acoustical:	Limited frequency response Distortion Feedback Occlusion effect Blocking of residual hearing "Quality of sound"
Stigma	
Convenience:	Discomfort of plugged ear canal Hearing aid maintenance

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## Alternative Therapy for Hearing Loss

Hearing Loss      Mild ----- Profound

Sensorineural	Implantable Hearing Device ← Cochlear Implant
Mixed	Implantable Hearing Device ← Cochlear Implant
Conductive	Surgery or Implantable Hearing Device

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## Implantable Hearing Devices

### Bone Coupling (Bone Conduction Device)

- BAHA (Cochlear)
- Ponto (Oticon), Alpha1 (Sophono) etc...

### Middle Ear Coupling

- Sound Bridge (MedEl) – single point attachment
- MET (Otologics)
- Esteem (Envoymedical), etc...

### Inner Ear Coupling

- DACS (Cochlear)
- Ingenia (Sonova)

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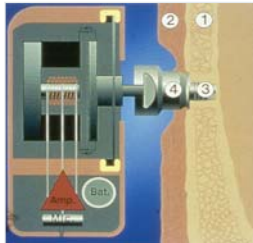
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## BAHA System



Skull-Bone

Sub-cutis and Skin

Implantable Titanium Screw

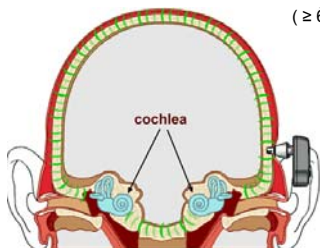
Titanium-Abutment

## BAHA Processors



## BAHA Indication

Conductive HL  
Mixed HL  
Single Sided Deafness  
 $\leq 45$  dB HL Bone conduction PTA  
( $\geq 60\%$  speech discrimination scores)



## BAHA Indication



- Chronic otitis media
- Post Surgery
- Congenital atresia
- (Otosclerosis)

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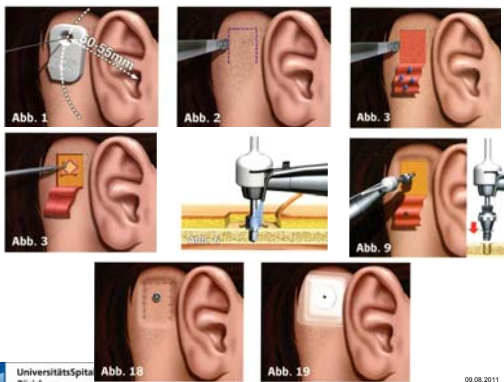
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## BAHA Surgery



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## BAHA Complications



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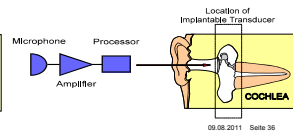
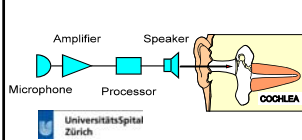
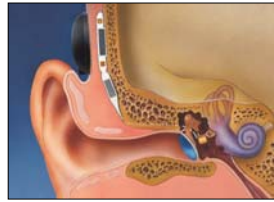
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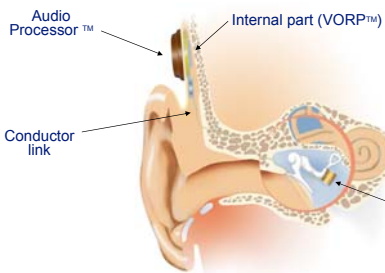
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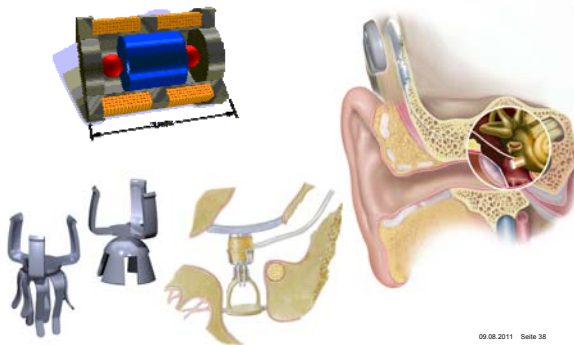
## Acoustic Amplification vs. Direct Drive



## Vibrant Soundbridge



## Vibrant Soundbridge



## Cochlear Implant



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## Goals of Cochlear Implantation

Optimal integration into the "hearing world" (social und school integration)

Understanding of speech and identification of common sounds

Development of speech and natural voice

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## Medical Assessment for Cochlear Implantation

- Audiological assessment:
  - pure tone audiometry
  - Free-field audiometry
  - Speech audiometry
  - important: best-fit hearing aids
- Imaging: MRI and/or CT
- Additional disabilities
- Children: speech and language level
- Interdisciplinary Counseling: preoperative expectation -> postoperative satisfaction

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## Indications for Cochlear Implantation

- Prelingual deafness
- Postlingual acquired deafness, progressive hearing loss
- stable family support mechanism and realistic expectations as to outcome
- Educational program enrolled

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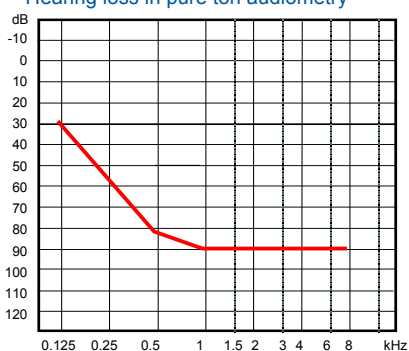
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## Hearing loss in pure ton audiometry




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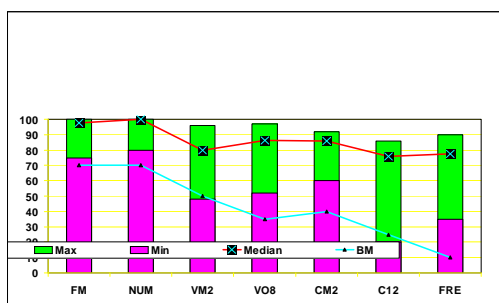
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## Speech audiometry with best-fitted hearing aids




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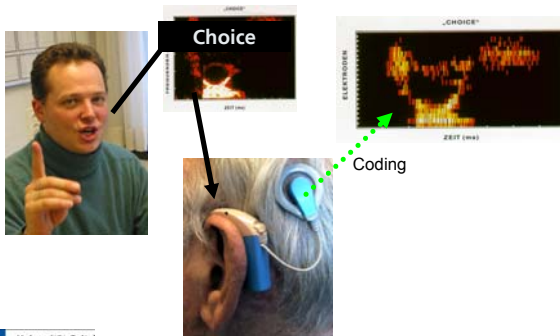
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## Medical Contraindications

- Absent cochlea or absent cochlear nerve
- Cochlear pathologies, that don't allow placement of an electrode
- Retro-cochlear pathology
- General conditions that don't allow surgery
- Otitis media (acute or chronic)
- Setting that doesn't allow CI-rehabilitation

## How does the CI work



## Costs

Hardware	CHF 35'000
Medical interventions- and rehabilitation	CHF 15'000

### Sponsor

- „Geburtsgebrechen: IV/AI (up to 21st year of age)
- Over age of 21: IV/AI or AHV/AVS and health insurance

### CI Centers

- In CH five centers are entitled to implant and fit CI



## Surgery (typical)

- Hospitalisation 3 d
- Operation approx. 2h
- Impedance and VIII action-potentials measurements intraoperatively
- Pressure dressing 24h
- Healing time 4 weeks (Switch-On)

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## Surgical Risks

- Infection
- Bleeding
- Facial nerve / Chorda lesion
- Dizziness, Tinnitus
- Failure to implant
- Implant failure

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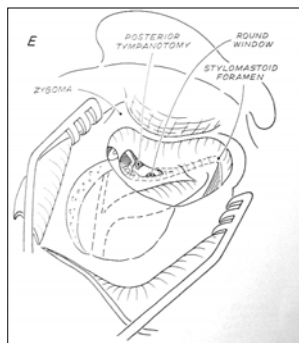
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## Anatomy / Surgery



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## Bilateral Implantation

- Improvement of speech understanding in noise
- Possibility of spacial and directional hearing
- Subjective advantage has been shown
- "Better" side will always be reached
- No deprivation of the non stimulated side
- „Reserve" in case of implant failure
- Bilateral stimulation likely to be important for the development of the auditory system

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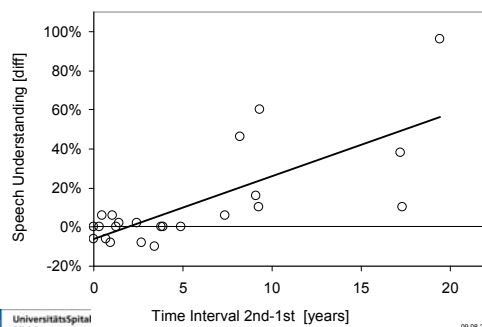
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## Bilateral Implantation



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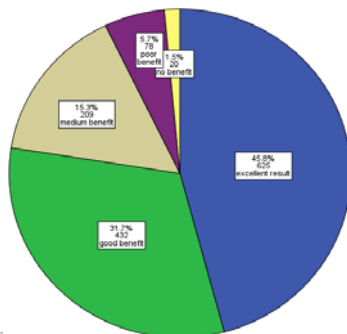
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## Subjective Results CH



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## Discussion

- Hearing preservation surgery
- Single sided deafness
- Tinnitus
- Fully implantable device

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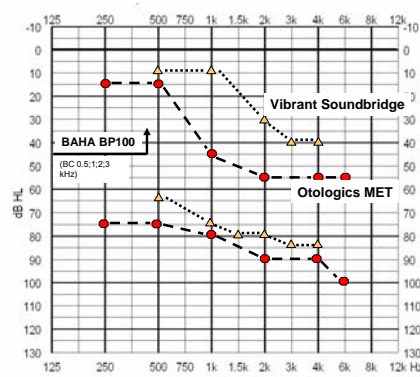
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## Summary: Audiological Indication Range




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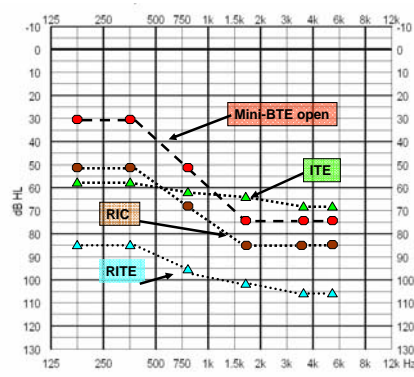
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## Summary: Audiological Indication Range




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