

# Hearing loss Indication and Strategies for medical and audiological therapy

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**Corso: Electropysiology and psychoacoustics with auditory implants**  
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# Clinic of Otorhinolaryngology & Hearing Center / MHH

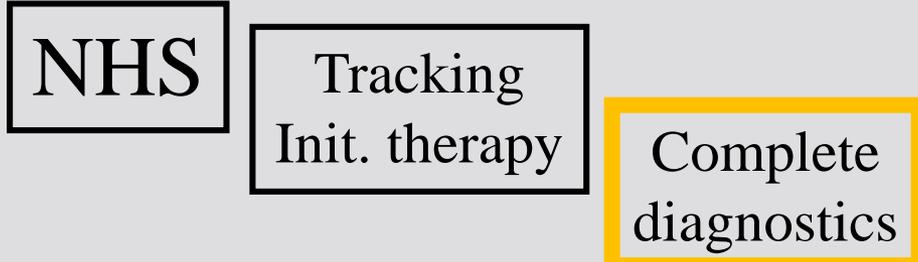


Deutsches Hörzentrum

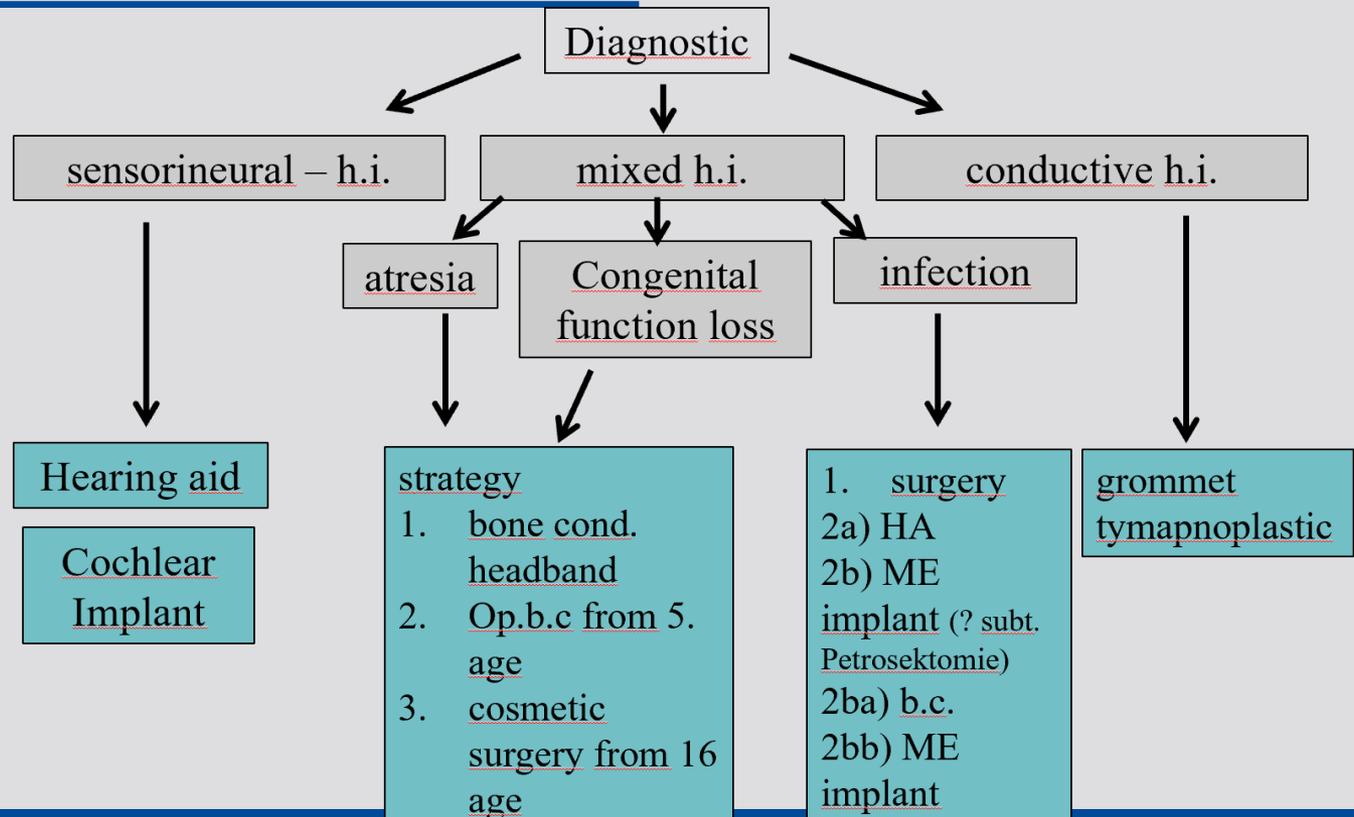


NIFE

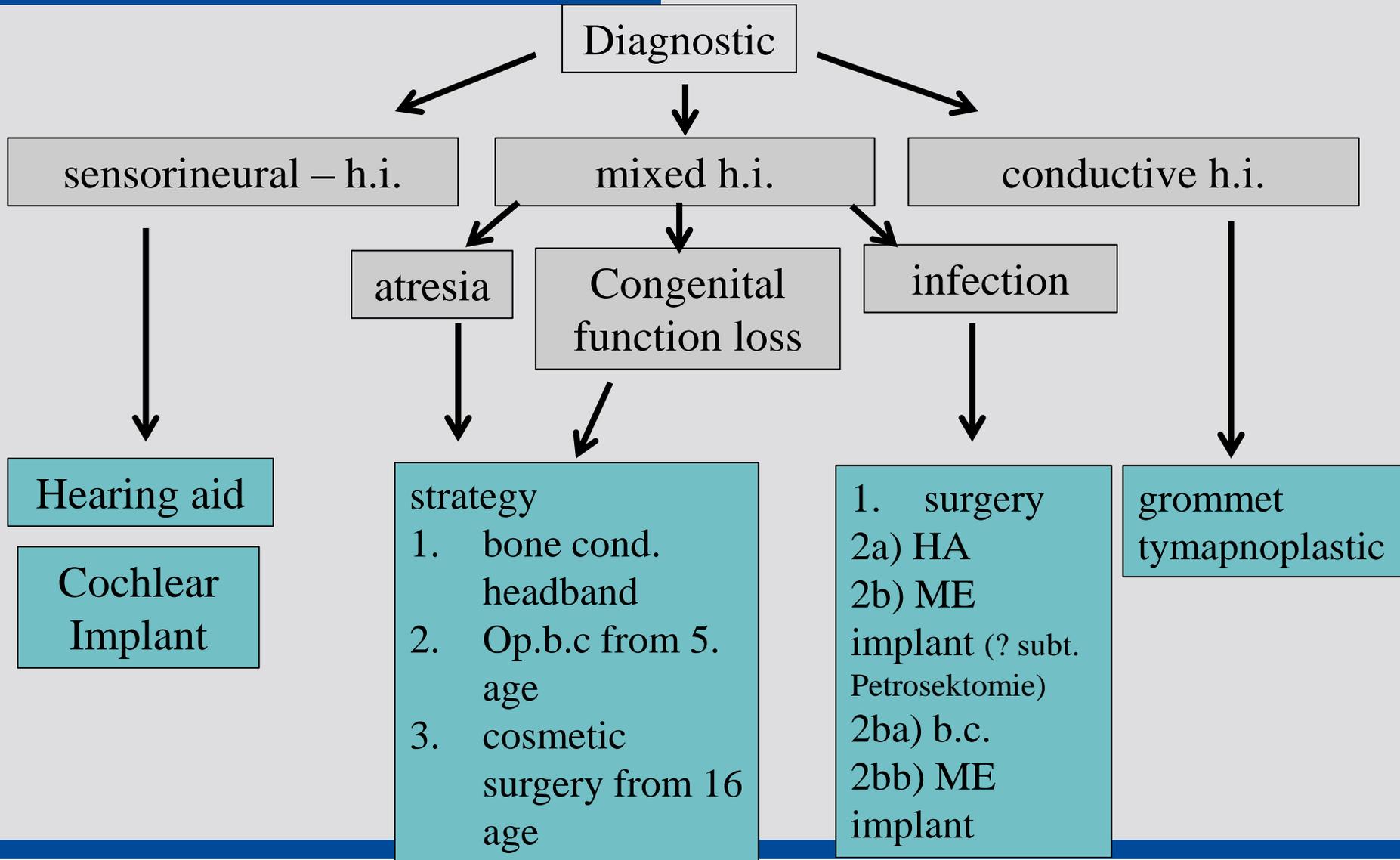
# Providing hearing therapy in children



## Strategy with hearing impairment



# Strategy with hearing impairment



# Early-Management of Hearing Impairment in children

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- constant available
- reliable professionals
- building up confidence in therapy (CI cannot be tried out)
- preparing premedication / reducing fear

Cave = increasing number in special cases

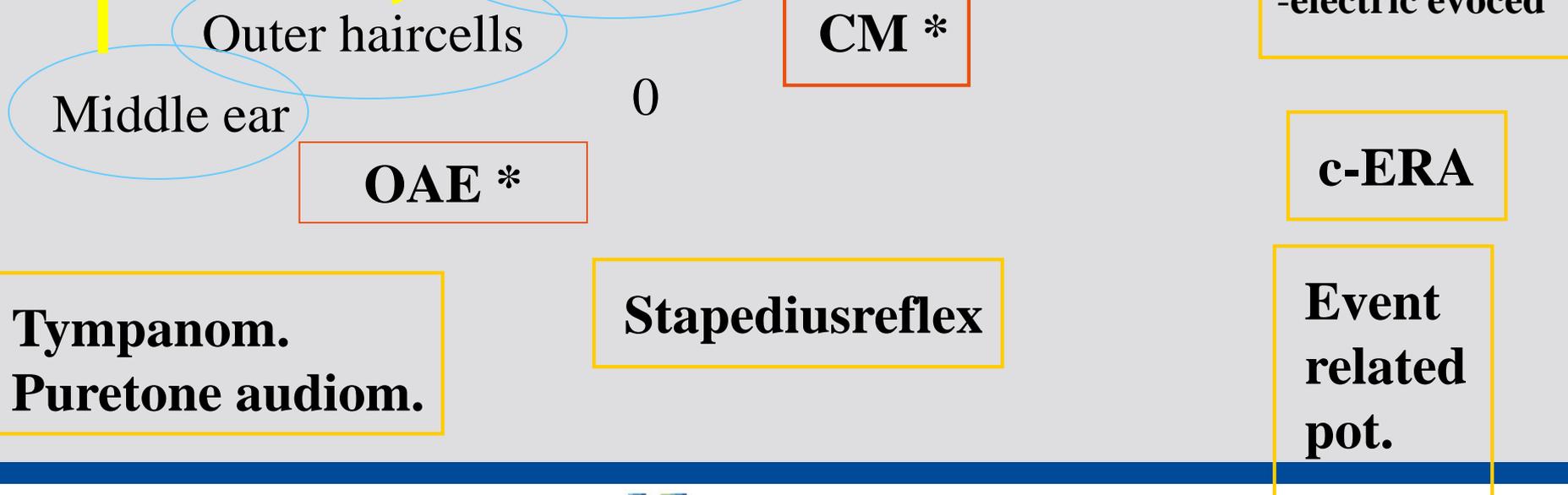
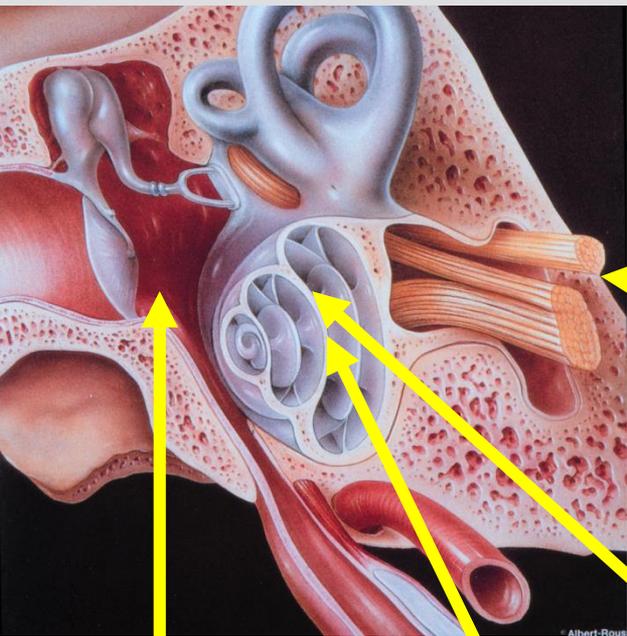
- children
- seniors

# „Complete diagnostics in profound hearing impaired“

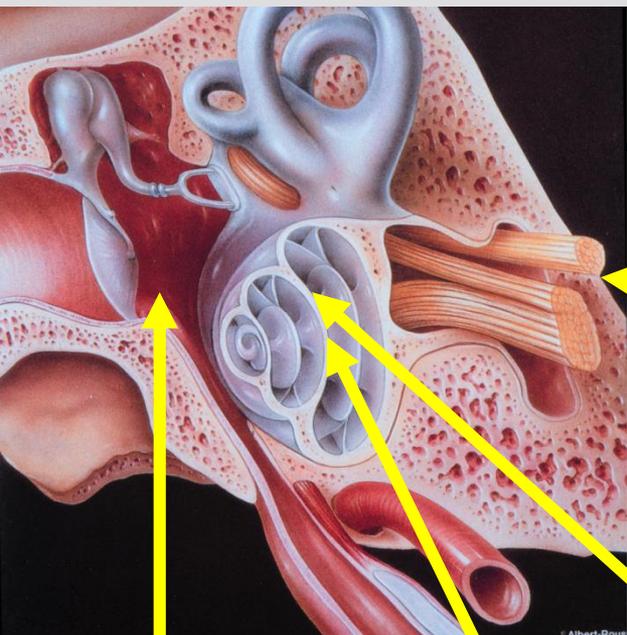
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- within 6. / 7. month of life
- middle ear inspection after PC and Adenotomy
- Hearing Aid-audiology and evaluation
- ERA to register threshold
  - ABR, SN10, CAP, ECochG, ASSR
- radiology = CT and MRI
  - ? 3 Tesla , Spektroskopy, ??
- logopedics developmental evaluation
- counseling parents
- additional diagnostics (neuropediatrics, genetics, ...)

# Audiological diagnostics



# Audiological diag



Middle ear

Outer haircells

Inner haircells

Post-Synap

Pre-Synapsis

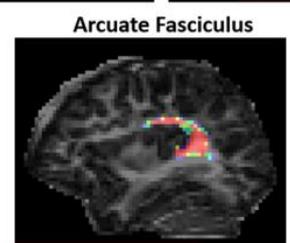
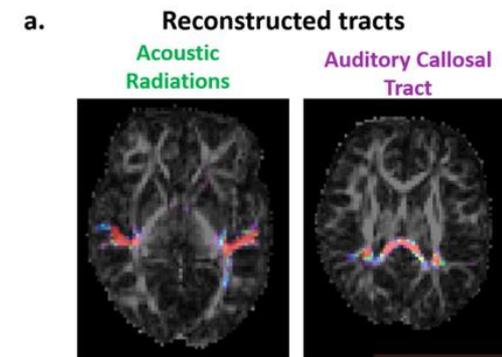
OAE \*

CM \*

CAP

Tympanom.  
Puretone audiom.

Stapediusreflex

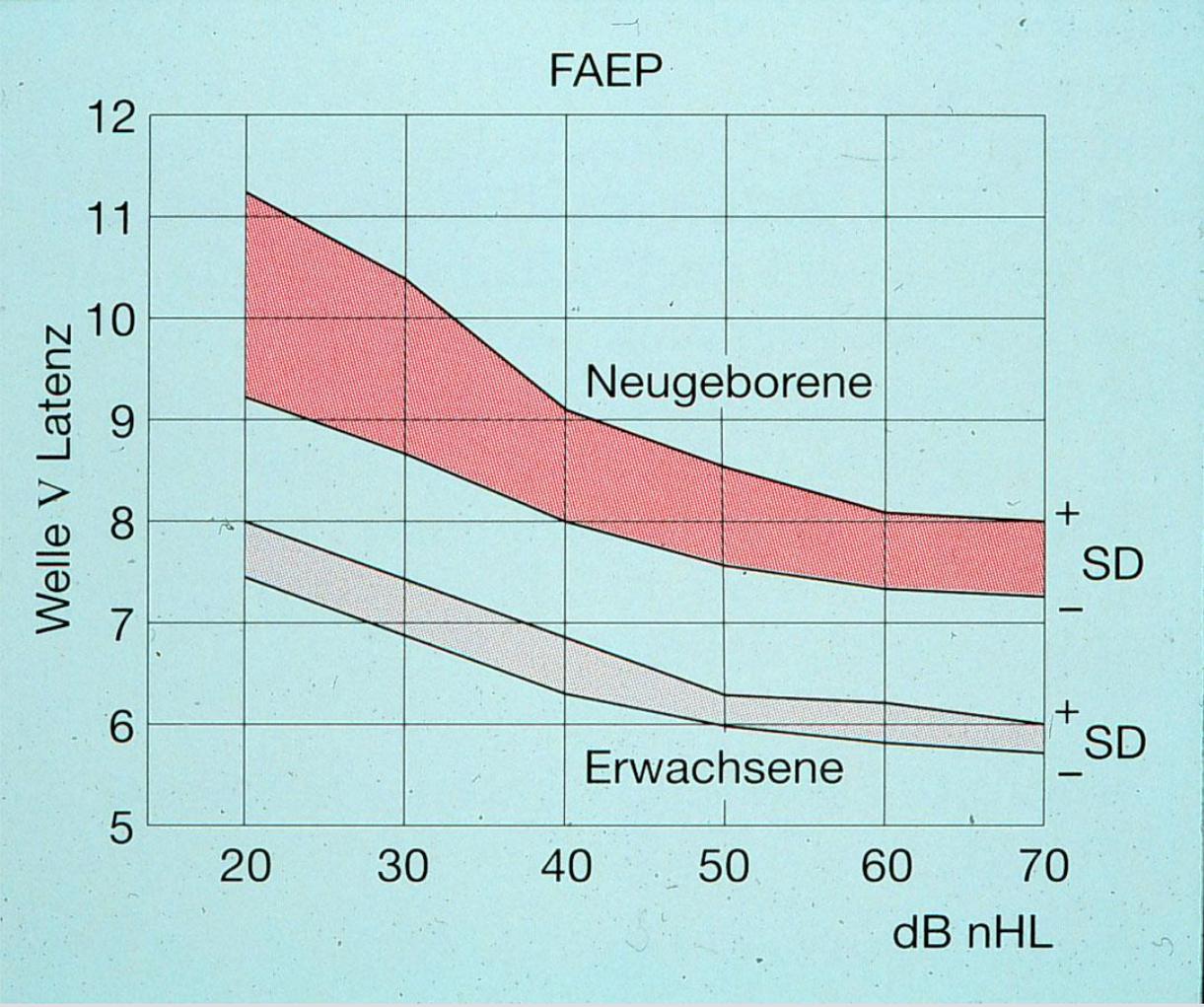


b. -ACOUSTIC ABRK  
-electric evoked

c-ERA

Event related pot.

# FAEP development



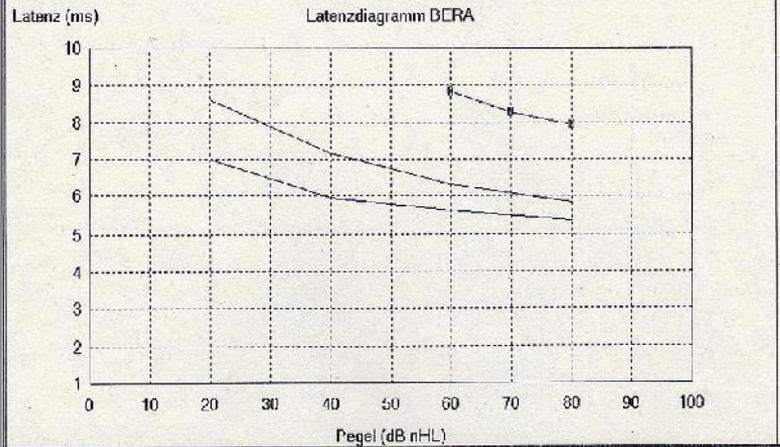
# Development of neural plasticity

Verzögerung in der Hörbahnreifung  
Reizantwort links bis 60 dB

M.M. Alter: 2 Monate

b Jewett links 80

7 April 2011 9:12:55

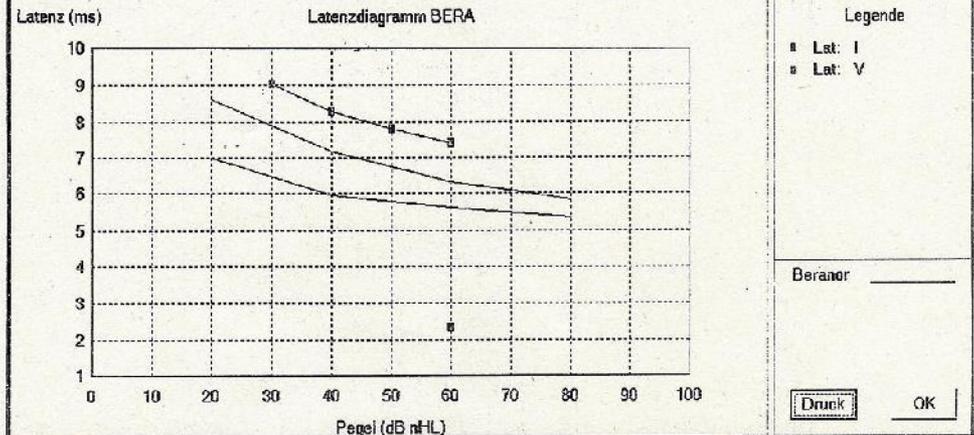


Verzögerung in der Hörbahnreifung  
Reizantwort links bis 60 dB

M.M. Alter: 8 Monate

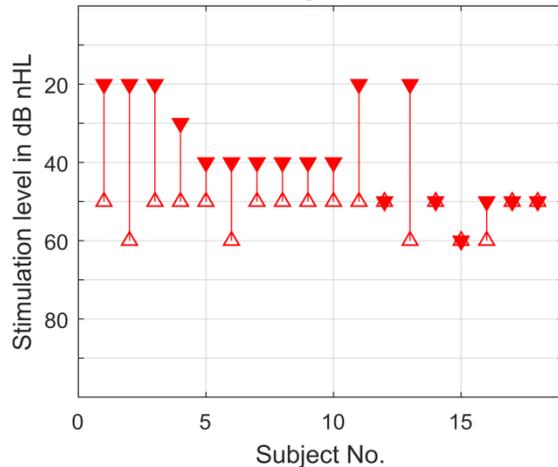
b Jewett links 80

6 Okt. 2011 9:06:09

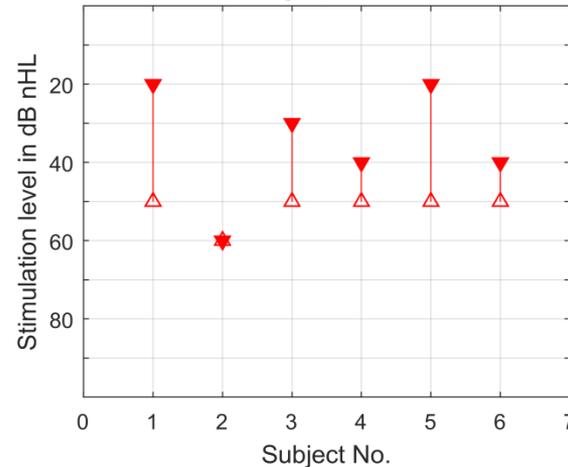


# Development of neural plasticity

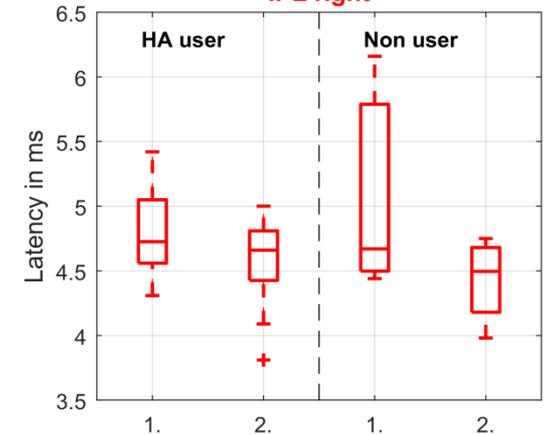
ABR thr. right, HA users



ABR thr. right, non HA users



IPL right



Vol.:(0123456789)1 3European Archives of Oto-Rhino-Laryngology (2021) 278:4187–4197

<https://doi.org/10.1007/s00405-020-06498-3>

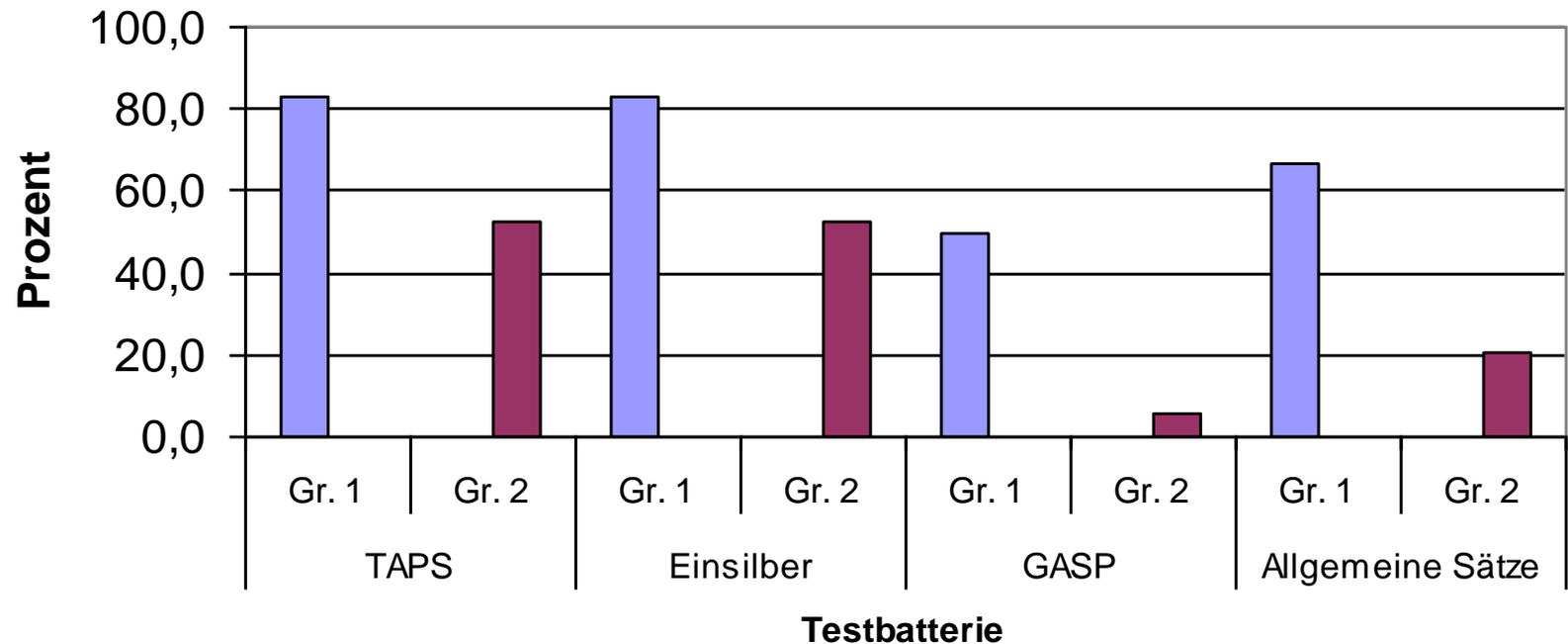
OTOLOGY

**Monitoring of the auditory pathway maturation after early intervention during the first year of life in infants with sensorineural hearing loss**

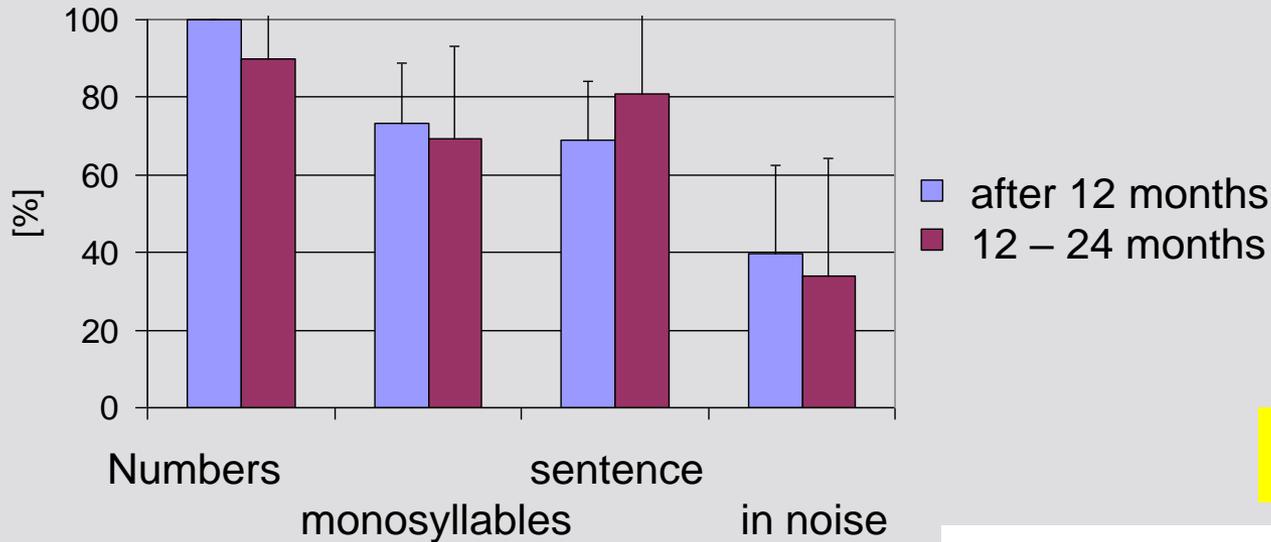
F. Matin<sup>1</sup> · S. Haumann<sup>1</sup> · W. Roßberg<sup>1</sup> · D. Mitovska<sup>1</sup> · T. Lenarz<sup>1</sup> · A. Lesinski-S

# Development of Speech understanding

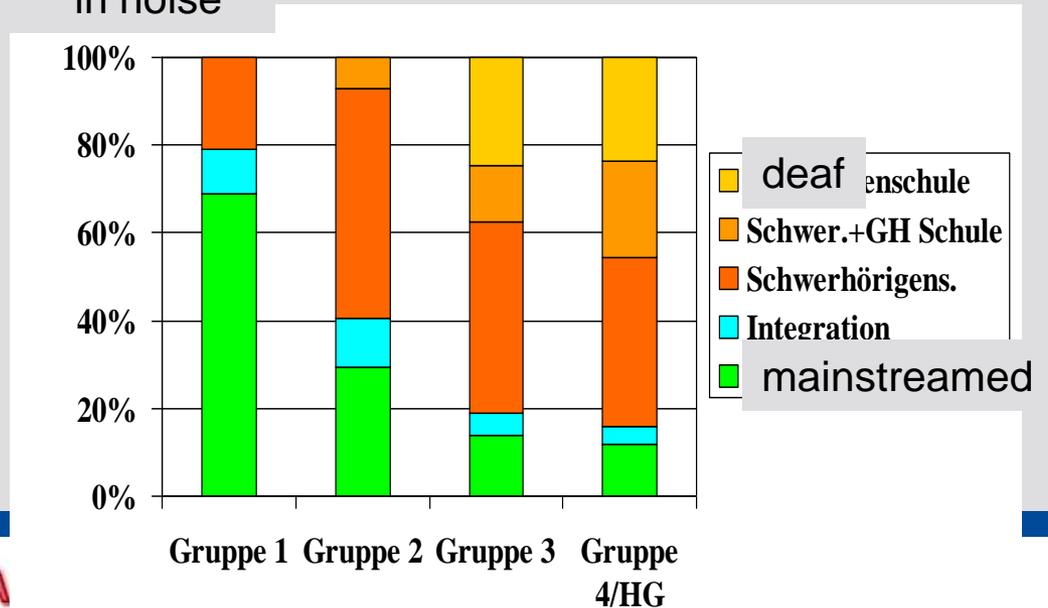
**Wort- und Satzverstehen - open set-  
im Alter von 2,5 Jahren  
(Gr. 1 = 24 Monate, Gr. 2= 18 Monate postop.)**



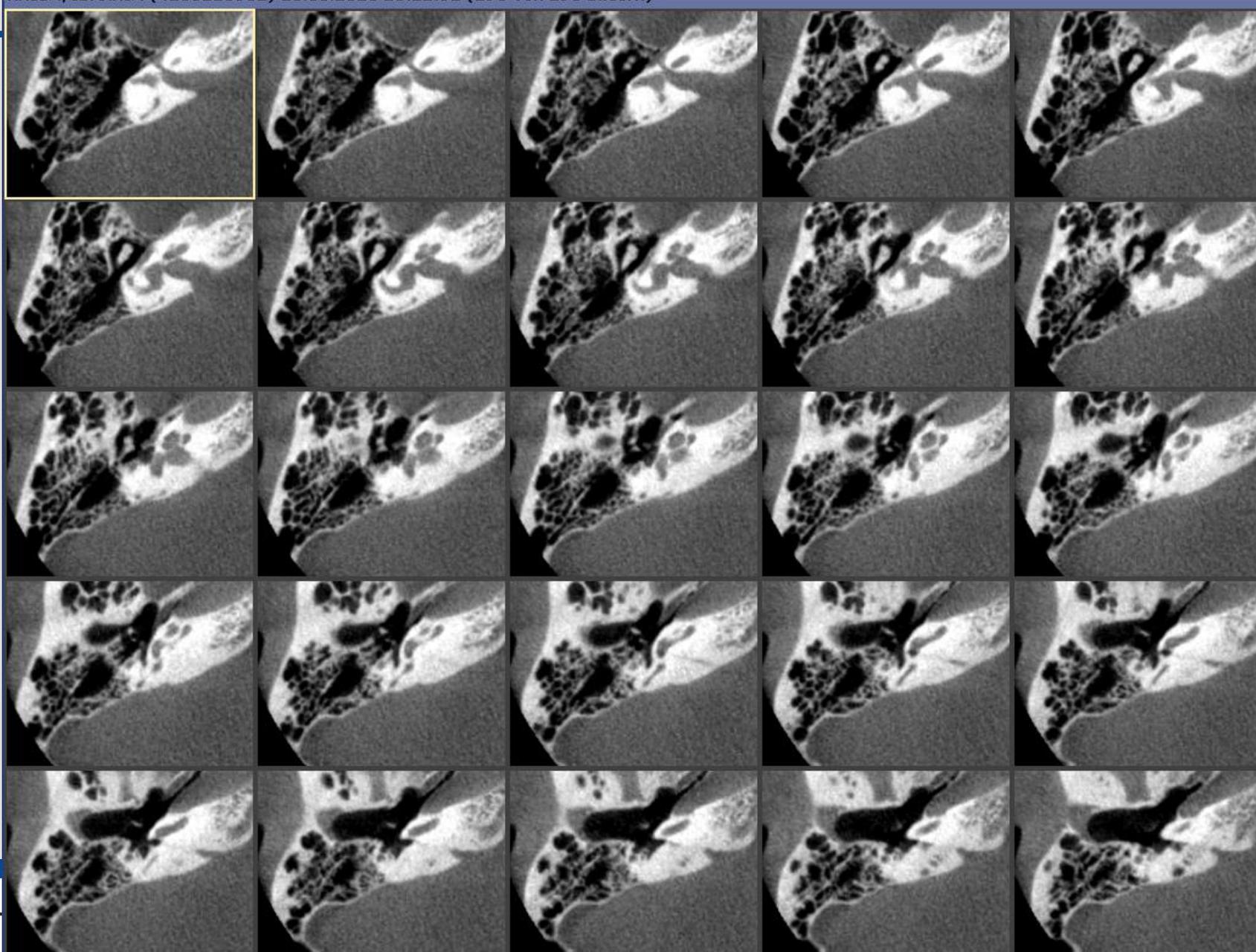
# Results after 9 – 10 years

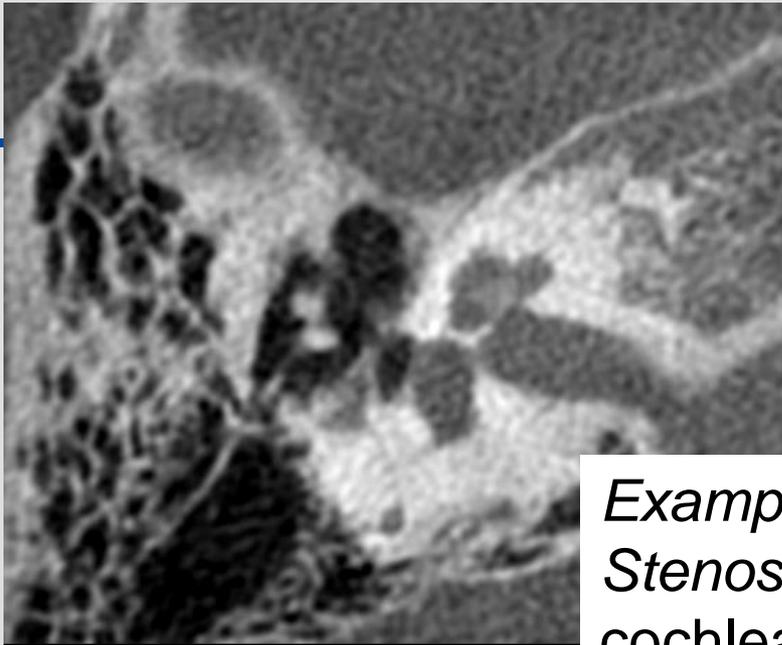


School education

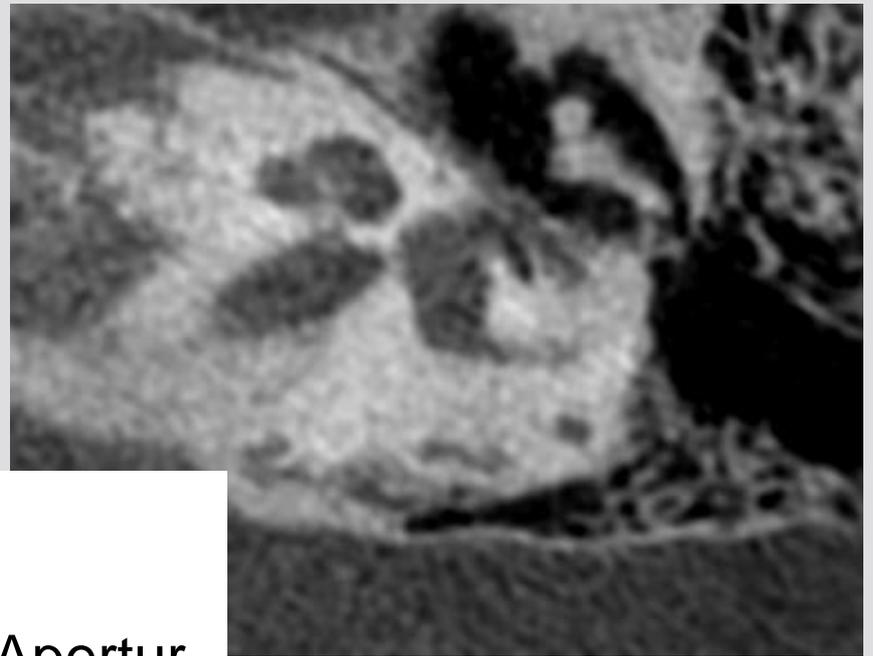


# Digital Volume Tomography



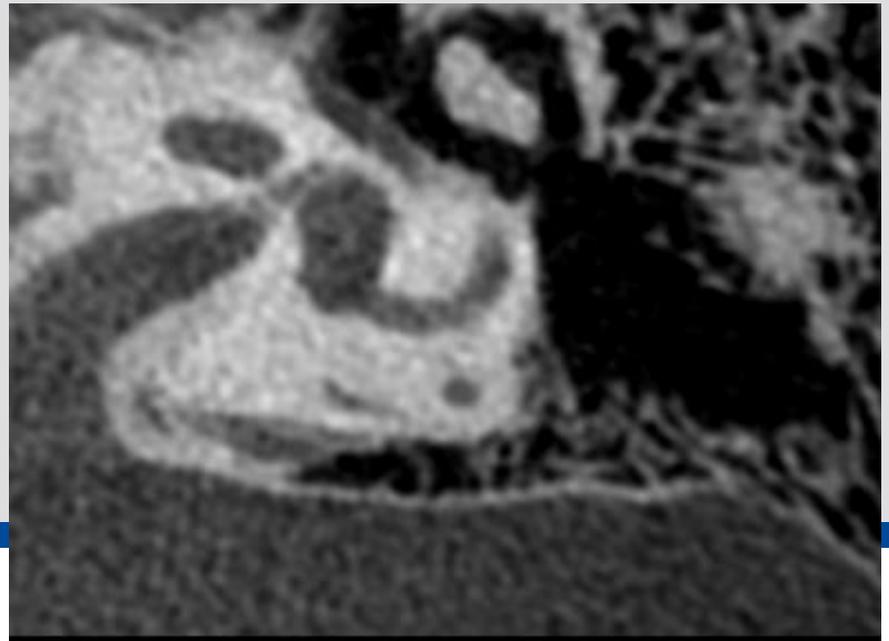
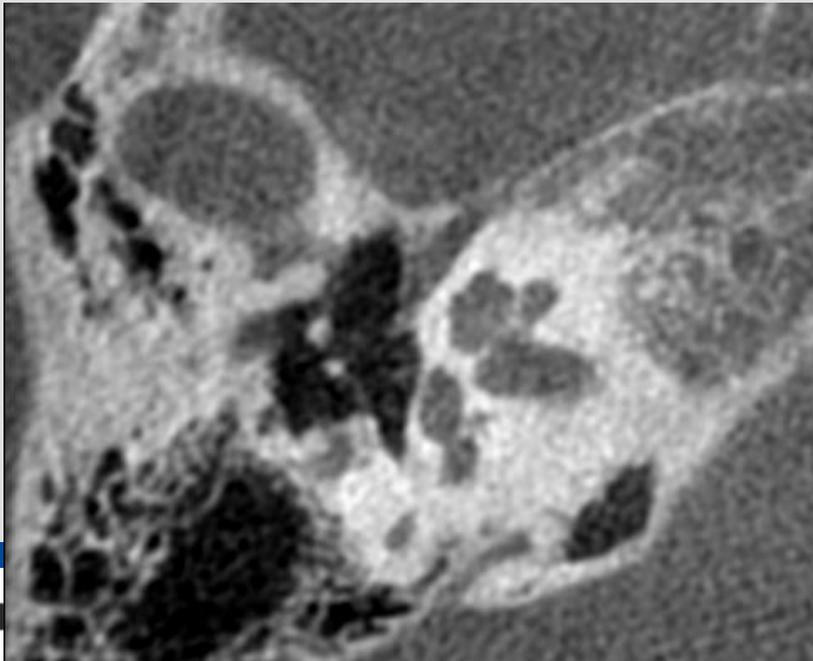


right

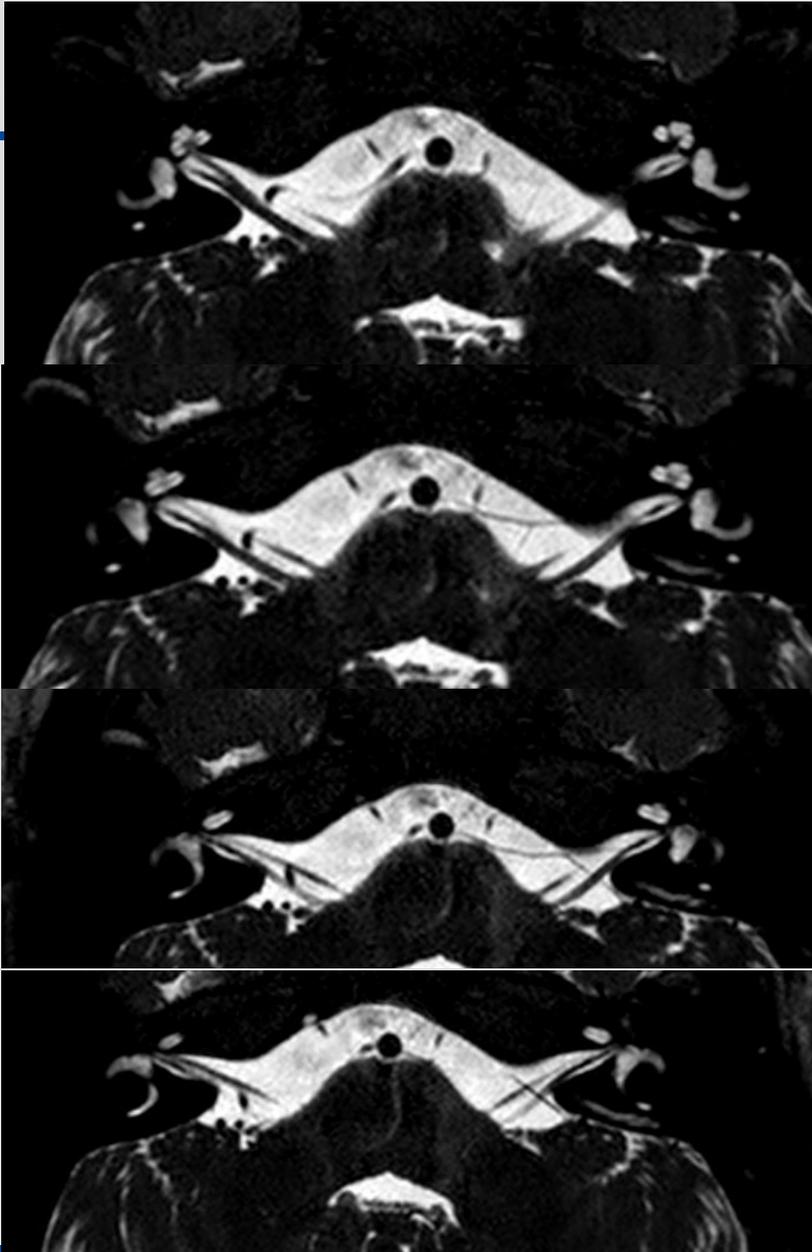


left

*Example:*  
*Stenosis*  
cochleare Apertur

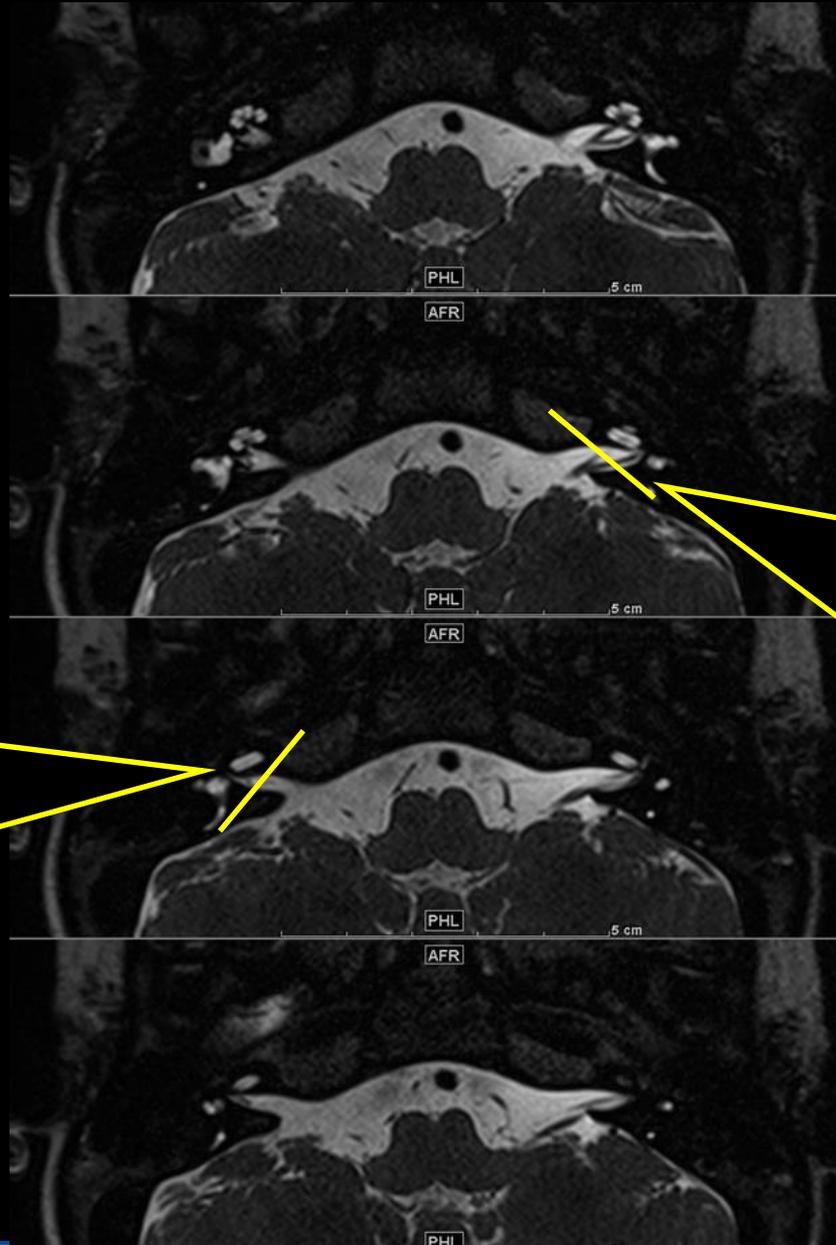


*Example:*  
*Stenosis*  
cochleare Apertur

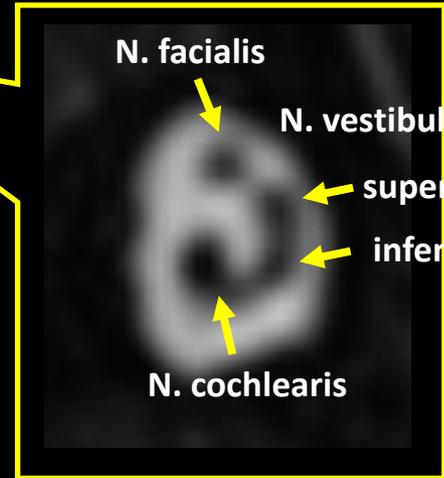


\*28.2.2007 :  
Normacusis right  
congenital deaf left

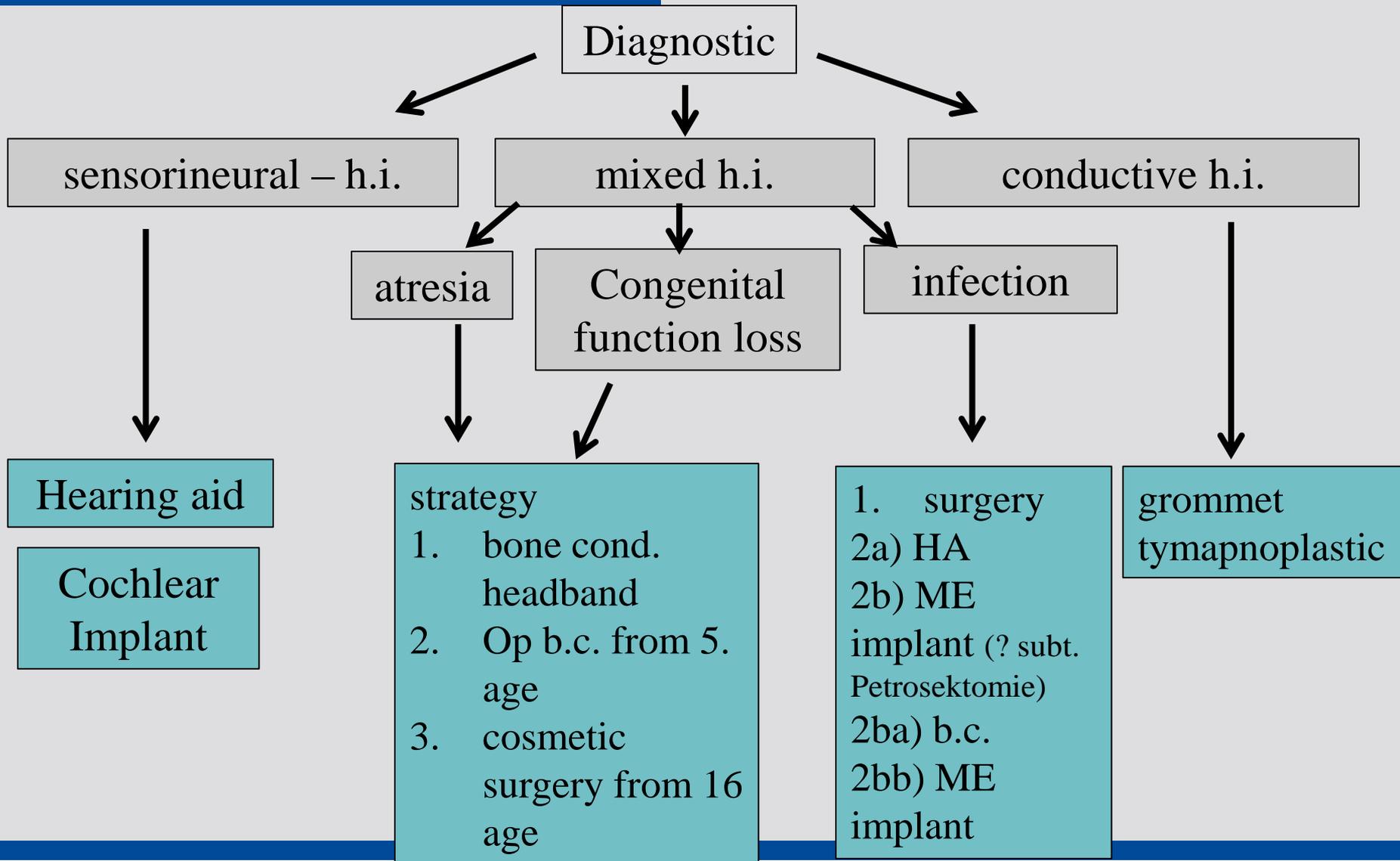
Re:  
V. a. Aplasie  
N. cochlearis

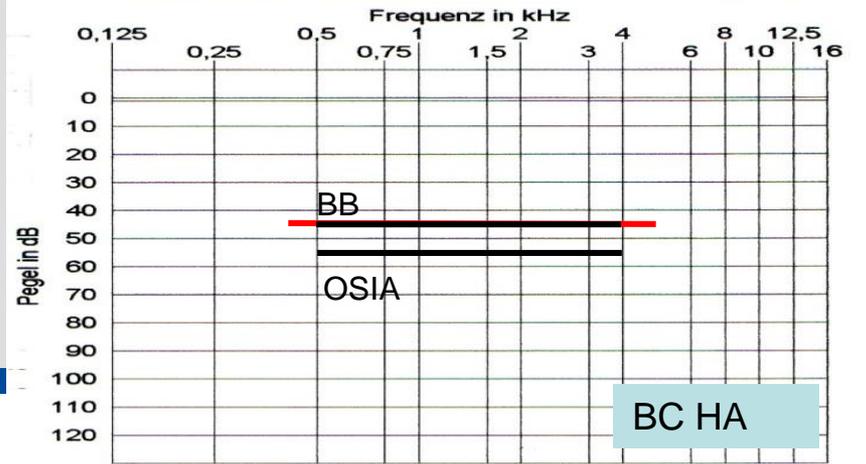
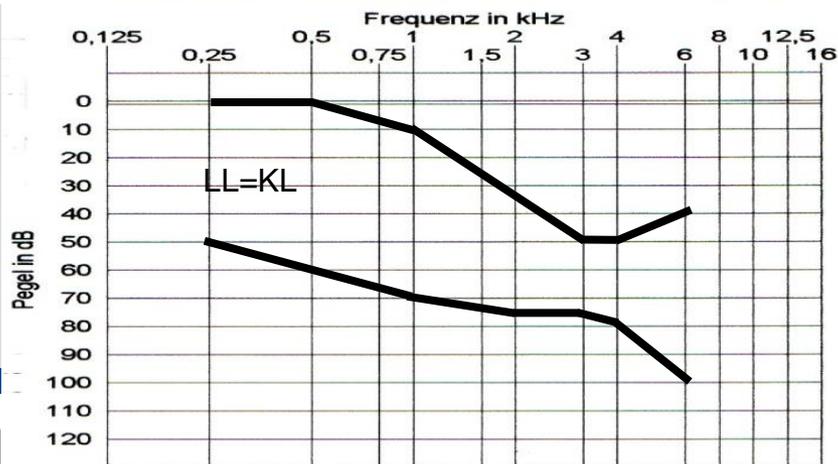
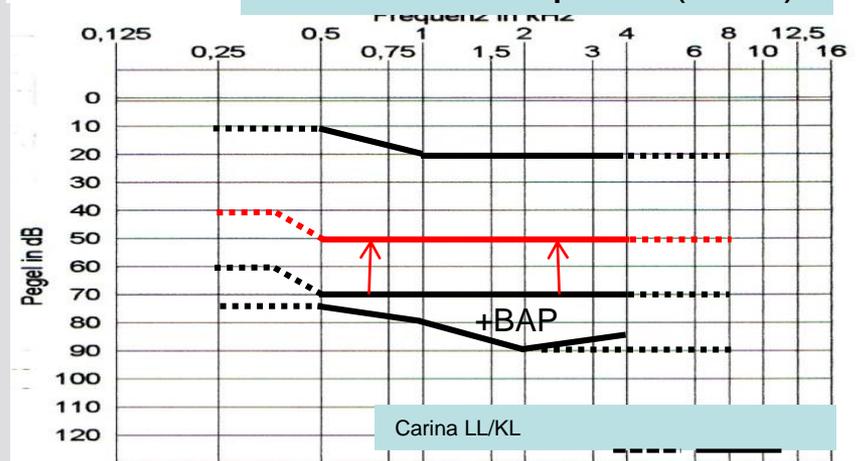
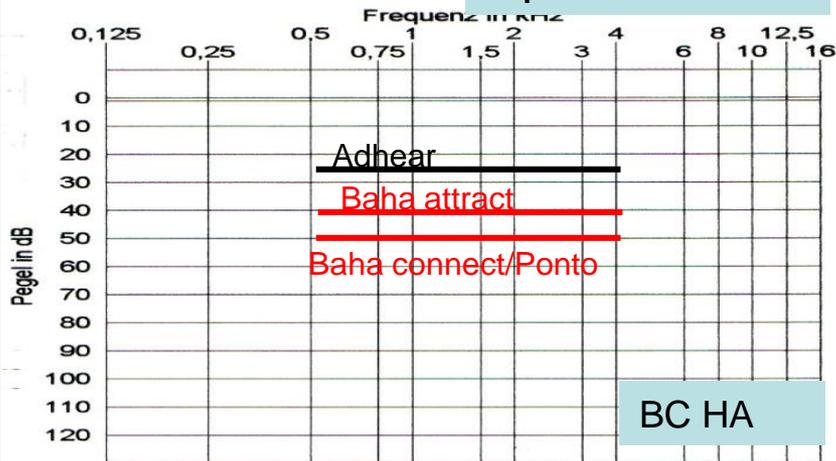
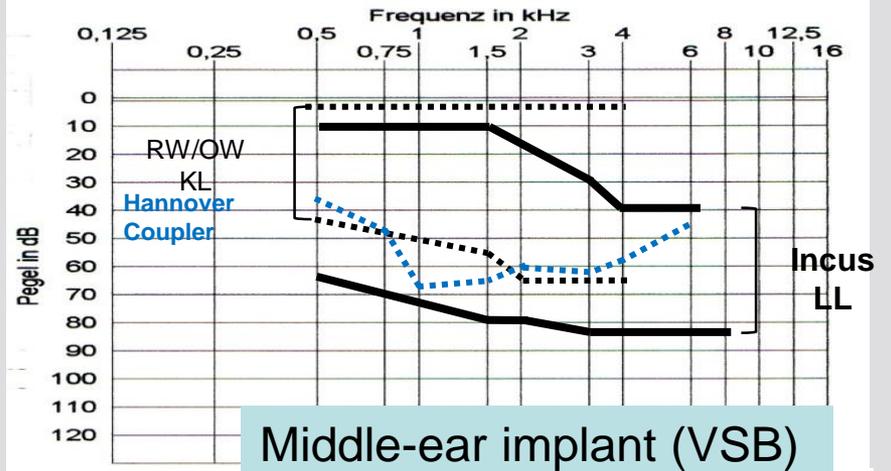
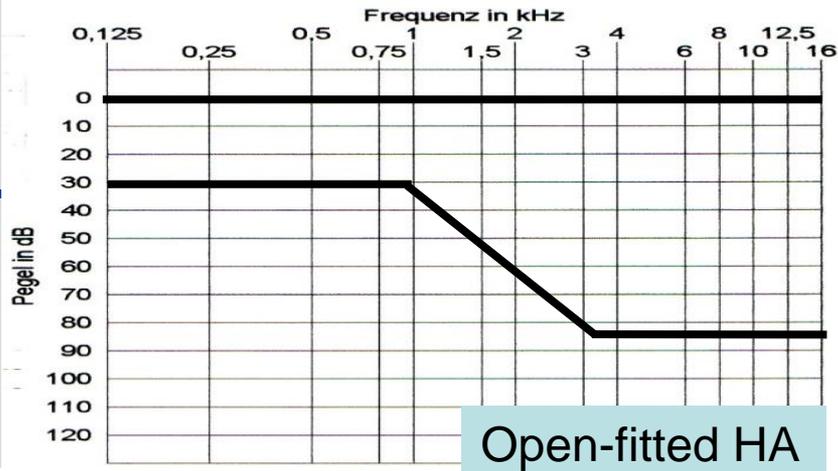


Li:  
o. p. B.



# Strategy with hearing impairment

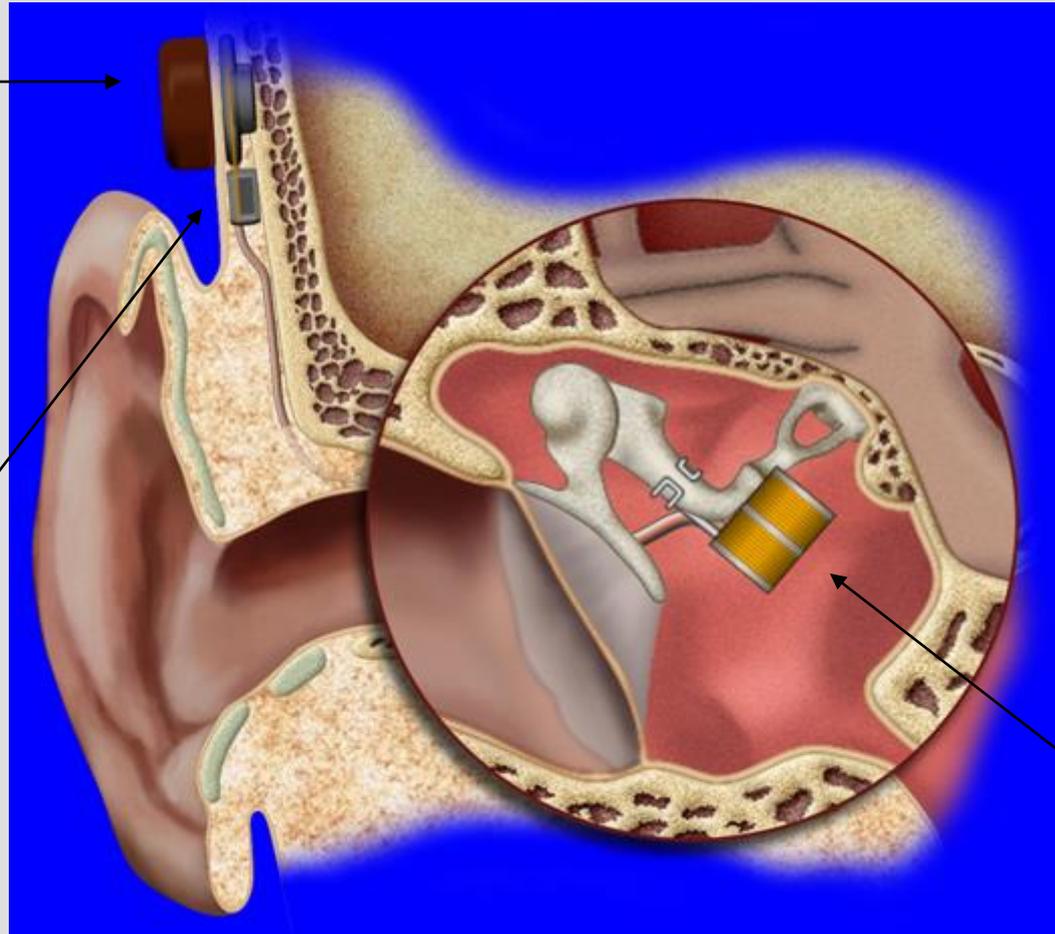




# Vibrant<sup>®</sup> Soundbridge (VSB)

Audio processor

Implant

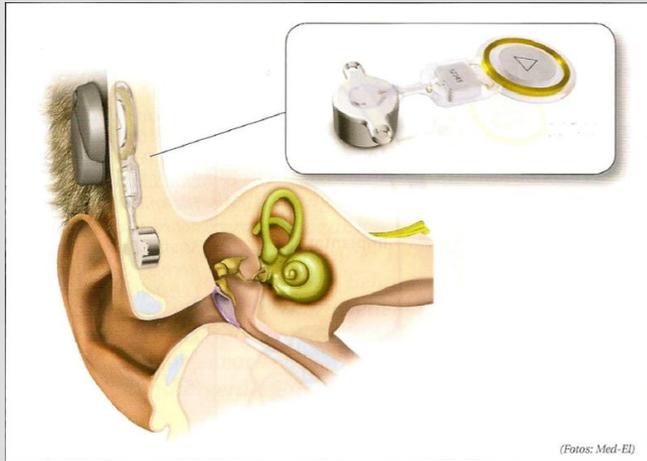


Floating  
Mass  
Transducer

# Direct comparison

transcutaneous

percutaneous

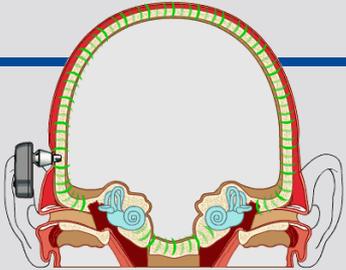


Bonebridge  
MED-EL



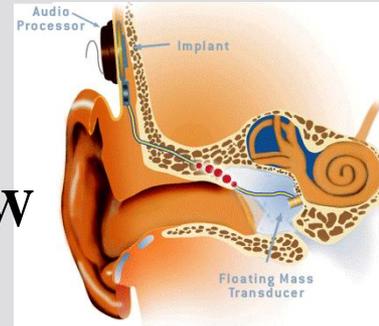
BAHA BP100  
Cochlear

# BAHA Vs VSB-RW

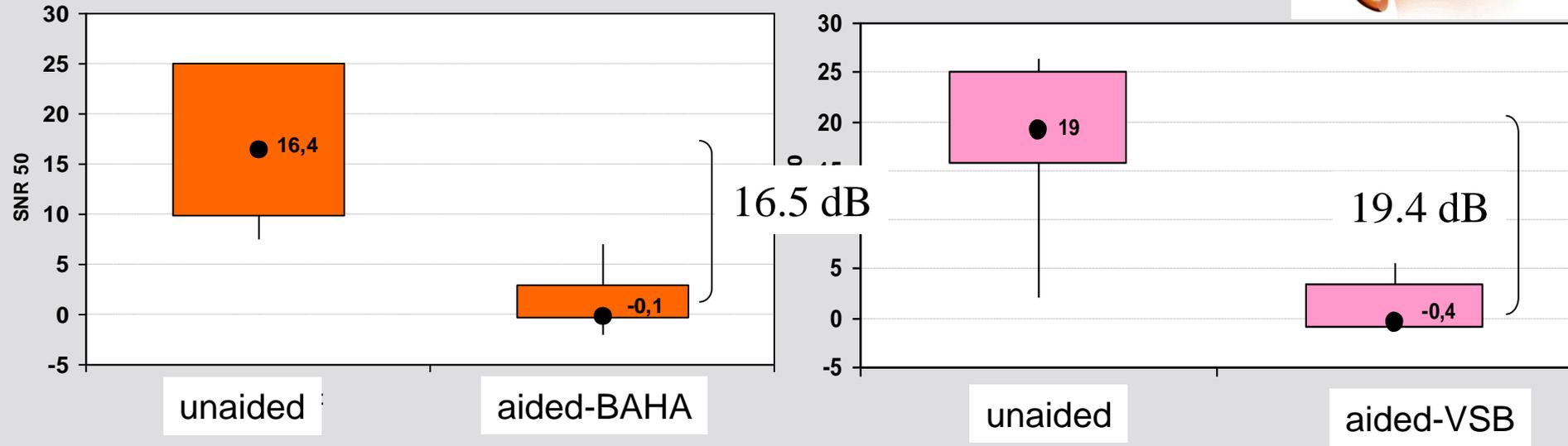


**BAHA**  
OLSA

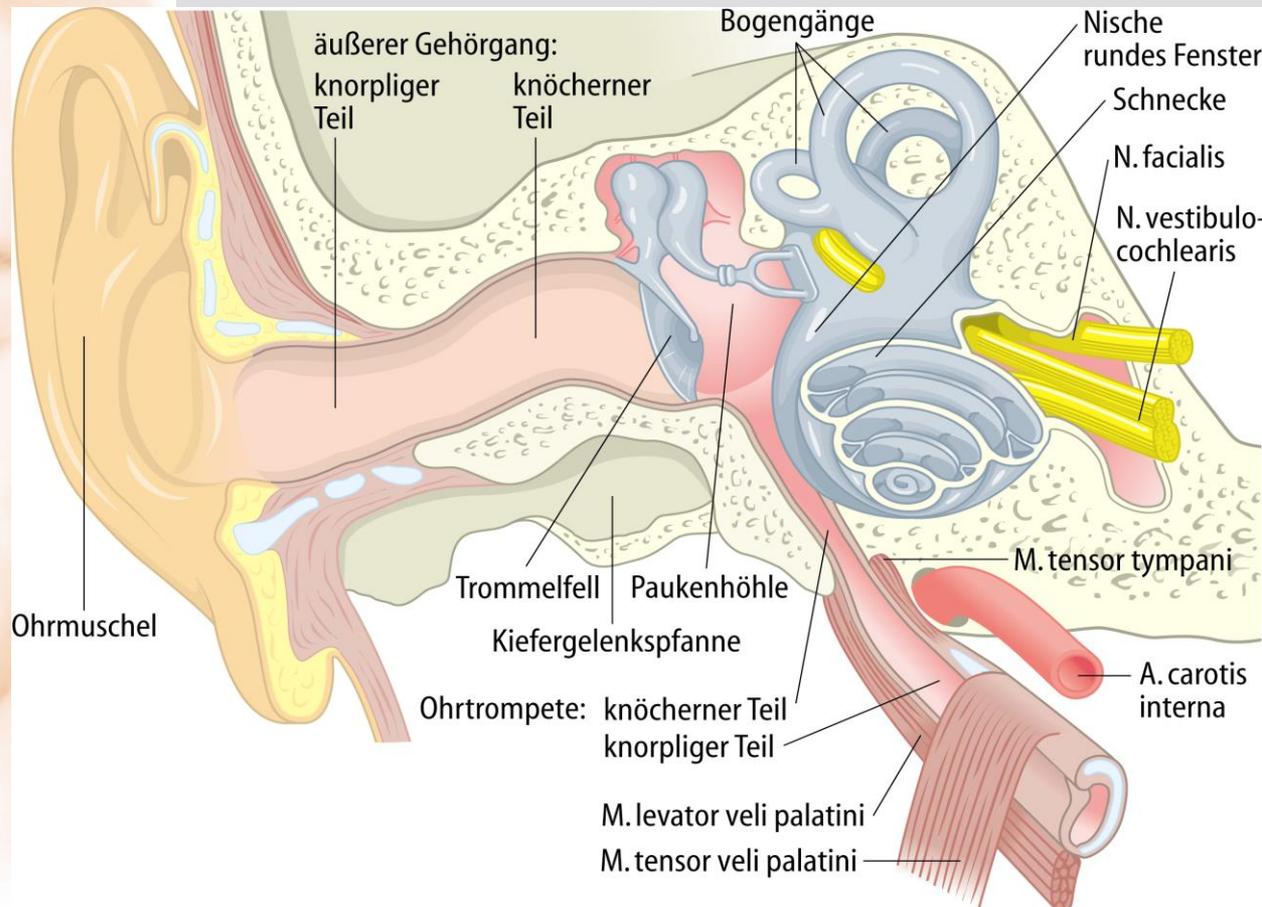
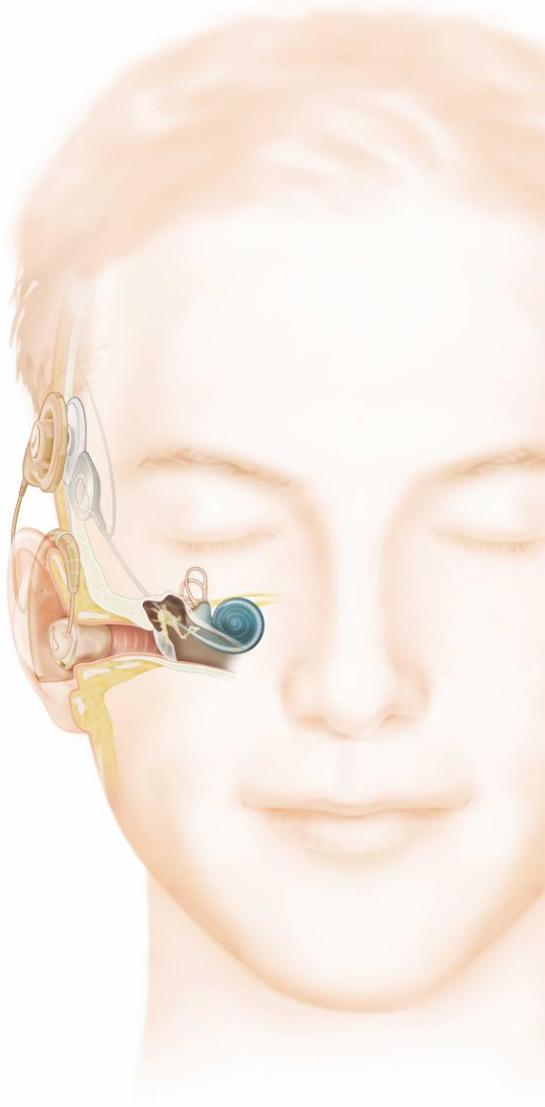
Speech in noise

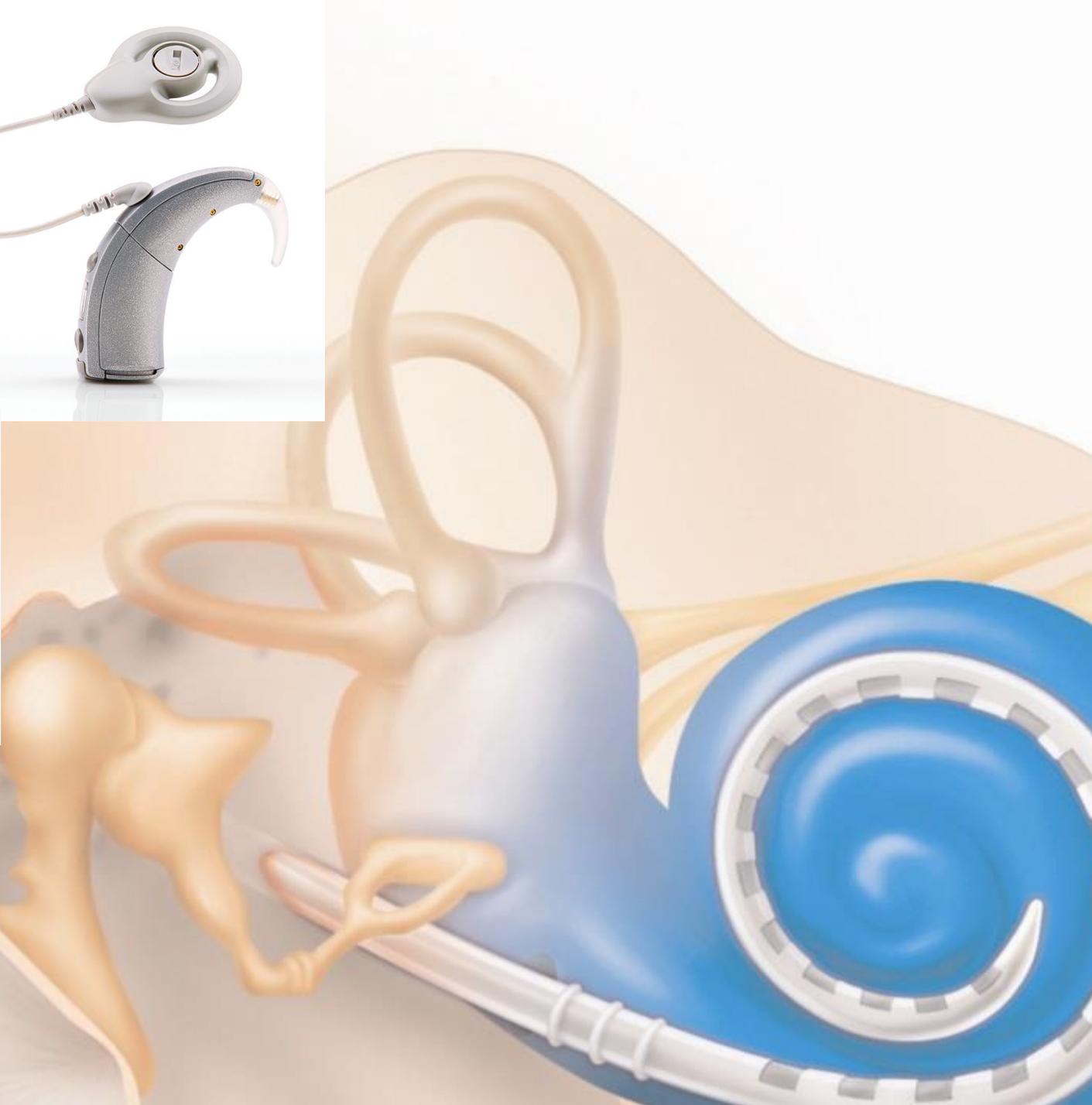


**VSB-RW**  
OLSA

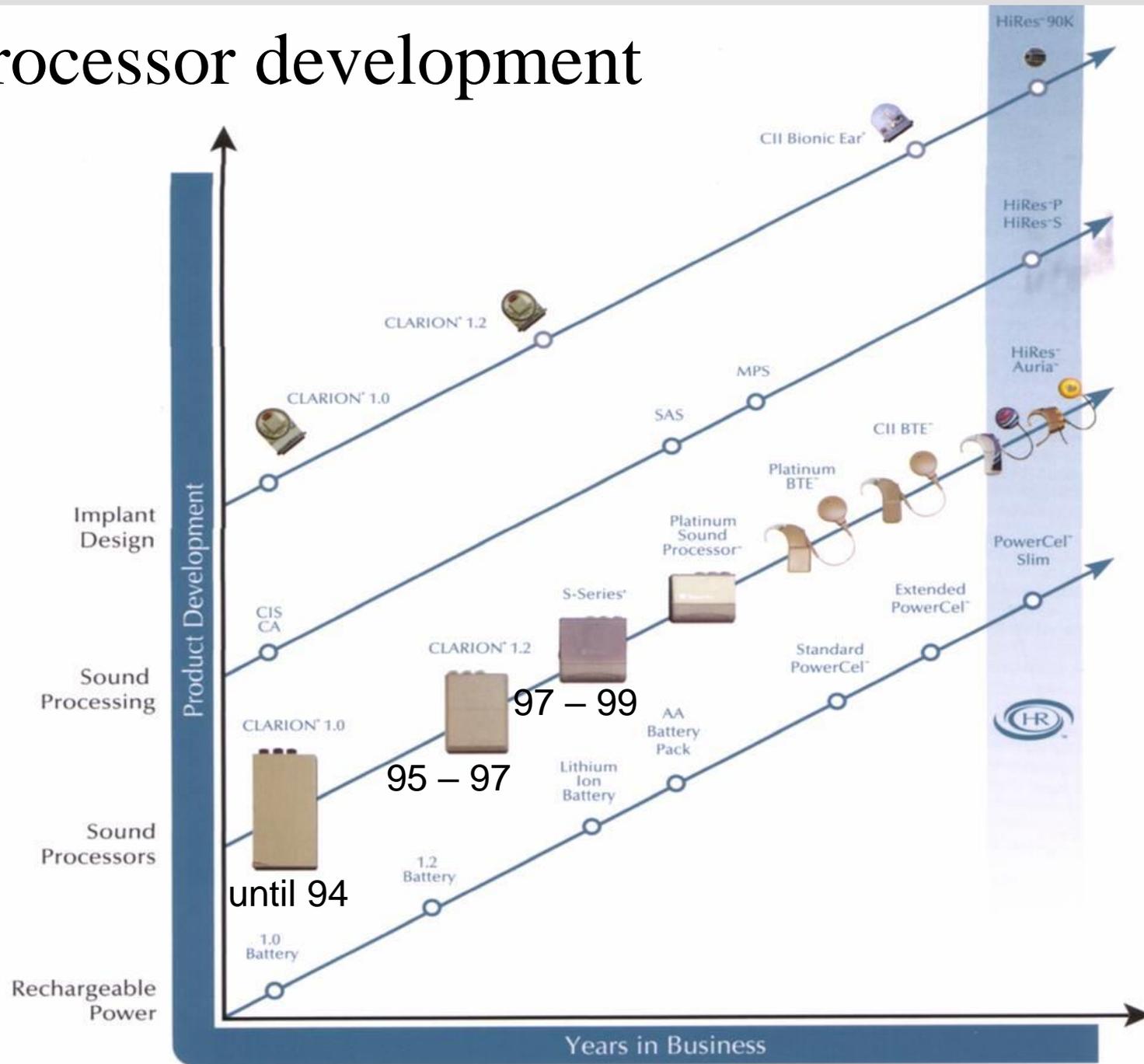


Speech in noise with OLSA-Test; Median-, 1. & 3. Quartile



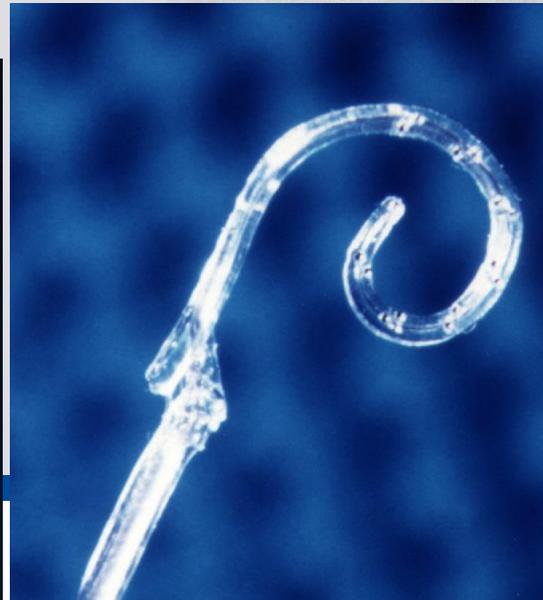
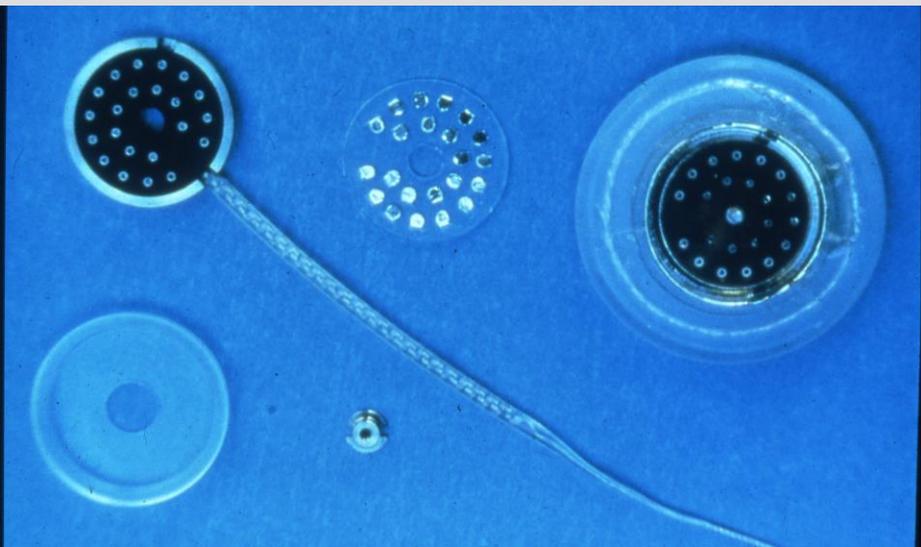
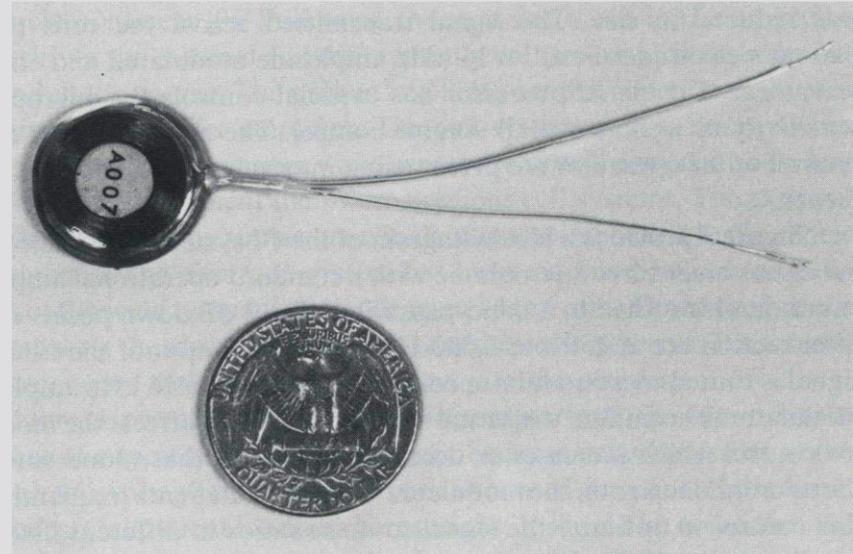
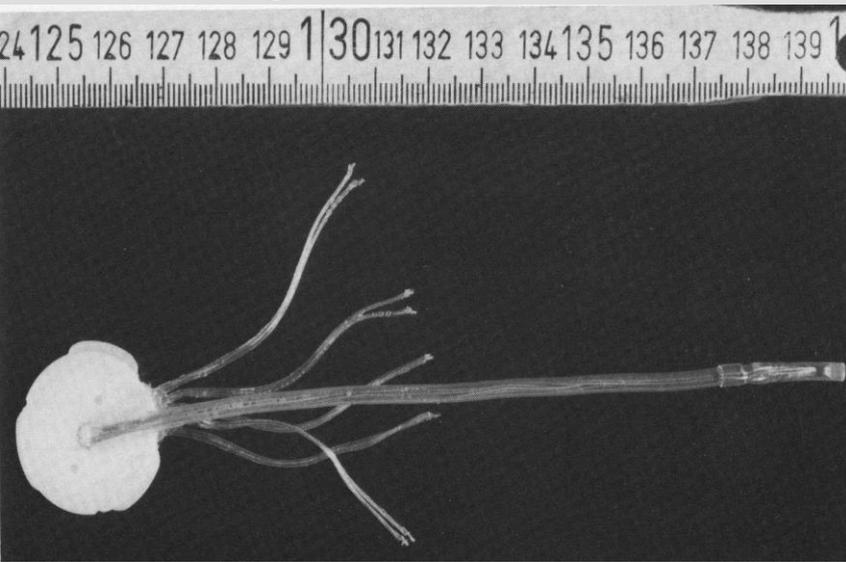


# Speech-processor development



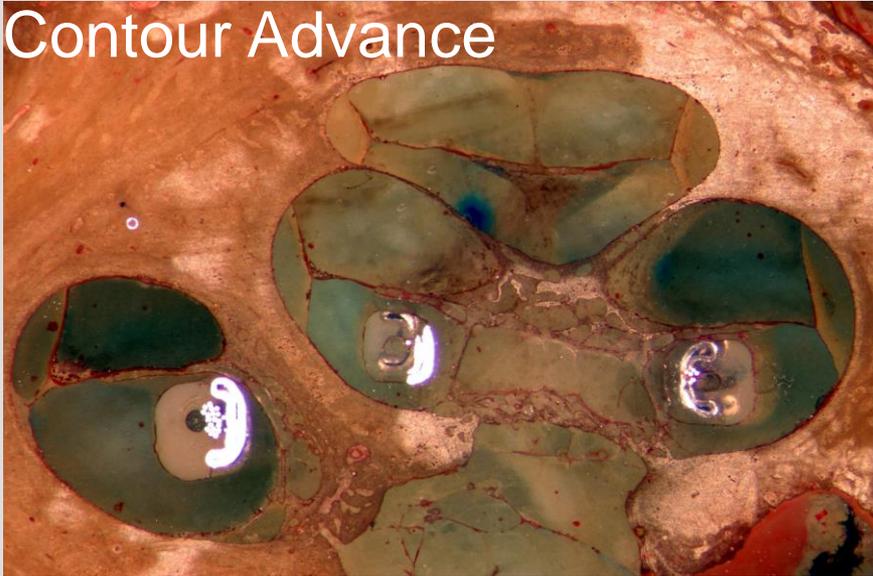
# Cochlear-Implantat Design

## Design 1984 -2010

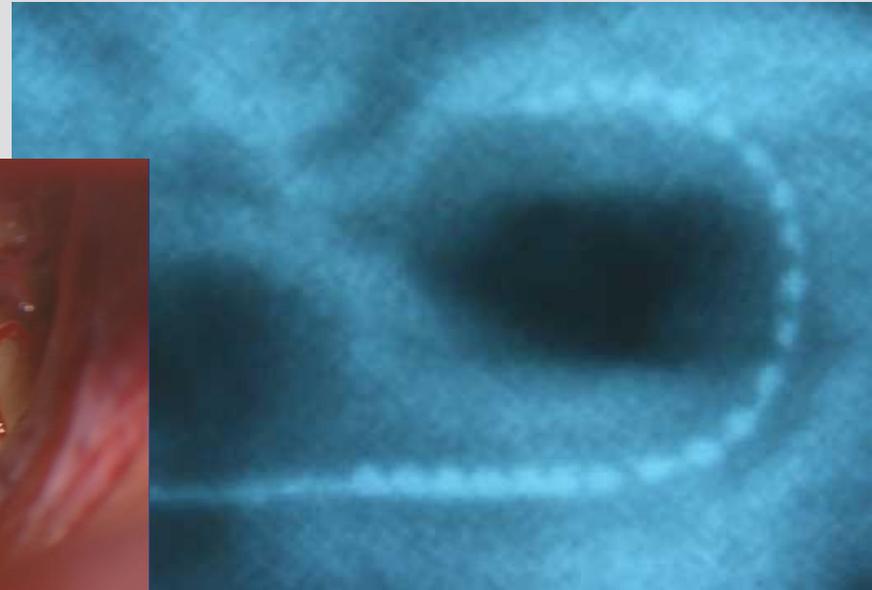


# Challenges surgery & electrode design

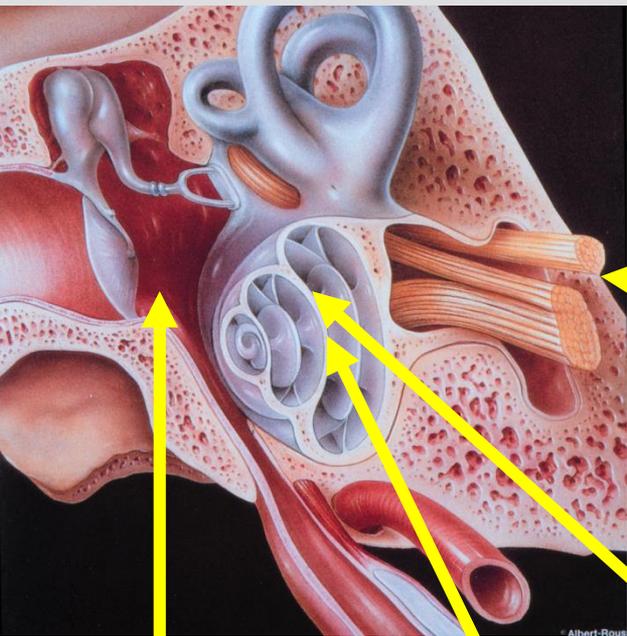
Contour Advance



Hybrid-L



# Audiological diagnostics



Middle ear

Outer haircells

Inner haircells

Neurale tracks

Post-Synapsis

Pre-Synapsis

**ERA**  
-acoustic ABR  
-electric evoked

**CAP**

**CM \***

**OAE \***

**c-ERA**

**Tympanom.  
Puretone audiom.**

**Stapediusreflex**

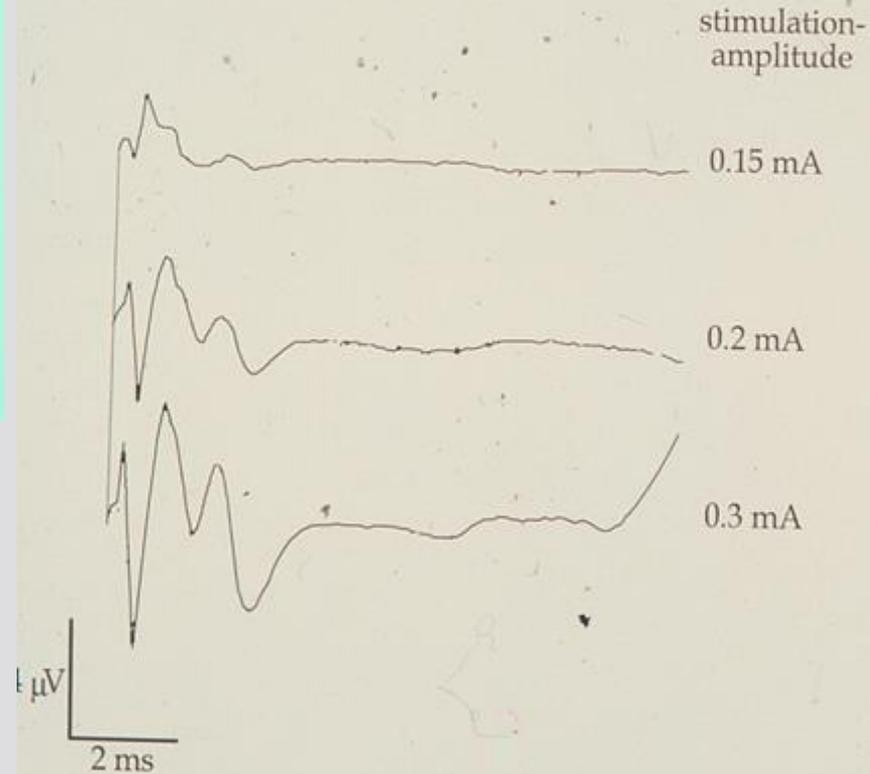
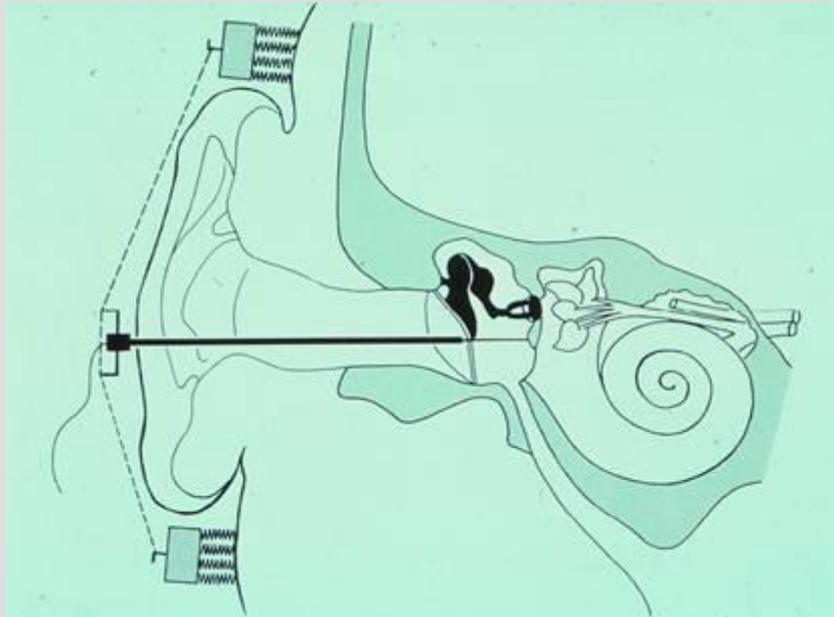
**Event  
related  
pot.**

0



# E-BERA

patient: E.N.  
electrode-location: ERA ipsilateral  
stimulation-location: promontory  
pulse-duration: 0.15 ms



# Indications

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A 1) No speech understanding in noise with HA (< 30 HSM) with bilat. profound hearing impairment

A 2) High frequency deafness (residual hearing)

B) In children < 2 years ABR threshold 80 dB

C) Unilateral deafness

ABI

NF2

Aplasia of the nerve  
meningitis

AMI

NF2

# X-Ray – bilateral, simultaneous child

## Hybrid + Contour Advance



### Indications

#### EAS Concept

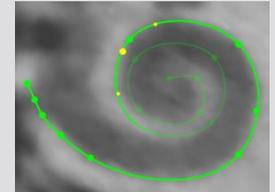
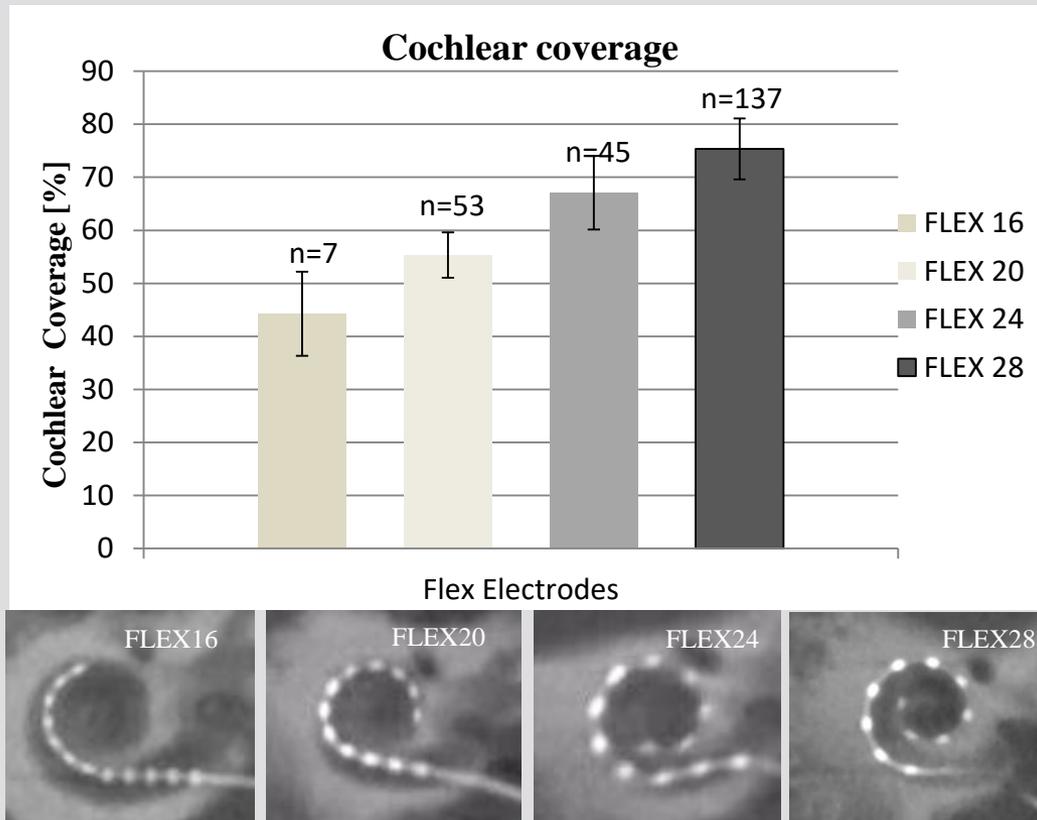
#### 1. High frequency deafness

- adults
- cong. children
- progressive

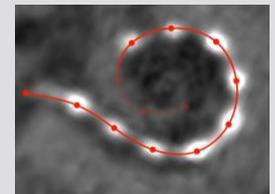
#### 1. Bilat. cong. Profound hearing impair.

➔ Standard elec. + Hybrid

# Cochlear Geometry



Präoperative Messung:  
Cochleäre Länge  $CL_{LW}$



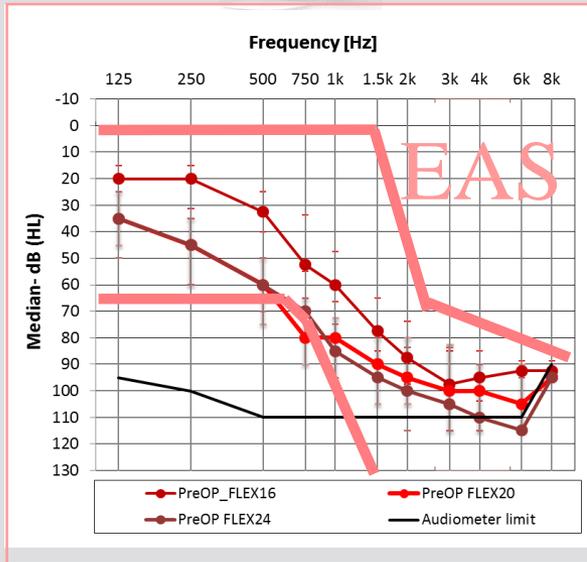
Postoperative Messung:  
Inserierte Elektrodenlänge  
IEL

# Individual selection of electrode insertion depth

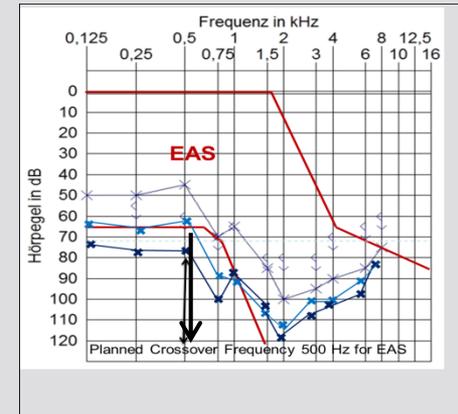
Patients with **functional residual hearing** aiming for electric-acoustic stimulation (**EAS**)



➔ **Partial insertion** of „normal“ electrode



- Prediction of postoperative residual hearing
- → **Planned Crossover Frequency (CF)** for EAS
- **Frequency information** along the cochlea for **specific CL**
- Calculate **individual IED** to cover frequency up to **CF**

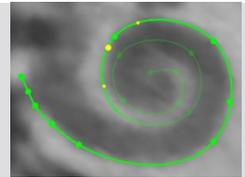


**Planned Crossover for EAS**  
 Preoperative air-conduction threshold (AC)  
 Predicted AC at first activation for 16 mm insertion  
 Predicted AC at first activation for 20 mm insertion

Inserted electrode depth (IED)



FLEX28



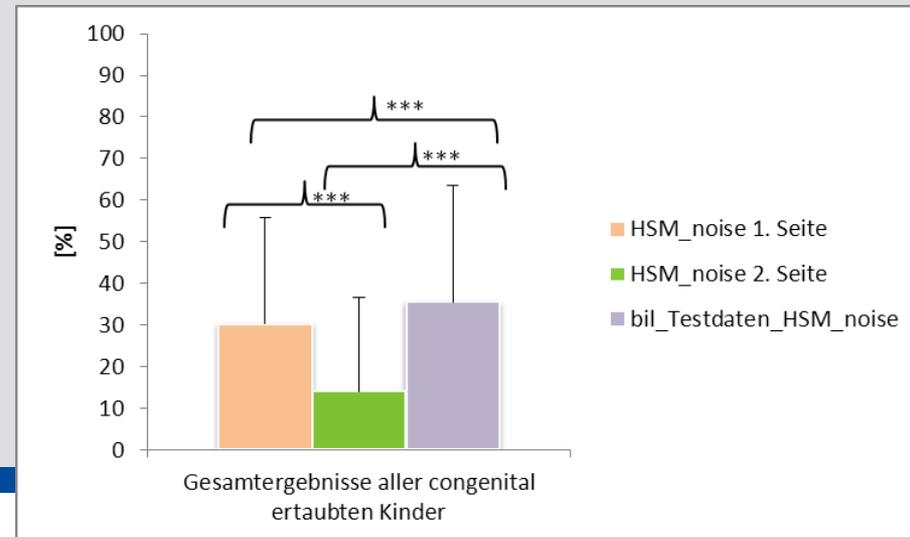
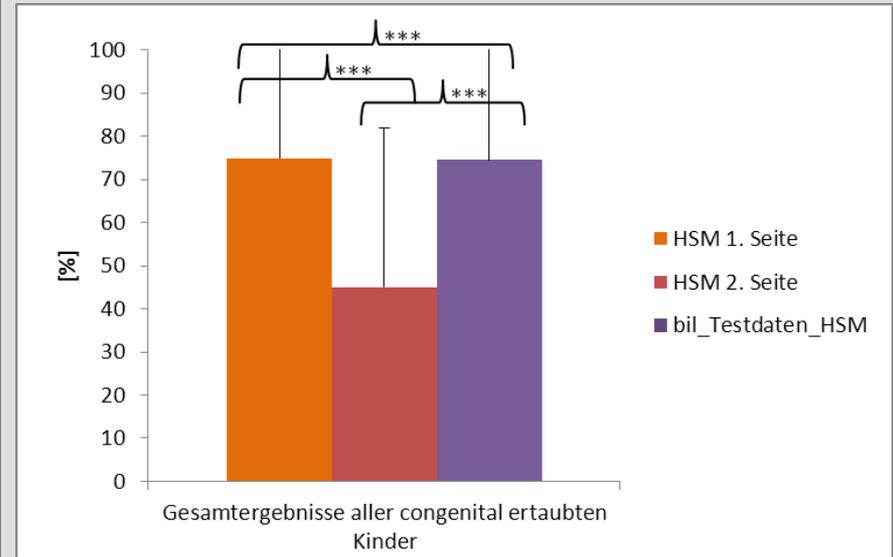
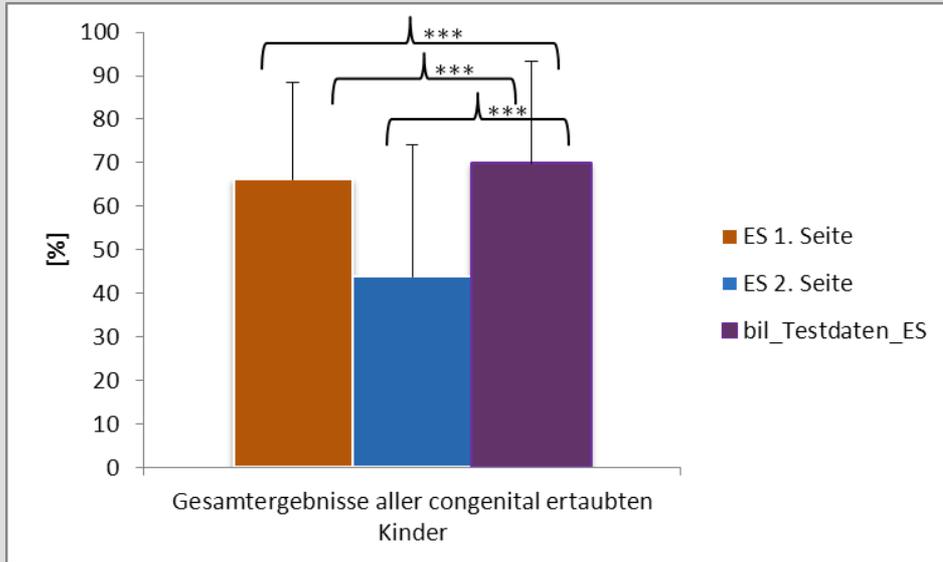
# Bilateral CI in Children ? – *sequential* -

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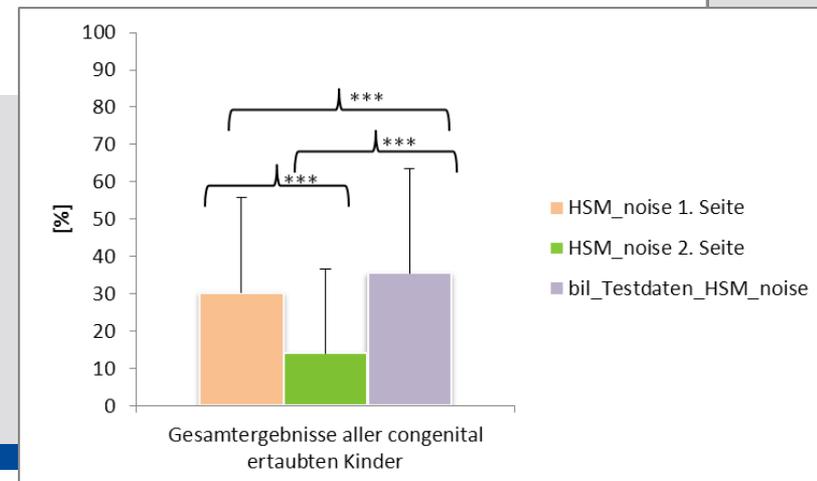
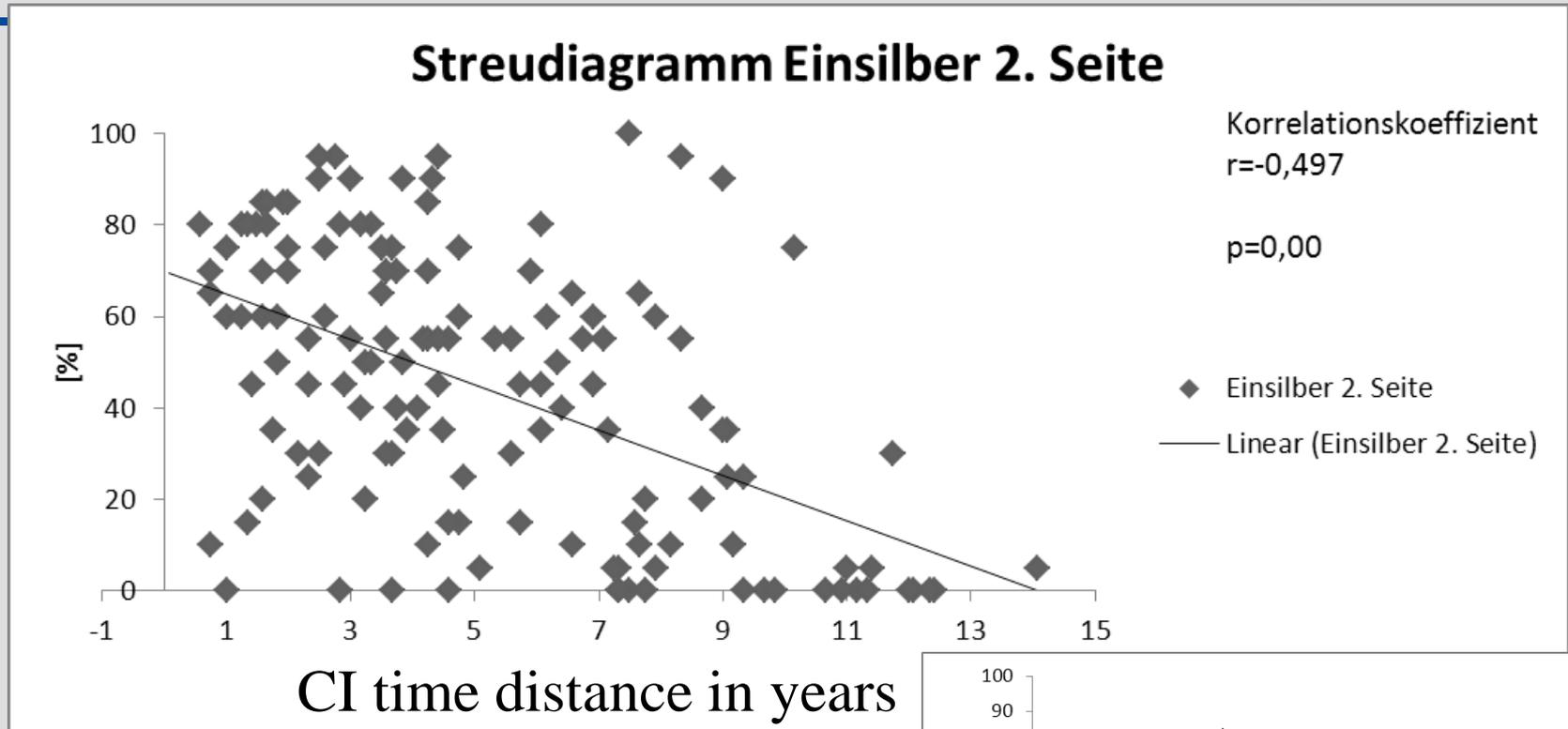
## Retrospective Study

- 251 congenital deaf children, age while study 4 - 20 years
- CI-time-period: 2 months up to 14 years
- 2. Side minimum 1 year
- Speech perceptive tests, last test result
- Freiburger Monosyllables, HSM-Sentence test in Silence and noise (10 dB S/N Ratio), Freefield 65 dB
- 110 answers

# Results all children

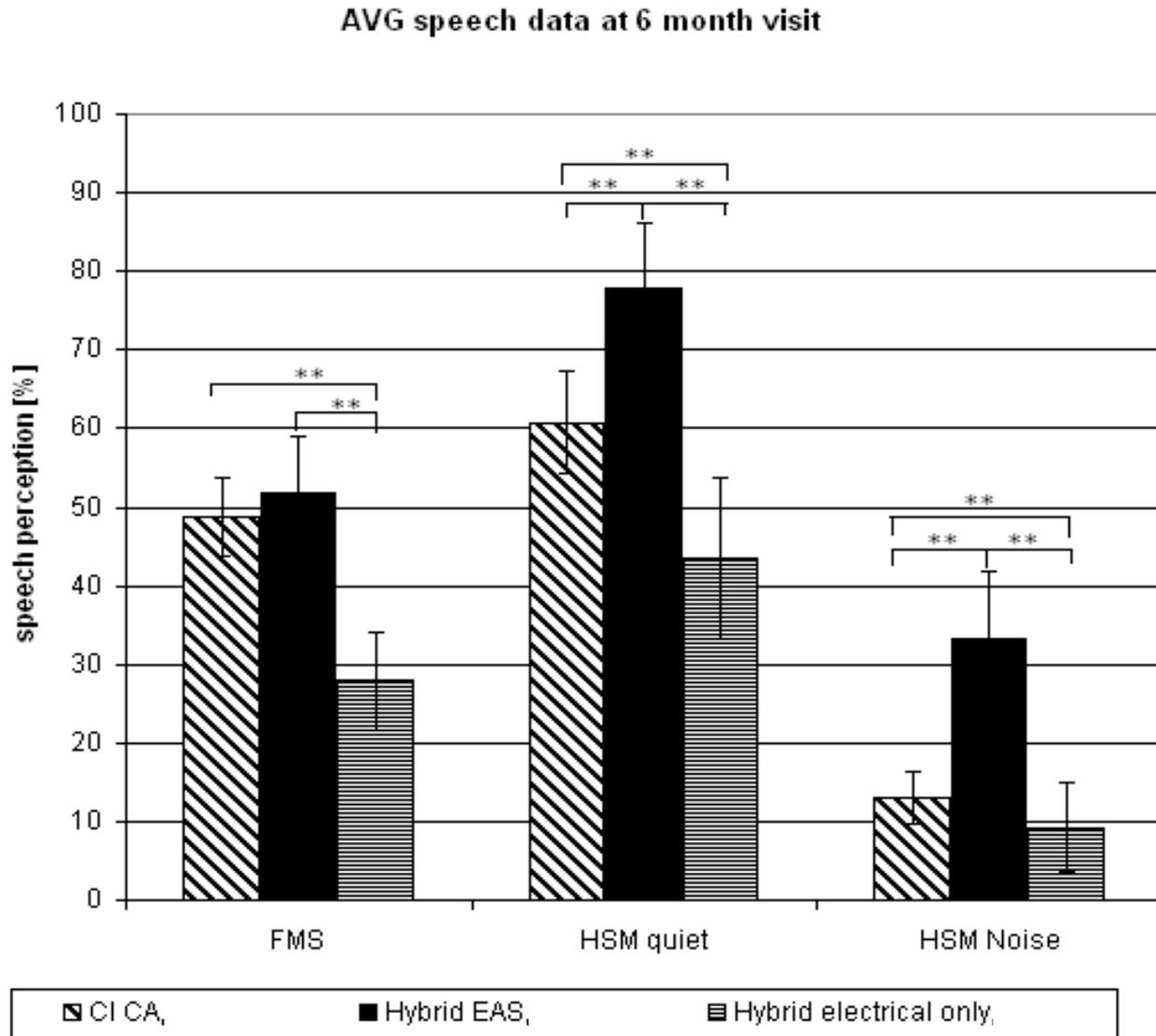


# Correlation 2. side ~ CI time period



# Speech understanding after 6 months

Hybrid-L (n=80), Reference (n=165)



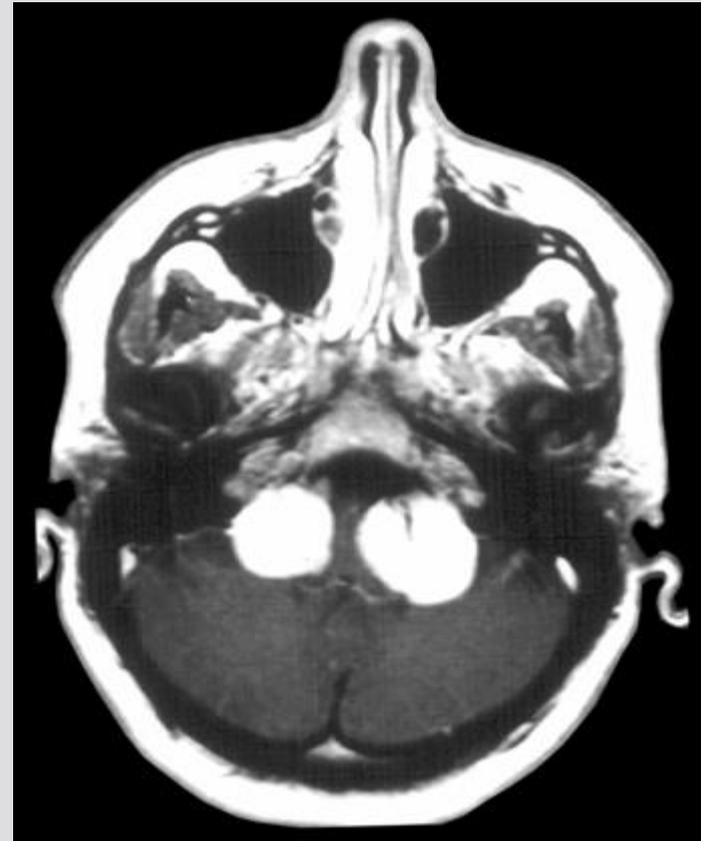
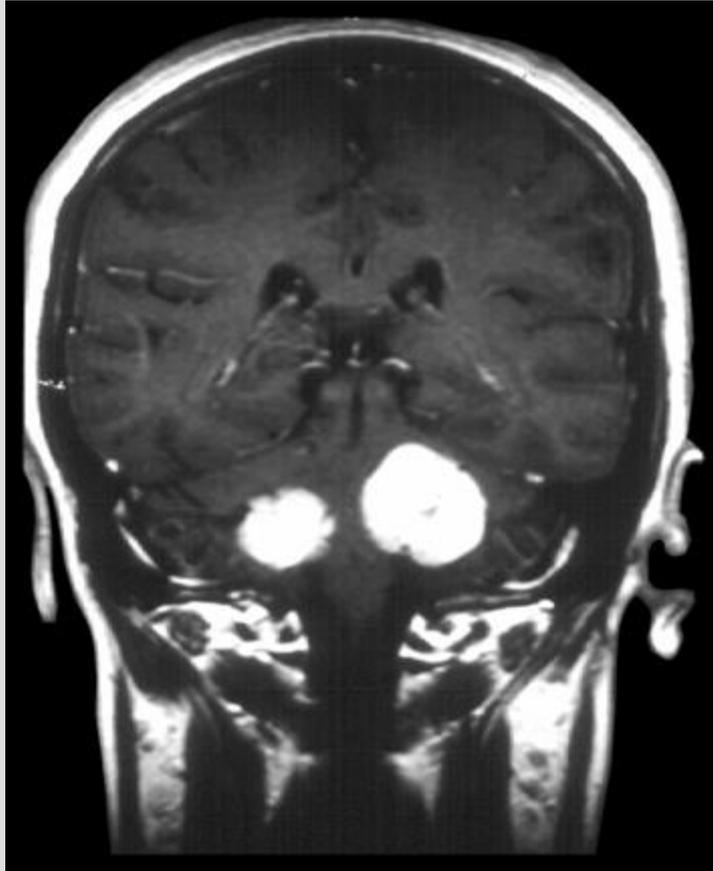
# Current Electrodes

- Connective Tissue Formation around the Electrode
- Increase in Electrode Impedances postoperatively

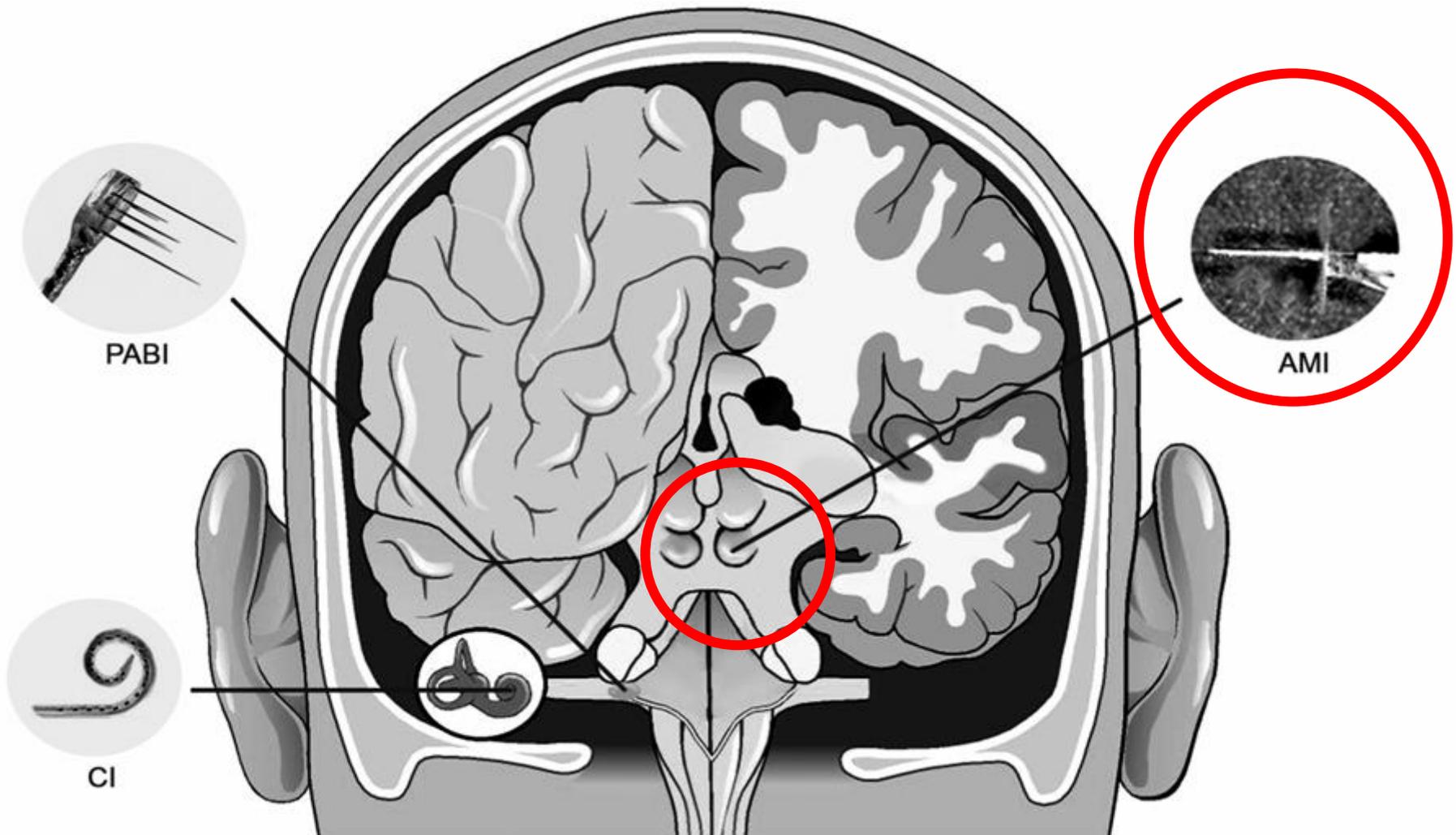


- Electrode contacts: Platin/Iridium (90/10)
- Carrier: Silastic LSR 30 and HCRP 50

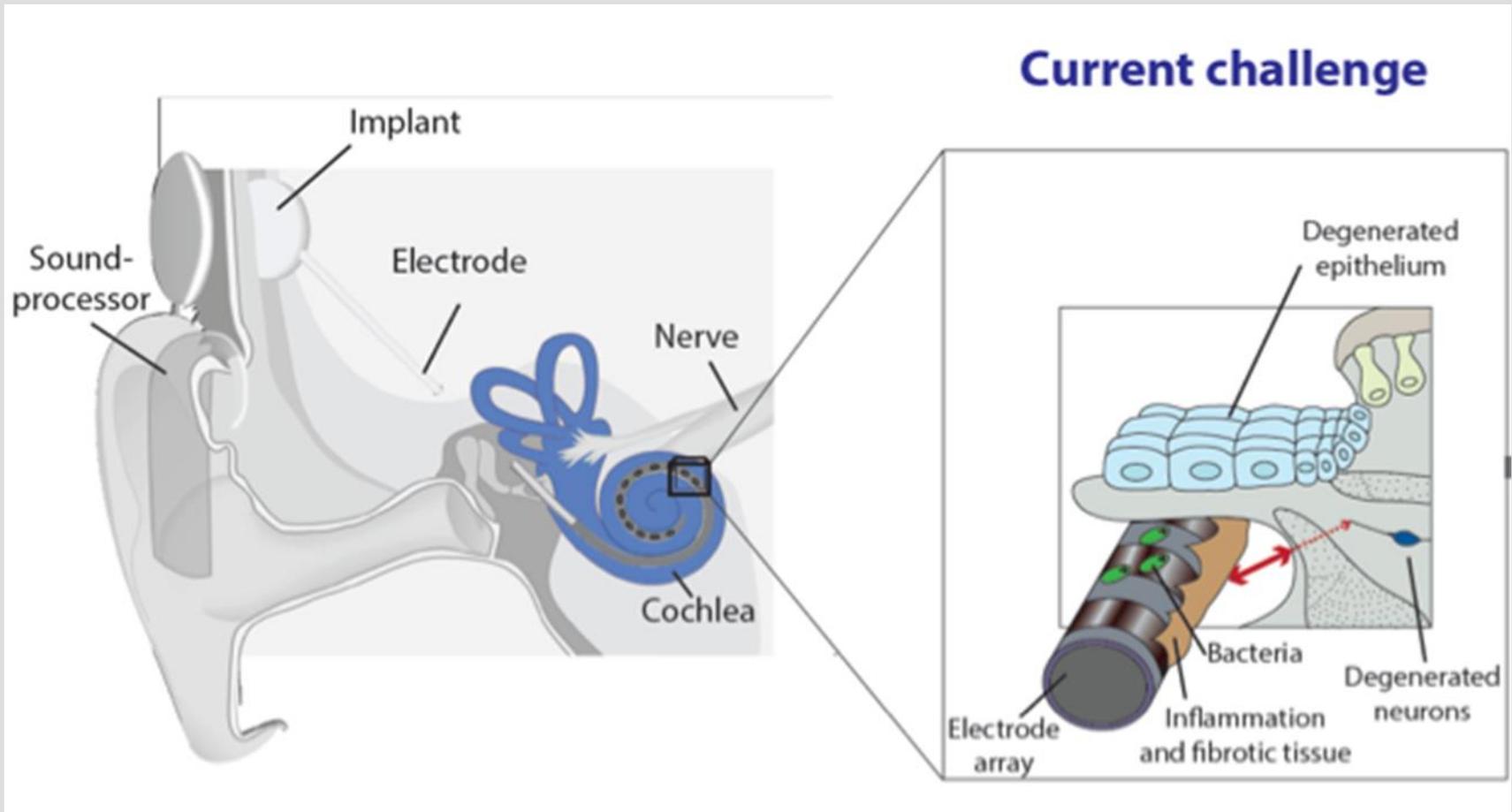
# Neurofibromatosis type II



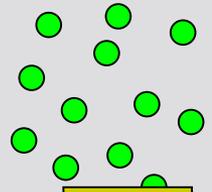
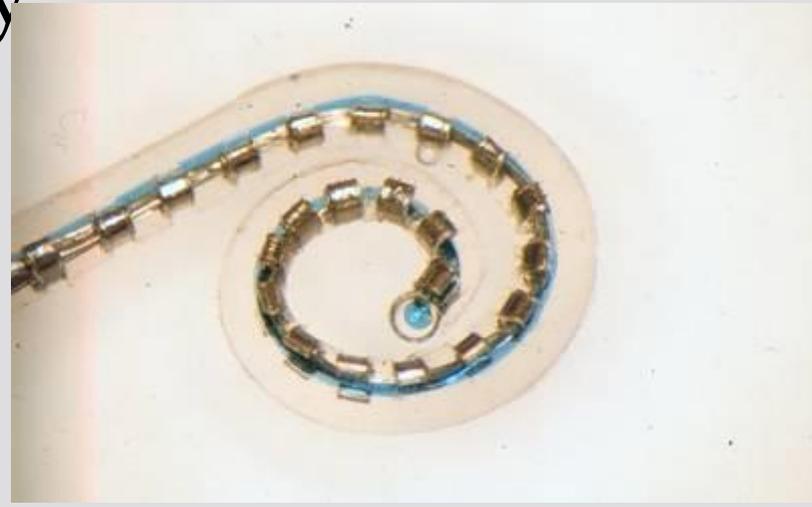
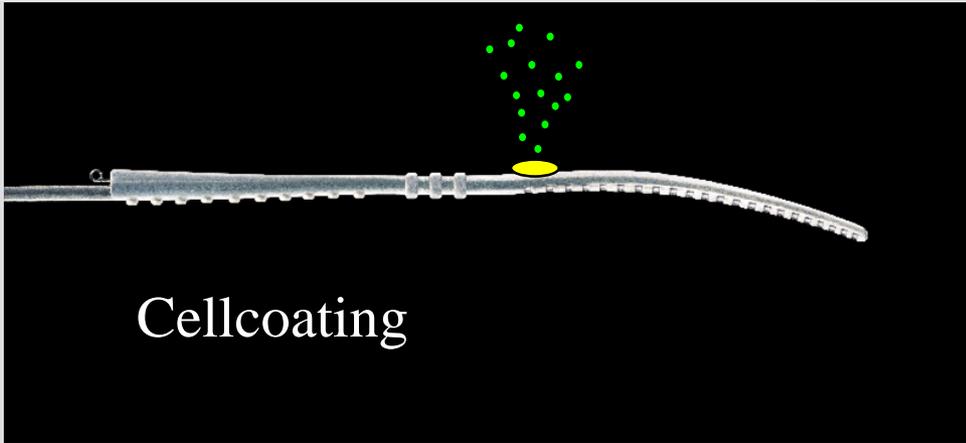
# Auditory Prostheses



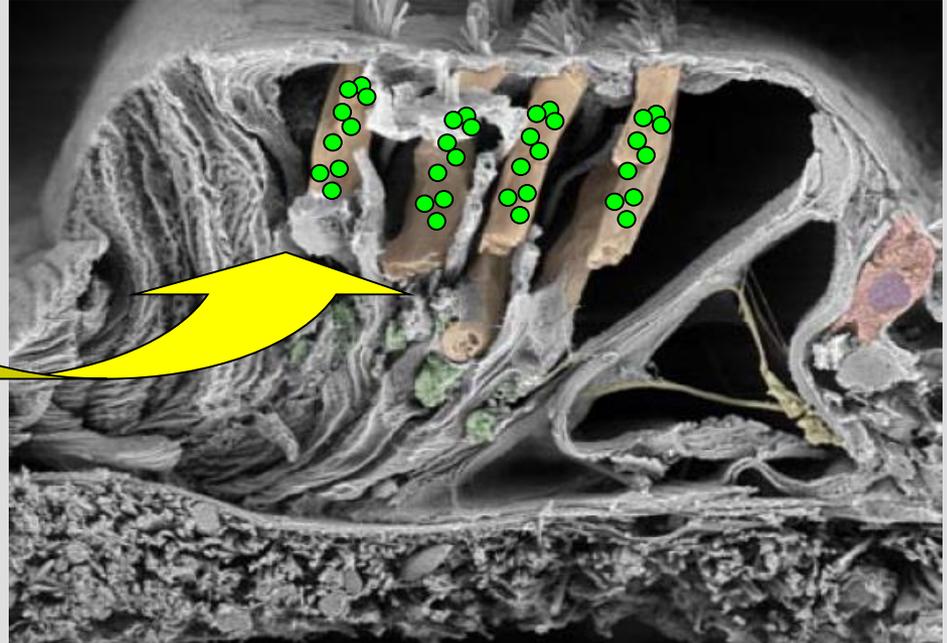
# Focus on CI Therapy



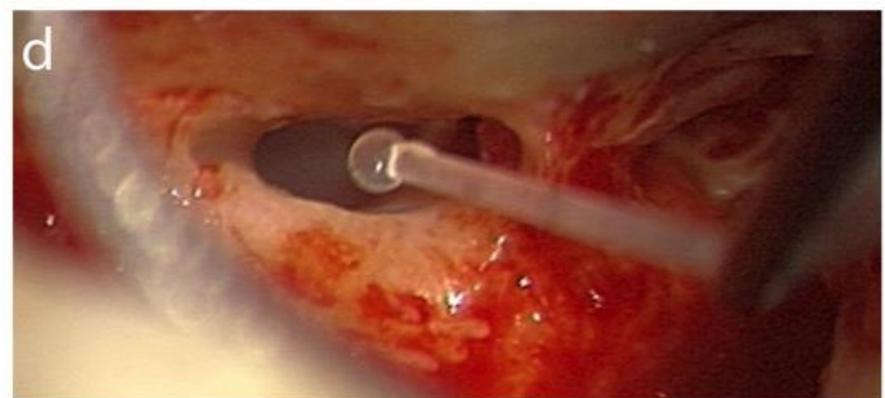
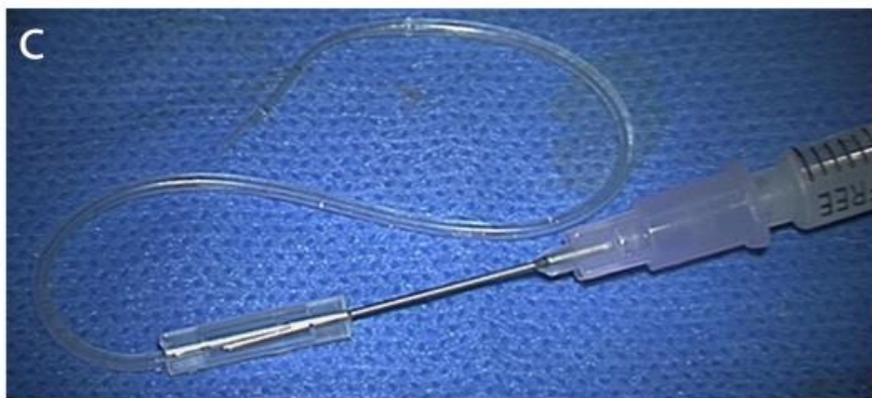
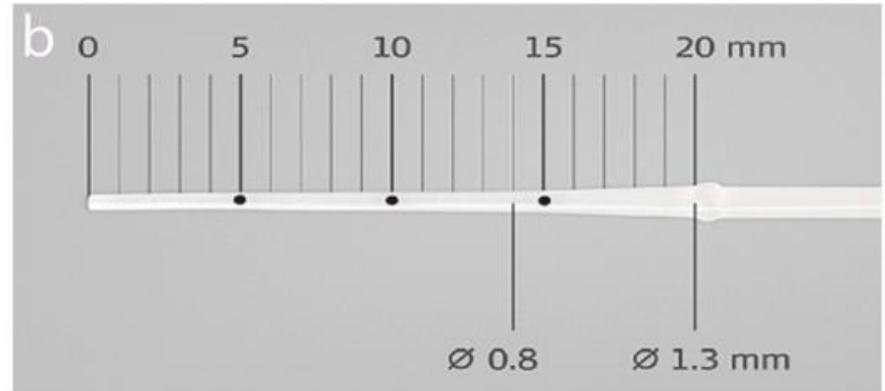
# Intracochleare Pharmakologie



Nanoparticle



# Drug Delivery: Cochlear Catheter



# Biohybrid-electrode in residual hearing

Römer et al. *Stem Cell Research & Therapy* \_\_\_\_\_  
 DOI 10.1186/s13287-016-0406-y

Stem Cell Research & Therapy

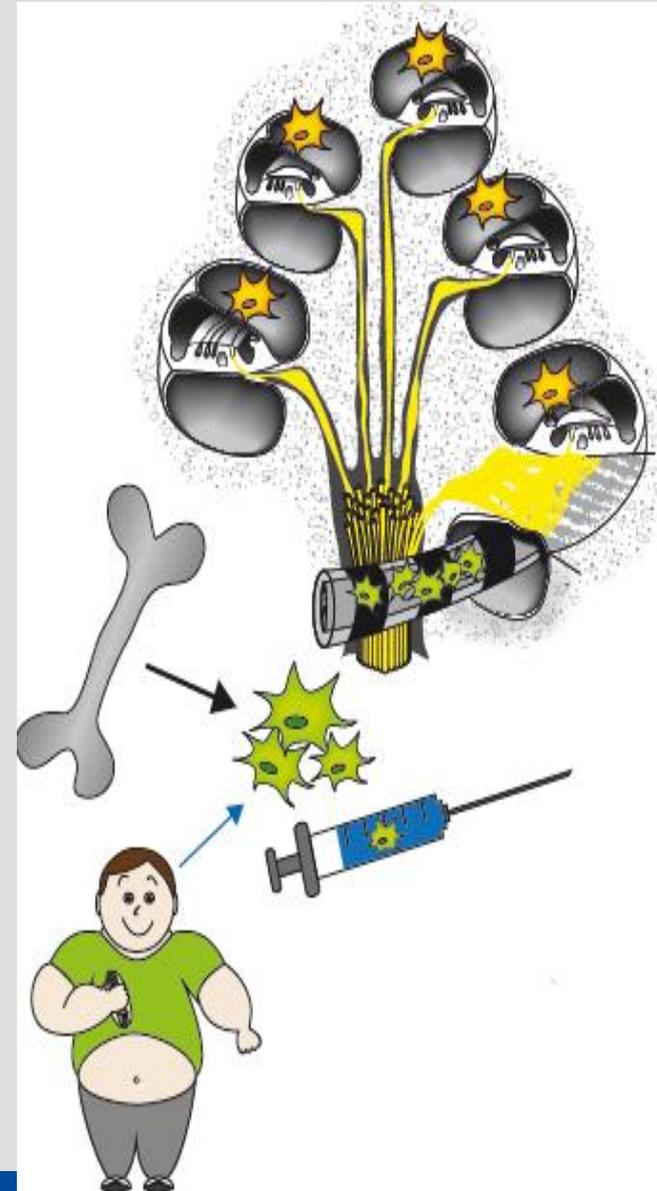
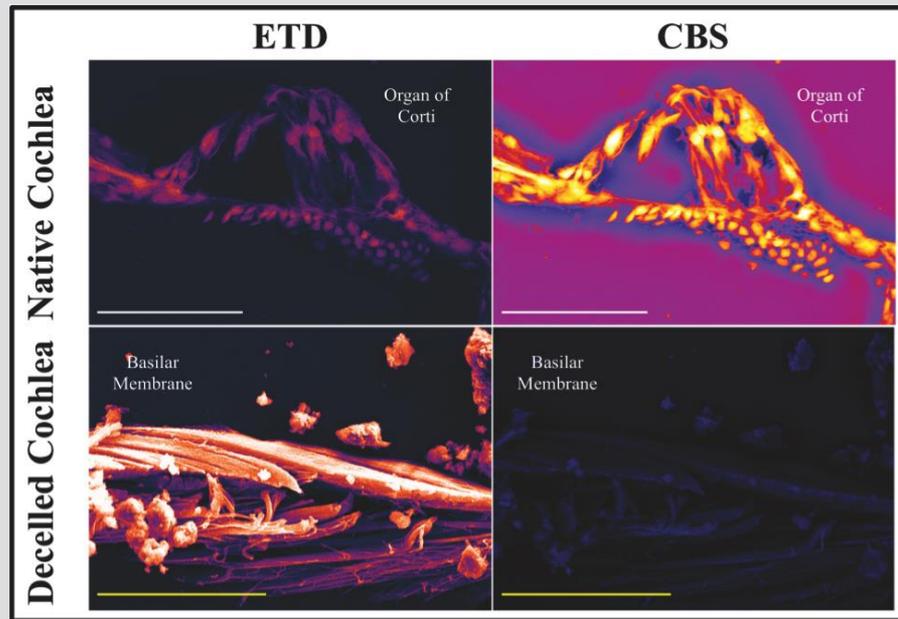
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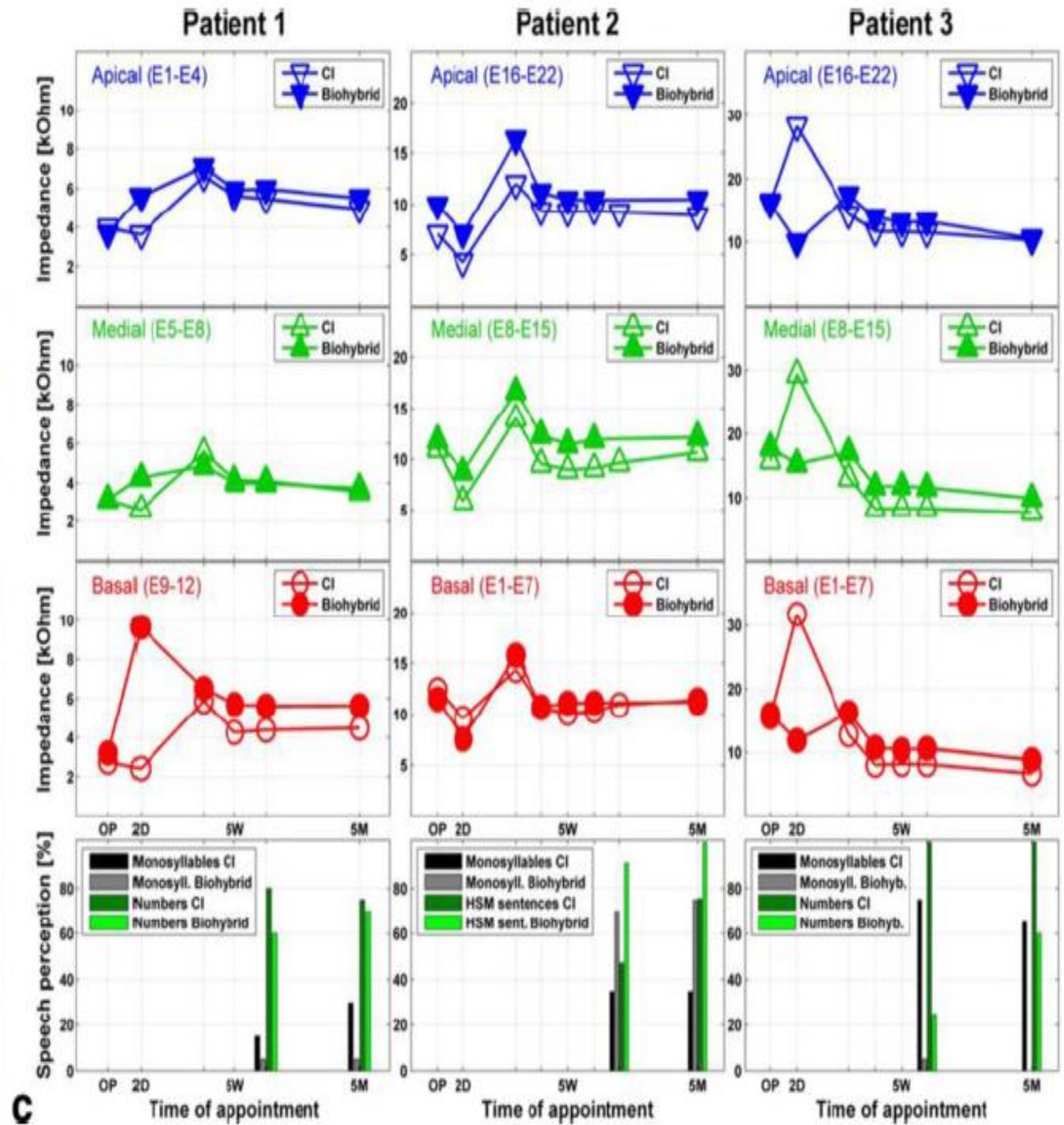
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## Biohybrid cochlear implants in human neurosensory restoration

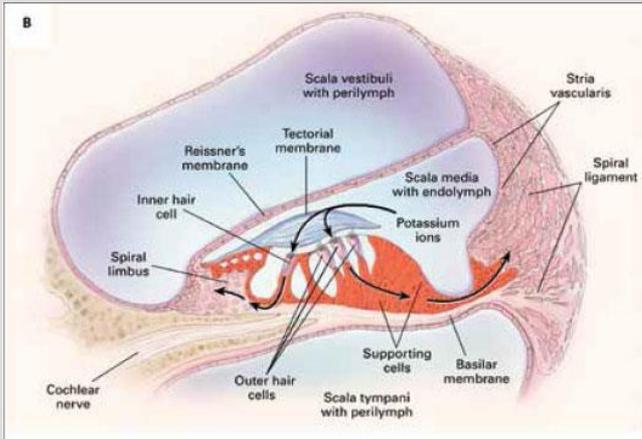


Ariane Römer<sup>1,4</sup>, Ulrike Köhl<sup>2</sup>, Omid Majdani<sup>1,4</sup>, Stephan Klöb<sup>2</sup>, Christine Falk<sup>3</sup>, Sabine Haumann<sup>1,4</sup>,  
 Thomas Lenarz<sup>1,4</sup>, Andrej Kral<sup>1,4</sup> and Athanasia Warnecke<sup>1,4\*</sup>

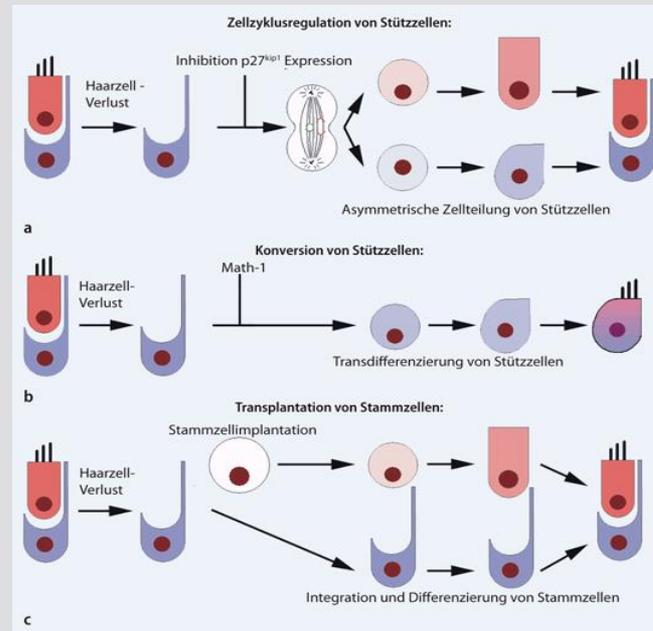
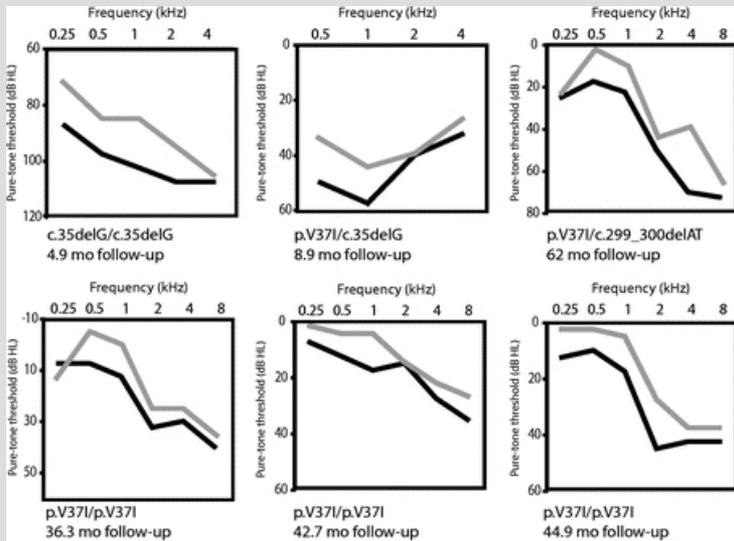




# Genetic in Hearing

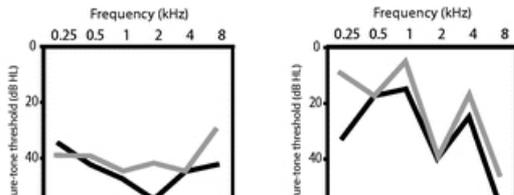


Wonkam et. al



Chan et. al

Löwenheim et. al



# Grazie !

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