

Prof. Rudolf Probst

Klinik für Ohren-, Hals- und Gesichtschirurgie

# Technical Hearing Aids (HA) (Part 1 – Overview of Devices)



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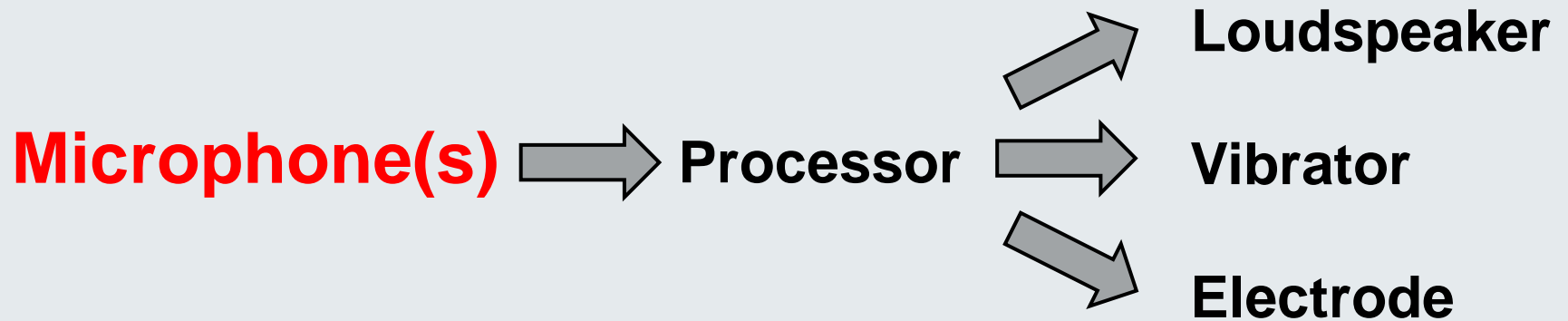
# Technical Hearing Aids



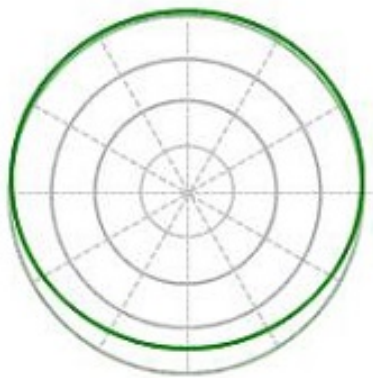
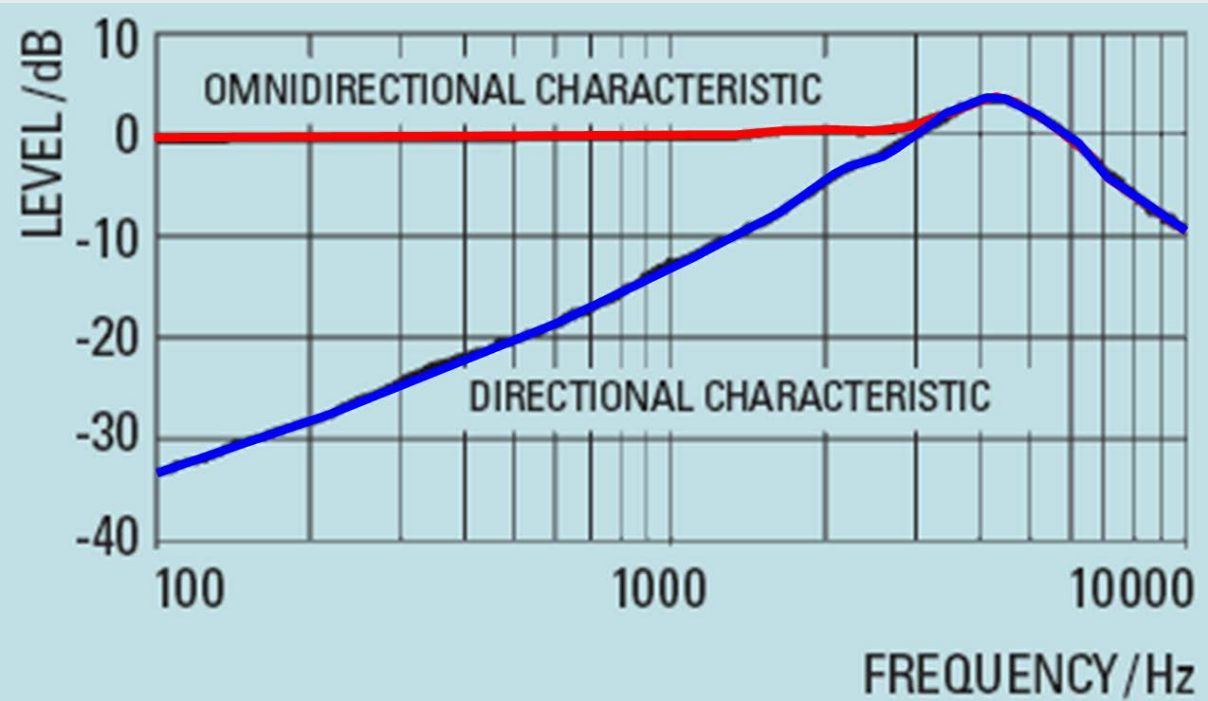
# Technical Hearing Aids



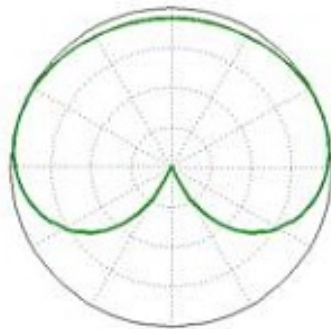
# Technical Hearing Aids



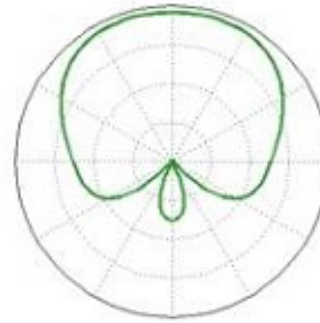
# Microphones



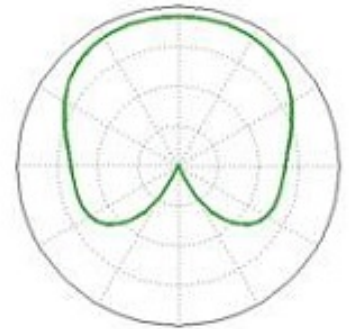
Real ear sound



UltraZoom



Fixed StereoZoom



Adaptive StereoZoom

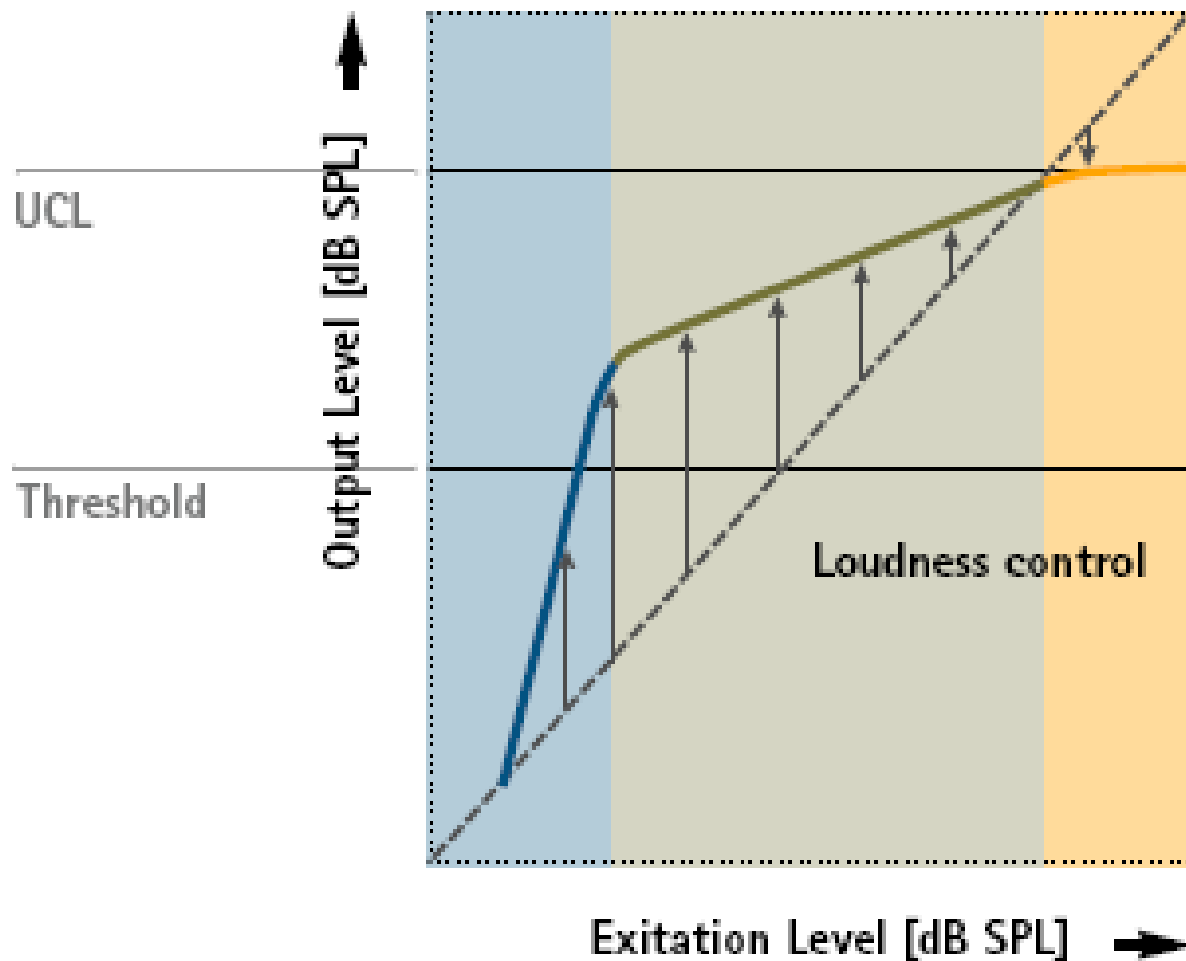
# Microphones

- Microphone as input in all HA
- Different characteristics (omnidirectional, directional)
- Most HA have more than one connected microphone
- Connections between microphones right and left

# Technical Hearing Aids



# Processor



- Loudness Limiting:  
Loud sounds
- Compression:  
Range of speech sounds
- Expansion:  
Soft squelch for low level signals



# Processor

- Nearly always digital processing
- Level-dependent amplification (compression)
- Frequency-dependent processing (2-25 channels)
- Feedback-suppression
- Speech recognition
- Noise reduction

# Technical Hearing Aids – principal types

- External acoustic HA
- Vibrators
- Special HA
- Neurostimulators

# Technical Hearing Aids



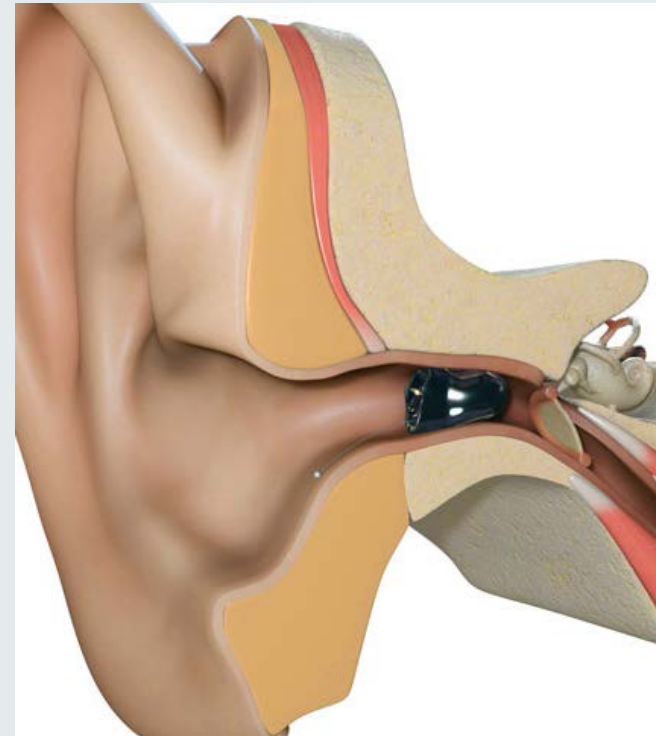
# Technical Hearing Aids

- External acoustic HA
  - Closed fit
    - BTE with individual earmold (acoustic lead)
    - ITC with individual shell (CIC, ITC, IIC ...)
  - Open fit
    - BTE contains speaker (acoustic lead)
    - BTE and speaker in the ear canal (electric lead)
- Vibrators
- Special HA
- Neurostimulators

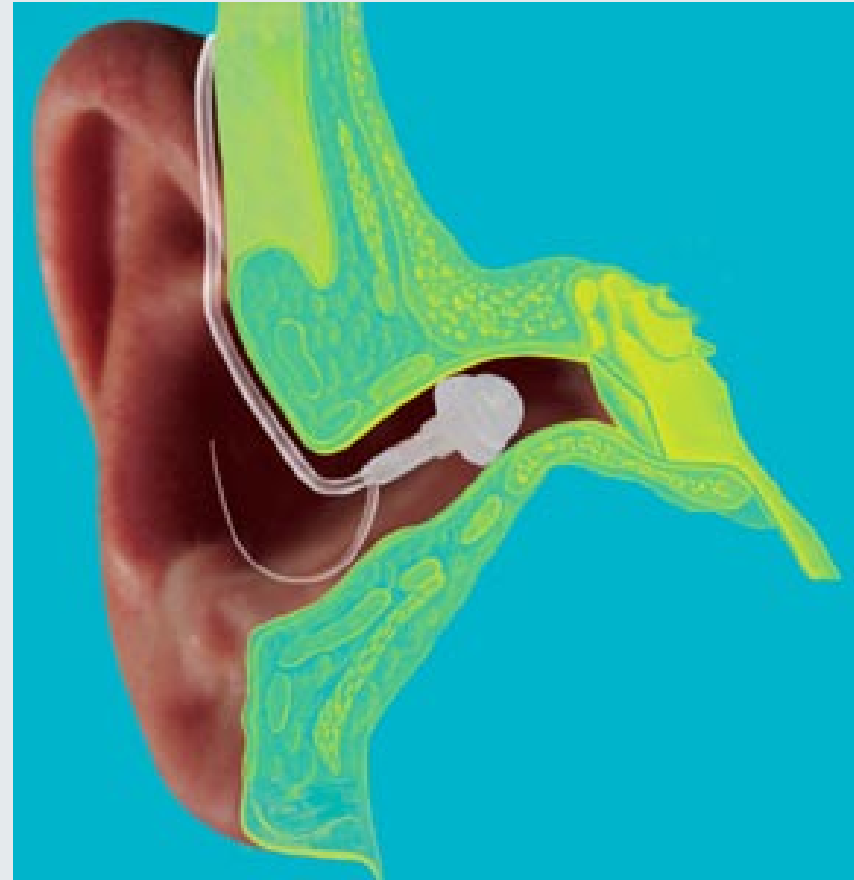
## BTE with individual earmold



## ITC with individual shell (CIC, ITC, IIC ...)



## BTE containing speaker – acoustic lead



## BTE with external speaker – electric lead (RIC)

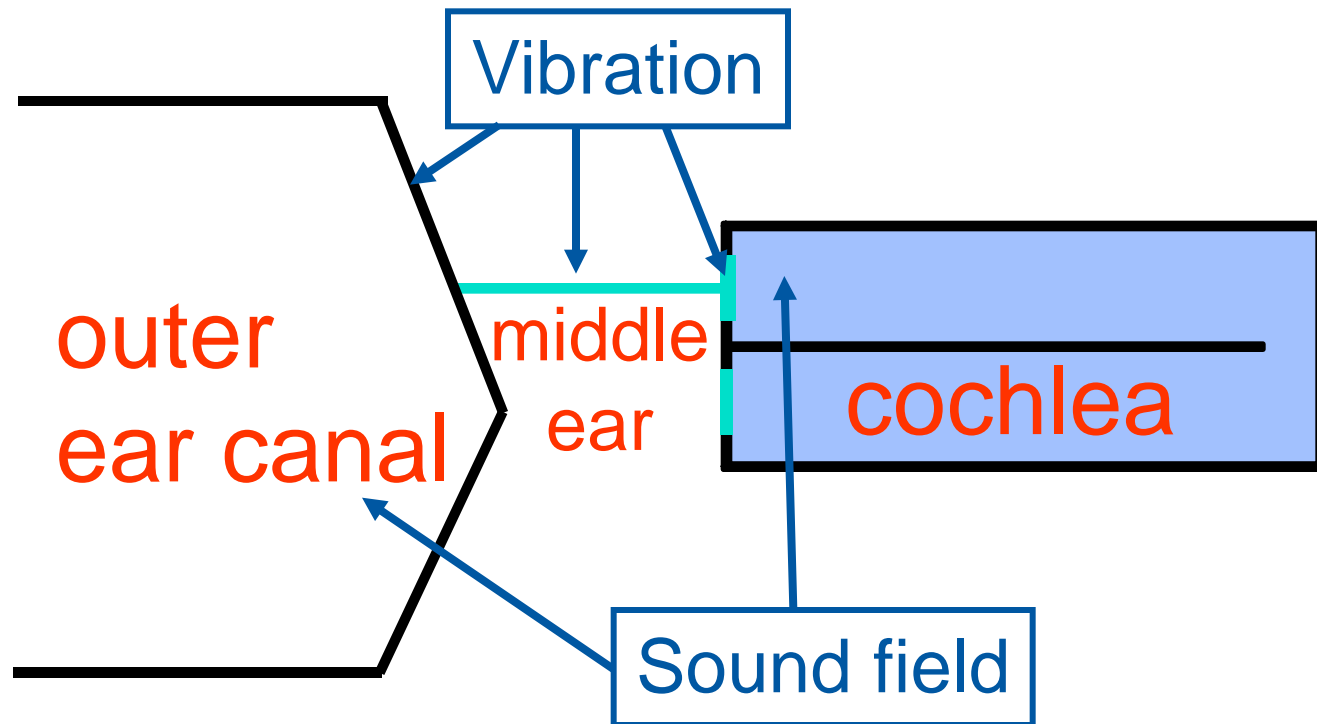




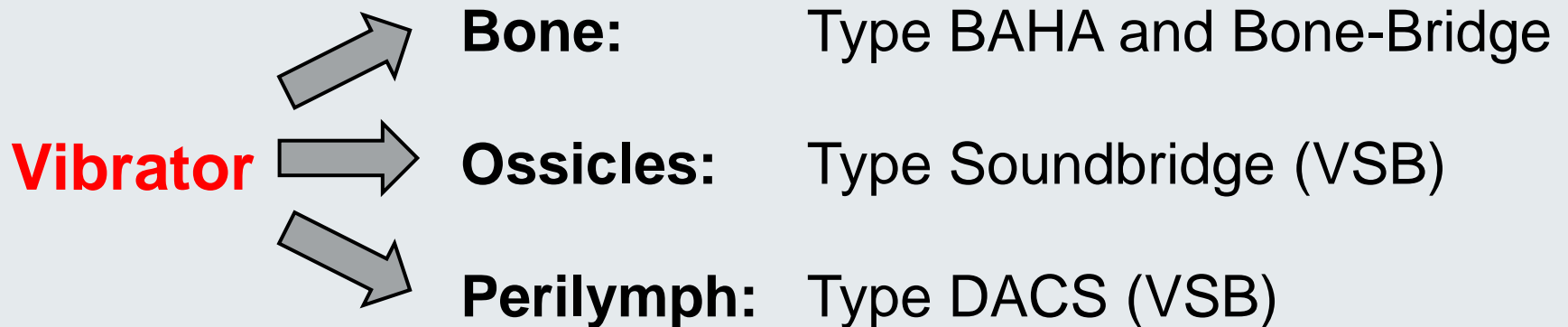
# Technical Hearing Aids



# Sound transmission



# Vibrator Hearing Aids – Vibroplasty



# Hearing Aids

- External acoustic HA
- Vibrators
  - Bone vibrator
    - Exterior-transcutaneous
    - Bone implanted
      - » Percutaneous connection
      - » Transcutaneous EM connection
  - Vibrant SoundBridge (VSB)
    - Coupled to ossicles
    - Coupled to round window
  - Direct inner ear stimulation (DAX)
- Special HA
- Neurostimulators

# Vibrator Hearing Aids – Exterior-transcutaneous



# Vibrator Hearing Aids – Transcutaneous



# Vibrator Hearing Aids – Transcutaneous



Neumann 2011



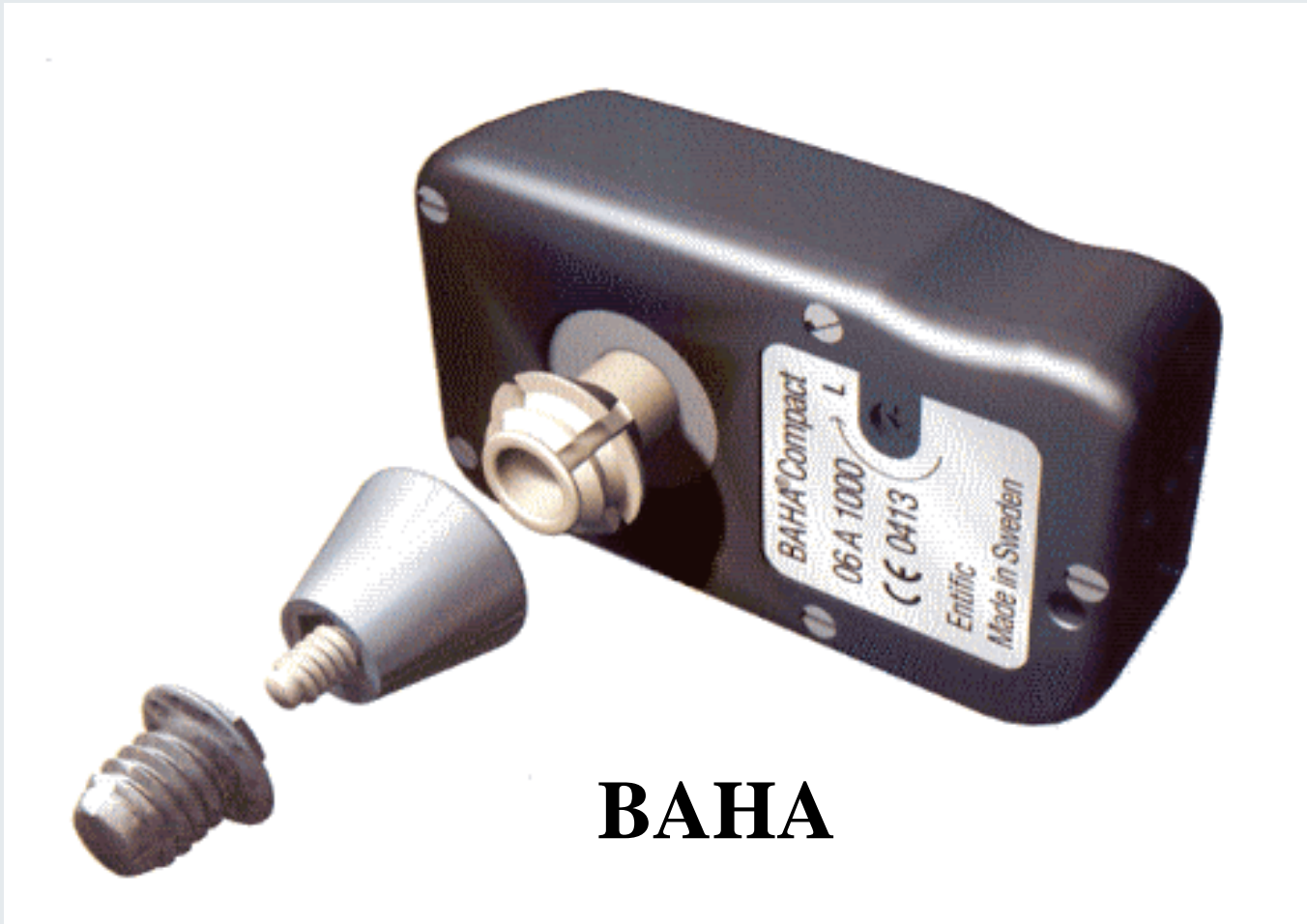
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# Vibrator Hearing Aids – Percutaneous



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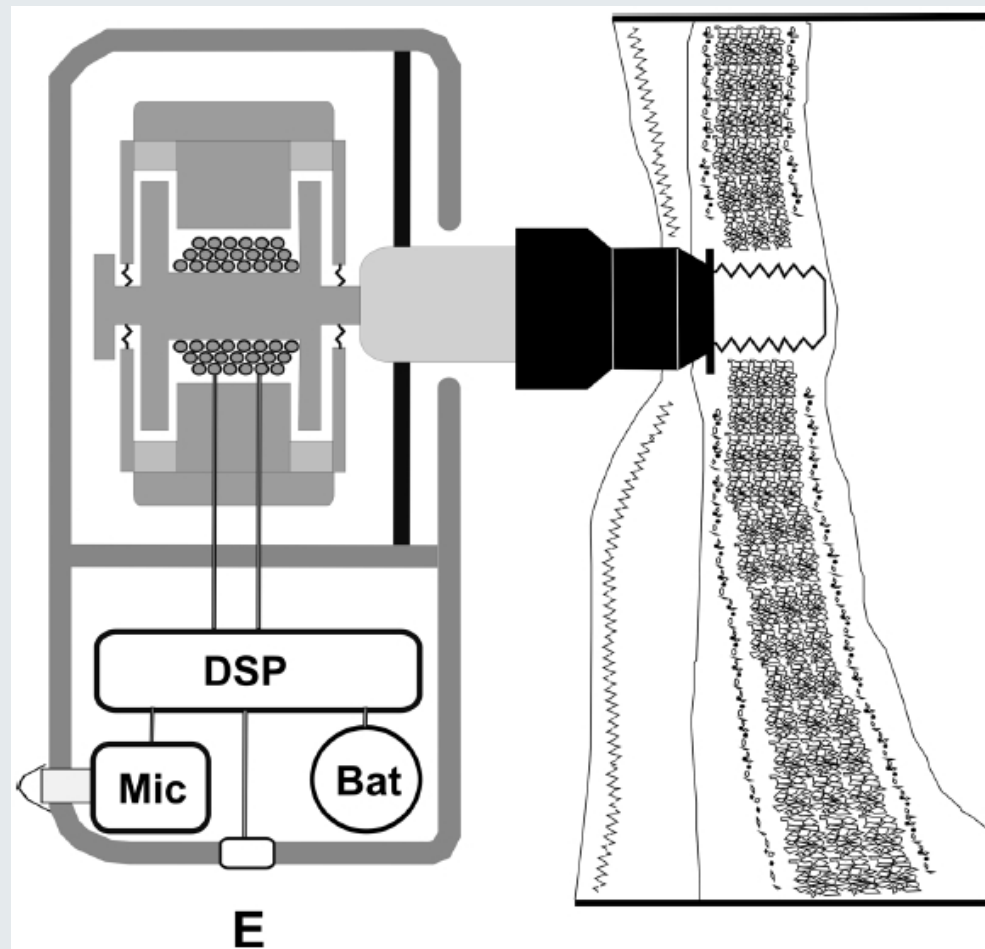
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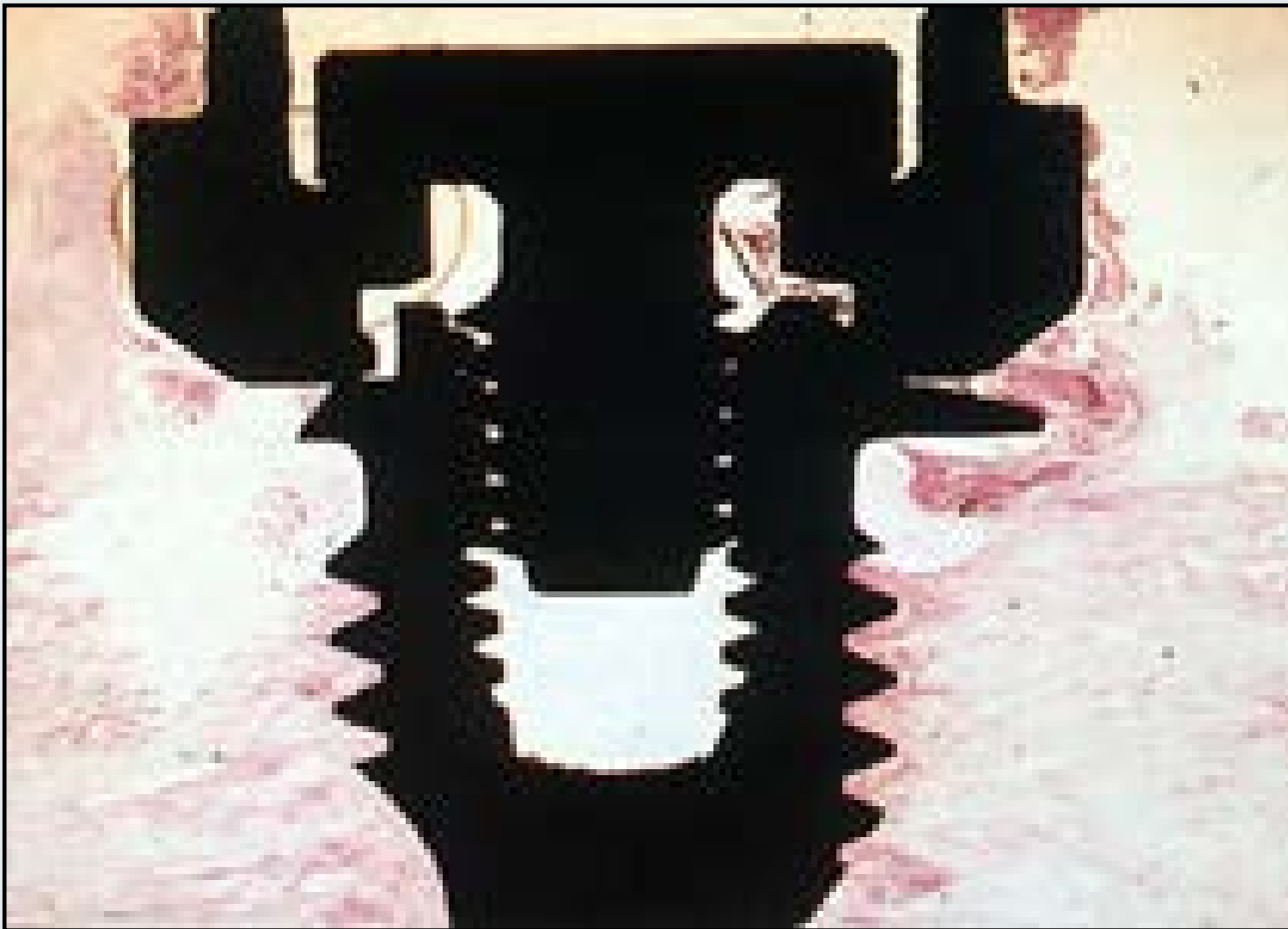
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# Vibrator Hearing Aids – Percutaneous



# Vibrator Hearing Aids – Percutaneous



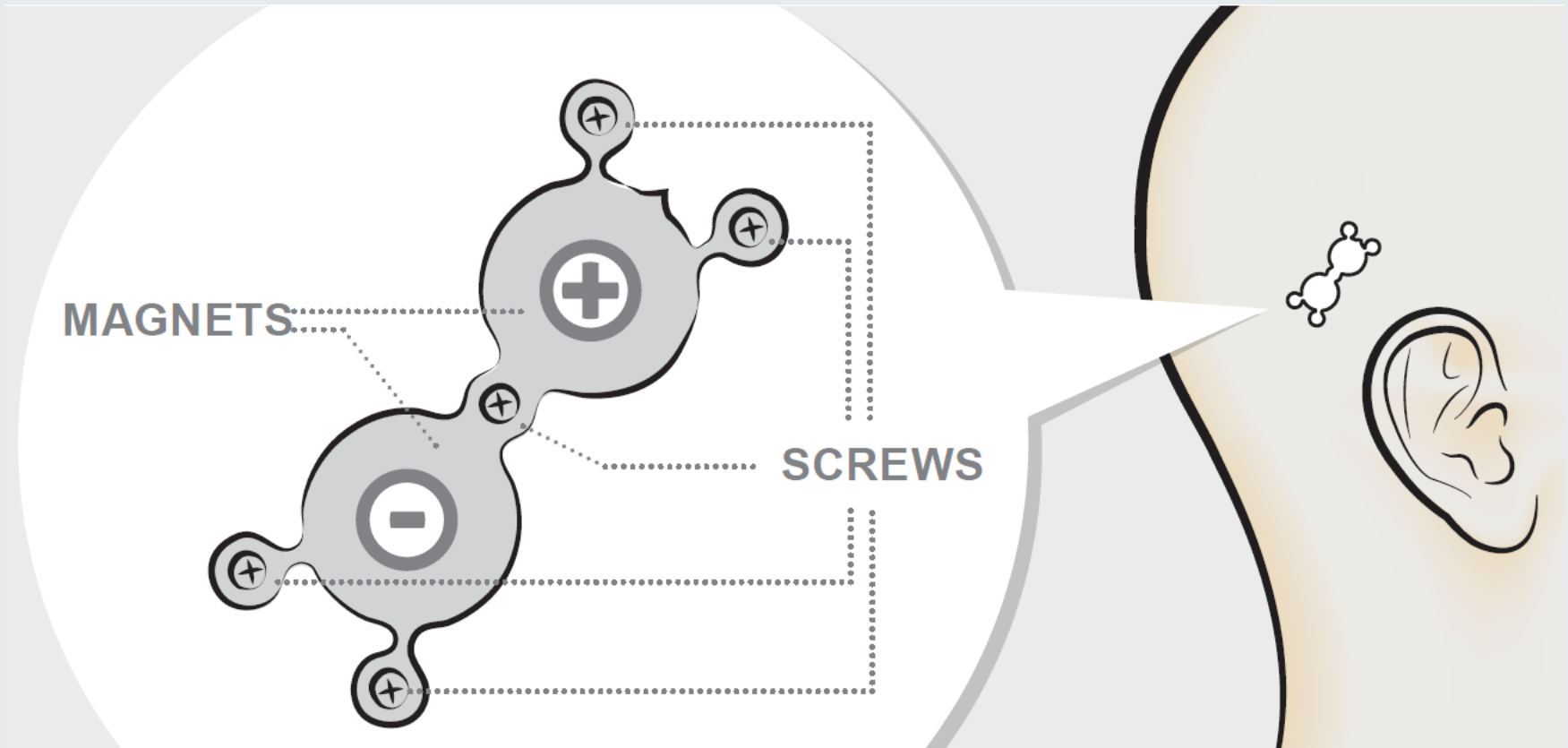
# Vibrator Hearing Aids – EM connection (Attract)



# Vibrator Hearing Aids – EM connection (BoneBridge)



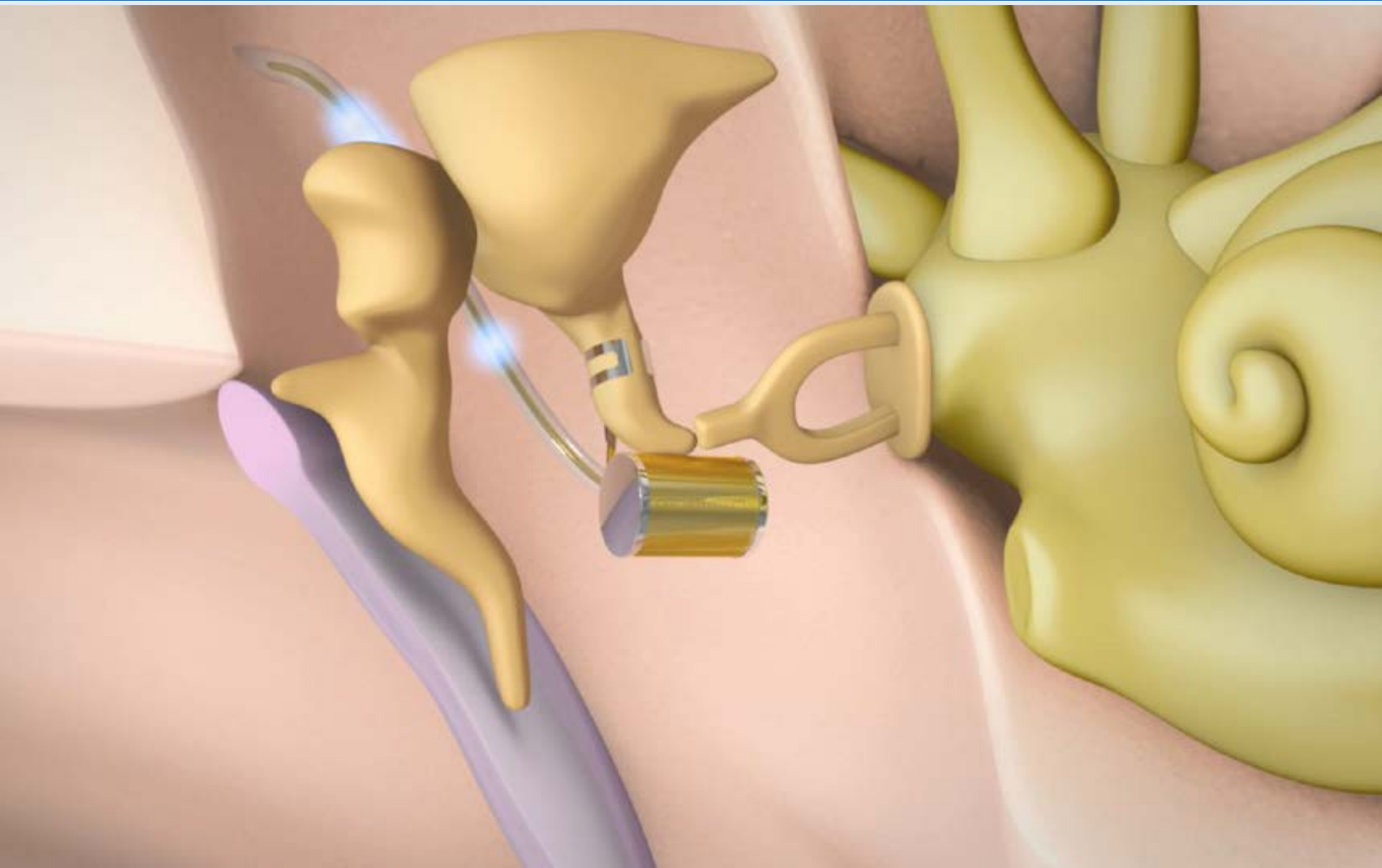
# Vibrator Hearing Aids – EM connection (Sophono)



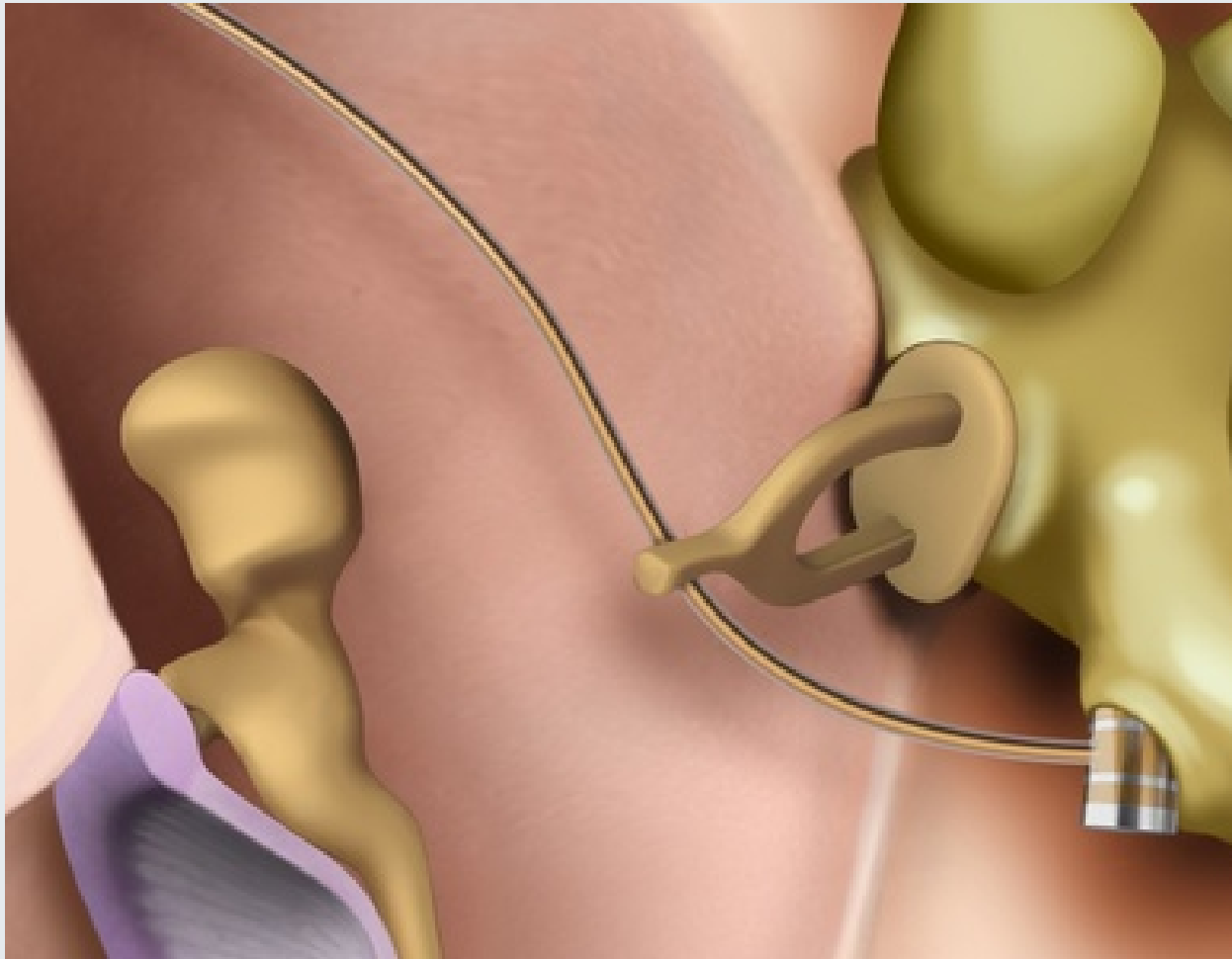
# Vibrator Hearing Aids – VSB





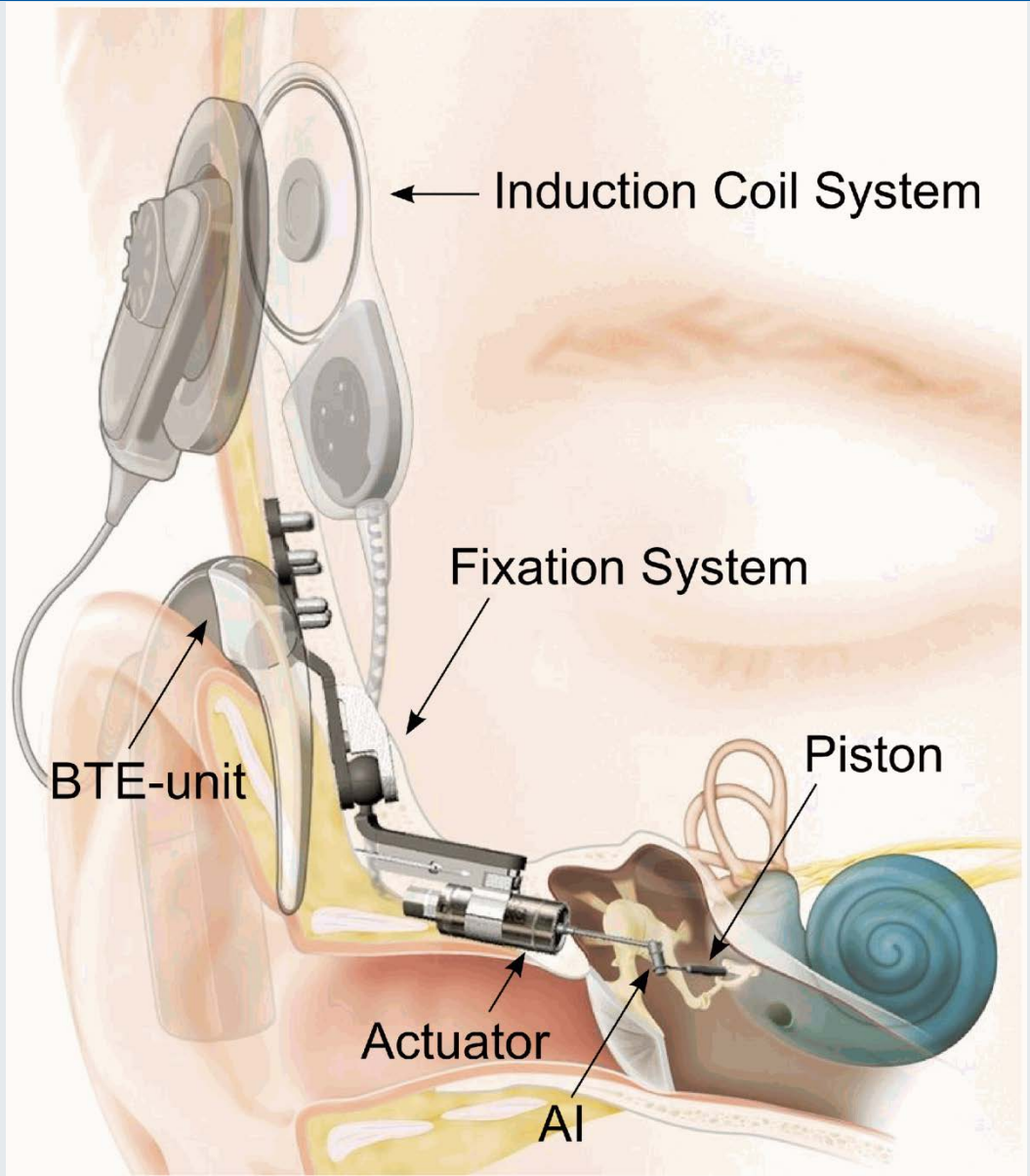
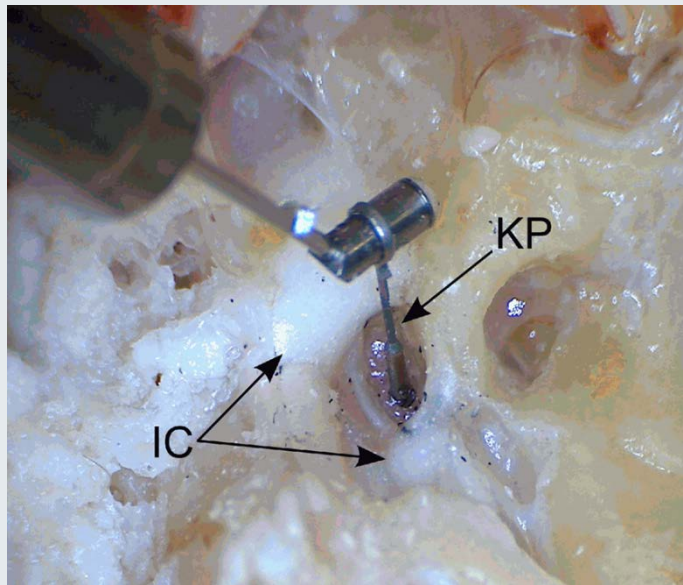


# Vibrator Hearing Aids – VSB





# Vibrator HA – DACS

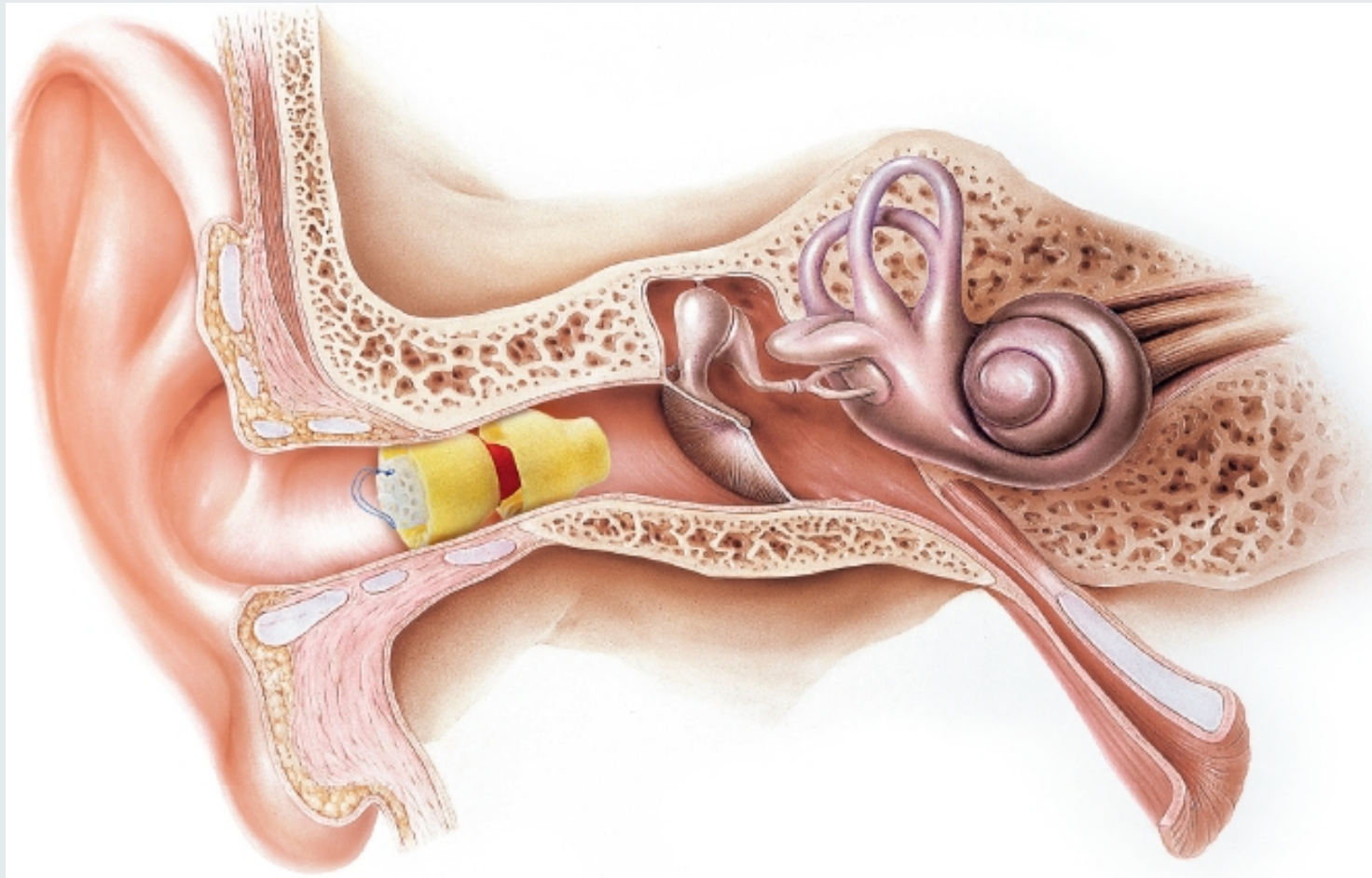


Grossöhmichen et al.  
PLoS ONE 10(3): e0119601, 2015

# Hearing Aids

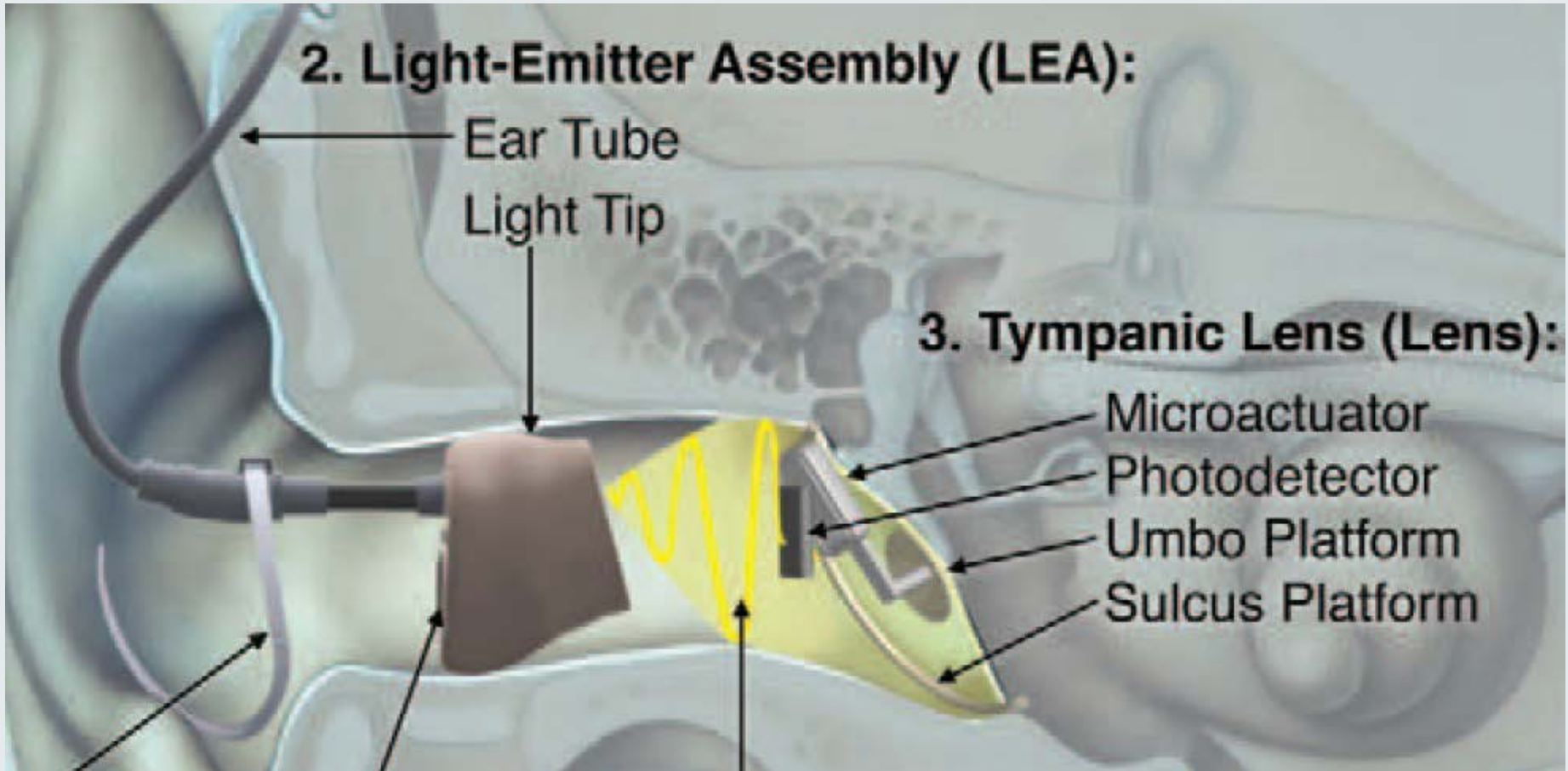
- External acoustic HA
- Vibrators
- **Special HA**
  - Lyrica
  - Earlens
  - SoundBite
- Neurostimulators

## Lyric – special ITC

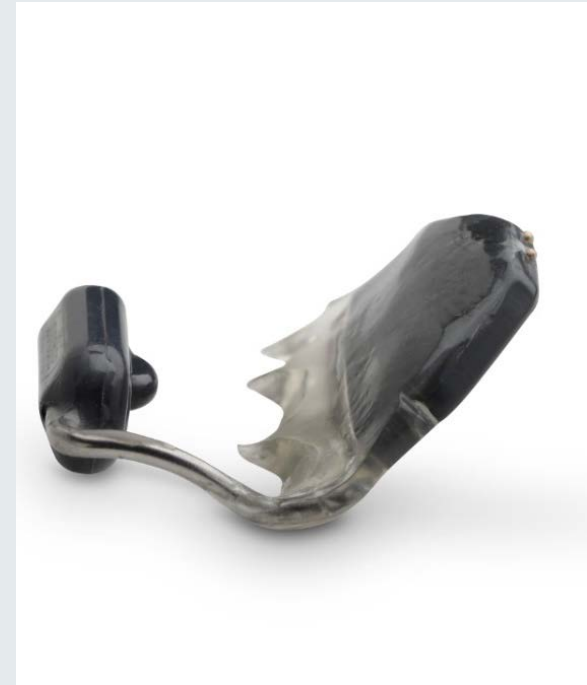




# Earlens



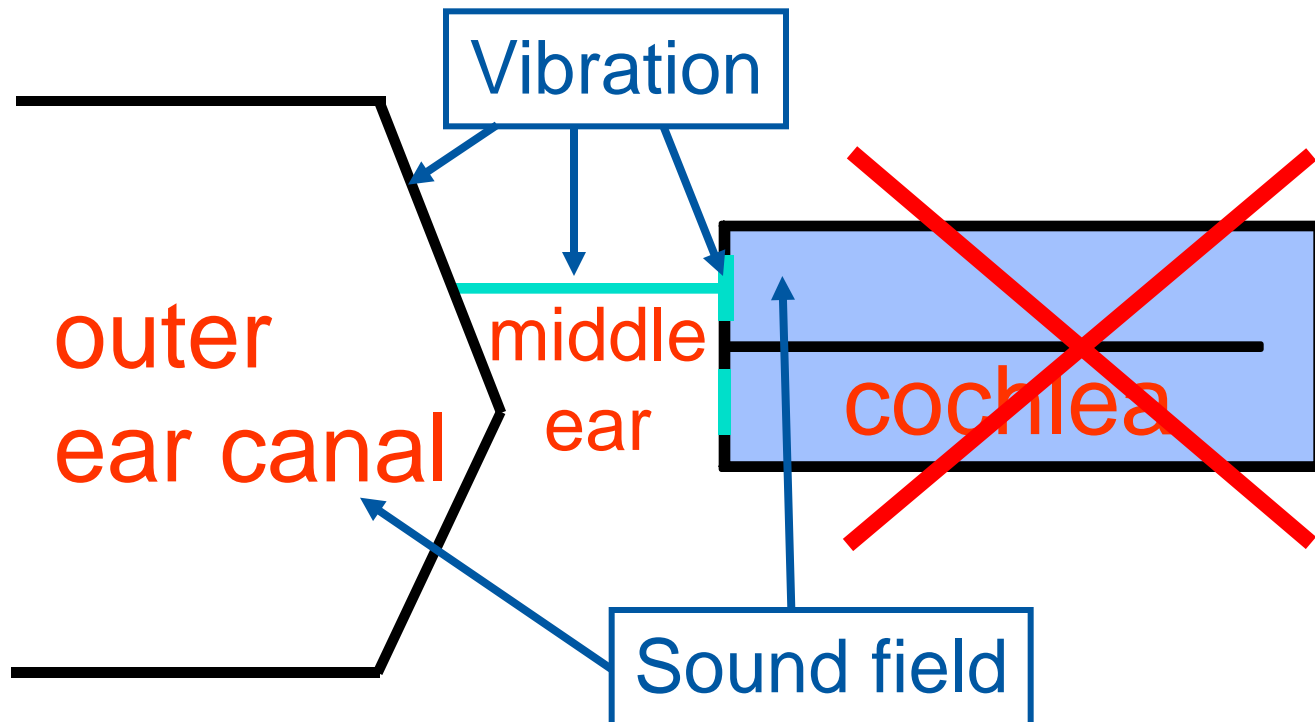
# SoundBite



# Technical Hearing Aids



# Sound transmission

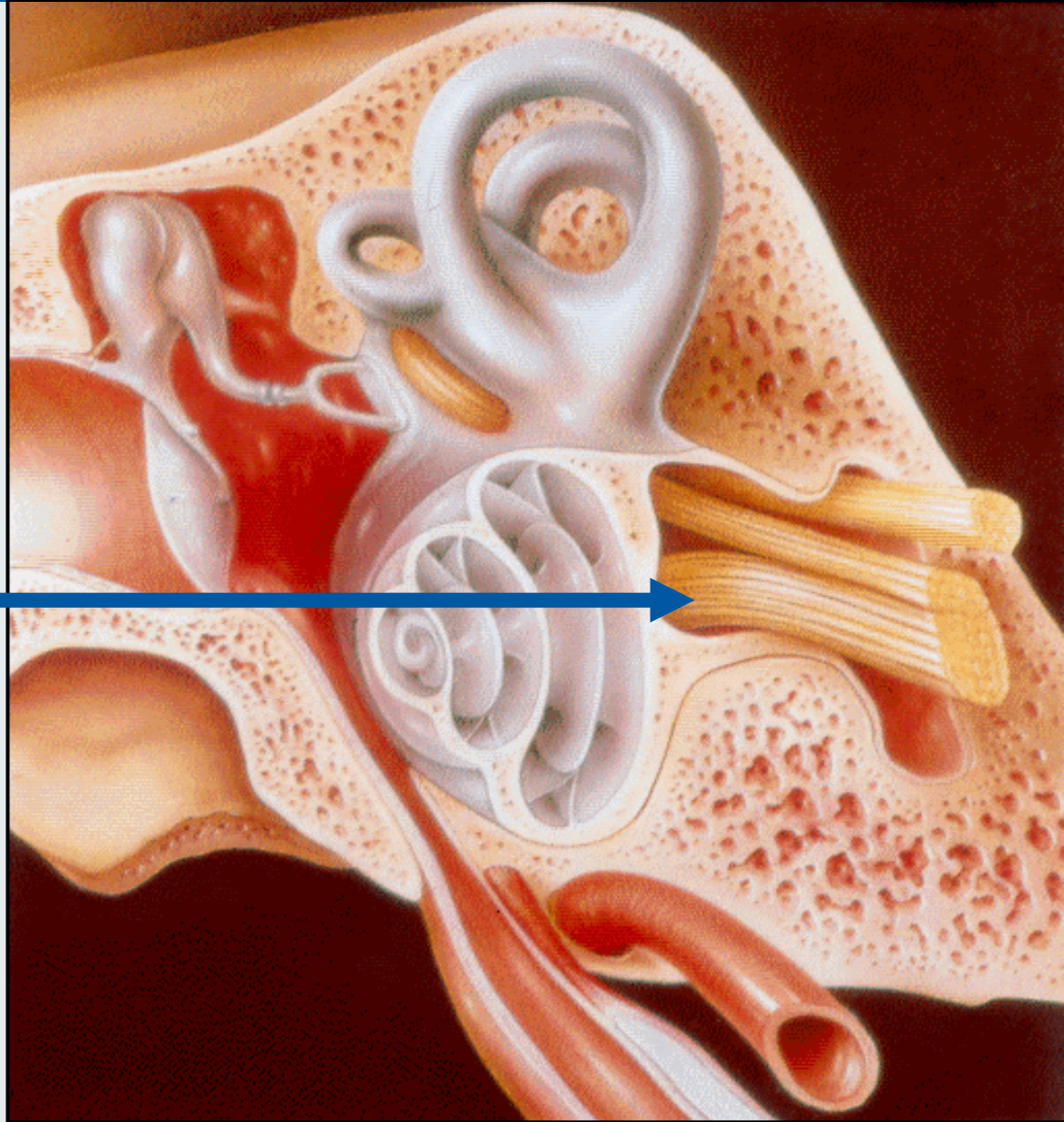


# Hearing Aids

- External acoustic HA
- Vibrators
- Special HA
- **Neuro-Stimulators**
  - Cochlear Implant – CI (intra-cochlear stimulation)
  - Brainstem Implant – ABI (intra-cranial stimulation)



direct electrical  
stimulation of the  
cochlear nerve



# Cochlear implant



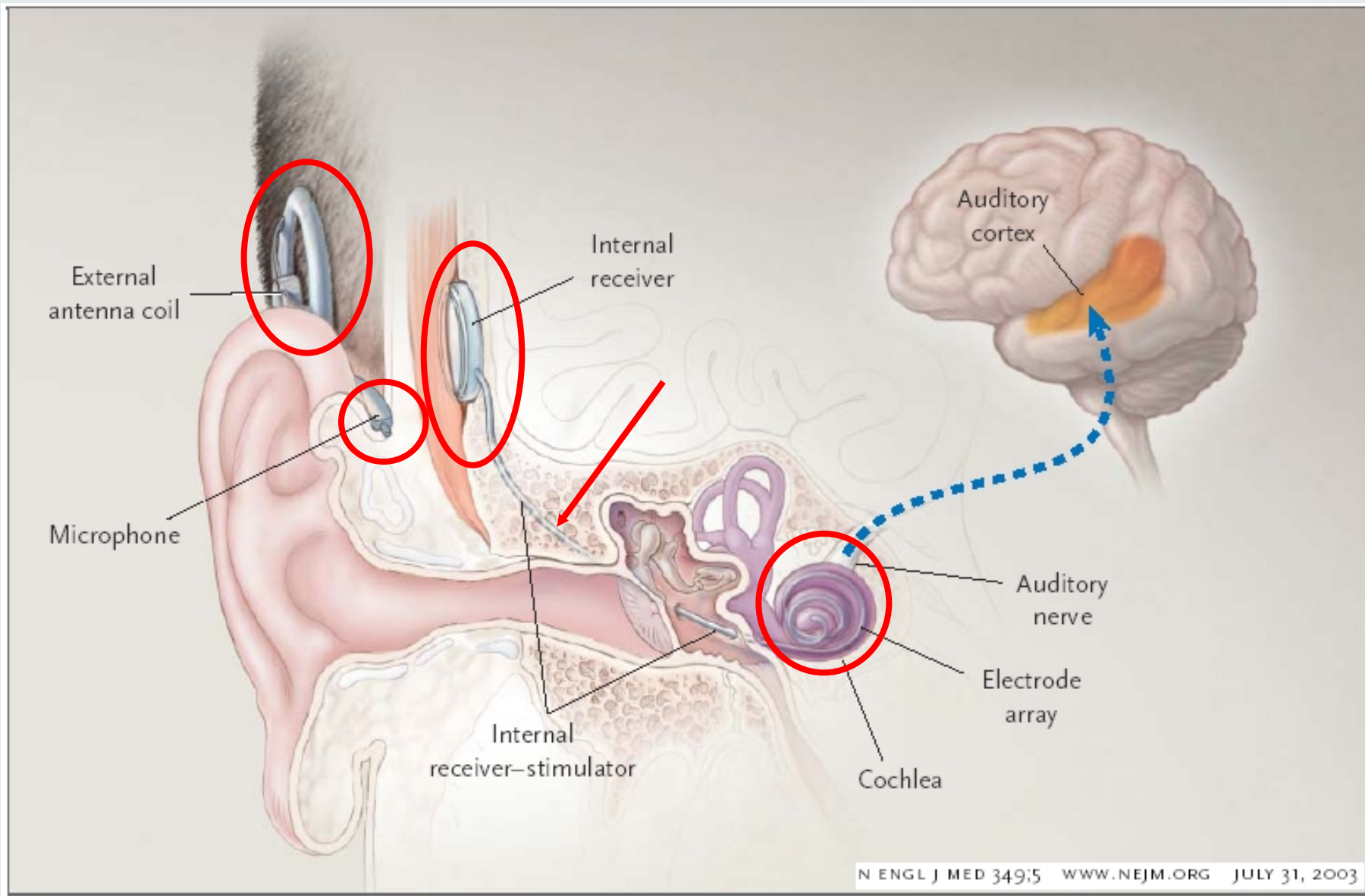
# Cochlear implant



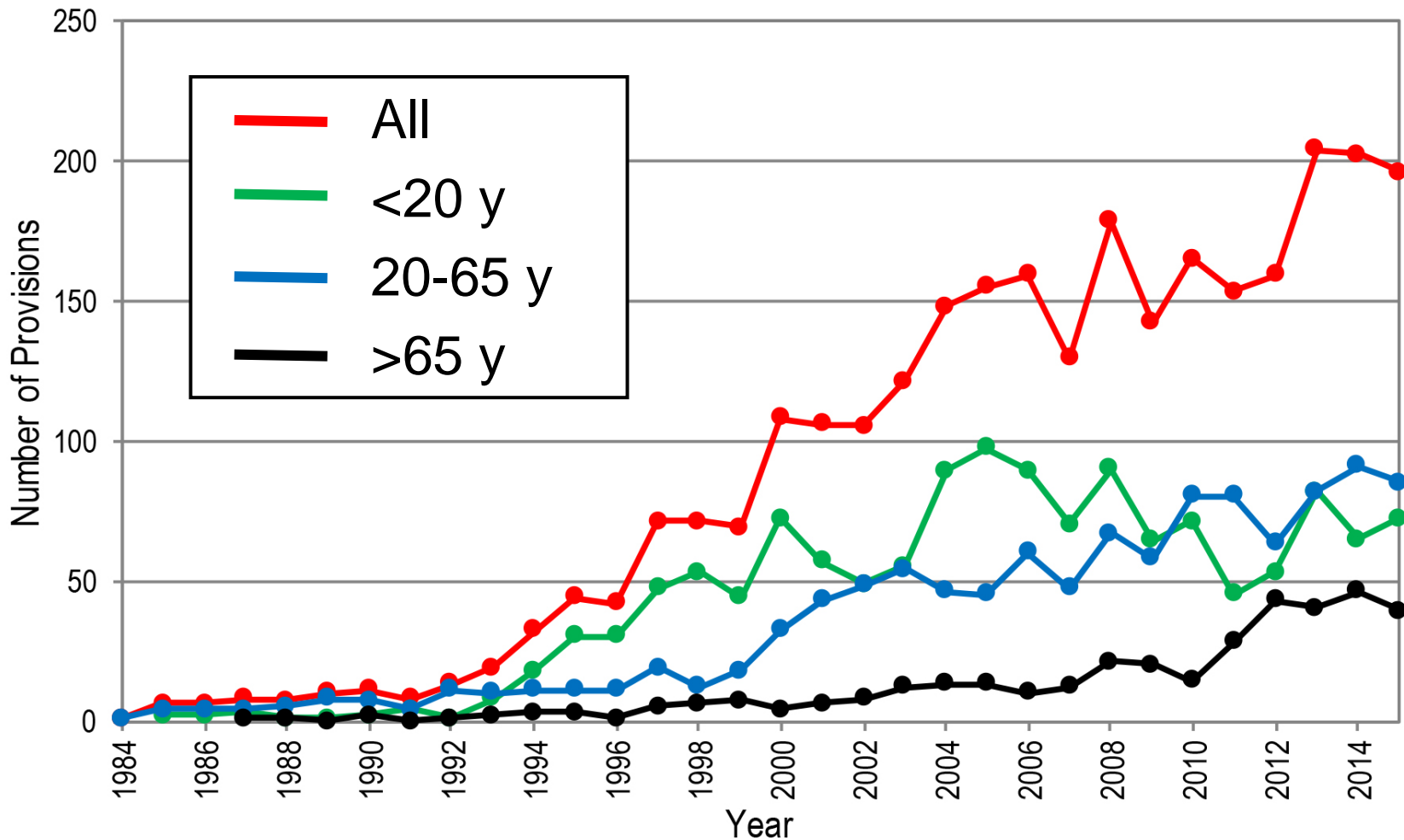
# Cochlear implant







# Cochlear implant



# Cochlear implant

