노년기 이명 및 난청의 관리

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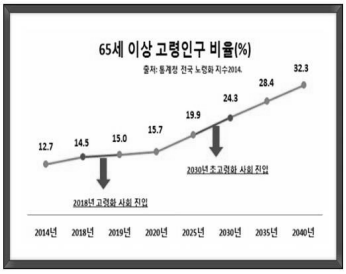
Presbycusis & Tinnitus

- 1.2 billion people in the world over the age of 60, by 2025 (WHO)
- 65–75 years :25%
  >75 years: 70–80% suffer from SNHL
- 난청에 동반되는 이명 유병률도 나이에 따라 증가하여, 60 세 이상에서 12%



Exclusive disease of Presbytinnitus

- **Objective tinnitus(extrinsic tinnitus or pseudotinnitus)**
  - 혈관성 이명 (Vascular cause)
    - 동맥성
      - 죽상경화 경동맥질환 (Atherosclerotic carotid artery disease, ACAD)
      - 뇌혈관질환 (Intracranial vascular abnormalities)
      - 동정맥루 및 동정맥류 (Ateriovenous fistulas and aneurysms)
      - 이상 동맥 위치 (Aberrant artery anatomy)
      - 고혈압성 질환 (Hypertension)
    - 정맥성
      - 양성 두개내 고혈압 (Benign intracranial hypertension)
      - 정맥성 잡음 (Venous hum)
      - Arnold-Chiari malformation
      - Glomus tumors
  - 비혈관성 이명 (Nonvascular cause)
    - 근육 수축성 이명 (Palatal, stapedial, and tensor tympani muscle myoclonus)
    - 지속적 이관개방증 (Patulous E-tube)

Tinnitus and Hearing Loss

Tinnitus Pitch

- Strong association between pitch of tinnitus and frequency range of abnormal hearing
- Correspond to frequency region in which audiogram exhibits a steep decline or threshold of >40dB

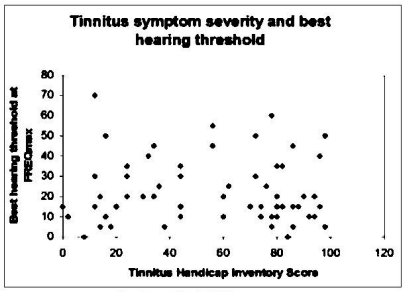
Tinnitus Localization

- With asymmetrical hearing losses, tinnitus typically lateralizes to poorer thresholds
- Non-lateralized tinnitus tend to have symmetric losses

(Nuttall et al., 2004)

Tinnitus and Hearing Loss

No correlation between tinnitus severity and hearing threshold



(Tsai et al., 2012)

Treatment of Tinnitus

- There is NO unique treatment for tinnitus
- There is NO consensus on the best treatment for tinnitus
- Most tinnitus treatments lack supporting evidence, such as controlled trials
- 2 categories of treatment
  - Focus on tinnitus
  - Focus on tinnitus reaction

Component of Tinnitus Management

- Medical therapy
- Counseling
  - Instructional
  - Adjustment based (cognitive-behavioral intervention)
- Amplification (HA)
- Implantable hearing device

Management Tinnitus with medication

Off-label drugs for tinnitus

- Antiarrythmics
  - **Lidocaine**
  - Tocainide
  - Flecainide
- Anticonvulsants
  - Carbamazepine
  - Gabapentine
  - Lamotrigine
  - Pregabaline
  - Valproic acid
- Anxiolytics
  - **Clonazepam**
  - **Alprazolam**
  - **Diazepam**
- Glutamate receptor antagonists
  - Acamprosate
  - Caroverine
  - Menantine
- Antidepressants
  - **Amitripryline**
  - Trimipramine
  - Nortriptyline
  - Paroxetine
  - Sertaline
  - Fluoxetine
- Muscle relaxants
  - **Baclofen**
  - Cyclobenzaprine
- Others
  - Misoprostol
  - Atrovastatin
  - Nimodipine
  - Furosemide
  - Cyclandelate
  - Sulpride
  - Melatonin

Management Tinnitus with HA

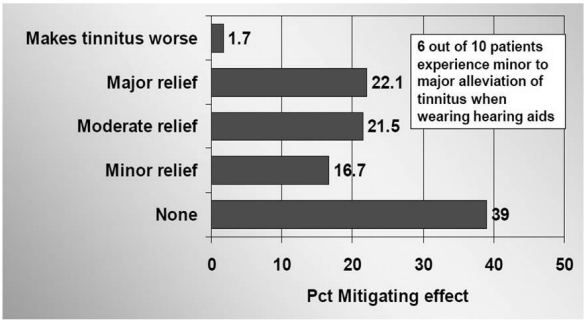
Amplification

- Total or partial relief for many patients
  - Improves hearing & communication
  - Reduces fatigue and stress
  - Stimulates deprived auditory system
  - Diverts attention
  - Interference of tinnitus mechanism
- Ideal Characteristics of Amplification
  - Low compression thresholds
  - Broad frequency responses
  - Flexible acoustic options

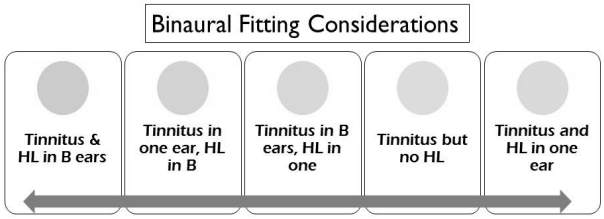
Benefits of Amplification

- General counseling during hearing aid fitting
  - Helps in the understanding of tinnitus
- Speech amplification
  - Decreases attention on tinnitus
- Environmental sounds amplification
  - Reduces the audibility of tinnitus

Effectiveness of HA in Tinnitus



Binaural or Monaural?



- No matter where tinnitus originates, it almost always becomes a central nervous system issue.
- Binaural stimulation is always recommended with the exception being a dead ear.

Tinnitus Masking

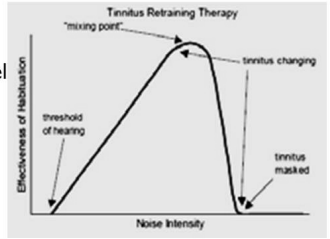
- Introduced in the 1970s by Jack Vernon Ph.D.
- Broadband sound is utilized in addition to amplification to provide a sense of relief from tension or stress caused by tinnitus
- Counseling is considered secondary

Jack Vernon Ph.D.
American Father of Tinnitus

Mixing Point
Setting Tinnitus Masker

Use the ascending technique

- Decrease all sliders to 0
- Begin to increase the level
- Instruct patient to acknowledge when the signal is mixed with the tinnitus
- 2 sounds are heard- therapy signal and the tinnitus
- Do not use total masking



Verifying Settings

1. Tones should be audible, but relatively soft
2. Tones should not interfere with conversational speech
3. Tone volume is sufficient to just begin to decrease annoyance level of tinnitus

Counseling (TRT)

Tinnitus Retraining Therapy (TRT)

- Introduced in the 1990s by Pawel Jastreboff Ph.D.
- Based on the philosophy of habituation therapy
- Utilizes a combination
  - Counseling
  - Sound enrichment (i.e. noise generator) to disregard their negative reaction to their tinnitus

Pawel Jastreboff Ph.D.
Neurophysiological Model of Tinnitus

Neurophysiologic model of Tinnitus

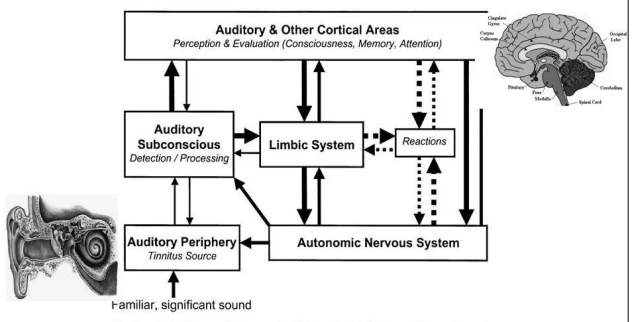
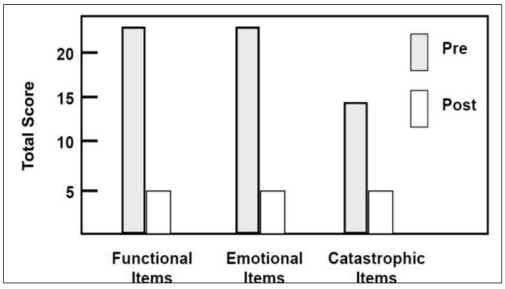


Fig 1. A block diagram of the neurophysiologic model of tinnitus and decreased sound tolerance. Note multiple functional connections between involved systems crucial in the development of conditioned reflex arcs.

Tinnitus Retraining Therapy

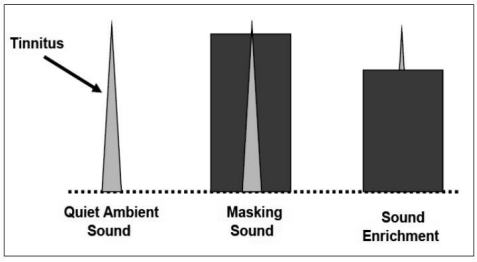
- Based on neurophysiological model of tinnitus
- Ability of the nervous system to suffer persistent functional changes of its circuitry
- Neuroplasticity
  - Habituation
    - Suppression of response to innocuous stimuli repeated
    - "It is the reduction or elimination of CNS activity in response to repetitive stimuli"
  - Awareness
    - More effective response to a noxious stimulus

Benefit of Counseling in Tinnitus



THI scores before versus > 6 months after counseling (Hall & Haynes, 2001)

Sound Enrichment Treatment



(Pawel Jastreboff)

Sound Therapy

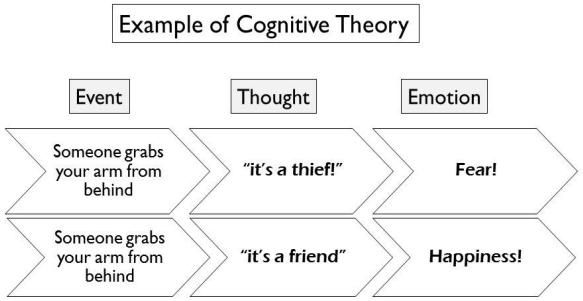
No one fitting strategy has been shown to be the most effective

- Completely mask
- Partially mask
- Mix

No one type of sound has been shown to be the most effective

- Music
- Noise
- Relaxation
- Environmental

Cognitive Behavioral Intervention

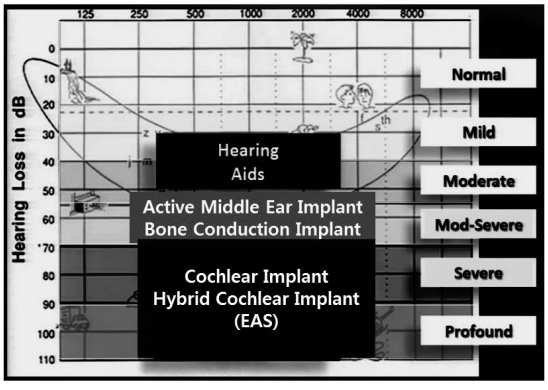


Summary

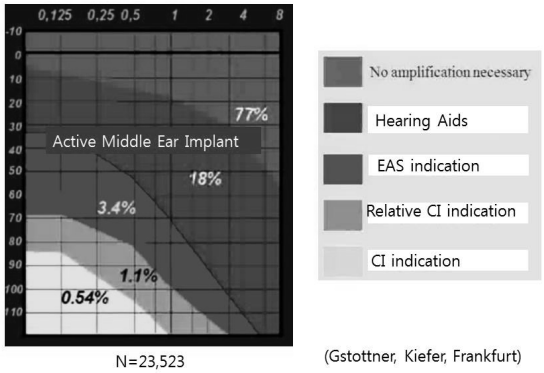
- Tinnitus is a symptom, not a disease.
- Audiologic and medical diagnosis is essential.
- With general and short term management options, most patients (> 80%) return to the quality of life they enjoyed before the perception of bothersome tinnitus.
- Effective extended tinnitus management options are available
- All patients with bothersome tinnitus should have hope

Management Tinnitus with Implantable Devices

Implantable Hearing Devices



Indication for Hearing Devices



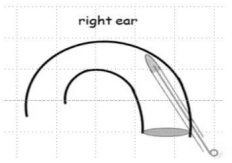
N=23,523

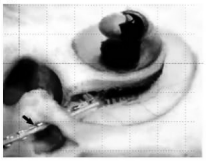
(Gstottner, Kiefer, Frankfurt)

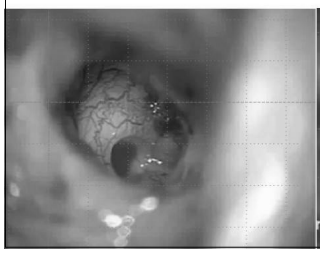
Recent Hot Issues

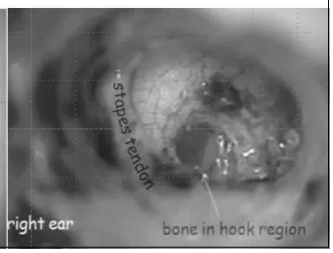
- **Hearing Preservation with Round Window Approach**
  - Elctro-Acoustic Stimulation (EAS)
- **Active Middle Ear Implant (AMEI)**
- **Cochlear Implant**

Hearing Preservation
Round Window Approach



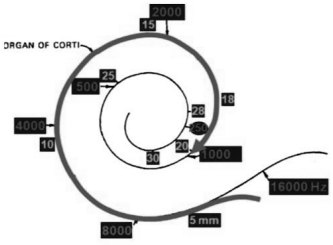






Hybrid CI
Electro-Acoustic Stimulation(EAS)

- Electrode insertion only in the non-functioning region of the cochlea
- Insertion depth dependent on the extent of residual hearing
  - 1 kHz=20mm
  - 500 Hz=25mm



(Adapted from Otte et al, 1978)

Hybrid CI
Electro-Acoustic Stimulation

Recent Hot Issues

- **Hearing Preservation with Round Window Approach**
  - Elctro-Acoustic Stimulation (EAS)
- **Active Middle Ear Implant (AMEI)**
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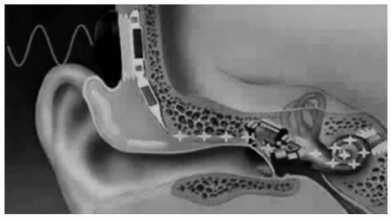
Active Middle Ear Implants

- **Simplify 3 steps process to 2 steps process**
- **Ossicle chain transducers**
  - Transduction of amplified electrical to acoustic, then to vibration
    - Electromagnetic
    - Piezoelectric



Active Middle Ear Implants

Rationale

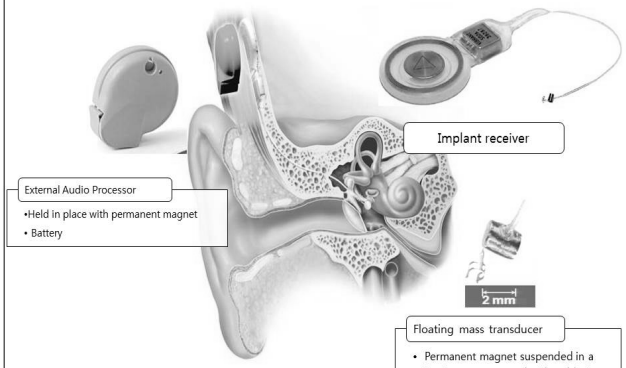
- Better cosmetic
- Precludes occlusion effect
- Avoidance of feedback
- Increase high frequency emphasis and gain
- Improve sound fidelity

Active Middle Ear Implant

Semi Implantable AMEI	
Med-EL Vibrant®	Electromagnetic
Otologics MET®	Electromagnetic
Ototronix Maxum®	Electromagnetic

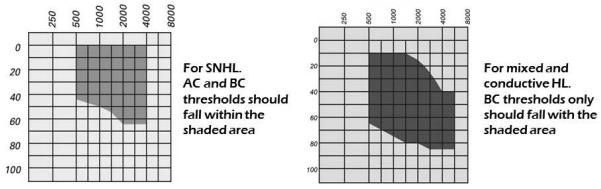
Fully Implantable AMEI	
Envoy Esteem II®	Piezoelectric
Otologics Carina®	Electromagnetic

Vibrant Soundbridge®
Component



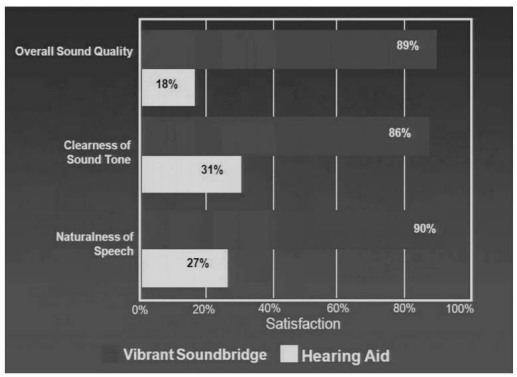
Vibrant Soundbridge®
Patient Section Criteria

- Adult 18 years +
- Moderate to severe SNHL
- Word recognition score 50% or better
- Normal middle ear function
- Realistic expectation



(Courtesy of VIBRANT MED-EL)

Vibrant Soundbridge®
Better Sound Quality



Active Middle Ear Implants
Challenges and Issues

Transducer Issue
- Long-term injury to the ossicular chain
- Need long term follow up results

Multiple surgeries to replace battery

MRI compatibility

Registration and Cost Issues
- Registration KFDA
- Medical insurance coverage

Summary

- Tinnitus is a symptom, not a disease.
- Audiologic and medical diagnosis is essential.
- Effective extended tinnitus management options are available
- Presbytinnitus resolved variable devices (HA, AMEI, CI and etc.)