Implantable Treatments for Different Types of Hearing Loss

Margaret Dillon, AuD
Marcia Adunka, AuD
Implantable Technologies

• Types of hearing loss
• Bone-anchored devices
• Middle ear implantation
• Cochlear implantation
Audiogram

Normal
Mild
Moderate
Severe
Profound
Audiogram

Normal
Mild
Moderate
Severe
Profound
Audiogram

- Normal
- Mild
- Moderate
- Severe
- Profound
Types of Hearing Loss

- **Conductive**
  - Dysfunction in the conduction of sound by the outer ear, tympanic membrane, and/or middle ear

- **Sensorineural**
  - Dysfunction within the inner ear (cochlea) and/or auditory nerve

- **Mixed**
  - Conductive + Sensorineural
Types of Hearing Loss

• **Conductive**
  » Dysfunction in the conduction of sound by the outer ear, tympanic membrane, and/or middle ear.
Types of Hearing Loss: Conductive
Types of Hearing Loss

- **Sensorineural**
  - Dysfunction within the inner ear (cochlea) and/or auditory nerve
Types of Hearing Loss: Sensorineural
Types of Hearing Loss

- Mixed
  » Conductive + Sensorineural
Types of Hearing Loss: Mixed
Hearing Aids

- Amplify the acoustic signal

Phonak
Implantable Treatments

• Bone-anchored devices
  » Transmission of sound via bone conduction

• Middle ear implants
  » Transmission of sound via vibratory stimulation

• Cochlear implants
  » Transmission of sound via electric stimulation of the auditory nerve
Bone-Anchored Devices

- Stimulation of the acoustic signal via bone conduction
Bone-Anchored Devices

• Three Part System:
  » Titanium Screw surgically implanted into mastoid
    • Approximately 2 month osseointegration
  » External Abutment transfers the sound vibrations
  » Sound Processor
Bone-Anchored Devices

- **Indications** (FDA approvals)
  - CHL and Mixed HL (1996)
  - Single-Sided Deafness (SSD; 2002)
Middle Ear Implants

- **Esteem**
  - Envoy Medical

- **Maxum**
  - Ototronix

- **Vibrant Soundbridge (VSB)**
  - MED-EL Corporation
Vibrant Soundbridge (VSB)

- Converts sound into controlled, amplified vibrations
- Direct drive stimulation of the middle ear structures
Vibrant Soundbridge (VSB)

- Two Part System:
  - Internal
    - Vibrating Ossicular Prosthesis (VORP)
Vibrant Soundbridge (VSB)

- Vibrating Ossicular Prosthesis (VORP) with Floating Mass Transducer (FMT)
  - Wide frequency range up to 8 kHz
  - Preservation of residual hearing
Vibrant Soundbridge (VSB)
Vibrant Soundbridge (VSB)

- **Two Part System:**
  - External
  - Audio Processor
Vibrant Soundbridge (VSB)

• Magnetic connection between internal and external components
Vibrant Soundbridge (VSB)

- Approved Indications
  - Adults
  - Bilateral moderate-to-severe sensorineural hearing loss
  - Word Rec > 50%
VSB Clinical Trial

- Clinical Trial of the Vibrant Soundbridge as a Treatment for Conductive and Mixed Hearing Loss, Using Direct Round Window Cochlear Stimulation
  - Multi-center clinical trial to evaluate VSB in a new population
  - Sponsored MED-EL Corporation

CAUTION: Investigational device. Limited by US law to investigational use.
VSB Clinical Trial

- Candidacy Criteria
  - Conductive & mixed hearing loss
  - Traditional amplification unsuccessful
  - Word Rec > 30%
  - CNC Words

CAUTION: Investigational device. Limited by US law to investigational use.
VSB Clinical Trial

- Candidacy Criteria
  - Conductive & mixed hearing loss
VSB Clinical Trial

CAUTION: Investigational device. Limited by US law to investigational use.
VSB Clinical Trial

• Potential Conditions
  » Congenital malformations (Atresia, Microtia)
  » Stenosis of external auditory canal
  » Allergies to earmold material
  » Chronic otitis externa
  » Chronic draining ears
  » Eczema/Psoriasis of the ear
  » Unresolved acoustic feedback
  » Large mastoid bowl following surgery
VSB Clinical Trial

- FMT placed in Round Window (RW) Niche
  - Bypass conductive component to deliver vibrations directly to the cochlea
  - Active RW stimulation

CAUTION: Investigational device. Limited by US law to investigational use.
VSB Clinical Trial

• Potential Benefits
  » Appropriate amplification
  » Little to no acoustic feedback
  » Improved ability to understand speech in quiet and noise
  » Ability to wear technology without occluding the ear canal

CAUTION: Investigational device. Limited by US law to investigational use.
VSB Clinical Trial

• Results
Cochlear Implantation

- Electrical representation of an acoustic signal
  - Insertion into scala tympani of the cochlea
  - Bypass damaged sensory cells
Cochlear Implantation

Cochlear Corporation
Cochlear Implantation

- **Indications**
  - Moderate-to-profound sensorineural hearing loss
  - Limited speech perception abilities with conventional amplification.

**Pre-Operative Aided Speech Testing**

- **Word Test**
  - Hearing Aid: 16%
  - $A_B = \text{Hearing Aid Both Ears}$
Cochlear Implantation

Post-operative

Aided Speech Testing

Word Test

CI Right 80%
CI Left 84%

$C_R = \text{Cochlear Implant Right Ear}$
$C_L = \text{Cochlear Implant Left Ear}$
Cochlear Implantation

- Cochlear Implant Candidate?
  - Greater residual low-frequency hearing, yet poor speech perception

CAUTION: Investigational device. Limited by US law to investigational use.
Electric-Acoustic Stimulation

CAUTION: Investigational device. Limited by US law to investigational use.
Electric-Acoustic Stimulation

- Candidacy criteria

CAUTION: Investigational device. Limited by US law to investigational use.
Electric-Acoustic Stimulation

• Candidacy Criteria
  » Adults (>18 years)
  » Stable hearing thresholds
  » Poor speech perception with appropriately fit hearing aids

CAUTION: Investigational device. Limited by US law to investigational use.
Electric-Acoustic Stimulation

• Results

CAUTION: Investigational device. Limited by US law to investigational use.
Electric-Acoustic Stimulation

- Preoperative

CAUTION: Investigational device. Limited by US law to investigational use.
Electric-Acoustic Stimulation

- Post-operative

Post-Operative

Aided Speech Testing

Word Test

EAS 90%

$C_L = $ Cochlear Implant Left Ear

CAUTION: Investigational device. Limited by US law to investigational use.
Contact

Margaret Dillon, AuD, CCC-A, F-AAA
Assistant Professor
University of North Carolina at Chapel Hill
School of Medicine
Department of Otolaryngology / Head and Neck Surgery

Email: mdillon@med.unc.edu