Understanding and Treating Severe & Profound Hearing Loss

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Who Are These Patients?
The Nature of Severe and Profound Sensorineural Hearing Loss
What has changed in the peripheral auditory system?
Etiologies (incomplete list):

- Congenital
- Viral
- Meningitis
- Ototoxicity
- Sudden or Idiopathic
- Burned-out Meniere's
Physiological Changes

Intact cochlea

Damaged cochlea

Picture credit: House Ear Institute, Los Angeles
What else has to go right?
Example Audiograms
Variability in Performance
What do physiological changes mean for the individual patient?
Speech Understanding in Noise

Signal-to-noise ratio (S/N) required for 50% correct performance

Souza (2009)
Speech Understanding in Quiet

Lamore, Verweij & Brocaar, (1990)

Fig. 1. Maximum discrimination score for phonemes (DS) as a function of the mean PTA at the frequencies 0.5, 1 and 2 kHz (PTAM = Fletcher Index): the curve has been fitted to the data points by eye; the plusses in this and other figures indicate cases in which two or more data points coincide. From (2) by permission of "Audiology".
Boothroyd (1993)
The Role of Multi-channel, Nonlinear Amplification
What does it take to get the most out of the speech signal?
Amplified Speech must be both:

**Audible & Useable**
Speech Guard E
Pascoe, 1988

Fig. 4

MEAN COMFORT AND DISCOMFORT LEVELS
RE HEARING THRESHOLD LEVELS

UCL
MCL
HTL

± 1 STD. DEV.
The Role of Frequency Lowering
Who, When and How?
It’s all about dead zones, right?
Amplified Speech must be both:

Audible & Useable
Frequency Lowering Technologies

Frequency Lowering

Low frequency

High frequency

Composition

Translation

Transposition

Compression
Frequency Composition
But if Dr. Simpson's office calls when I am gone, go ahead and put them through to my voicemail.
In nineteen thirty six, Hans Christian Andersen published the Little Mermaid.
Who, When and How?
Transitioning to New Instruments
Why can this be difficult?
### Fitting steps in Genie

1. **Prescribe gain - Personal Profile tool**
   - Prescribe advanced settings based on individual preferences.
   - Ask the questions one by one and select the answers.
   - Consider playing the sound files to hear a difference between the described scenarios.

   Note: The patient should wear his/her current hearing aids when listening to the sound demos.

2. **Set feedback limits - Feedback Manager tool**
   - Set feedback limits and prevent static feedback.
   - Analyse the feedback path by running a feedback measurement.

3. **Adjust loudness - Overall Loudness trimmer**
   - Adjust prescription to the individual loudness perception.
   - Use Overall Loudness trimmer to adjust the prescription to the individual loudness perception.
   - It changes both gain and MPO to protect speech intelligibility.

4. **Ensure acceptance - Fine tuning of gain**
   - Make further gain adjustment only if warranted due to lack of immediate acceptance by your patient.
   - Adjust the gain controls according to feedback.

   Reactions to new gain rationale could be:
   a) "Distant sounds and own voice are softer compared to before"
   Probable cause: Soft gain is reduced below 2000 Hz with DSE compared to APD prescription.

   b) "Sound is generally too bright or sharp compared to before"
   Probable cause: Moderate and loud gain is increased above 1500 Hz with DSE compared to APD prescription.
Bi-Modal Fittings
What is the role of the hearing aid?
Bimodal Hearing Aid Fitting Guidelines

ABSTRACT
In a bimodal fitting, one ear is stimulated acoustically with a hearing aid and the other is stimulated electrically with a cochlear implant.

Bimodal hearing aids benefit all children and adults with multichannel implants and severe hearing in the contralateral ear. Oticon has implemented a bimodal fitting guide in the C-FIT fitting software. As developed by Carla Reyes, Staff Audiologist at Boys Town National Research Hospital, these bimodal fitting flowcharts serve as a guide to clinical audiologists as they navigate the bimodal fitting process. The goal is to provide a single, evidence-based method for decision making, yet remaining flexible to handle the constraints in everyday clinical practice.

Based on the latest knowledge on bimodal research, this paper explains the rationales, the recommended strategies, the problems, and the caveats of the bimodal fitting.

- Candidates for bimodal fitting
- When to fit the hearing aid
- How to fit the hearing aid for bimodal patients
- Bimodal flowchart
- Evaluation of benefits
- Case Studies
Bimodal Flowchart:

1. Start with wideband fitting
   - Is the patient a candidate for frequency lowering? [YES | NO]
     - Create frequency lowering program & Verify loudness balance
       - Is the patient satisfied? & Is bimodal performance better than or equal to CI alone? [YES | NO]
         - Use frequency lowering
           - Further evaluation needed
         - Use wideband fitting
           - YES
           - NO
         - Use reduced bandwidth
   - Address any sound quality concerns with the hearing aid & Verify loudness balance
     - Is the patient satisfied? & Is bimodal performance better than or equal to CI alone? [YES | NO]
     - Create restricted bandwidth program with or without low frequency emphasis & Verify loudness balance
       - Is the patient satisfied? & Is bimodal performance better than or equal to CI alone? [YES | NO]
Summary

- Damage is More Complex
- Poor Perceptual Abilities
  - Speech is a complex signal
- Variability
- Signal Processing Must Match the Needs of this Unique User Group and the Individual
- Experience / Opinions Matter
  - Transitioning
- HA as a Secondary Device
  - Bimodal Guidance
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