P84 Evaluating Speech Audibility with ADHEAR: Enhancing Audibility Measurements through a Skull Simulator Adaptor

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Overview

ADHEAR is a non-surgical, adhesive bone conduction hearing system developed by **MED-EL**. It is designed for individuals with conductive hearing loss. ADHEAR works by transmitting sound vibrations through the bones of the skull to the inner ear, bypassing the outer and middle ear, where the conductive hearing loss typically occurs. This makes it a good solution for individuals who may not be suitable for traditional hearing aids or surgical interventions like bone-anchored hearing aids.

While ADHEAR is relatively new, the existing evidence supports its utility in certain populations, especially those who prefer or require non-surgical options (Gawliczek et al., 2018). However, more long-term studies are still needed. To date, one advantage of percutaneous bone conduction device options is that there are methods and tools designed to help the audiologist prescribe and measure output so that the audibility of speech can be assessed on an individual basis.

Here we present a tool from MED-EL (ADHEAR adaptor) and a method (DSL-BCD) that allows clinicians to use more objective methods to assess audibility directly, without the need to rely on outdated outcome tools like the aided audiogram

Why is the Aided Audiogram Unreliable?

Table 2 Critical Differences in dB for Aided Sound-Field Thresholds at Six Frequencies for Two Confidence Levels (p)*

p	250	500	1000	2000	3000	4000
0.05	11.9	15.7	15.1	15.1	16.1	16.5
0.10	10.0	13.2	12.7	12.7	13.5	13.8

Why is the Aided Audiogram Inaccurate?

1. Limited Hz measured
2. Noise Floor
3. Calibration
4. No MPO
5. Not Speech

Why is a generic prescription like DSL-BCD preferred?

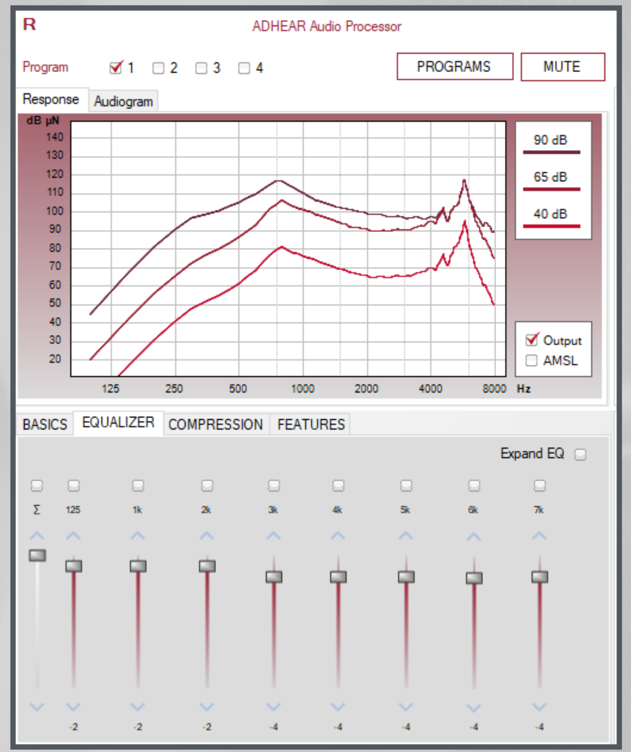
1. Provides a **standardized, evidence-based** approach for fitting hearing devices
2. **Maximizes speech audibility** across a wide range of frequencies
3. Ensures audibility for **soft speech** while maintaining comfort for louder sounds
4. Suitable for individuals with **diverse hearing profiles**, including children and those with conductive and mixed hearing loss
5. Offers a **consistent framework** for evaluating and comparing audibility outcomes across different devices and fitting scenarios

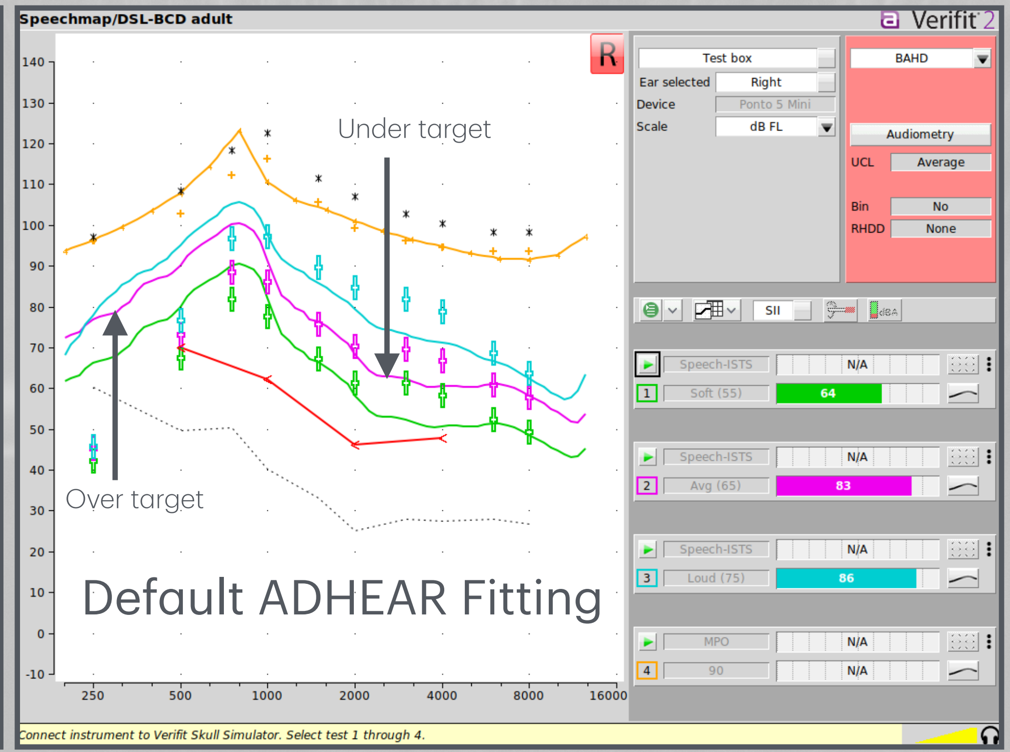
Computational Differences between DSL Air and DSL BCD

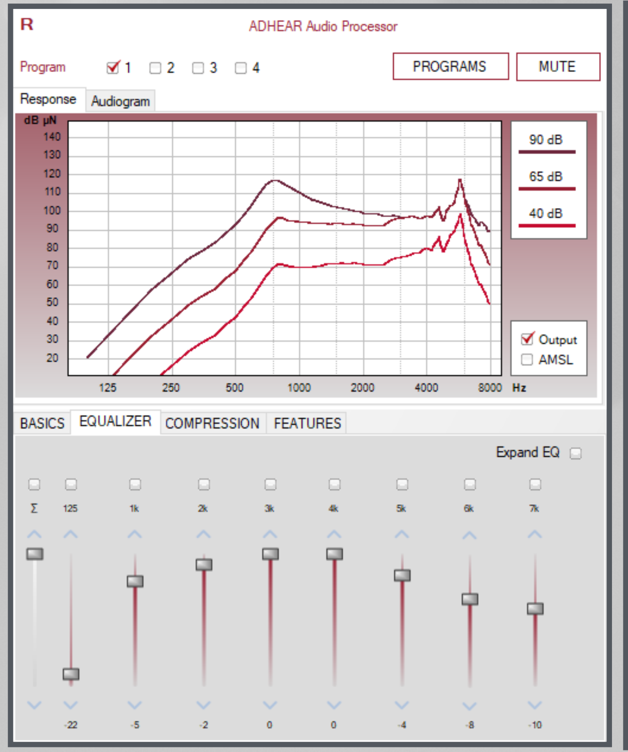
Table 1. Computational stages in the DSL v5.0 air conduction prescription, and adaptations within the DSL-BCD prescription.

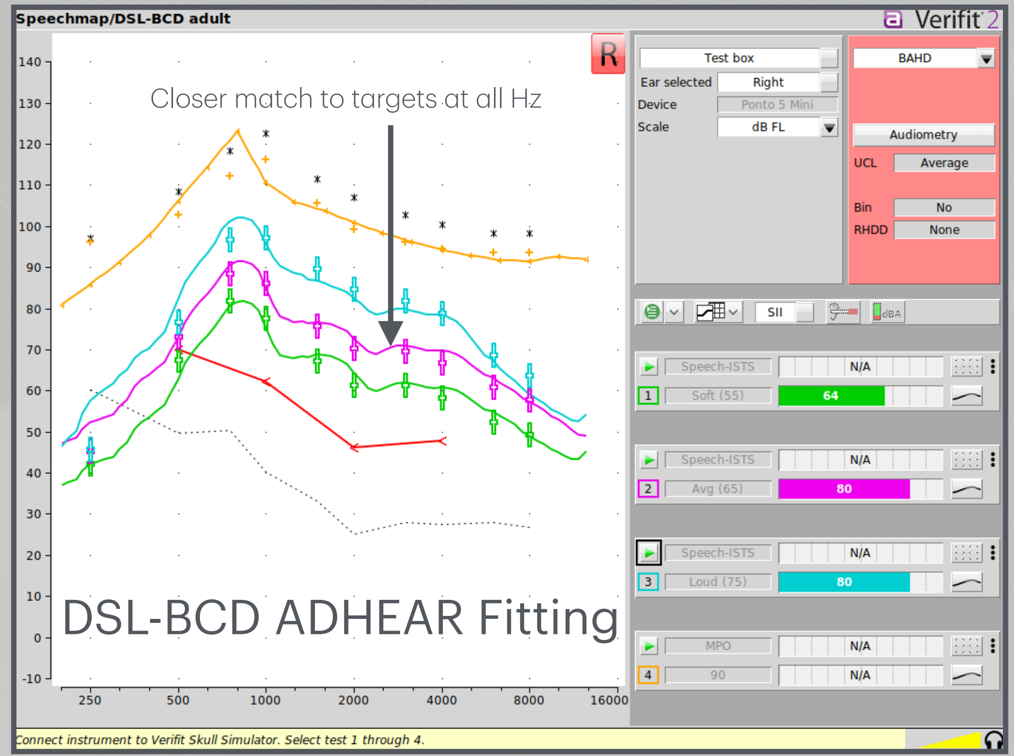
Stage	*Sub-stage*	*Air conduction prescription*	*Percutaneous BCD prescription*
Assessment	Lower limit	Detection thresholds in dB HL.	Detection threshold measured through the abutment in dB dial level (non-standard).
	Transformation	Transform HL to 2cc SPL. Transform to ear canal SPL	Transform dial level to dB FL on a skull simulator. Transform to on-head FL.
	Interpolation	Interpolate to provide data at one-third octave centre frequencies.	Same.
	Upper limit	Predict or measure upper limits of comfort in ear canal SPL.	Same, but further compressed and limited to the device-specific maximum output.
	Mapping	Apply a target generation procedure that maps inputs to outputs.	The DSL-BCD prescription initially used the same shaping (v1.0) but a modified shape was developed in this paper. Modified targets use a low-frequency cut (v1.1).
	Listener customisation	Customize for the listener type and listening situation.	Same.
	Device customisation	Customize for the device's channel structure. Convert to linear gain if required.	Same.
	Verification customisation	Convert for use with other test signal and/or measurement types. Account for venting.	Venting is not a factor in BCD, so venting corrections have been omitted.

Hodgetts & Scollie, 2017









How do we do it?

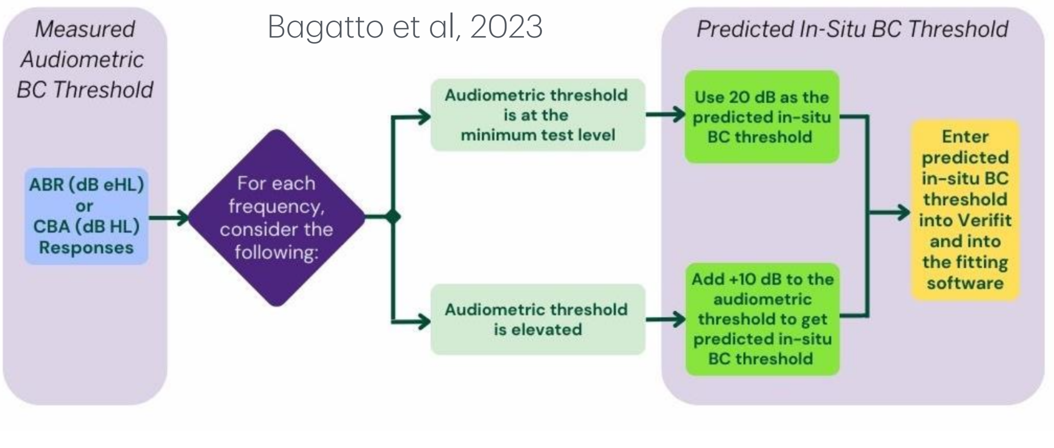


Figure 2. Obtaining predicted in-situ BC thresholds from audiometric thresholds when in-situ testing is unavailable.

Step 1: Enter Predicted In-situ BC threshold into Verifit as per above.

Step 2: Choose ponto 3 as the device as ADHEAR is not yet in the software. This sets the MPO of the ADHEAR to that of the Ponto 3

Step 3: Launch ADHEAR fitting software.

Step 4: Adjust equalizer settings in ADHEAR software until targets are approximated for 55, 65, and 75 dB speech.

Step 5: Store the settings in the software and continue creating other programs if desired.

Step 6: Measure and store the output for each program in the Verifit for future comparisons.

Limitations and Future Directions

A more direct method of measuring both the in-situ thresholds within ADHEAR software as well as a more direct method of measuring the output of the device with the skin in place is still under evaluative trials with several research groups (including ours) and Audioscan. This tool (surface or skin microphone), when available, will allow for all measures (thresholds and outputs) to be evaluated in the actual use case (when the skin is included). Skin is known to be variable, however, the method proposed here works well and far surpasses the aided audiogram as a verification tool for speech audibility.

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References

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