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BONE CONDUCTION

Objective measurement of audibility for patients with bone conduction devices using a new skin microphone

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Abstract

For a long time, there has been a need for objective measurements to evaluate the individual benefit of audibility for patients with bone conduction devices (BCD).

In this study we have measured 29 patients with different percuteneous, active and passive transcutaneous BCDs (Baha, Ponto, BCI, Sentio, BoneBridge) using a skin microphone placed on the forehead.

The results show that a skin microphone placed on the forehead can be used to measure audibility for any bone conduction device, Figure 1.

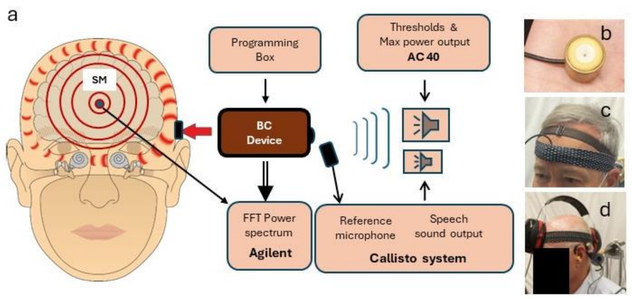

Figure 1. The complete set-up (a) for measurements with the skin microphone (b), which is placed on the forehead and held in place by a softband (c). For extra shielding, an earmuff (d) is placed over the skin microphone. The measurement set-up also consists of an audiometer (AC40), an Agilent 35670, and a Callisto system with a reference microphone.

Objectives

To evaluate a new method that can be used in a clinical setting to obtain an optimal hearing aid fitting for each individual with a bone conduction device.

Methods and Materiels

We have measured aided InSitu warble tone sound field thresholds and maximum power output using a loudspeaker 1 meter in front of the patient, while simultaneously measuring the sound on the forehead using a skin microphone. A second loudspeaker, 30 cm from the hearing aid, provided a speech signal which also was measured with the skin microphone.
The patient's own BCD was used in all tests and the spectrum of the skin microphone signal was measured with a signal analyser Agilent 35670.
The individual dynamic range was determined by subtracting the skin microphone signal at hearing thresholds from the corresponding signal at MPO level. Thereby, the dynamic range can be used to measure the audibility of the speech signal with the same skin microphone.

Results

The measurements show that the method with a skin microphone placed on the forehead can be used to measure the audibility of patients with different bone conduction devices, Figure 2. The results have also been used to adjust the gain, to increase audibility. The increase in audibility was verified by speech tests, before and after the adjustment was carried out.

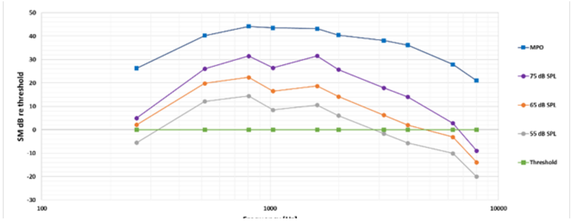

Figure 2. Average result of MPO, thresholds, and ISTS speech at three different levels (55, 65, and 75 dB SPL) from 29 patients, normalized by thresholds.

A new more user-friendly skin microphone system is under development (together with Audioscan, Canada) that contains an integrated sound protecting casing and a reference microphone which can be plugged in to already existing sound test systems.

Conclusion

In conclusion, it was found that the proposed method with a skin microphone placed on the forehead can be used:
- to determine the dynamic range of individual patients with any kind of bone conduction device,
- to measure the audibility of individually fitted bone conducted devices, and
- to detect and help to improve a poor fitting.

References

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2. Persson, A, Håkansson, B., Fredén Jansson, K. J., Reinfeldt, S., & Eeg-Olofsson, M. (2024). Objective verification of audibility in bone conduction devices. *International Journal of Audiology*, 1-7. https://doi.org/10.1080/14992027.2024.2335511

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