Field Study News

AudiogramDirect

In-situ hearing tests at their best

Summary

The latest version of the Phonak fitting software, Phonak Target 1.2, sees the return of AudiogramDirect. This in-situ hearing test enables fitters to check client's hearing directly through any Spice hearing instrument, taking into account the properties of the individual ears and the chosen hearing instruments with their acoustic coupling. This method provides a fast and accurate point for a successful fitting when used in conjunction with a diagnostic hearing test. With AudiogramDirect you can accurately fit any Spice hearing device directly from your laptop or PC, without the use of any additional audiometric equipment.

A validation study, involving 39 participants with various degrees of hearing loss fitted with a selection of devices, investigated the reliability of AudiogramDirect compared to standard diagnostic audiometry measured with the Aurical system using headphones.

The results conclude that AudiogramDirect is a good way to tests clients hearing from mild to profound hearing loss.

Introduction

Most modern digital hearing aids now have on-board sound generators that produce frequency specific pure tones, so an *in-situ hearing test* can be performed. The ability to test the hearing thresholds directly through the hearing aid placed in the ear (in-situ), makes the fitting more precise, achieving an accurate and custom initial fitting that will have a huge impact on initial satisfaction and the overall success of a professional practice (Block, 2008). In-situ hearing tests can also be used to observe how standardized audiometric hearing levels will vary because of the influence of residual ear canal volume (Keidser et al, 2011). The procedure also takes into account the effects of the depth of the instrument in the ear canal, the effectiveness of the acoustic coupling seal in the ear canal, the effects of venting, and the specific receiver in that instrument (Block, 2008). This correction allows the target gains to represent the hearing loss more accurately (Keidser et al, 2011). The real-ear measures enable the hearing aid to match those target gains with more precision (Block, 2008). The result is a fitting that is based on the actual characteristics of your client ear rather than average data. This makes it possible to customize the fitting responses for your specific patient and, by doing so, improve the accuracy of the fitting (Block, 2008).

In-situ audiometry is an attractive option because it requires less equipment and resources, and may save on clinical time used when transferring threshold data between different test modules. One downfall is that in-situ audiometry is currently limited to measurements of air conduction thresholds (Keidser et al, 2011). Another disadvantage of in-situ audiometry is that it requires special equipment like the hearing aids before the hearing test can be performed. It also cannot be used to directly compare with other measurement devices in the market. Finally, in-situ hearing tests should be used to compliment already measured diagnostic audiometry and not as a measurement on its own.

Goal of the Trial

The goal of this validation study was to determine if audiograms tested with AudiogramDirect and a Spice hearing instrument are comparable and reliable as measurements made with traditional audiometry (TA) with headphones. Studies have suggested that both behavioral and/or physiological changes can lead in a test-retest variability of audiometric test results (Stuart et al, 1991; Landry et al, 1999) of up to 10-15dB.
The study assessed if measured points using AudiogramDirect fall into a tolerance range of +/- 10 dB for mild to moderate hearing loss and moderately severe to profound hearing losses for the single frequencies. To increase reliability of findings the test was performed with different acoustical coupling options: xS receivers with open dome; xP receiver with closed dome; SlimTubes with open and closed domes and individual ear pieces.

The reference measures were performed with a standard audiometer, Aurical, in the traditional way.

Subject and Devices

Test subjects

A total of 39 participants took part in the validation study. There were 19 participants, 3 female and 16 male, with a mild to moderate hearing loss, average age was 68 years (fig.1). The remaining 20 participants, 18 male and 2 female, had a moderately severe to profound hearing loss, with the average age of 68.25 year (fig.1).

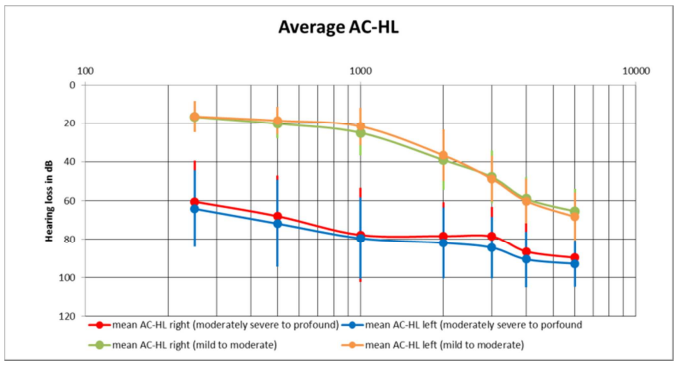

Figure 1: Averaged hearing loss of all particiapnts

Devices

To increase reliability of the AudiogramDirect findings as well as to cover a broad range of product styles and acoustical coupling, the following set-up was chosen for the participants with a mild to moderate hearing loss. The participants were fitted with Audéo S SMART IX CRT devices and Ambra microM devices. Audéo S SMART IX devices fitted on the right ear had xStandard (xS) receivers and open domes while devices fitted on the left ear had xPower (xP) receivers and closed domes. Ambra microM devices fitted on the right ear had SlimTubes with open domes and the left ear fitted with SlimTubes and closed domes. The participants with a moderately severe to profound hearing loss were fitted with Naída S IX SP and UP devices and individual earpieces.

Test Method

The participant's standard audiogram was measured using the Aurical system and headphones approximately 1.5 months prior to measuring with AudiogramDirect. Phonak Target 1.2 with AudiogramDirect was used to measure the participants hearing using the Spice hearing aids and the appropriate acoustic parameters for the participants hearing loss.

Results

All the results were reliable and robust, falling into the defined range of +/- 10 dB for mild to profound hearing losses.

Mild to moderate hearing loss

38 Aurical audiograms (left and right, 7 main frequencies: 250Hz, 500Hz, 1kHz, 2kHz, 3kHz 4kHz and 6kHz) were compared to AudiogramDirect measures. 94% of all AudiogramDirect measurement points with Audéo S IX and xS (right ear) or xP (left ear) CRT were within the predefined +/- 10 dB range (fig. 2). 89% of all AudiogramDirect measurement points with Ambra microM with SlimTubes were also within in the predefined +/- 10 dB range (fig. 3). 6.8% of the points fell out of the defined range. This could be related to concentration issues or environmental noise effects and therefore can be neglected. The variance doesn't show any specific direction.

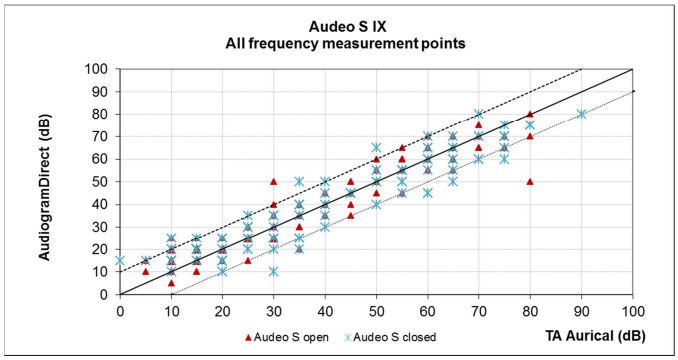

Figure 2: All AudiogramDirect measurement points (250Hz, 500Hz, 1kHz, 2kHz, 3kHz, 4kHz and 6kHz) for Audéo S IX in comparison to traditionally measured audiogram (TA) with Aurical with a +/- 10 dB range.

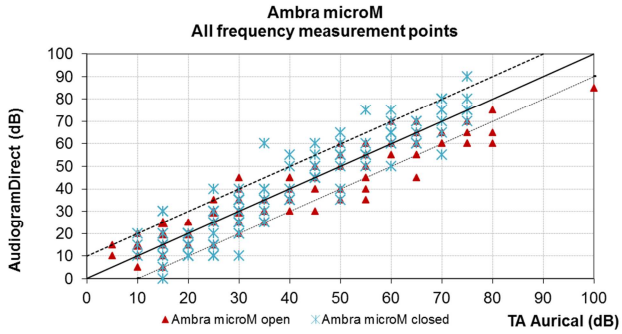

Figure 3: All AudiogramDirect measurement points (250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz and 6000Hz) for Phonak Ambra in comparison to traditionally measured audiogram (TA) with Aurical with a +/- 10 dB range.

Moderately severe to profound hearing loss

For the moderately severe to profound hearing loss, AudiogramDirect measures compared to Aurical audiograms showed good results and did not deviate by more than 10 dB for 94.1% of all AudiogramDirect measurement points (fig. 4).
In the lower frequencies, some clients showed a larger deviation which could be due to the vent leakage of the ear pieces. The ear pieces of some clients did not fit well in the ear canal, so the real vent effect could be larger than the chosen one in the acoustic coupling.

In the high frequencies there were less measurement points because most profound hearing losses were out of the measurement range of AudiogramDirect which limits measuring up to 6 kHz and not beyond 100dB.

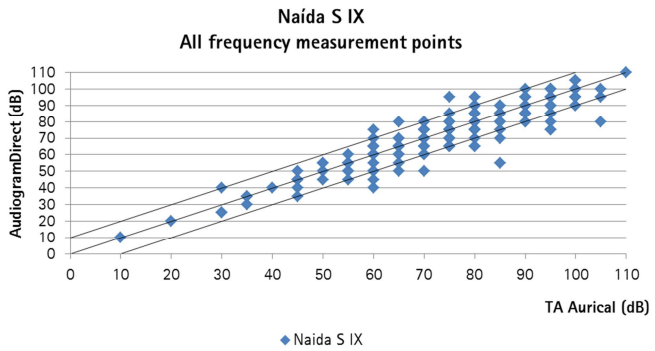

Figure 4: AudiogramDirect results for Naída S IX with individual earmolds to traditionally measured audiogram (TA) with Aurical with a +/- 10 dB range.

Conclusion

The outcome of this study shows that when used in conjunction with a diagnostic hearing test already performed, Audiogram Direct is a quick, reliable and robust tool to check clients hearing during follow ups or if there is a change in their hearing.

The results for clients with a mild to moderate hearing loss with CRT or BTE devices and a variety of acoustic couplings show that AudiogramDirect can be used as a reliable hearing test tool with a wide range of hearing loss.

For moderately severe to profound hearing losses, AudiogramDirect also performs as a very useful tool enabling hearing care fitters to give their clients a more individual and hearing aid specific fitting.

References

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