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Reconsidering the Limits of Normal Hearing

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Abstract

A proposal is made that 15 dB HL, rather than 25 dB HL, be considered the upper limit of normal hearing sensitivity. This recommendation is based on an explanation of the change from an earlier philosophy and the fact that so many people with hearing levels that average less than 25 dB HL consider themselves to have hearing difficulty. Such reclassification of people with slight to mild hearing losses would dignify their clinical complaints and aid in counseling that would assist them with their hearing difficulties.

Key Words: ANSI = American National Standards Institute, ASA = American Standards Association, ISO = International Standrds Organization, PTA = pure-tone average

For some time, there has been disagreement on just how far down the audiogram patients' auditory thresholds need to fall before clinicians consider them to have a hearing loss. This disagreement results in confusion to patients and their families and affects communication among hearing care professionals. The lack of consensus may be due to a number of factors, some of which are reviewed here.

BACKGROUND

When audiometers were first introduced, it was decided that the 0-dB reference level should not be stated in sound pressure level (reference of 20 μPa) but rather in hearing level, the number of decibels required to obtain auditory thresholds on individuals with normal hearing sensitivity. One reason for this is the fact that hearing is not equally sensitive at all frequencies, and so the audiometer automatically emits a different SPL at each frequency when the attenuator is set to 0 dB HL.

Individual manufacturers largely determined the calibration of early audiometers. Therefore, a theoretically totally reliable, normal-hearing person, when tested using different audiometers, would produce slightly different audiograms. When the data from the Beasley (1938) study were incorporated into the standards set by the American Standards Association (ASA) (1951), this presumably changed, and all audiometers manufactured in the United States should have produced identical results. Still, there were differences in the audiometric zero that could be found on audiometers used in other countries. This changed again when the International Organization for Standardization (ISO) published its standards for 0 dB HL (Davis and Kranz, 1964). At this point, all audiometers properly calibrated to ISO standards throughout the world should have produced identical audiometric results. That was a milestone; however, the ISO data suggested that the SPL values used for normal hearing on the ASA scale were too high, that is, a person tested on an audiometer calibrated to ASA values who showed a 0-dB threshold would demonstrate about a 10-dB threshold on an ISO-calibrated device. Normal-hearing people actually heard better than was previously thought. In 1969, the American National Standards Institute (ANSI) (previously ASA) published the new American standards for audiometric zero, which were very close to the ISO values. Updated versions of these data have shown very slight changes (ANSI, 1996). The differences in the SPLs required to find threshold according to the ASA and ANSI standards are shown in Table 1, and, once again, vary slightly as a function of frequency and the receivers used.

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Table 1 Differences between the Reference Threshold Levels for Audiometers According to the ASA (1951) and the ANSI (1996) Standards

	Frequency (Hz)									
	250	500	750	1000	1500	2000	3000	4000	6000	8000
Decibels	15	14	14	10	10	10	8.5	6	9.5	11.5

THE PROBLEM

When the ASA standard was in force, interpretation of the upper limit of normal hearing was customarily set at 15 dB HL (e.g., Newby, 1958). Patients whose thresholds were better than 15 dB HL were generally told that they had normal hearing, and those whose thresholds were poorer than 15 dB HL were advised that they had hearing losses that were slight, mild, moderate, moderately severe, severe, or profound. The American Medical Association (AMA) percentage of hearing impairment was devised so that the pure-tone average (PTA) at 500, 1000, and 2000 Hz for each ear was computed, then 15 dB was subtracted from that value (for normal hearing) and the remainder was multiplied by 1.5 percent (AAOO, 1959). Therefore, anyone with a PTA of 15 dB HL or less had a 0 percent hearing impairment and anyone with a PTA of 82 dB HL or greater had a 100 percent hearing impairment. All other PTAs yielded percentages of hearing impairment that were between these extremes.

It appears that something unforeseen happened when the change from ASA to ISO and then to ANSI occurred. Instead of recognizing that the ASA data were too lenient, and that people with normal hearing had better sensitivity than had heretofore been assumed, the interpretation of the audiogram changed. It was decided that 25 or 26 dB should be considered the upper limit of normal hearing sensitivity, thus adhering to the earlier (incorrect) SPL values.

Although many clinicians continue to consider 15 dB HL (re: ANSI, 1996) to be the lower limit of normal hearing sensitivity (e.g., Martin and Clark, 2000), thus advising their patients of this fact, a greater number tell their patients that a 25-dB PTA suggests normal hearing (e.g., Mills, 1978). Clinicians who see patients with audiograms that run between 15 and 25 dB HL are usually seeing those individuals because they complain of difficulty hearing, and these patients may become confused when they are told "You have normal hearing." As a matter of fact, the formula for computing percentage of hearing impairment was modified (AAOO, 1979) to substitute 26 dB for 15 dB HL as the lower limit of normal hearing sensitivity. This meant that 100 percent hearing impairment was reached with a PTA of 92 dB HL, a level that many clinicians would agree can constitute a considerable amount of residual hearing.

SOME DATA

We decided that instead of posing a philosophical position about what hearing level constitutes the upper limit of normal hearing sensitivity, it is only patients experiencing hearing difficulty who could advise us. With this in mind, we sought a system of inquiring into this matter.

In 1997, we contacted a major manufacturer of hearing aids and requested their assistance in answering this question. We asked them to provide us with the number of hearing aids sold, based on the hearing levels of the patients who purchased these instruments. The presumption was that anyone willing to spend money to buy a hearing instrument must be experiencing difficulty in hearing. To our surprise and delight, Starkey Laboratories generated data that were far beyond our hopes and expectations, and we are most grateful to them for this.

Over an unstated period of time, Starkey Laboratories dispensed hearing instruments to 556,026 clients. The breakdown of the numbers and percentages of individuals with different degrees of hearing loss based on their PTAs is shown in Table 2.

The fact that 29,333 (5.3%) of over half a million hearing-aid purchasers whose PTAs were less than 25 dB HL sought assistance in dealing with their hearing impairments is distinct evidence that many people, who may be told that their hearing is normal based on their PTA, would clearly testify that this is not the case. It is very likely that at least some of the clients had depressed hearing at 4000 and 6000 Hz, which may have been the reason for seeking

Table 2 Sales of Hearing Aids to Patients with Differing Degrees of Hearing Loss Over an Undisclosed Period of Time*

Pure-Tone Average (in dB HL)	*Number of Instruments Sold*	*%*
Under 5	865	0.2
5–9.9	1558	0.3
10–14.99	3993	0.7
15–19.9	8076	1.5
20–24.99	14,841	2.7
25–29.99	24,500	4.4
>29.99	502,193	90.3
Total	556,026	100.0

*Pure-tone average, in decibels, at 500, 1000, and 2000 Hz. Data courtesy of Starkey Laboratories.

assistance. The point, however, is that by certain classic schemes, these people are considered to have normal hearing. Our many years of listening to patients complain about their hearing difficulties reinforce this judgment.

CONCLUSION

It is probable that many of the patients who purchased hearing aids whose hearing appears normal based on the PTA probably had hearing losses in the high frequencies. Examination of a patient's audiogram easily reveals these kinds of difficulties, but when the audiometric configuration is ignored and only an average of the thresholds at three or four frequencies is considered in determining whether a patient has a hearing loss, patients may ultimately suffer from misclassification of the severity of their difficulties. It is also possible that some of the people who purchased hearing aids did, in fact, have completely normal hearing but desired amplification for reasons of their own. This is a phenomenon over which no clinician has control.

We do not make this recommendation lightheartedly, but we feel that it is important that agencies such as the Veterans Administration and the military, organizations like the American Academy of Otolaryngology, the American Academy of Audiology, and the American Speech-Language-Hearing Association, and clinicians (physicians and audiologists) reconsider their concept of the amount of hearing loss that constitutes a disability to patients. We believe that returning to the notion that 15 dB HL (ANSI, 1996) should be considered the upper limit of normal makes very good sense. Certainly, adopting this upper limit has important medicolegal implications. Also, the impact such a change would have on the concept of "minimal hearing loss" (e.g., children with otitis media) needs to be fully explored. We do not recommend that everyone with a PTA greater than 15 dB HL should be considered for amplification but rather that their complaints of hearing difficulty be recognized and explored.

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