

Audiometric Baseline Revision: Separate or Single?

By Laurie Wells, MS FAAA – CAOHC Course Director in Colorado

The best method of revising audiometric baselines after either a persistent decrease or improvement in hearing has been an interesting and often debated topic over the years. Recently, there has been renewed interest in the specific issue of whether both ears should be assigned the same baseline audiogram (single-ear baseline or whole-test baseline) or whether each ear should have a separate baseline reference (separate ear baselines). The author maintains that revising baselines for each ear separately is the preferred approach for three reasons: 1) regulatory compliance requirements, 2) hearing loss prevention purposes, and 3) to recognize the value and necessity of binaural hearing. While baseline revision is the responsibility of the professional supervisor (either an audiologist or a physician), it is important for the occupational hearing conservationist (OHC) and the employer to understand the implications of treating baselines as single or separate ear references.

Example Employee Hearing Tests

For this discussion, sample hearing tests of a fictional, noise-exposed employee will be used to compare the single-ear baseline revision approach to the separate-ear baseline revision. The example is presented without age corrections for simplification. As seen in Table 1, the employee has normal hearing in both ears when hired in 2002. On the 2003 annual, the left ear is slightly worse in the STS frequencies, and the right ear shows a persistent STS due to a documented non-work related personal medical condition. The 2004 annual shows additional hearing decrements in the left ear for the STS frequencies and essentially no change in the right ear when compared to the previous 2003 exam.

Table 1: Raw hearing thresholds

kHz	LEFT EAR								STS avg	RIGHT EAR								STS avg
	.5	1	2	3	4	6	8	.5		1	2	3	4	6	8			
2002	10	10	05	00	05	10	05		15	10	10	05	05	00	05			
2003	10	10	05	10	15	10	05	6.7	35	35	30	30	20	25	25	20		
2004	10	10	15	15	25	05	00		40	35	35	25	20	25	20			

Using a single-ear baseline revision approach in Table 2, the baseline is revised to the 2003 test for both left and right ears, due to the persistent STS in the right ear. The 2004 test shows no STS in either ear when the 2003 revised baseline is used for comparison.

Table 2: Single-ear baseline revision (highlighted test is revised baseline)

kHz	LEFT EAR								STS avg	RIGHT EAR								STS avg
	.5	1	2	3	4	6	8	.5		1	2	3	4	6	8			
2002	10	10	05	00	05	10	05		15	10	10	05	05	00	05			
2003	10	10	05	10	15	10	05	6.7	35	35	30	30	20	25	25	20		
2004	10	10	15	15	25	05	00	8.3	40	35	35	25	20	25	20	0		

In contrast, the separate-ear baseline approach is shown in Table 3. The baseline for only the right ear is revised to 2003, and the left ear baseline stays at the original 2002 test. Here, the 2004 annual test shows an STS in the left ear, because it is compared to the original 2002 baseline.

Table 3: Separate-ear baseline revision (highlighted tests are revised baselines)

kHz	LEFT EAR								STS avg	RIGHT EAR								STS avg
	.5	1	2	3	4	6	8	.5		1	2	3	4	6	8			
2002	10	10	05	00	05	10	05		15	10	10	05	05	00	05			
2003	10	10	05	10	15	10	05	6.7	35	35	30	30	20	25	25	20		
2004	10	10	15	15	25	05	00	15	40	35	35	25	20	25	20	0		

The difference between the two approaches is in the identification of the STS on the 2004 annual test for the left ear: there is no left STS (8.3 dB shift) evident when using the 2003 baseline reference (single-ear baseline), however there is an STS (15-dB shift) evident when using the original 2002 baseline reference (separate-ear baseline).

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The OSHA Occupational Noise Standard, CFR 1910.95 (g)(10)(i), and the MSHA Health Standards for Occupational Noise Exposure in Coal, Metal, and Nonmetal Mines, 30 CFR Part 62.101, state: a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000 Hz, 3000 Hz, and 4000 Hz, *in either ear*. In the above example, the single-ear baseline approach does not comply with the OSHA and MSHA requirement to identify STS *in either ear*, because the 2004 STS in the left ear is missed. In order to identify the 2004 STS, there must be a separate baseline reference for the left ear so that the 2004 test is compared to the original 2002 baseline.

To clarify its position on baseline revision, OSHA issued a letter of interpretation on May 8, 2003. The letter states: “When the professional evaluating the audiogram determines that a baseline revision is appropriate, whether due to a persistent STS or improved thresholds, the baseline must be revised for each ear separately.” The entire letter is posted on the CAOHC website (caohc.org) under the section on “OSHA Recordability – Current Issues” or may be accessed directly at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=24565

Hearing Loss Prevention

The purpose of audiometric testing for noise-exposed employees is to allow early identification of temporary threshold shift resulting from over exposure to noise. Timely intervention of employee notification, retraining, and hearing protection fitting will ideally stop the decrease of hearing and prevent a permanent hearing loss. In the example above, the left ear shows a pattern of hearing change consistent with noise exposure between 2002 and 2004. If the STS in 2004 is not identified, because it is compared to the revised 2003 baseline, then intervention will not occur until additional hearing loss is accrued. Late identification leads to hearing conservation programs that *document* hearing loss instead of *preventing* hearing loss.

This position was reinforced by professionals of the National Hearing Conservation Association (NHCA) during the development of the NHCA Professional Guide for Audiometric Baseline Revision in 1996, which stated that “The two ears are examined separately and independently. If one ear meets the criteria for revision of baseline, then the baseline is revised for that ear only. Therefore, if the two ears show different hearing trends, the baseline for the left ear may be from one test date, while the baseline for the right ear may be from a different test date.” The full text of the NHCA document is available at http://www.hearingconservation.org/rs_pos_AudiometricRevision.html

Value of Hearing

Imagine the frustration of an avid bird watcher, who finally hears the long awaited song of a Vermillion Flycatcher, yet is deprived of the pleasure of spotting the colorful bird. It is gone before its location can be identified. Probably everyone, at one time or another, has heard a sound, but couldn't tell where it was coming from. For someone with hearing in only

one ear, or with hearing loss greater in one ear than the other, localizing sound is very difficult if not impossible. Our ability to localize sound depends on having two functioning ears. Another significant benefit of binaural hearing is the ability to better hear and understand speech, particularly in a noisy environment. Just as having vision in two eyes provides depth perception and increases our range of sight, having hearing in both ears facilitates effective communication, enhanced sound quality, and provides protection by permitting early detection and localization of sound sources.

Revising baselines for both ears simultaneously ignores the fact that we have two sensory organs that are affected differently by illness and injury. All animals depend on more than one normal hearing mechanism for their communication and survival. Having two ears gives added function just like having two hands, two feet, two eyes, etc. When monitoring occupational injuries and illnesses for other parts of the body, each part is treated and monitored independently from its counterpart. For example, if an employee loses a finger on the left hand at work, there is a recordable injury to the left hand only. The status of the right hand is not affected by injury to the left hand. Furthermore one can justifiably argue that the undamaged ear (or finger) is even more important to auditory (hand) function creating a greater need to closely monitor the “better” ear (hand) due to the greater dependence on its normal function. If hearing professionals do not treat each ear as separate, independent and vital sensory organs, then the misconception that “one ear is enough” will continue to be perpetuated.

Considerations of Single vs. Separate-Ear Baselines

Some audiometric management software programs have been designed to analyze data using *either* single- or separate-ear baselines. The option is typically chosen during the set-up procedure, determined when the database is established. In some programs, the “default” setting is for single-ear baselines and the user must select separate-ear baselines for each new database. Some programs allow the user to change from single-ear to separate-ear baseline references in an existing database; however the software will move and revise baselines automatically. Re-analysis may create differences in STS identifications and rates. It is critical that baseline references be approved by the professional supervisor and not simply reset by a software program; therefore any change in baseline analysis must be done under the supervision of the physician or audiologist overseeing the audiometric testing program. Baseline references must be documented before and after the change in analysis and historical records maintained.

The use of separate-ear baseline references is the preferred method for providing accurate identification of occupational hearing loss and provides the most protection to the employee. Recognizing each ear as a separate and valuable sensory organ, promotes better awareness and hearing health care. After all, two ears are better than one.

Laurie Wells, MS FAA, Associates in Acoustics, Inc., Evergreen, CO