

A Clinician's Guide to Noise Induced Hearing Loss

Noise-Induced Hearing Loss (NIHL)

Noise induced hearing loss (NIHL) is a hearing loss that typically occurs gradually over time due to prolonged exposure to excessive noise levels greater than 85 decibels (dB). It may also occur from exposure to a very intense sound, such as an explosive blast. This is referred to as an acoustic trauma and usually results in a sudden hearing loss.

NIHL is permanent in nature because excessive noise damages the hair cells of the cochlea, resulting in a sensorineural hearing loss. Noise exposure affects both ears, and usually causes a hearing loss at 3000, 4000 or 6000 Hz. It does not affect the low frequencies.

On an audiogram, the configuration of the hearing loss reveals a distinctive notch, typically greatest at 4000 Hz, sometimes referred to as a "noise notch." As exposure continues, the notch gradually deepens and widens, affecting adjacent frequencies.

NIHL increases most rapidly during the first 10-15 years of exposure with the rate of hearing loss declining over time. This is in contrast to the rate of hearing loss due to presbycusis, or age-related loss, which accelerates over time.

NIHL usually affects both ears equally; but it may result in an asymmetrical hearing loss under unique circumstances. For example, an individual with a history of firearm use may have a greater loss in one ear due to the positioning of the head while shooting which may expose one ear to more noise than the other (the head shadow effect).

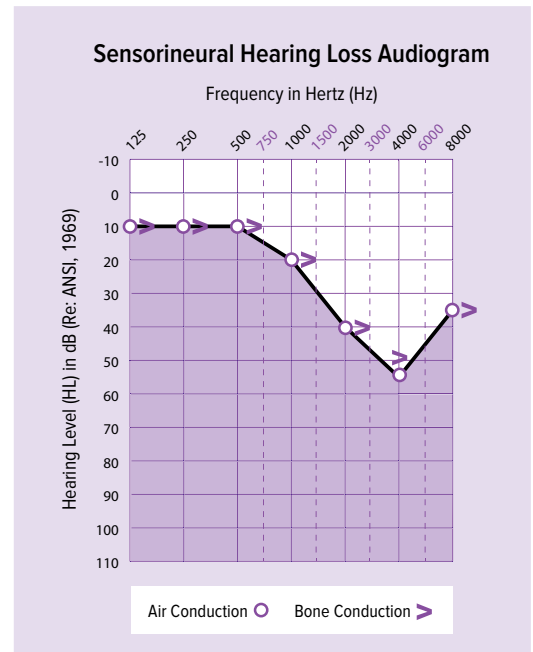
NIHL can be occupational (work-related) or non-occupational. Non-occupational noise exposure can occur at home (e.g., stereos, lawnmowers, power tools) or during recreational activities (e.g., guns, motorcycles, concerts, iPods, ATVs, snowmobiles).

Occupational Noise-Induced Hearing Loss (ONIHL)

To confirm occupational noise induced hearing loss there must be a pattern of hearing loss consistent with noise induced hearing loss and evidence to confirm a clear history of occupational noise exposure, in Alberta, above safe limits.

Within Alberta, the Occupational Exposure Limit for noise is 85 decibels (dBA) averaged over an 8 hour day (the 8 hour time weighted average). This means that for limited periods, a worker may be exposed to higher noise levels as long as the average exposure over eight hours remains lower.

Continuous noise exposure is more damaging than interrupted exposure to noise which permits the ear to have a period of rest and recovery. Noise exposure can be reduced through the use of a variety of hearing protection devices such as earplugs and earmuffs.



http://www.osha.gov/dts/osta/otm/noise/health_effects/sensorineural.html

The risk of occupational noise-induced hearing loss (ONIHL) is low at exposure levels below 85 dB (8-hour time-weighted average) but increases significantly as exposures rise above this level.

Occupational noise induced hearing loss has a very specific pattern on an audiogram and progresses in a predictable manner over time.

To determine whether or not the configuration and progression of the hearing loss are consistent with ONIHL, the WCB considers the following characteristics typical of ONIHL:

- The hearing loss is sensorineural.
- The hearing loss occurs in both ears.
- The hearing loss is similar in both ears.
- The hearing loss is characterized by a notch from 3000-6000 Hz with normal hearing at 250-1000 Hz.
 - The first sign of ONIHL is a “notching” of the audiogram at 3000, 4000 or 6000 Hz with recovery of at least 15 dB in the higher frequencies.
 - As exposure continues, the notch gradually deepens and widens.
 - In the early stages of NIHL, the hearing loss has recovery (i.e. less hearing loss) in the higher frequencies, in contrast to presbycusis, which produces a high-frequency hearing loss in a down-sloping pattern without recovery at the higher frequencies.
- Noise exposure does not produce a loss greater than 40 dBHL in the lower frequencies.
- Noise exposure does not produce a loss greater than 75 dBHL at high frequencies.
- Hearing loss due to noise exposure increases most rapidly during the first 10-15 years of exposure. The rate of hearing loss decelerates as the hearing thresholds increase.
- Noise induced hearing loss does not progress after noise exposure is discontinued.
- Word recognition is fairly good (greater than 75 per cent).

The WCB also considers the following characteristics which are not typical of ONIHL:

- The presence of hearing loss in the low to mid frequencies (250-100 Hz).
- A “flat” loss (hearing loss that is fairly constant or “flat” across frequencies).
- A profound hearing loss (>80 dB).
- A hearing loss that is asymmetric; greater in one ear.
- Rapid hearing loss late in a working career (ONIHL develops gradually, but most rapidly in the first 10-15 years of exposure).
- Significant hearing loss progression in spite of appropriate hearing protection.
- Hearing deterioration post-noise exposure (ONIHL does not progress once the hazardous exposure has stopped. Hearing loss experienced well after the noise exposure occurred is unlikely to be related to the noise exposure).
- The risk of ONIHL is low at exposure levels below 85 dB (8-hour time-weighted average).

To establish a cause and effect relationship between noise exposure and hearing loss, the configuration of the audiogram must be consistent with the characteristics of occupational noise induced hearing loss. Additional factors that are considered include:

- **Test–retest reliability.** This is the variation in measurements taken by a single person or instrument on the same item and under the same conditions. The “minimally reliable measurable difference” for accuracy during testing is 5-10 dB. This means that thresholds may vary by 5 to 10 dB between hearing tests. Five dB of recovery is not sufficient recovery to constitute a noise notch because it falls within the “standard error of measurement”. The minimal clinically important difference (MCID) for thresholds testing at a specific frequency is 15 dB.
- **Other causes of notching.** The 4000 Hz dip seen on pure tone audiograms is often observed in the early stages of noise-induced hearing loss, or acoustic trauma. However, not all notches are caused by noise exposure. A notch can occur with various diseases (such as viral infections), head injuries, hereditary hearing loss, ototoxicity, acoustic trauma, acoustic neuroma, perilymphatic fistulas, and barotrauma. In many cases the cause is unknown.

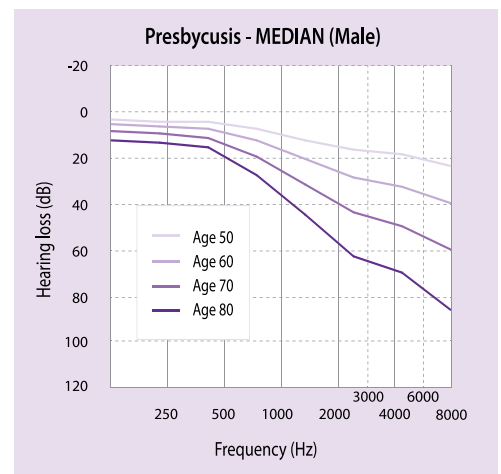
Presbycusis (Age-Related hearing Loss)

Most people eventually develop presbycusis, or age-related hearing loss. It is a progressive, bilateral, symmetrical, sensorineural hearing loss. It affects high frequencies more than low, and men earlier than women.

The ISO 7029 standard provides expected threshold changes due purely to age for carefully screened populations (i.e. excluding those with ear disease, noise exposure etc.), based on a meta-analysis of published data. On an audiogram, presbycusis is characterized by a downward sloping high frequency sensorineural loss.

There are many causes of presbycusis. Most commonly it arises from changes in the inner ear of a person as he or she ages, but presbycusis can also result from changes in the middle ear or from complex changes along the nerve pathways leading to the brain.

Age-related hearing loss due to presbycusis is gradual; however, the rate of hearing loss due to presbycusis accelerates over time, especially after age 60. Many individuals do not recognize their age-related loss until later in life. By age 80, there is typically no difference in hearing between a noise exposed and a non-noise exposed individual.



Determining entitlement

There are a number of causes of sensorineural hearing loss besides occupational noise exposure including recreational noise exposure, diseases, genetics and aging (presbycusis). A claim for ONIHL hearing loss may be accepted by WCB-Alberta when:

- The pattern of hearing loss shown on the audiogram is consistent with NIHL, and
- There is a clear history of prolonged occupational noise exposure in excess of the Occupational Exposure Limit while the worker was working in Alberta or was entitled to coverage under WCB-Alberta while working in a place other than Alberta.

References:

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4. Nondahl D, Xiaoyu S, Cruickshanks K, Dalton D, et al. Notched audiograms and noise exposure history in older adults. *Ear Hear*. 2009;30:1-8.
5. http://www.osha.gov/dts/osta/otm/noise/health_effects/sensorineural.html
6. ISO 7029. Acoustics – statistical distribution of hearing thresholds as a function of age, Geneva, Switzerland: International Organization for Standardization, 2000