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# NIHL-Shape of the Audiogram – Part 2

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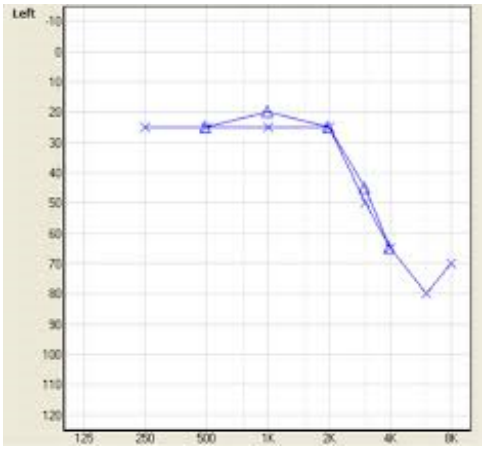
The "shape" or configuration of the sensori-neural hearing loss, at least in worker's compensation board claims for noise exposure, is one of the base elements for deciding whether a hearing loss is indeed a noise induced hearing loss. Yet, not all audiograms of workers exposed to high levels of noise (or music) have a "notched" audiogram with the greatest hearing loss being in the 3000-6000 Hz frequency region.




Dr. David Barrs, MD, who is now with the Mayo Clinic in Rochester, MN, did some interesting work earlier in his career. [2]. Barrs and his colleagues found that only 37% of those workers who were exposed to noise and had a sensori-neural hearing loss had an audiometric notch in the 3000-6000 Hz frequency region.

They attributed this to a number of potential reasons such as presbycusis which over time reduced the 6000 Hz and 8000 Hz acuity such that the upper frequency end of the notch was flattened out. Nevertheless, not having an audiometric notch does not prevent a diagnosis of noise exposure, and conversely, having an audiometric notch does not mean that the hearing loss was noise induced.

As we will see below, the studies about the various proposed reasons for why the greatest hearing loss is in the 3000-6000 Hz region reads as an historical novel with contributions from as far back as 1934.

Since these original studies (which were in some cases, mere opinion) a number of "position" papers and consensus group statements have been attempting to place these historical works in their proper current clinical contexts. Among others, these include ACOEM Guidance Statement for Occupational Hearing Loss, (2012) from the American College of Environmental Medicine. which stated, among other things, that the audiometric notch could vary depending on the spectrum of the noise source as well as the shape (but primarily the length) of the ear canal.

Another excellent review for those who are interested in further reading is an article entitled "5

Myths in Assessing NIHL" (from Audiologyonline.com). This article deals with, as the name suggests, 5 myths about NIHL and one of them is about the symmetrical versus asymmetrical shapes of the audiogram. This remains a highly contested area, not because there is debate on whether this actually occurs (it does) but how a worker who has an asymmetrical hearing loss should be compensated- should the better hearing thresholds be used, or some weighted combination of the two ears?

And finally, for those who are more interested in musicians, I have a nice review article about some of these issues, also at www.audiologyonline.com.

Here is a synopsis of the studies about the various potential reasons about the NIHL notch. Several explanations have been proposed for this audiometric notch over the past almost 80 years but to date, there is no one accepted explanation; it is a frequently observed audiometric shape (but not the only noise induced shape):

Crow, Guild, and Polvagat, 1934 have shown that part of the explanation may be related to a poorer blood supply in the cochlea that corresponds to the 3000-6000 Hz region;

Bohne, 1976 showed that there is a greater susceptibility for damage of the supporting structures of the cochlear hair cells in the 3000-6000 Hz region;

Hilding, 1953, and Schuknecht and Tonndorf, 1960 showed that the orientation of the stapes footplate in the middle ear, into the inner ear is such that the primary force vector aims towards those cochlear hair cells in the 3000-6000 Hz region, with the effect of eventual failure because of the constant hydro-mechanical action; and

Tonndorf, 1976, and Caiazzo and Tonndorf, 1977, have shown that permanent noise exposure has its greatest effect approximately one half octave above the peak frequency of the noise spectrum, and since the "peak" is typically that of an adult's ear canal resonance (at 2700 Hz), the greatest hearing loss will be the 4000-6000 Hz region.

Despite the age of these references, there are no more modern data that contradict these findings or suppositions.

## Footnote

Barrs, D., Althoff, L., Krueger, W., & Olsson, J. (1994). Work-related, noise induced hearing loss: Evaluation including evoked potential audiometry. Otolaryngology- Head and Neck Surgery, 110(2), 177-184.