

# OTOACOUSTIC EMISSIONS AND HIGH - FREQUENCY AUDIOMETRY IN THE ASSESSMENT OF NOISE-INDUCED HEARING LOSS

W.J. Sulkowski, W.Matyja, M.Sward-Matyja, S.Kowalska

ENT& Audiology Division, Nofer Institute of Occupational Medicine, Lodz, Poland

**Introduction** Hearing loss caused by noise is incurable but preventable and thus the regular monitoring of workers' hearing is important.

Recently, the data are reported that the high-frequency audiometry (HFA) i.e. pure-tone audiometry (PTA) extended over the range of 8000 Hz, as well as otoacoustic emissions (sounds measured in the external ear canal that reflect nonlinear and active processes in the cochlea) can be used as a sensitive measure for detection of noise-induced cochlear damage (1,2,3,4).

The goal of presented study was to examine the usefulness of the above two modern tests for preclinical early identification of hearing loss.

**Material and methods** The study included 196 workers aged 18-51 years, employed in a metal industry plant for the period ranging from 4 months to 37 years and exposed to the noise levels of Leq 89 dB-A. The controls comprised 46 age-matched individuals.

While waiting for the hearing testing all subjects were examined by the ENT physician and special individual questionnaire was completed to exclude those with ear pathology and other confounding factors.

Next, the routine pure-tone audiometric tests extended into the frequencies range 1000 and 12000 Hz were performed; the distortion-product otoacoustic emissions (DPOAEs) were recorded on both ears using the MAICO ERO-SCAN analyzer. The DPOAE test consisted of simultaneous presenting two primary tones at frequencies f1 and f2 and the amplitudes of evoked emissions were measured at f2 frequencies of 1500, 2000, 3000, 4000 and 6000 Hz.

The findings were statistically estimated using the linear correlation coefficient and the non-parametric tests: Spearman range correlation and Tau-Kendall test.

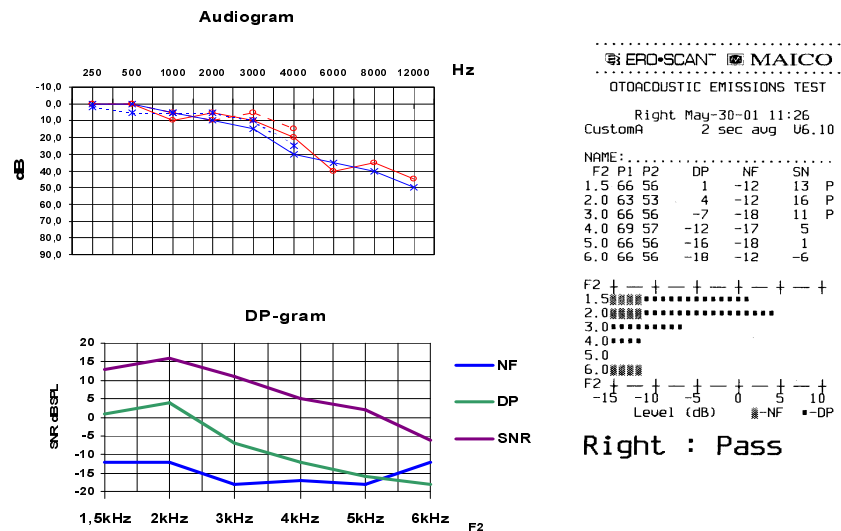
**Results and conclusions** The results of this study revealed the occurrence of bilateral sensorineural hearing loss of various degree in 68% of noise-exposed subjects (see an example in Fig. 1) vs slightly elevated pure-tone thresholds in 7% of controls.

The hearing loss have increased gradually with duration of the noise exposure and consequently with age of workers.

The DPOAEs were present only in persons with pure-tone hearing thresholds down to 50 dB and their reduced amplitudes were well correlated with the audiometric thresholds close to f2. In some cases of normal audiograms (17%) obtained from workers with a short employment ( $\leq 3$  years) the predictions of cochlear lesion reflected by subtle alterations in DPOAEs were found.

Usually, the DPOAEs changes were accompanied in those workers by the elevation of high-frequency hearing thresholds in the HFA range of 10000-12000Hz, not evident in the routine audiometry.

It may be concluded therefore that both the distortion-product emission test and the high-frequency audiometry provide an early indication of cochlear damage from noise which may be overlooked in the routine pure-tone audiometry.



**Fig. 1.** Noise-induced hearing loss recognized in 45 years old man (P.S.) occupationally exposed to noise for 10 years.

**Keywords:** noise-induced hearing loss, distortion product otoacoustic emissions, high-frequency audiometry

#### References:

1. Attias J, Bresloff I, Reshef I, Horowitz G, Furman V: Evaluating noise-induced hearing loss with distortion product otoacoustic emissions. *Br J Audiol* 1998, 32, 39-43.
2. Hallmo P, Borchgrevink H M, Mair I W S: Extended high-frequency thresholds in noise-induced hearing loss. *Scand Audiol* 1995, 24, 47-53.
3. Kowalska S, Sulkowski W J: Measurements of otoacoustic emissions in industrial workers with noise-induced hearing loss. *Inter J Occup Med Environ Health* 1997, 10, 441-446.
4. Prasher D, Sulkowski W J: The role of otoacoustic emissions in screening and evaluation of noise damage. *Inter J Occup Med Environ Health* 1999, 12, 183-192.