



email id: subhu21sahoo@gmail.com

TESTS OF SUSCEPTIBILITY

Subhasmita Sahoo (MASLP)
Assist .Prof ,Dept of Audiology
IHS, Bhubaneswar

TABLE OF CONTENTS

- ❑ Test of Susceptibility
- ❑ Introduction to Noise Susceptibility
 1. By measuring temporary threshold shift.
 2. Aural Harmonic test.
 3. By Comparison.
 4. By determining temporary threshold shift.
 5. Can OAE be used for measuring susceptibility of NIHL.

➤ Noise Susceptibility or Individual susceptibility towards NIHL

- Estimate suggests that, 30 million person in the United States are exposed to dangerous sound levels each day (NIDCD, 1998)
- Hearing loss is highly vulnerable; some individuals appear to be vulnerable, while others are resistant to NIHL
- Based on available data, the NIOSH (1996) [National Institute for Occupation Safety and Health] calculated that 15% of workers exposed to noise level 85dB will develop hearing impairment over their lives.

- Many references have been made in the literature to TOUGH and TENDER ears. Referring to differences in degree of susceptibility.
- There are ears that can be referred as TOUGH ears which can sustain themselves in noisy environment. And others can be referred as TENDER ears which are more susceptible to NIHL.
- There is great vulnerability in the amount of NIHL suffered between people exposed to same level of noise.
- Two people in the same environment can have quite different degrees of hearing loss.

- Considerable attention has been focused on the problems of identifying those individuals, who when placed in the noisy environment could be susceptible to NIHL while other remain unaffected with hearing loss in same noisy environment.
- If such individuals could be identified, they could be assigned less noisy work environment or at least could be provided with best possible **Ear Protective Devices** when working in noisy area.
- Numerous attempts have been made to devices tests for susceptibility that could be administered at the time when baseline/reference audiogram is obtained.

➤ There are following factors that have been noted with an increased susceptibility to NIHL

1. Hyperlipidemia
2. Ototoxic drugs
3. Family history
4. Vascular disease
5. Diabetes mellitus
6. Meniere's disease
7. Iron deficiency
8. Atherosclerosis
9. Presbycusis
10. Intoxication in the form of tobacco, smoking or alcohol

➤ The overall pattern of NIHL is influenced by the following factors:

1. Overall intensity of noise in dB.
2. Temporal pattern of noise.
 - Continuous
 - Intermittent
 - Transient
3. Spectral pattern of noise i.e. frequency component.
4. Overall duration of exposure to the noise i.e. Time Weighted Average (TWA).
5. Individual susceptibility to noise.

TESTS OF SUSCEPTIBILITY

- Attempts have been made to devise tests for susceptibility that could be administered at the time of baseline audiogram. they include:-

1) By measuring Temporary Threshold Shift

- First routine audiometric tests are conducted and thresholds are obtained and then the subject is presented fatiguing stimulus (FS), either pure tone or wideband noise.
- After a prescribed level of exposure to the subject's threshold at same frequency (specially for 4KHz) is measured immediately after the cessation of FS.
- The individual who incur greater amount of threshold shift and the longest time for his threshold to return to normal is presumed to be more susceptible person to contract permanent irreversible hearing impairment if placed in the noisy environment for working longer duration time.

2) Aural Harmonic test of Lawrence and Blanchar

- This test attempt to determine the minimum intensity at which the responses of the ear at a particular frequency becomes distorted or non-linear and produces harmonics.
- This test is based on the assumption that at some times as the intensity is increased the ear will overload i.e. unable to respond without distorting and distortion is manifested by progression of aural harmonics i.e. multiples of the stimulus frequency.
- Lawrence and Blanchar believed that when an ear is driven into non-linearity by a high intensity stimulus and this condition that produces distortion into the ear is allowed to persist for any considerable length of time which will result in breakdown of auditory system.

- This presence of aural harmonics can be detected by introducing the second tone in the ear, known as Probe tone. This probe tone is exactly twice the frequency of original stimulus. If a probe tone will interact with aural harmonics to produce the sensation of beats.
Ex; stimulus tone (ST)=1001 or 1002 hz and probe 2002 or 2004 hz.
- The client is instructed to adjust the loudness up and down in relation to each others until he hears beats.
- ST is presented at suprathreshold level and probe should be presented in the same earphone at 60 dB and above.
- The best beat is considered which is produced at the rate of 4 seconds.

- The tester gradually decreases intensity until beats disappear. Again the subjects has to rearrange the ST and probe tone until beats are produced
- This step is repeated 3-4 times until beats finally disappear. The hearing level of 1001 Hz and 1002 Hz finally disappear; the hearing level of 1001 Hz or 1002 Hz tone at which beats finally disappear is considered to be the threshold of non-linearity.
- Earlier the non-linearity even at the lower intensity of the stimulus is required to produced breakdown in the auditory system.
- In the light of the above, it can be said that non-linearity threshold is directly proportional to susceptible.

3) By Comparison

- comparing the results of periodic audiological examination, the estimate can be made of how the employee is being affected by the noisy working environment over the period time.
- Comparison can be made of subsequent audiological reports if one is having pre-employment testing i.e “baseline audiogram”.
- Periodic tests are performed at an annual interval for the worker working in the noisy environment greater or equal to 85 dBA.
- Follow up audiogram or retesting can be made more frequently like 6 months as per regulations practiced in that particular condition and the shift in the baseline is obtained or Hearing Loss is observed.
- The employee is subjected to further medical audiological evaluation to determine etiology of Hearing Loss.

4) By determining TTS

- To determine TTS of the employee's hearing he is taken away from noisy environment for 14 hours or wears EPD's for 14 hours prior to the baseline audiogram.
- Then he is exposed to the noisy environment and tested for the threshold shift after working in the noisy environment.
- AAOO recommended that a change in hearing threshold is considered to be significant if the threshold in either ears worsen by 10dB and more at the frequencies 500 Hz, 1KHz, 2 KHz, 4KHz and 6KHz.
- AAOO also recommended threshold shift of 15 dB at 500 Hz, 1 KHz & 2KHz or 20 dB at 3KHz or more than 30 dB at 6KHz, then it warrants medical intervention to prevent damage to hearing.

- Several investigator had found that individual with high pre-exposure hearing level will incur less TTS to a given exposure than individuals with good hearing.
- Kryter believes that the best index of susceptibility is that the subject is to be exposed continuously for 2 minutes and after exposure of 2 minutes, threshold shift and threshold shift after 2 minute of exposure.
- $NITTS = HL2 - HL1$.

5) Can OAE be used for measuring susceptibility of NIHL

- Currently to identify the risk of NIHL in the industrial worker much more attention has given to the test called “OAE”.
- OAE are the sound produced by the inner ear that are measured in the ear canal with the specific microphone; the presence of OAE’s in the ear canal indicates the activity of OHC’s in the cochlea.
- The OHC’s of cochlea are known to have greater sensitivity to excessive noise exposure. Clinically, it is known to us that normal ear produces OAE’s while noise damaged ears produces smaller OAE’s or none at all because of the damage to the OHC’s and surrounding structures.

- Lapsley, Miller and Marshal (2007), have shown that a average OAE's may decreases after noise exposure before significant elevation in the hearing threshold, moreover, they also studied the group of normal hearing individual who were regularly exposed to the hazardous noise level tend to have lower OAE's than similar group of normal hearing people without such exposure; thus, it can be inferred that low level OAE's may predict susceptibility to future NIHL.
- In the longitudinal study with 338 volunteers audiometric thresholds and OAE were measured after 6 month of noise exposure on an aircraft carrier, while the average amplitude of the OAE's decrease significantly. There were no change in average audiometric threshold. Furthermore, there were no significant correlation between the change in audiometric threshold and changes in OAE's and DP-OAE were moderately correlated. In this study, the best predictor was TE-OAE.

- Amplitude in the 4KHz half octave frequency band with risk increasing more than 6 fold or from 3% to 20% as the emission amplitude decreased. In this study, the OAE's was successful indicating noise induced changes in the Inner Ear which were undetected by audiometric tests, OAE may therefore, be a diagnostic indicator or predictor for NIHL.
- The biggest benefit that OAE provide over the audiometric test is that changes in OAE's may be detected long before than the changes in the Psychoacoustic level.
- This allow us to effectively implement hearing conservation program which may prevent hearing damages.
- TE-OAE's and DP-OAE's are most frequently applied tests for the purpose of screening hearing loss and predicting susceptibility of noise exposure.
- DP-OAE's predict hearing threshold at Mild to Moderate degree of Hearing Losses.

