Noise Induced Hearing loss
Prevention, diagnosis and management

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29th Alexandria International Combined ORL Congress

A Noisy Work Place
Noise as a Problem

- Noise induced hearing loss (NIHL) is a reduction in hearing associated with exposure to noise
- NIHL is a preventable cause of deafness
- It can be temporary – Temporary Thresholds Shift (TTS) or permanent - Permanent Thresholds Shift (PTS)
- It can be caused by steady or impulse noise

Acoustic trauma

- Acoustic trauma is when a single intense sound causes immediate hearing loss
- Mainly from impulse noise arising from gunshots, explosions and blasts
- No TTS
- Causes direct mechanical injury to the cochlea
Pathology

- Metabolic mechanisms
- Structural mechanisms
- Apoptosis and necrosis
- Genetic susceptibility with some individuals have tough ears and others have tender ears
Recreational Noise Exposure

- Personal Stereos, I.Pods, Mp3 players
- Night clubs
- Playing in bands/orchestras
- Shooting
- Motorcycling
- Motorboats

Prevention of NIHL

- Education
- Equipments
- Regulations
UK Noise Regulations

• 1963 saw the first official notification that working in high noise levels can cause hearing loss
• 1972 Code of Practice recommended a noise limit of 90dB(A) for 8 hours shift
• 1974 Health & Safety Act. Employers are under a legal obligation to minimize risks to employees

UK Noise Regulation

• 1990 Europe-wide legislation on noise got onto the statute book and 85dB(A) was recognised as the hazard level

• 2006 Control of Noise at Work Regulations introduced lower action level of (80dB $L_{EP,d}$) and upper action level of (85dB $L_{EP,d}$) as well as exposure limit values (87dB $L_{EP,d}$)
Annual Hearing Tests to Monitor Effectiveness

Reduction to the Source of Noise

- Noisy machines can be enclosed to ↓noise
- Change machines to the ones emitting the least possible noise
- Regular maintenance for machines
- Change the design and layout of workplace
Reduction to Noise Exposure

• Limitation of the time of Exposure
• Adequate rest period as interruption significantly decrease the amount of damage
• Health and Safety training

Provide & Maintain Personal Ear Protection
Expected Attenuation Values

<table>
<thead>
<tr>
<th>Type of hearing protection</th>
<th>Attenuation (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry cotton wool</td>
<td>0</td>
</tr>
<tr>
<td>Waxed cotton wool</td>
<td>5</td>
</tr>
<tr>
<td>Soft plastic earplugs</td>
<td>10</td>
</tr>
<tr>
<td>Personalised earmoulds</td>
<td>10</td>
</tr>
<tr>
<td>Glass down earplugs (e.g. Bilsom range)</td>
<td>15</td>
</tr>
<tr>
<td>Plastic foam earplugs (e.g. EAR range)</td>
<td>15</td>
</tr>
<tr>
<td>Earmuffs</td>
<td>20</td>
</tr>
</tbody>
</table>

Ear Muffs- Advantages

- Difficult to loose (important in food packaging factories)
- Easy to fit properly
- Provides the best attenuation
- For very high noise levels earmuffs and earplugs can be worn together.
Ear Muffs- Disadvantages

• Interfere with wearing spectacles or other personal protective equipment (e.g. Helmets)
• Can be uncomfortable so not suitable for prolonged use
• Interfere with communication
• Expensive

Mark Hearing Protection Zones
Educate The Workforce

Diagnosis

- History of noise exposure including work, military, leisure and hobbies
- NIHL is usually associated with tinnitus
- Post-shifts hearing loss or Tinnitus
- Right or left handed, Even exposure?
- Significant head injury
- Meningitis
- Drugs history looking for ototoxicity
- Family history of HL
**Diagnosis**

- Otoscopy
- Pure tone audiogram including 3 & 6 kHz
- Sound proof room
- Noise free >16 hours
- Analyse any previous hearing tests

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**Diagnostic Requirements-R1**

- High Frequency SNHL.
- Hearing Threshold Level (HTL) at 3, 4 or 6kHz is at least 10 dB more than the HTL at 1 or 2kHz
- When Telephonics TDH-39 audiometer earphones used, subtract 6dB from HTL at 6kHz\(^1\)

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Diagnostic Requirements-R2

- Noise exposure
- Intensity
- Duration
- Frequency spectrum
- Use of hearing protection

Diagnostic Requirements-R3

- Audiometric configuration
- High frequency Notch, HTL at 3 and/or 4 and/or 6kHz is at least 10 dB more than 1 or 2 kHz and at 6 or 8 kHz.
- High frequency Bulge, HTL at 3 and/or 4 and/or 6kHz is at least 10 dB greater relative to the comparison values for age-related hearing loss
Effect of Ageing on Pre-existing NIHL

Figure 1: Hearing Sensitivity of Males by Decade. (Details about the graph and data representation are not provided in the image.)

Figure 2: Slight variation in sensitivity across different frequency ranges for males in various age groups.
Management

- Prevention
- Education
- Hearing aids and hearing tactics
- Assistive listening devices
- Tinnitus Retraining therapy

NIHL – nearing the end.....

- Any Questions?
Grading Tinnitus Severity

- Guidelines (McCombe et al) suggest five grades of severity. The numbers in brackets related to scores on the self-report Tinnitus Handicap Inventory (THI) questionnaire.
- Grade 1 - slight (THI 0-16)
  Only heard in quiet environment, very easily masked. No interference with sleep or daily activities. This grading should cover most people who are experiencing but are not troubled by tinnitus.
- Grade 2 - mild (THI 18-36)
  Easily masked by environmental sound and easily forgotten with activities. May occasionally interfere with sleep but not daily activities.
- Grade 3 - moderate (THI 38-56)
  May be noticed even in the presence of background or environmental noise although daily activities may still be performed. Less noticeable when concentrating. Not infrequently interferes with sleep and quiet activities.
- The majority of people suffering tinnitus should fall into grades 2 and 3.
Grading Tinnitus Severity

• Grade 4 - severe (THI 56-100)
  Almost always heard, rarely if ever masked. Leads to disturbed sleep pattern and can interfere with ability to carry out normal daily activities. Quiet activities adversely affected. Hearing loss is likely to be present. Grading in this group should be uncommon.

• Grade 5 - catastrophic (56-100)
  All tinnitus symptoms at level of severe or worse. Hearing loss likely to be present. Associated psychological pathology is likely to be found in hospital or GP records. Grading in this group should be extremely rare.
In the absence of other strong competing factors, a high frequency notch (HFN) in a pure tone audiogram can support a diagnosis of probable occupational noise induced hearing loss (ONIHL) in an individual with a history of sufficient exposure to excessive noise. Although supportive, a HFN is not diagnostic of ONIHL because the features can be observed in other pathologies (Luxon, 1998).
Coles et al (2000) set out guidelines for the diagnosis of ONIHL in medico-legal practice. The guidelines state that a HFN can be diagnosed if a hearing threshold level (HTL) at 3 and/or 4 and/or 6 kHz was at least 10 dB greater than at 1 or 2 kHz and at 6 or 8 kHz, after any correction for earphone type (Lutman & Qasem, 1998).

Osei-Lah & Yeoh (2010) found that a HFN not attributable to noise exposure or any other factor is common.

Osman & Kay (yet to be published) found

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Diagnosis

• Diagnosis is based on the balance of probability or, in other words, more likely than not
• There should be a quantitative relationship between the amount of alleged exposure and the hearing level
• Look out for non-organic hearing loss, some may require cortical electric response audiometry
• Apportionment

Essential requirements

• Pure tone audiometry
• Otoscopy
• Diagnosis of probable cause (multiple causes may exist)
• Quantification of impairment, disability and handicap due to hearing loss and tinnitus
• Estimation of any constitutional impairment
• Apportionment
Main References

• Google images
Sources of noise

- Industrial
- Military
- Leisure
- Hobbies
- Accidents

A noisy work place!
Even noisier

The Ear
Inner ear hair cells

Damaged hair cells
Effect of Occupational Noise

- Intensity
- Duration
- Frequency spectrum
- Source of Noise – impulse/constant
- Sensitivity of subject
- Use of hearing protection

NIHL at 90 and 100 dBA

Figure 8.4: Progression of NIPTS for 90 and 100 dB(A) (median data, ISO-1999 (1990) reproduced with kind permission).
Diagnosis

• Type and duration of ear protection worn
• If no acoustic engineer’s report estimate noise levels: was a shout required to be heard etc.

Hearing Conservation Programme

• Evaluate and identify risk
• Reduce the exposure to noise
• Enforce the programme
• Annual hearing tests to monitor effectiveness