Upper Limb Musculoskeletal Disorders: Identification & Control of Physical Stress

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Work Factors Associated with Upper Limb Cumulative Trauma Disorders

1. Repeated or sustained exertions
2. Forceful exertions
3. Localized mechanical stresses
4. Posture stresses
5. Low temperatures
6. Vibration

Exposure-Response

Response
(Pain, Fatigue, Myalgia, Tendinitis, etc.)

Factor I + II

Factor I

Background Level

Exposure (Repetition, Force, Contact, Posture)

Localized Contact Stress

Mechanical stresses resulting from contact between the body and external objects, e.g., tools, parts, workstation

Stress, \( \sigma = \frac{F}{A} \)

Force
- \( F \) (pounds or Newtons)

Area
- \( A \) (inches\(^2\) or meters\(^2\))

pounds / inches\(^2\) or Newtons / meter\(^2\)

Stress Calculations

\( \sigma = \frac{F}{A} \)

Sitting on a flat surface (10 in x 10 in)
\( \sigma = \frac{100 \text{ lb}}{100 \text{ in}^2} = 1.0 \text{ psi} \)

Sitting on a rail (1 in x 10 in)
\( \sigma = \frac{100 \text{ lb}}{10 \text{ in}^2} = 10.0 \text{ psi} \)

Sitting on a nail (0.1 in diameter)
\( \sigma = \frac{100 \text{ lb}}{0.008 \text{ in}^2} = 12,500 \text{ psi} \)

- Pressure applied using 1cm² probe to surface of hand --- External Applied Surface Pressure
  - Pressure Pain Threshold
  - Acceptable EASP for 8 hours
- Subjects
  - 8 females 19-46 years
  - 8 males 24-42 years

**Pressure Pain Thresholds**

<table>
<thead>
<tr>
<th>Pressure Pain Thresholds</th>
<th>Estimated acceptable surface pressure for 8 hrs</th>
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</thead>
<tbody>
<tr>
<td>PIT of the right hand</td>
<td></td>
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</table>

**Identification and Evaluation of Contact Stresses**

1. Describe work method as a sequence of steps or elements
2. Inspect each work element for contact between workers and: parts, tools, equipment, work stations, arm rests, etc.
3. Calculate or rate stress based on force and area of contact

**Rate Contact Stresses**

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<thead>
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<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fingers</td>
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<tr>
<td>Wrist-Palm</td>
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<td>Forearm</td>
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<tr>
<td>Elbows</td>
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</table>

**Peak**
- highest stress occurring during each cycle or task

**Average**
- time weighted stress over entire cycle or task

**Discomfort**

**Control Recommendations**

1. Avoid stress concentrations over underlying nerves and tendons
2. Distribute loads over as large an area as possible for a given task
3. Cushion all surfaces and corners that come into contact with the body
4. Locate work so that the body does not contact sharp edges
Upper Limb Musculoskeletal Disorders - Analysis and Control of Physical Stresses

Scissors

Stress concentration on median nerve

Stresses spread out along handle

Callous from stress concentration

Pivot Action Pliers

References