Ergonomics Intervention in the TFT-LCD Module Assembly Process

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Introduction

- Many researches indicated many ergonomics factors in work environment would induce musculoskeletal injuries factors
- They are:
  - Forceful exertions
  - Awkward postures
  - Localized contract stresses
  - Repetitive motions
  - Prolonged activities
  - Restless
Introduction

- Ergonomic Checklists are used to identify ergonomic risk factors in work environment

- The checklist has been used to evaluate:
  - Workers’ posture
  - Working stress
  - Duration of task
  - Frequency of motion
Introduction

- BRIEF is the abbreviation of the Baseline Risk Identification of Ergonomic Factors

- Identified the risk of MSD in the segment of body
  - Basing on the rating rules of BRIEF checklist
  - The rating number was larger than 2
Objective

- Survey the work-related musculoskeletal disorders
- Evaluate ergonomics hazards in job and work station
- Proposal improvements
Subject

- Module assembly operators of TFT-LCD factory in the Southern Taiwan
Module Assembly Operators
Method

- A cross-sectional study

Tools:
- Questionnaire
- Ergonomics job analysis
- BRIEF Checklist
Method

- Used modified NMQ questionnaire

- To collect the information of
  - Demographic data
  - Working years
  - Sports habits
  - Musculoskeletal disorders (segment, frequency)
Questionnaire

LCM 場人員肌肉骨骼調查問卷

問卷結構：

A 基本資料
1. 員工姓名：_____________ 員工編號：_____________
2. 性別： □ (1) 男 □ (2) 女
3. 年齡：______歲 身高：______公分 體重：______公斤
4. 工作職別：_____________
   □ (1) 卸料開關 □ (2) B/L 開關 □ (3) 電動開關 □ (4) 電動開關 □ (5) OLB
   □ (6) OLB 檢驗 □ (7) silicon □ (8) 半田簿記 □ (9) 半田機器 PCB
   □ (10) 達克替替 □ (11) B/L 機器 □ (12) 小型機器 □ (13) 機器機器
   □ (14) C 型銑床 □ (15) AGING □ (16) CJ □ (17) CJ 機器 □ (18) CI
   □ (19) QA(F1) □ (20) QA(C1) □ (21) 內包 □ (22) 外包
   □ (23) 塑料機器 □ (24) 乙酸
6. 數字程度： □ (1) 高中 □ (2) 職業 □ (3) 大學 □ (4) 見點
7. 請問您是否長年運動？ (每週 3 次以上，每次 15 分鐘以上) □ (1) 否 □ (2) 是
8. 請問您在職業訓練如何？ (可複選)
   □ (1) 正常 □ (2) 低頭 □ (3) 高頭 □ (4) 低頭 □ (5) 低頭 □ (6) 低頭 □ (7) 低頭 □ (8) 低頭 □ (9) 低頭
9. 風鈴及是否有下列疾病？ (可複選)
   □ (1) 頸部 □ (2) 肩部 □ (3) 背部 □ (4) 頸部 □ (5) 背部 □ (6) 背部 □ (7) 背部 □ (8) 背部 □ (9) 背部 □ (10) 背部 □ (11) 其他
10. 請問您從事這份工作多久了？________年________月

B 肌肉骨骼現況
1. 請問您是否曾經因同志造成肌肉骨骼方面不適？ □ (1) 無 □ (2) 有
   □ (3) 沒有 □ (4) 不太確定 □ (5) 可能有 □ (6) 有

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Method

- Ergonomics job analysis
  - The motion of module assembling procedures:
    - Binding, typing, inspecting TFT-LCD glass, moving glass, pulling material...etc
  - Analysis these steps
  - Point out the potential ergonomics hazards in these steps
Method

- Based on the results of ergonomic job analysis
  - Investigators filled the lists of BRIEF checklist for each operator

- All data analysis was performed using the SPSS 10.0
Results
## Result - Questionnaire

### Demographic data of operators

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Yr)</td>
<td>26.8</td>
<td>4.6</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>57.4</td>
<td>13.2</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>161.8</td>
<td>7.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Category</th>
<th>Number (N)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>70</td>
<td>24.9</td>
</tr>
<tr>
<td>Female</td>
<td>211</td>
<td>75.1</td>
</tr>
<tr>
<td>Level of Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height school</td>
<td>195</td>
<td>69.4</td>
</tr>
<tr>
<td>College</td>
<td>75</td>
<td>26.7</td>
</tr>
<tr>
<td>University</td>
<td>11</td>
<td>3.9</td>
</tr>
<tr>
<td>Exercise (Y/N)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>58</td>
<td>20.6</td>
</tr>
<tr>
<td>No</td>
<td>223</td>
<td>79.4</td>
</tr>
</tbody>
</table>
Questionnaire (Gender)

- Male: 75%
- Female: 25%
Questionnaire (Level of education)

- High school: 69%
- College: 27%
- University: 4%
Questionnaire (Exercise)

- Yes: 79%
- No: 21%
## Result - MSD by self-report

Percentage of musculoskeletal disorders by self-report

<table>
<thead>
<tr>
<th>Position</th>
<th>Number</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>139</td>
<td>49.5</td>
</tr>
<tr>
<td>Shoulder</td>
<td>168</td>
<td>59.8</td>
</tr>
<tr>
<td>Up-back</td>
<td>86</td>
<td>30.6</td>
</tr>
<tr>
<td>Elbow</td>
<td>54</td>
<td>19.2</td>
</tr>
<tr>
<td>Low-back</td>
<td>74</td>
<td>26.3</td>
</tr>
<tr>
<td>Wrist</td>
<td>111</td>
<td>39.5</td>
</tr>
<tr>
<td>Hand</td>
<td>57</td>
<td>20.3</td>
</tr>
<tr>
<td>Hip</td>
<td>26</td>
<td>9.3</td>
</tr>
<tr>
<td>Leg</td>
<td>37</td>
<td>13.2</td>
</tr>
<tr>
<td>Knee</td>
<td>36</td>
<td>12.8</td>
</tr>
<tr>
<td>Shank</td>
<td>75</td>
<td>26.7</td>
</tr>
<tr>
<td>Ankle</td>
<td>55</td>
<td>19.6</td>
</tr>
<tr>
<td>Others</td>
<td>1</td>
<td>0.4</td>
</tr>
</tbody>
</table>
# Result - Analysis of BRIEF

Percentage and number of MSDs per segment in BRIEF checklist

<table>
<thead>
<tr>
<th>segment of body</th>
<th>number</th>
<th>percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>135</td>
<td>100.0</td>
</tr>
<tr>
<td>Back</td>
<td>112</td>
<td>83.0</td>
</tr>
<tr>
<td>Right shoulder</td>
<td>75</td>
<td>55.5</td>
</tr>
<tr>
<td>Left shoulder</td>
<td>66</td>
<td>48.8</td>
</tr>
<tr>
<td>Right hand &amp; wrist</td>
<td>48</td>
<td>35.6</td>
</tr>
<tr>
<td>Left hand &amp; wrist</td>
<td>25</td>
<td>18.5</td>
</tr>
<tr>
<td>Legs</td>
<td>8</td>
<td>5.9</td>
</tr>
<tr>
<td>Right elbow</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Left elbow</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
## Result

<table>
<thead>
<tr>
<th>Item</th>
<th>Have MSD Number (Percentage)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 20</td>
<td>16 (57.1)</td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>144 (74.6)</td>
<td>0.151</td>
</tr>
<tr>
<td>More than 30</td>
<td>42 (73.7)</td>
<td></td>
</tr>
<tr>
<td><strong>Work experience</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1month-3month</td>
<td>17 (54.8)</td>
<td>0.001</td>
</tr>
<tr>
<td>4month-1year</td>
<td>55 (61.8)</td>
<td></td>
</tr>
<tr>
<td>1year-2year</td>
<td>21 (77.8)</td>
<td></td>
</tr>
<tr>
<td>2year-3year</td>
<td>27 (87.1)</td>
<td></td>
</tr>
<tr>
<td>3year-4year</td>
<td>37 (90.2)</td>
<td></td>
</tr>
<tr>
<td>4year-5year</td>
<td>38 (79.2)</td>
<td></td>
</tr>
<tr>
<td>More than 5year</td>
<td>10 (76.9)</td>
<td></td>
</tr>
</tbody>
</table>
Discussion (Percentage of MSD)

- MSD prevalence:
  - Research by the Institute of Occupational Safety and Health found 63.3% 
  - In this study was 73%
Discussion - Questionnaires survey

- The MSD results different reasons might be:
  - The questionnaire and the types of industry were different
  - The operators in module assembly process need long time and repetitive activities
Discussion - BRIEF checklist

- Percentage of MSD by segment
  - 100% (Neck)
  - 83.0% (Back)
  - 55.5% (Right shoulder)
  - 48.8% (Left shoulder)
Discussion

- BRIEF checklist can indicate whether there are have higher MSD risks in work environment

- But in some segments may be over-counted
  - The BRIEF checklist indicates all risk factors but the subjects may not have the symptoms of MSD
  - The symptoms of MSD (pain, ache, …etc) is more like a objective information than subjective information
Discussion

- This research shall be continued to examine these risk factors by biomechanics.

- The ergonomic approach of reengineering and process revising will be installed.
Recommendations
Recommendations

- Redesign work station
- Revise standard operation procedure
- Administration
Conclusions

- Priority areas
  - Shoulder 76.7%
  - Neck 62.9%
  - Wrist 52.9 %
Conclusions

- In assembly process, we propose that tasks should be taken apart to reduce frequency of using hand and wrist.

- In the light-on process, we recommend:
  1. Lowering operation height by changing operation position or the workstation height
  2. Adopting the wrist support during operation
  3. Arranging all hand tools in a suit place.
Conclusions

- In packing process, we suggest introducing an automatic machine to reduce the manpower or adjusting workstation height.

- In administration, we propose to establish an anthropometry database and to select the suitable personnel.
Thanks for your attention!!

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