Biomechanics and Load in the WorkHab Functional Capacity Evaluation: An Update

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FCE: 2018
Effect of Load on Biomechanics in the WorkHab FCE

• Safe Maximal Lift = maximum load that an individual is able to safely lift.

Purpose:

• To evaluate any change in biomechanics between safe minimum and safe maximum lifts during the WorkHab FCE.
Effect of Load on Biomechanics in the WorkHab FCE Method:

**Method:**
- Experimental laboratory based study

**Sample:**
- 30 healthy volunteers

**Health Questionnaire, BP**
- 3 min step test
- Joints marked – foam ball/ink

**Wrist, Elbow, Shoulder, Hip, Knee, Ankle, Spinous processes:**
- C7, T7, L3, S2

**Digital recording of lifting component**
- Rear Coronal + Right sagittal planes

**Darfish ProSuite**
- Min + Max lift
- Lift ÷ 1/3rds
- Calculation of joint angles

**Data analysis:**
- Descriptive + Paired t-test
Angles

Ankle  Knee  Hip  Lumbar  Spine  Elbow  Shoulder

89.7°  132.1°  146.6°  164.2°
# Effect of Load on Biomechanics in the WorkHab FCE

## Results – Overhead lift

<table>
<thead>
<tr>
<th>Joint</th>
<th>0/3</th>
<th>1/3</th>
<th>2/3</th>
<th>3/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulnar deviation</td>
<td>0.007</td>
<td>0.016</td>
<td>0.004</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>0.023</td>
<td>0.005</td>
<td>0.004</td>
<td>#</td>
</tr>
<tr>
<td>Shoulder</td>
<td>0.007</td>
<td>0.0036</td>
<td>#</td>
<td>0.038</td>
</tr>
<tr>
<td>Thoracic extension</td>
<td>#</td>
<td>0.05</td>
<td>#</td>
<td>0.001</td>
</tr>
<tr>
<td>Lumbar extension</td>
<td>#</td>
<td>#</td>
<td>0.027</td>
<td>0.003</td>
</tr>
</tbody>
</table>
Effect of Load on Biomechanics in the WorkHab FCE Results – Floor to Bench Lift

Red = Floor to Bench (P values)

<table>
<thead>
<tr>
<th>Joint</th>
<th>0/3</th>
<th>1/3</th>
<th>2/3</th>
<th>3/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar flexion</td>
<td>0.001(d)</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>Hip flexion</td>
<td>&lt;0.001(d)</td>
<td>0.021(a)</td>
<td>&lt;0.007(d)</td>
<td>&lt;0.001(d)</td>
</tr>
<tr>
<td>Knee flexion</td>
<td>0.027(a)</td>
<td>0.005(d)</td>
<td>#</td>
<td>0.004(d)</td>
</tr>
<tr>
<td>Ankle</td>
<td>&lt;0.001(a)</td>
<td>0.019(d)</td>
<td>0.001(d)</td>
<td>&lt;0.001(d+a)</td>
</tr>
</tbody>
</table>
Effect of Load on Biomechanics in the WorkHab FCE

Results – Bench to Shoulder Lift

<table>
<thead>
<tr>
<th>Joint</th>
<th>0/3</th>
<th>1/3</th>
<th>2/3</th>
<th>3/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar extension</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>Elbow</td>
<td>0.000 (d)</td>
<td>0.008 (a)</td>
<td>#</td>
<td>0.009 (a)(d)</td>
</tr>
<tr>
<td>Shoulder</td>
<td>0.000 (d)</td>
<td>#</td>
<td>#</td>
<td>0.000 (a)</td>
</tr>
<tr>
<td>Thoracic extension</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>0.004(a)</td>
</tr>
</tbody>
</table>

Blue = Bench to Shoulder (P values)
Effect of Load on Biomechanics in the WorkHab FCE

Discussion – Overhead lift

**Ulnar deviation:**
- peaked at 36.16 degrees two thirds of the way through the lift
- participants reaching end range during their safe maximal lift

**Elbow:**
- Participants inclined to keep the load closer to their body when it was heavier by increasing elbow flexion

**Shoulder:**
- Shoulder flexion increased despite the overhead lift height remaining the same

**Thoracic and Lumbar Spines**
- Both in increased extension in parts of the maximum lift

**Hip, Knee and Ankle**
- Lack of findings
Effect of Load on Biomechanics in the WorkHab FCE Discussion – *Floor to bench lift*

**Lumbar**
- less hyperextended when lifting maximum weights.
- start point of the descending phase where weights were being lifted off the bench = significant difference

**The hip**
- ↑ flexion when lifting the load from the bench (0/3 point of the descending phase) and placing the load back on the bench (2/3 and 3/3 points of the ascending phase).
- more likely to be in hyperextension when lifting min vs max wgts.

**Knee**
- minimal changes are noticed in knee joint angle between minimum and maximum lift.

**Ankle joint**
- reduction in dorsiflexion when lifting maximum weights
Lumbar

- No significant difference in lumbar spine extension ascending or descending

Elbow

- ↓ flexion at 1/3 ascending
- ↑ flexion 3/3 ascending and 0/3 descending – highest point, harder to keep close to body

Shoulder

- ↑ flexion 3/3 ascending and 0/3 descending – highest point, harder to keep close to body

Thoracic

- ↑ extension at 3/3 ascending – longer lever arm
Effect of Load on Biomechanics in the WorkHab FCE Discussion

Kinematic changes important in determining SML
Elbow and shoulder flexion – OH
Hip, Ankle, lumbar – FB
Elbow and shoulder – BS

Changes in joint angles support assessors clinical reasoning and observations of SML

Consideration of handle placement with lifting
Effect of Load on Biomechanics in the WorkHab FCE

References:


