Whole-body composition influences postural control with the arms playing a key role in the regulation of standing balance [1, 2]. Nearly half of persons with upper limb (UL) loss fall once per year [3] and prosthesis use may impose a postural disturbance [1, 3]. Understanding the effects of wearing an UL prosthesis on balance may inform intervention strategies to enhance postural control.

**Purpose:** Evaluate the acute effects of wearing an UL prosthesis on standing balance, particularly the impact of matching the mass of the impaired (prosthetic) limb to the sound limb.

**Methods**

**Design:** Repeated-measures study; 11 subjects with unilateral UL loss (8 transradial/3 transhumeral; 50±18yrs; 175.1±7.4cm; 79.6±22.6kg).

**Experimental Protocol**
Three trials of 30 seconds of quiet standing under three prosthesis conditions:
1) Without wearing a prosthesis;
2) Wearing the subject's customary prosthesis; and
3) Wearing a mock prosthesis that matched the mass of the impaired (prosthetic) limb to the sound limb.

**Equipment and Data Analysis**
- **Equipment:** 2 embedded force plates that collect instantaneous Center-of-Pressure (COP) location.
- **Measures:**
  - Mean COP anterior-posterior/medial-lateral (AP/ML) range, and sway area for each side (impaired, sound).
  - Sway area estimated using the Khachiyan Ellipsoid Algorithm with a tolerance of 0.001 cm.
  - Symmetry Index estimated weight distribution between sides (>0=sound side bias; <0=impaired side bias).
- **Fallers** defined as falling at least once in past 12 months.
- **Mixed ANCOVAs** performed on COP range, sway area, and Symmetry Index (side*condition*Faller/Non-Faller group).

**Results**

<table>
<thead>
<tr>
<th></th>
<th>AP COP Range (cm)</th>
<th>Medial-Lateral COP Range</th>
<th>COP Sway Area</th>
<th>Symmetry Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>2</td>
<td>0.3</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Customary</td>
<td>3</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Mock</td>
<td>4</td>
<td>0.8</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td><strong>p-value</strong></td>
<td>0.013</td>
<td>0.028</td>
<td>0.011</td>
<td>0.008</td>
</tr>
</tbody>
</table>

Error Bars = 95% Confidence Interval; p-values correspond to between-condition analyses.

**Conclusions**

- Wearing an UL prosthesis may improve weight symmetry in persons with unilateral UL loss, but generally increased COP excursion.
- Increased COP excursion reflects greater sway of the whole-body center-of-mass and increased demands on postural control [4].
- No difference in COP parameters were significant (p ≥ 0.07) between subjects categorized as Fallers or Non-Fallers.
- Further research is needed to explore relationships between COP excursion and fall risk in persons with UL loss.

**References**


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