The Effects of Trunk and Lower Extremity Strength on Optimal Landing Mechanics During a One-Legged Drop Landing Task in Air Force Special Tactics Operators

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BACKGROUND

Air Force Special Tactics Operators perform missions that require operational tasks such as maneuvering over obstacles, traversing uneven terrain, and dismounting vehicles. Examples of operational tasks are shown in Figures 1-2. Operators often land from such tasks with one leg and with a tactical load, potentially compounding injury risk. Suboptimal trunk and lower extremity strength measures may lead to improper landing mechanics, particularly with single leg strategies.

METHODS

The purpose of this study was to determine the relationship between lower extremity and trunk isokinetic strength and landing mechanics in healthy male Operators.

SUBJECTS

A total of 128 male Air Force Special Tactics Operators participated in this study:
- Age = 27.7 ± 5.2 years
- Height = 177.6 ± 5.9 cm
- Mass = 83.8 ± 8.3 kg

INTERVENTIONS:

- Isokinetic strength was measured using an isokinetic dynamometer (Figures 3-4)
- Biomechanical analysis of a single leg landing from a 46 cm height was captured using a 3D motion capture system (Figures 5-6)

EQUIPMENT:

- Biodex System 4 (Biodex Medical Systems, Inc, Shirley, NY)
- 3D Video-Based Motion Analysis System (Vicon Motion Systems, Centennial, CO)

MAIN OUTCOME MEASURES:

- Dependent variables: Average peak torque (normalized to body weight) and time to peak torque (TTPT) for knee flexion, knee extension, trunk flexion, and trunk extension
- Biomechanical variables were collected at initial contact (IC) and included hip abduction, hip flexion, knee flexion, knee valgus/varus, peak vertical ground reaction force, and time to peak vertical ground reaction force

STATISTICAL ANALYSIS:

- Analyses were conducted on the right leg only. Correlations between the dependent and independent variables were examined using Spearman’s rho with significance set at p<0.05 a priori. Data were not normally distributed

RESULTS

- Pairwise comparisons revealed significant correlations between the variables outlined in Table 1 and Table 2

SUMMARY AND CONCLUSIONS

- The current study revealed few correlations between lower extremity strength and the drop landing task
- Trunk strength was shown to be most related to landing mechanics, yet still shows a weak relationship between the two
- Lower extremity strength did not appear to be related to landing mechanics
- The results of the current study indicate that landing mechanics may be influenced by other factors not examined in this study such as flexibility, neuromuscular control, and proprioception
- More research is warranted to determine if modifiable musculoskeletal factors that influence movement patterns can be changed to encourage optimal landing biomechanics

Table 1. Hip Abduction at Initial Contact

<table>
<thead>
<tr>
<th>Knee extension average peak torque</th>
<th>r value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip abduction at IC</td>
<td>0.206</td>
<td>0.023</td>
</tr>
<tr>
<td>Hip flexion at IC</td>
<td>0.225</td>
<td>0.013</td>
</tr>
</tbody>
</table>

Table 2. Hip Flexion at Initial Contact

<table>
<thead>
<tr>
<th>Knee extension TTPT</th>
<th>r value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip flexion at IC</td>
<td>0.209</td>
<td>0.020</td>
</tr>
<tr>
<td>Trunk flexion TTPT</td>
<td>0.258</td>
<td>0.004</td>
</tr>
</tbody>
</table>

**Figures 1-2: Operational tasks**

**Figures 3-4: Isokinetic strength testing**

**Figures 5-6: 3D Biomechanical testing**