The Effect of a Cognitive Task on Lower Extremity Biomechanics and Performance during Landing

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Overview

- Background on ACL injuries
  - History and prevalence

- The current study
  - Methods
  - Results/discussion

- Future directions for research
Severity and Prevalence of ACL Injury

- ACL injuries represent about 3% of all athletic injuries (Hootman & Agel, 2007)
  - Approximately 200,000 injuries annually (Dai et al., 2012).
  - 70% are non-contact (Boden, et al., 2000)
  - Women more susceptible

- Incomplete recovery from surgical intervention (Busfield et al., 2009)
  - Only 44% of athletes return to competitive sport (Ardern et al., 2011)
  - Only 63% return to pre-injury functioning

- Focus needs to be on prevention
Mechanisms of Non-Contact ACL Injury

Large forces on the knee load the ACL

- Initial Knee Flexion
- Knee Valgus
- Peak Vertical Ground Reaction Force
Effect of Cognitive Tasks

Research suggests:
- Injured athletes typically demonstrate unbalanced posture at time of landing (Krosshaug, et al., 2007)
- Cognitive tasks alter landing biomechanics and performance (Stephenson, 2015).

- Sports are dynamic environments
  - Athletes are required to react to stimuli
The Current Study

Purpose:
- to examine the effect of a secondary cognitive task on lower extremity biomechanics and performance during a jump-landing task.

Hypothesis:
- Subjects will land with:
  - Decreased knee flexion
  - Increased vertical ground reaction force
  - Decreased jump height
  - Increased stance time
Subjects

26 total subjects: 17M, 9F
- Age: 21.6 ± 1.3 years
- Height: 1.78 ± 8.7 m
- Mass: 75.6 ± 13.0 kg

Inclusion criteria

Exclusion Criteria

Retro-reflective marker placement
Testing Procedure

- Standardized warm-up
- Jump a distance equal to one half body height
- Immediately perform a countermovement jump for max height
- Three conditions
  - No cognitive task
  - Count backwards by 1
  - Count backwards by 7
Data Analysis

- Variables analyzed
  - Knee flexion angle at initial contact
  - Total knee ROM during first landing
  - Peak VGRF during first 100ms
  - Jump height
  - Stance time (time between initial contact and vertical jump)

- Statistical Analysis
  - Paired T-test
  - Type I error rate set at 0.05 for statistical analysis
## Results

Table 1: Descriptive Data (Means ± Standard Deviations) of Biomechanical and Performance Variables.

<table>
<thead>
<tr>
<th></th>
<th>Initial Knee Flex (deg)</th>
<th>Knee Flexion ROM (deg)</th>
<th>Peak VGRF (BW)</th>
<th>Jump Height (m)</th>
<th>Stance Time (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Cognitive Task</td>
<td>26.9 ± 6.5 *</td>
<td>79.9 ± 18.1 *</td>
<td>2.53 ± 0.52 *</td>
<td>0.47 ± 0.11 *</td>
<td>567.1 ± 152.3 *</td>
</tr>
<tr>
<td>Counting by One</td>
<td>24.5 ± 6.1 *</td>
<td>82.6 ± 17.1 *</td>
<td>2.79 ± 0.87 *</td>
<td>0.44 ± 0.11 *</td>
<td>593.3 ± 141.6 *</td>
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<tr>
<td>Counting by Seven</td>
<td>25.7 ± 7.6</td>
<td>83.7 ± 16.8 ^</td>
<td>2.66 ± 0.79</td>
<td>0.43 ± 0.11 ^</td>
<td>590.5 ± 140.1 ^</td>
</tr>
</tbody>
</table>

ROM: range of motion; VGRF: vertical ground reaction force; BW: body weight; * and ^: Significant differences between two conditions with the same symbol.
Discussion and Future Research

- The addition of a cognitive task CAN alter jumping mechanics and performance
  - Decreased performance
  - Increased risk for ACL injury

- Future directions for research
  - Incorporate more sport-specific cognitive tasks
  - Lab settings may not be representative of actual injury risk – incorporate cognitive component
References


