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

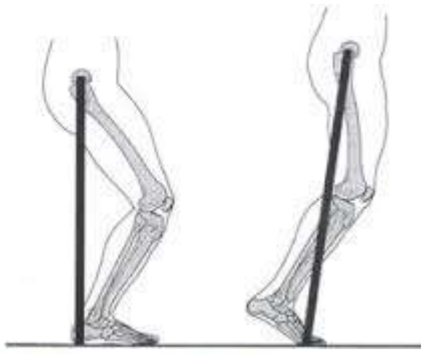
Severity and Prevalence of ACL Injury

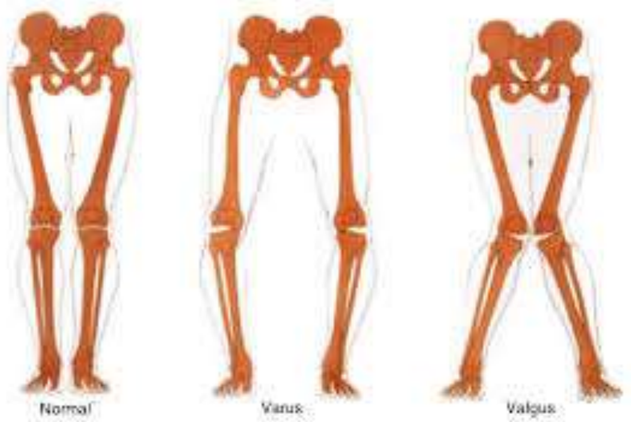
- ACL injuries represent about 3% of all athletic injuries (Hootman & Agel, 2007)
  - Approximately 200,000 injuries annually (Dai et al., 2012).
  - 70% are non-contact (Boden, et al., 2000)
  - Women more susceptible
- Incomplete recovery from surgical intervention (Busfield et al., 2009)
  - Only 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





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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

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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

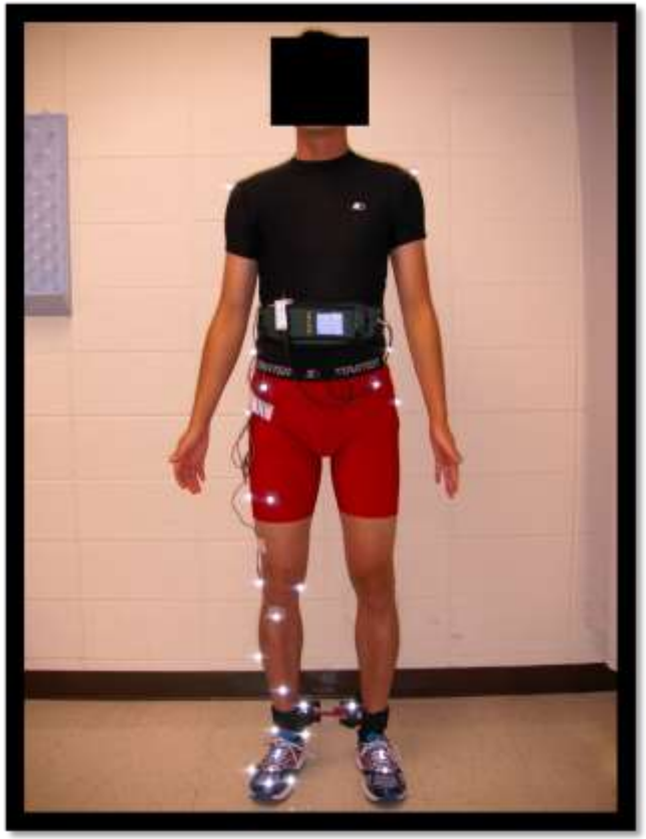
26 total subjects: 17M, 9F

- Age: 21.6 ± 1.3 years
- Height: 1.78 ± 8.7 m
- Mass: 75.6 ± 13.0 kg

Inclusion criteria

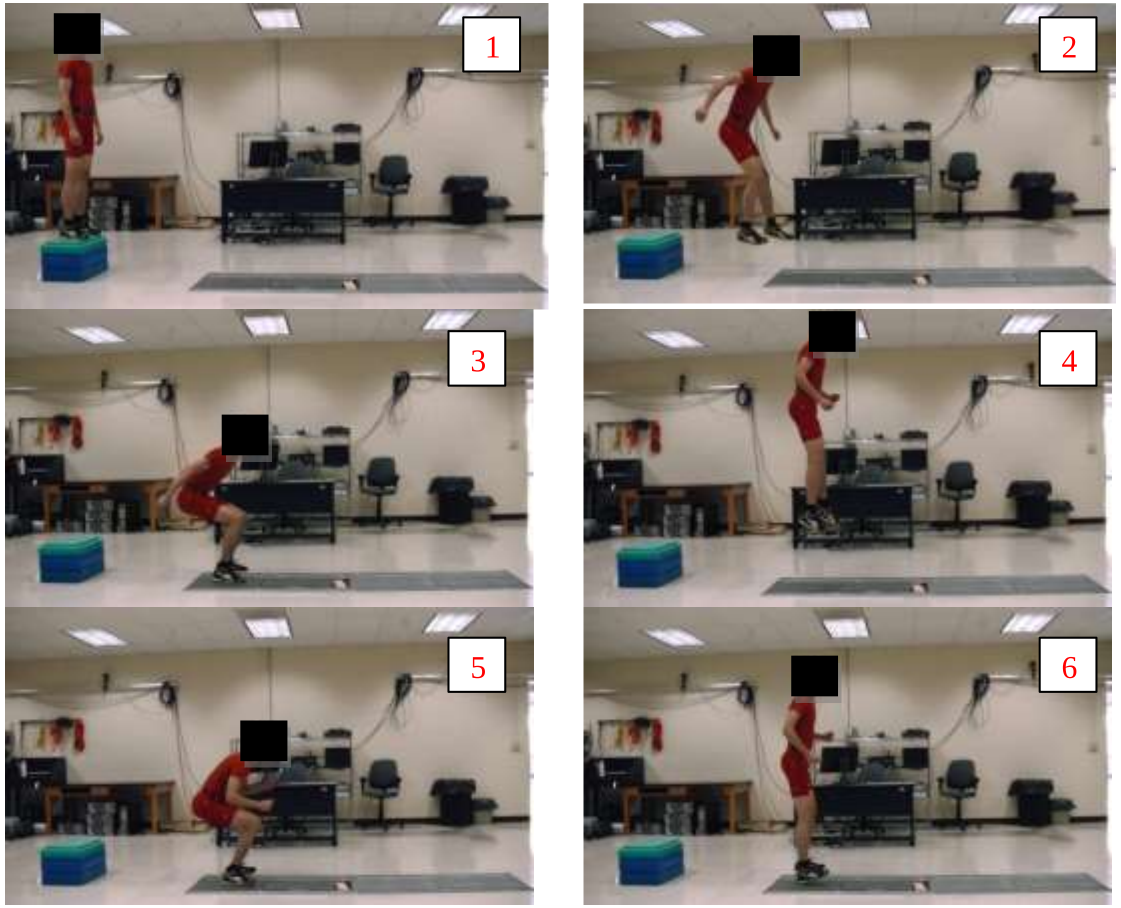
Exclusion Criteria

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.

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

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

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