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

First Author (yourself), Co-authors and Affiliation(s)

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Name: ___ Yvonne Sciascia ______ Advisor: ____ Boyi Dai ____________
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The Effect of a Cognitive Task on Lower Extremity Biomechanics and Performance during Landing

Introduction/Purpose

Anterior cruciate ligament (ACL) injuries commonly occur during jump-landing tasks when excessive loads are placed on the knee [1]. In sports that are performed in an open environment, jump-landing tasks are performed simultaneously with cognitive tasks. The allocation of attention to the sports environment may result in altered landing patterns associated with greater ACL loading.

Previously, researchers have studied the effect of choice-reaction tasks on jump-landing mechanics, during which individuals focus on a stimulus and react to the stimulus for a subsequent jump-landing task [2]. A recent study has shown that the available time of reaction could significantly affect lower extremity biomechanics and performance during landing [3]. The effect of allocation of attention alone on jump-landing mechanics, however, is still unclear.

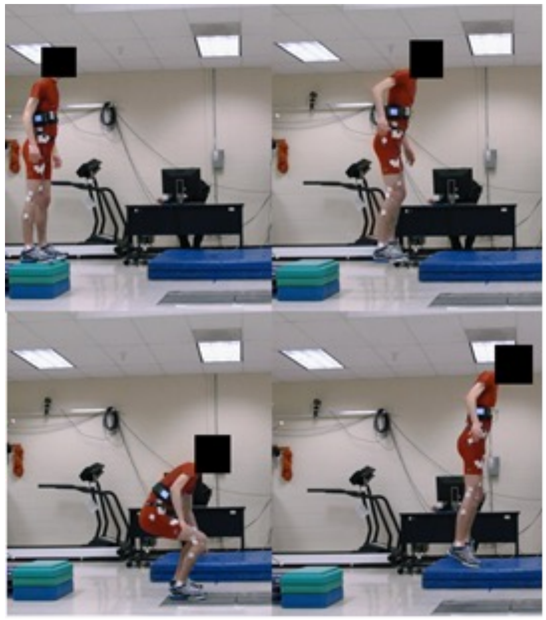
The purpose of this study was to examine the effect of a secondary cognitive task on lower extremity biomechanics and performance during a landing task. It was hypothesized that individuals would land with decreased knee flexion angles, increase impact vertical ground reaction forces (VGRF), decreased jump height, and increased stance time with the addition of a cognitive task.

Methodology

Seventeen male and nine female recreational athletes (age: 21.6 ± 1.3 yr.; height: 1.78 ± 8.7 m; mass: 75.6 ± 13.0 kg) participated in this study. Participants performed three successful trials of a jump-landing task in each condition: l: no cognitive task; 2. counting backwards by intervals of one; and 3. counting backwards by intervals of seven [4]. In each condition, subjects jumped forward off of a 30-cm box a distance equal to one half of their height. They landed with the foot of their dominant leg on a force plate and immediately jumped vertically for maximum height [3].

In the cognitive task conditions, subjects were given a randomly generated number and were instructed to count for the duration of the jump-landing task by intervals of either one or seven [4]. Subjects were required to count at least one correct number by intervals of seven, and two correct numbers by intervals of one. The order of three testing conditions was randomized. Participants' landing kinematics and VGRF were captured using eight Vicon cameras and a Bertex force plate.

Participants' knee flexion angles at initial contact, knee flexion range of motion during the stance phase, peak VGRF, jump height, and stance time were extracted for analysis. Repeated-measure ANOVAs with the landing condition as a within-participant factor were performed for each dependent variable. A significant ANOVA test was followed by paired-wise comparisons using 95% confidence interval. A type I error rate was established at 0.05 for statistical significance.



The jump-landing task

Results

Paired-wise comparisons (Table 1) showed that counting backwards by intervals of one resulted in decreased knee flexion angles at initial contact, increased knee flexion range of motion (Figure 2), increased peak VGRF (Figure 1), decreased jump height, and increased stance time compared with the no cognitive task condition. Counting backwards by intervals of seven resulted in increased knee flexion range of motion (Figure 2), decreased jump height, and increased stance time compared with the no cognitive task condition.

Table 1: Means ± Standard Deviations of Biomechanical and Performance Variables.

	Initial Knee Flexion (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

The decreased knee flexion angle at initial contact and increased vertical ground reaction force during the condition of counting backwards by intervals of one have been shown to be associated with increased ACL loading [5]. These changes suggest that the allocation of attention to the secondary task result in perturbation to the preferred jump-landing control patterns. Counting backwards by one and counting backwards by seven did not appear to lead to the same changes in landing mechanics. This may be attributed to the perceived difficulty of the task and corresponding allocation of attention. While the cognitive task in the current study could be easily implemented, future studies may develop sports specific cognitive tasks.

Implications

Performing a secondary cognitive task concurrently with a jump-landing task altered lower extremity biomechanics and decreased jump performance. Future studies may consider incorporating a cognitive task into current jump-landing protocols for ACL injury risk screening. The findings of the current study also have implications for jump performance assessment.

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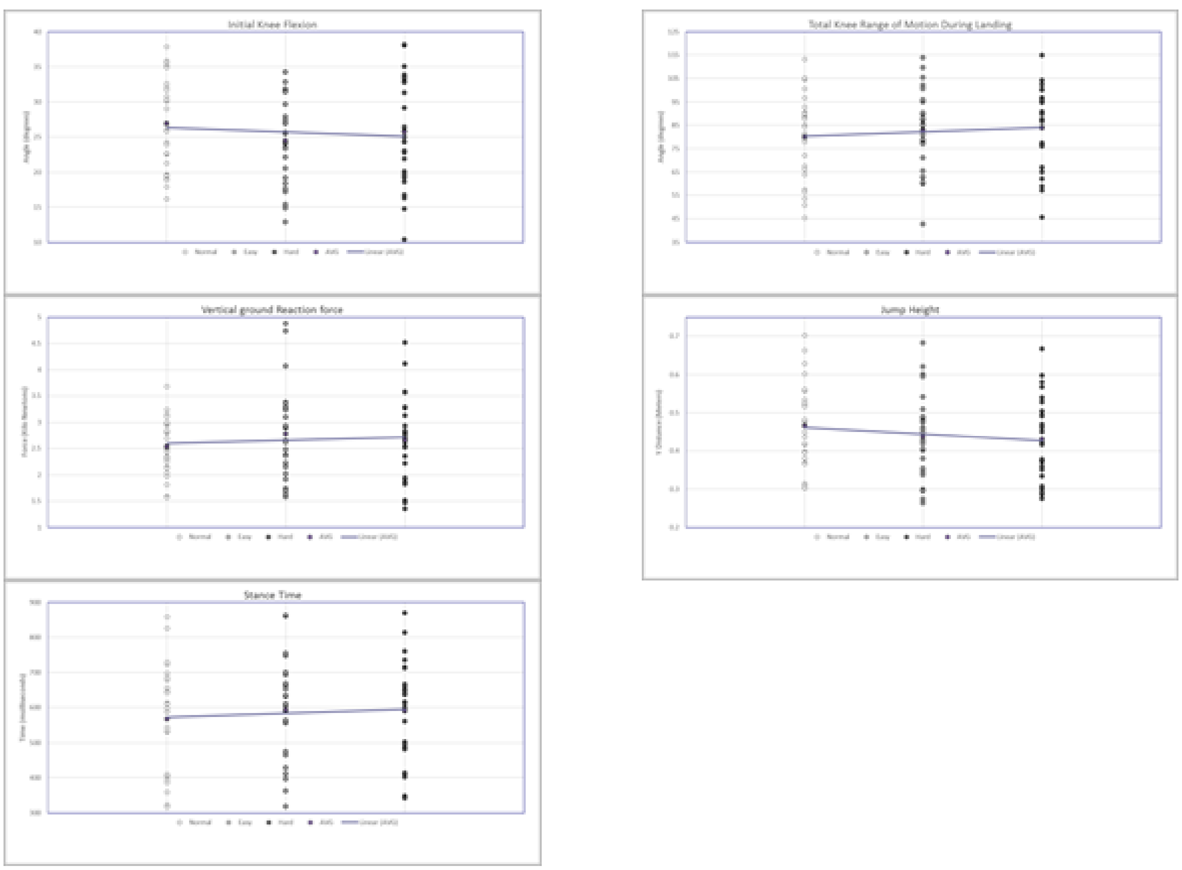

Figures of changes in dependent variables