

# Impact of cognitive load on knee kinematics during the landing of a squat-jump in ACL-recovered individuals

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## Summary

Individuals fully recovered from an anterior cruciate ligament injury still exhibit reduced movement quality and neurocognitive performance. This impairment can affect their ability to perform complex motor tasks, like dual-tasks. Therefore, this pilot study aimed to compare knee kinematics during squat-jumps in dual-task and single-task conditions in individuals fully recovered from an anterior cruciate ligament injury. Participants performed squat-jumps during an exergame (dual-task), while counting backwards by three (dual-task), and without additional cognitive task (single-task). Differences between the tasks were analyzed using a repeated-measures analysis of variance. The results showed no significant differences in knee flexion and knee valgus angles between the tasks, with large variability observed in all conditions. These findings suggest that movement adaptations when adding a cognitive task are highly individual, contrasting with previous research indicating that the addition of a cognitive task impacts landing mechanics.

## Introduction

Performing a motor-cognitive dual-task (DT) leads to interference of either the motor or cognitive task. Thus, possibly affecting the movement pattern. As motor-cognitive DTs are often performed during sport and individuals after an injury to the anterior cruciate ligament (ACL) have reduced motor as well as neurocognitive performance, reducing interference of the DT is particularly important [1]. Hence, the aim of this pilot study was to compare the knee flexion angle (KF) and the knee valgus (KV) between two different DT and a single task (ST) condition in fully recovered individuals after an ACL injury with subsequent reconstruction.

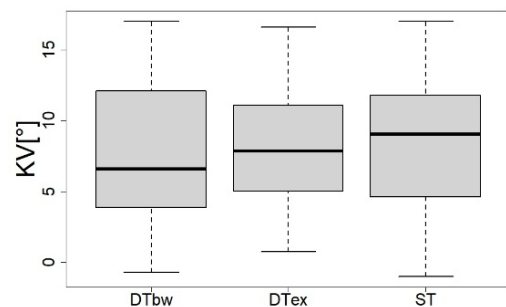
## Methods

11 fully recovered individuals (5 female) after ACL reconstruction were recruited. Participants performed a squat-jump during an exergame (DTex), while simultaneously counting backwards by three (DTbw), and without additional cognitive task (ST). Tasks were repeated five times and performed in a randomized order. Kinematics of the lower extremities was collected using camera-based motion capture (Vicon, Version 2.15) and a marker cluster set [2]. Data was processed with MATLAB (MathWorks, Version 2024a).

KF of the affected leg was extracted at initial contact after the jump and maximal KV (=knee abduction angle) of the affected leg was extracted between initial contact of the jump and 100 milliseconds after initial contact. Statistical analysis was conducted in R (Version 4.4.1) using a repeated-measures analysis of variance. Statistical significance was set at  $p < .05$ .

## Results and Discussion

Participants were on average  $25.7 \pm 4.0$  years old and mean time since ACL injury was  $4.9 \pm 3.0$  years. Mean KF at initial contact was  $29.7 \pm 9.7^\circ$  during DTbw,  $29.8 \pm 10.1^\circ$  during DTex, and  $29.5 \pm 11.3^\circ$  during ST. Analysis of variance showed no difference between tasks ( $F(2, 100) = 0.05$ ,  $p = .95$ , marginal  $R^2 < .001$ ). There was also large variability present in KV in all three tasks (Figure 1). Moreover, no significant difference was found between the three tasks for KV ( $F(2, 100) = 0.32$ ,  $p = .73$ , marginal  $R^2 < .001$ ).



**Figure 1:** Boxplot of the knee valgus (KV) for the three different tasks.

Our results contrast the study of Dai et al., who found decreased KF at initial contact after landing from a jump when adding a cognitive task [3]. However, we investigated a squat-jump in fully recovered individuals after an ACL injury while Dai et al. investigated a jump-landing from a box in healthy individuals. Large variability in KF as well as KV was present in all three tasks such that we can assume that adaptations in movement patterns are highly individual.

## Conclusions

No significant differences in KF or KV were found between DT and ST conditions in fully recovered individuals after ACL reconstruction, suggesting that adaptations in movement patterns to a DT are highly individual.

## Acknowledgments

The authors thank Sphery Ltd. for providing the exergame for the study duration.

## References

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