LANDING BIOMECHANICS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION: INSIGHTS ON THE SINGLE LEG HOP TEST

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Summary

The Single Leg Hop for Distance (SLHD) test is widely used for return-to-sport assessments after ACL reconstruction, measuring the Limb Symmetry Index (LSI) but not key biomechanical variables. This study analyzed 10 post-ACLR athletes performing the SLHD test, with data collected via OpenCap. Results showed reduced jump distance and flight time and increased dynamic valgus and decreased knee flexion in the injured limb, indicating altered landing strategies. Improving knee mobility and strength is essential for a safe return to sport, supported by motion analysis for evidence-based physiotherapy.

Introduction

The Anterior Cruciate Ligament (ACL) is one of the most injured structures in the knee, especially in sports contexts, with Anterior Cruciate Ligament Reconstruction (ACLR) being the standard treatment [1]. Post-surgical rehabilitation is lengthy, with specific criteria for return to sport, such as performance in the Single Leg Hop for Distance (SLHD) test. Although the SLHD provides objective LSI data, it does not assess biomechanical variables that may be affected by ACL injuries and persist after ACLR.

Methods

The sample consisted of 10 athletes participating in level I or II sports, according to the International Knee Documentation Committee, who underwent ACLR and met the inclusion and exclusion criteria. After a warm-up and familiarization period, the SLHD test was performed with video recordings. The testing area was calibrated beforehand, and the test was recorded at 120 Hz. Data on jump distance, flight time, maximum knee flexion, and dynamic valgus at landing were analyzed using OpenCap software and presented as mean and standard deviation. To identify differences between the lower limbs for the analyzed variables, an independent samples t-test was applied with a significance level of 0.05. Additionally, effect sizes were calculated using Cohen's d.

Results and Discussion

Decreases in the distance achieved and flight time were observed, both with a medium effect size, and an increase in dynamic valgus and a decrease in maximum knee flexion, both with a large effect size, in the injured lower limb. These findings suggest differences in landing strategies in individuals post-ACL reconstruction. The reduction in knee flexion and the increase in valgus may be related to knee mobility limitations, resulting in an inability to control the valgus collapse [2,3]. Additionally, the low flexion angle characterizes a stiffer landing, which is associated with higher joint loading and an increased risk of ACL injury [4,5,6]. Furthermore, the lower flight time in the injured leg suggest an impact on the ability to generate force or hesitation during the flight time.

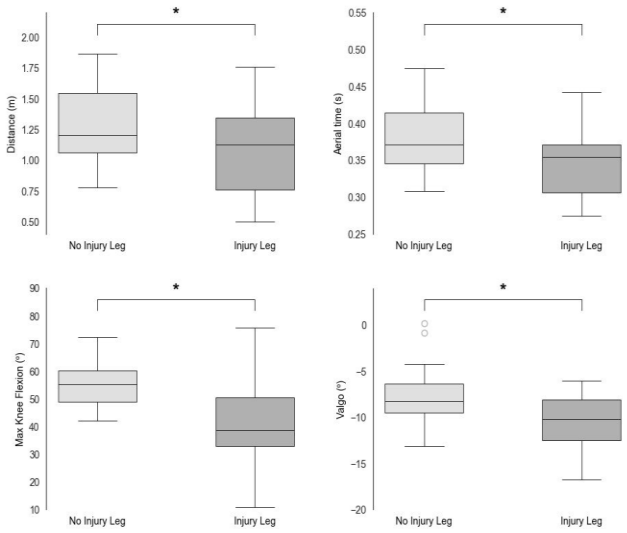

Figure 1: Boxplot comparing the variables of jump distance achieved, flying time, maximum knee flexion, and dynamic valgus between the injured and no injured leg.

Conclusions

The results of this study indicate differences in the mechanics of single-leg horizontal jumping in athletes post-ACL reconstruction, notably a reduction in knee flexion range of motion, jump distance, and flight time, as well as an increase in dynamic valgus in the injured limb during landing. Furthermore, the use of artificial intelligence and motion analysis software, such as OpenCap used in this study, provides greater practicality in data collection and processing, contributing to the advancement of evidence-based physiotherapy and optimizing therapeutic outcomes.

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