

# Limited knee extension during the take-off phase of one-leg vertical hops among individuals with ACL reconstruction

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## Summary

Limited knee extension after anterior cruciate ligament reconstruction (ACLR) is commonly found in clinical assessments, but whether this influences functional performance is unclear. We evaluated maximal knee extension angle during the take-off phase of one-leg vertical hops (OLVH) and its correlation to jump height among individuals with ACLR and asymptomatic controls. Forty-eight individuals on each group performed five OLVHs per leg and were recorded by motion capture. Preliminary analyses show significantly less knee extension for the injured compared with the non-injured leg (mean difference 4.9°,  $p < 0.001$ ) and controls (mean difference 8.2°,  $p < 0.001$ ). Maximal knee extension and jump height were not correlated for the ACLR injured leg ( $r = -0.26$ ,  $p = 0.07$ ), but were moderately correlated for the contralateral non-injured leg ( $r = -0.50$ ,  $p < 0.001$ ). After ACLR, limited knee extension was observed during the take-off phase of OLVHs, but its relevance to sports performance is unclear.

## Introduction

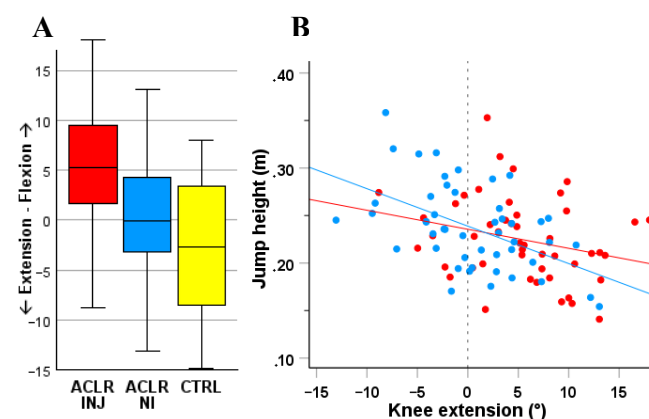
Following ACLR, regaining full knee extension is a key rehabilitation goal since deficits may reflect low quadriceps muscle strength, worse subjective outcomes, and development of knee osteoarthritis [1]. Limited knee extension in lying positions is nevertheless commonly reported for individuals who have completed rehabilitation after ACLR [2]. Less is however known about knee extension deficits during functional tasks and whether this influences performance. This may be particularly important in tasks such as vertical hops where the leg muscles must quickly extend the hip, knee and ankle during the take-off phase for optimal production of vertical forces. This study investigated whether maximal knee extension angle during the take-off phase of OLVHs differed between legs with and without ACLR, and whether this was correlated to jump height among individuals with ACLR.

## Methods

Forty-eight individuals with ACLR (mean age 26 years, 32 females) and 48 asymptomatic controls (mean age 22 years, 40 females) performed five repetitions of the OLVH for each leg. The ACLR group were tested on average 25.7 (min-max 7.4-129.6) months post-surgery and were cleared to return to sport. A 3D motion capture system and synchronized force plate recorded all hops. One leg from controls (no between-leg differences) matched to the ACLR leg for leg dominance (preferred leg to kick a ball) was analyzed. Maximal knee extension was compared between legs within the ACLR group using paired-samples t-tests and between groups using independent t-tests. Correlations between maximal knee extension angle and jump height among the ACLR group were assessed using the Pearson correlation coefficient.

## Results and Discussion

The ACLR group had significantly less knee extension in their injured compared with the non-injured leg (mean difference 4.9°,  $p < 0.001$ ) and controls (mean difference 8.2°,  $p < 0.001$ ) (Figure 1A). Possible explanations include knee joint restrictions due to the injury/surgery, low strength and/or trust in the knee, and type of rehabilitation. Maximal knee extension and jump height were not correlated for the ACLR injured leg ( $r = -0.26$ ,  $p = 0.07$ ), but were moderately correlated for the contralateral non-injured leg ( $r = -0.50$ ,  $p < 0.001$ ) (Figure 1B). Mean jump height was 0.22m (min-max 0.14-0.35) for the ACLR leg, 0.24m (0.15-0.36) for the contralateral non-injured leg, and 0.23m (0.16-0.36) for controls.



**Figure 1: ACLR Injured, ACLR Non-Injured, Controls.**

A: Mean maximal knee extension angle. B: Scatter plot for correlation analysis between maximal knee extension angle and jump height in ACLR.

## Conclusions

Individuals who have been cleared to return to sport following ACLR show a functional knee extension deficit during the take-off phase of the OLVH, but its relevance to sports performance is still unclear. After ACLR, knee extension should be assessed during functional tasks to identify deficits that might influence sports performance.

## Acknowledgments

We acknowledge funding from The Swedish Research Council, The Swedish Research Council for Sport Science, Region Västerbotten and King Gustaf V and Queen Victoria's Foundation of Freemasons.

## References

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