

Biomechanical Analysis of selected risk factors for an anterior cruciate ligament (ACL) rupture during training with the ExerCube

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Figure 1: The exergaming device ExerCube

Aim:

To investigate the biomechanics of lower extremities during training with the ExerCube and identify movements with potential risk for ACL injury.

Background:

Exergaming, which combines physical training with cognitive challenges, is known to be motivating during rehabilitation; however, the external focus of attention and cognitive load of a game may decrease the ability to control knee joint performance, which can be a risk factor for ACL rupture.



Figure 2: ExerCube



Figure 3: Ankle tracker



Current follow-up research: ExerUP!

Design and Evaluation of a digital exergame-based solution for effective and attractive Sportsrehab

- identification of high-risk movement patterns in athletes after ACL injury
- user requirements in rehabilitative settings
- development and evaluation of rehabilitation specific game scenarios

Methods:

The biomechanics during ExerCube training was measured using a sensor-based motion capture system (Xsens) in seven healthy, female athletes. Two risk factors (10°- 30° knee flexion, knee adduction) were identified during jumps, squats, and lunges. For statistical analysis, a two-way within subject linear mixed model was used.



Figure 4: Position of the Xsens markers

Results:

Healthy female athletes presented both risk factors (10°-30° knee flexion, knee adduction) in all movements, although to a different extent. While no significant differences were found for the knee flexion angle, the mean knee adduction angle was significantly higher in lunges (20.53°) compared to jumps (11.99°, $p = 0.04$). The fraction of movement duration during which the knee flexion angle was between 10° and 30° was 9.04% in lunges, 23.68% in squats, and 34.61% in jumps.

Conclusion:

Lunges, squats, and jumps are movements with risk for ACL injury in the ExerCube environment.

Further research in a larger sample and with a focus on combinations of risk factors is needed to evaluate how ExerCube training is best applicable in ACL rehabilitation.

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