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

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

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.

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. 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.

Current follow-up research in the project ExerUP! with de aim of designing and evaluating a digital exergame-based solution for effective and attractive sports rehabilitation. This is achieved by identification of high-risk movement patterns in athletes after ACL injury, definition of user requirements in rehabilitative settings and the development and evaluation of rehabilitation specific game scenarios