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Comparison of biomechanical risk factors for ACL injury between patients and healthy subjects during exergaming

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Background:

Exergaming - physically active gaming - offers great potential for rehabilitation after knee injuries in sports, as it combines physical and cognitive challenges. However, before its use in sports rehabilitation can be recommended as safe and reliable, it is necessary to assess the biomechanics associated with knee injuries - an abducted, internally rotated knee at 10-30° of flexion (Koga et al., 2010). The aim of this study was to compare knee valgus (KV) during 10-30° knee flexion between healthy individuals without previous knee injuries and patients undergoing rehabilitation after knee injuries in three exercises of a high-intensive, immersive exergame (ExerCube, Martin-Niedecken et al. 2019).
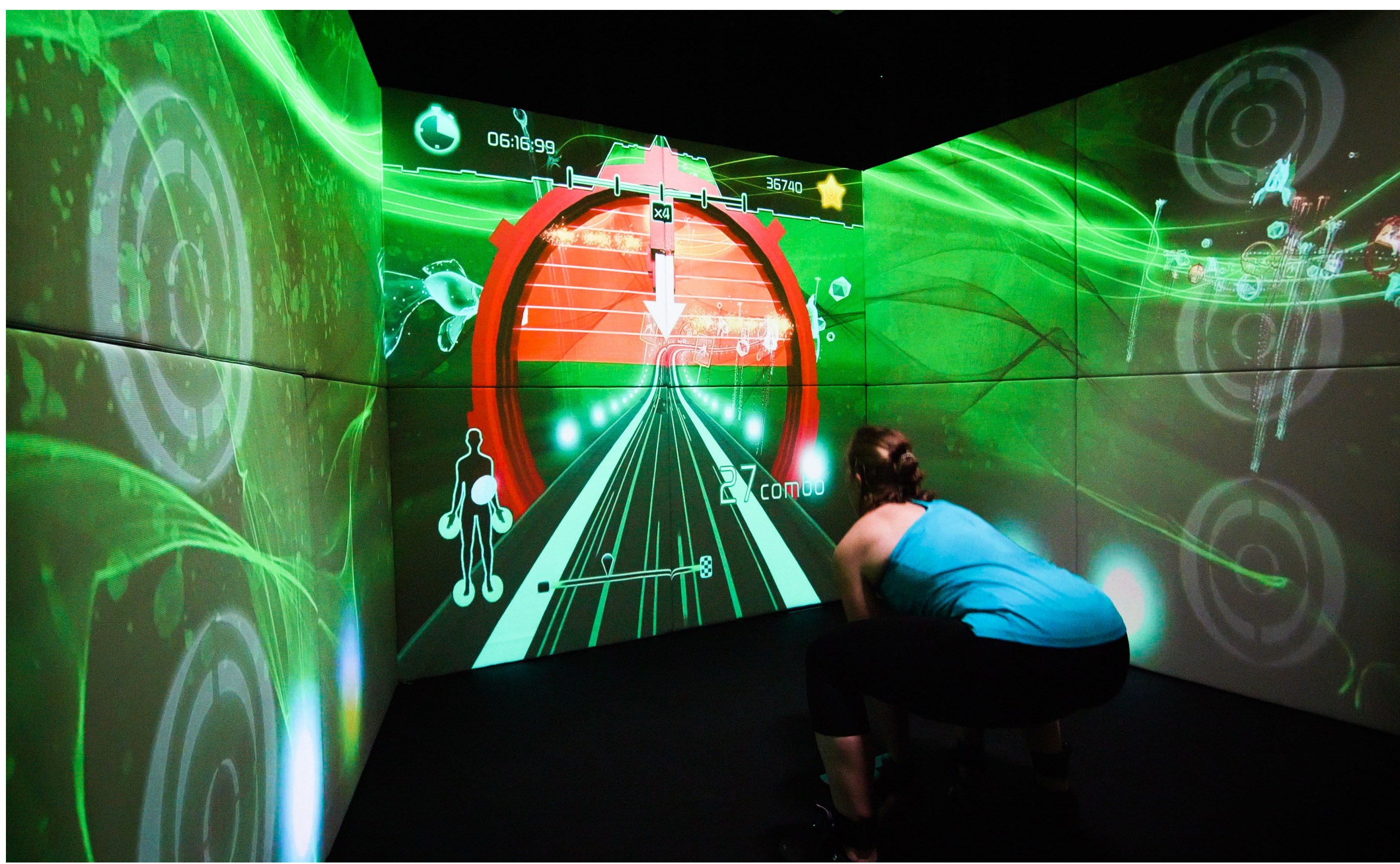

Figure 1: Squat during an ExerCube Training

Materials and Methods:

- Measurement of kinematics during a 25-minute exergame training (ExerCube)
- Motion capture (Vicon) of the hip and knee with clusters (Figure 2)
- 18 athletes (9 female, 9 male) without prior knee injuries
- 6 patients (2 female, 4 male) after ACL injury (RTS phase)
- Outcome: Mean maximal KV of right leg during 10-30° knee flexion
- Comparison of squat, jump, burpee
- Two-way within-subject linear mixed model

Figure 2: Marker Cluster

Results:

A significant main effect was found for exercise ($F_{(2,45)} = 57.03$, $p < .001$), but not for the difference between groups ($F_{(1,22)} = 0.45$, $p = 0.51$). Differences of mean values are displayed in Table 1.

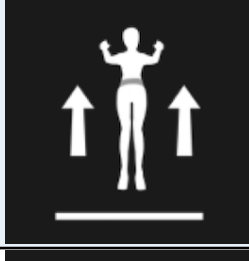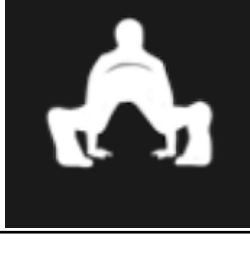| Exercise		KV of Patients [°]	KV of Controls [°]
		Mean (SD)	Mean (SD)
Squat		4.8 (3.2)	4.3 (3.5)
Jump		6.8 (3.1)	5.9 (3.0)
Burpee		8.6 (3.3)	6.9 (2.9)

Table 1: Mean angles of selected exercises compared to the other exercises. SD = standard deviation.

Conclusion:

There are no significant differences in KV between healthy participants and patients undergoing rehabilitation after knee injuries. This indicates that the pre-injury movement pattern was restored in the patients, and it can be assumed that the studied exercises during exergaming are safe for use in this stage of rehabilitation.

Figure 3: Jump during an ExerCube Training

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