INFLUENCE OF SPEED AND AMPLITUDE OF ROTATION OF A MOTORISED ROTATING PLATFORM ON KNEE KINEMATICS

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01 INTRODUCTION

Anterior cruciate ligament (ACL) injury occurs mainly in **non-contact** situations during **landing** or **cutting**. A three-dimensional (3D) mechanism is involved (Figure 1). **Motorised Rotating Platforms** (MRP) such as **imoove®** may recreate, through their 3D movement pattern, the kinematic conditions that lead to **ACL injury** and may, thus, be a specific exercise to improve dynamic knee stability during rehabilitation However, **knee kinematics** during MRP exercise remains unknown.

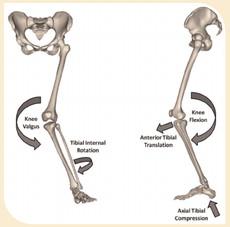

Figure 1: 3D ACL injury mechanism

Purposes

-To assess the influence of speed and amplitude of platform rotation on knee kinematics
- To highlight any similarity between knee kinematics during single-leg MRP exercise and ACL injury mechanism

Figure 2: helispherical movement of imoove® motorised rotating platform

02 METHOD

DESIGN

- **Factorial** design

		AMPLITUDE	
		SMALL	LARGE
SPEED	LOW	**C1**	**C2**
	HIGH	**C3**	**C4**

POPULATION

- 20 healthy participants

Age (SD), years	26.7 (5.4)
Sex, % women	25
Weight (SD), kg	71.6(13)
Size Mean (SD), m	175.4 (10.1)
Limb dominance, % right	45
IKDC subjective score	97.1 (4.9)

INSTRUMENTATION

- 12 retro-reflective markers
- **Video anaslysis** system (Smart DX, BTS Bioengineering), 100 Hz
- **imoove®** (AllCare Innovations, Chabeuil, France)

PROCEDURE

- Warming up + familiarisation
- Randomisation
- **1 minute** recording at each condition

DATA PROCESSING AND STATISTICAL ANALYSIS

- 1 plate rotation = 1 **cycle**
- Posteromedial and posterolateral rotation
- Mean kinematic pattern = average of cycles
- 2-way ANOVA repeated measure Statistical Parametric Mapping (SPM) {F} tests

03 RESULTS

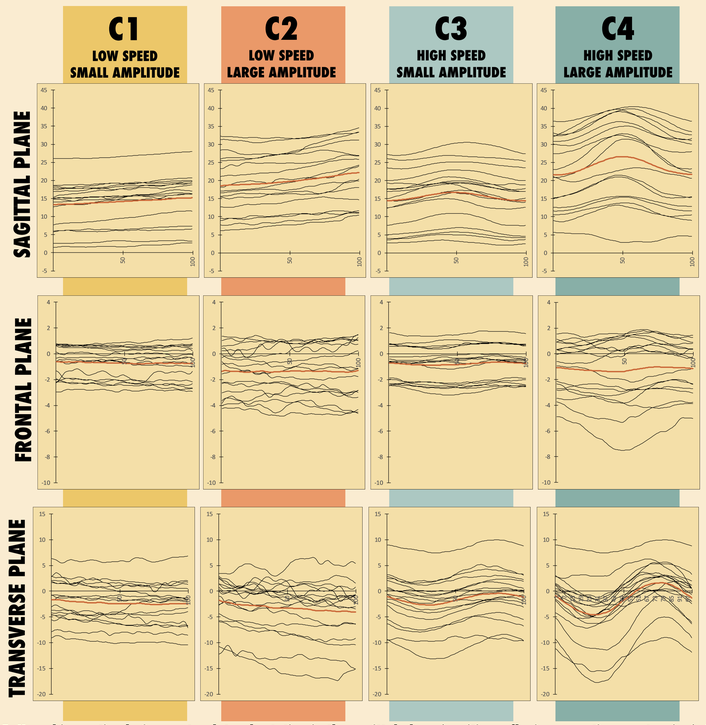

Figure 5: Knee kinematics during posterolateral rotation in the sagittal plane (positive = flexion, negative = extension), frontal plane (positive = adduction, negative = abduction) and transverse plane (positive = internal rotation, negative = external rotation) (n=17).

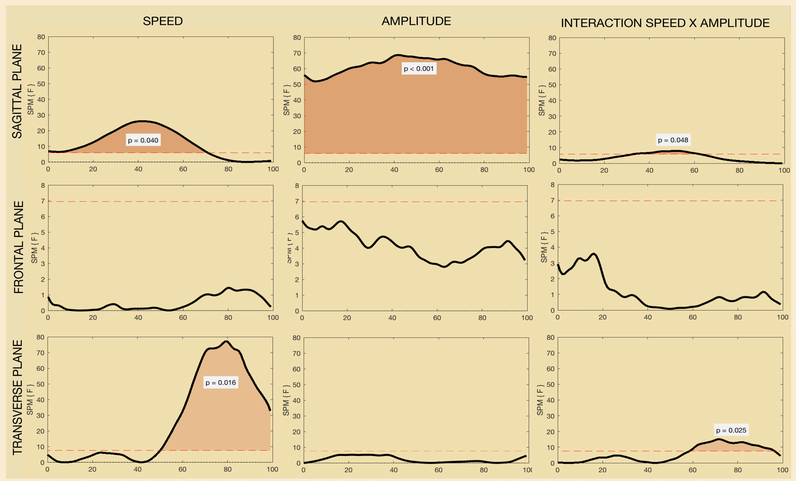

Figure 6: Effect of speed and amplitude of the MRP on the knee kinematics in sagittal, frontal and transverse plane during posterolateral rotation (p<0.05). Figures display the critical thresholds (F*) above which a significant effect occurs. SPM = Statistical Parametric Mapping

- Same pattern but individual strategies
- At **low speed** (C1 and C2), **no movement** of the knee
- At **high speed** , curve pattern displayed movement in sagittal and transverse plane
  - At C4, knee flexion increased by 5° (2.7° to 10.6°) to reach a **peak flexion angle of 26°** at 50% of the cycle
  - At C4, knee underwent an **internal rotation** of 6.2° (2.5° to 12.7°) between 29% and 79% of the cycle
- Significant **main effect** of **speed** on knee **sagittal and transverse plane kinematics**
- Significant **main effect** of **amplitude** on knee **sagittal plane kinematics**

04 DISCUSSION

- With small amplitude and low speed of plate rotation, balance strategies did not involve movement at knee joint
- MRP training with high speed coupled with large amplitude induced the most knee motion in sagittal and transverse plane.
- Similarities with the ACL injury mechanism:
  - Knee flexion
  - Tibial internal rotation
  - Peak internal rotation occurring slightly after peak flexion
- Train at high speed and large amplitude to induce knee motion in sagittal and transverse planes and train dynamic neuromuscular control of the knee

05 CONCLUSION

- MRP training might be relevant in the context of ACL rehabilitation as similarities between knee kinematics during single-leg MRP training and ACL injury mechanism have been found.
- Physiotherapist should be aware that high speed combined with large amplitude induce knee motion in sagittal and transverse plane.

Sources:
Figure 1: Levine et al (2013) /
Figure 2: reproduced with permission of allcare Innovations, Chabeuil, France

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