LA TROBE UNIVERSITY

ALTERED TRUNK MOVEMENTS DURING RUNNING AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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I DO NOT HAVE A FINANCIAL INTEREST OR OTHER RELATIONSHIP WITH A COMMERCIAL COMPANY OR INSTITUTION

INTRODUCTION

Return to running is essential for successful return to sport after anterior cruciate ligament reconstruction (ACLR)

Patients run with less knee flexion and lower knee flexion moments that do not resolve up to 5 years post-op

(Pairot-de-Fonteny 2021)

Minimal information about what this means for movement at other joints

Altered movement of the trunk may be important in considering risk of re-injury

(Hewett 2009, Hewett 2011,Song 2023)

Particularly important to investigate in a young active population who are at greater risk of further ACL injury

(Webster 2014, Wiggins 2016))

Therefore, the aim of this study was to compare the lower limb and trunk movements of young patients who had returned to sport after ACLR to a control cohort during overground running.

METHODS

PARTICIPANTS

- 15 with ACLR using hamstring autograft from single surgeon who had returned to sport
- 15 without injury of similar age and activity profile

Asked to run at two speeds (i) 50% maximum and (ii) 80% maximum (minimum 6 trials within 5% of average speed for each condition)

EQUIPMENT

3D motion analysis with cluster marker set and model (Conventional Gait Model 2)

Joint angles and external moments of ankles, knees, hips, pelvis and trunk calculated using inverse dynamics

DATA ANALYSIS

External moments normalized to body mass and height

Joint excursions calculated from initial contact to maximum knee moment

Data compared between groups using Analysis of Covariance (speed and body mass where not already accounted for)

Significant level $p<0.05$

RESULTS

GROUP DEMOGRAPHICS

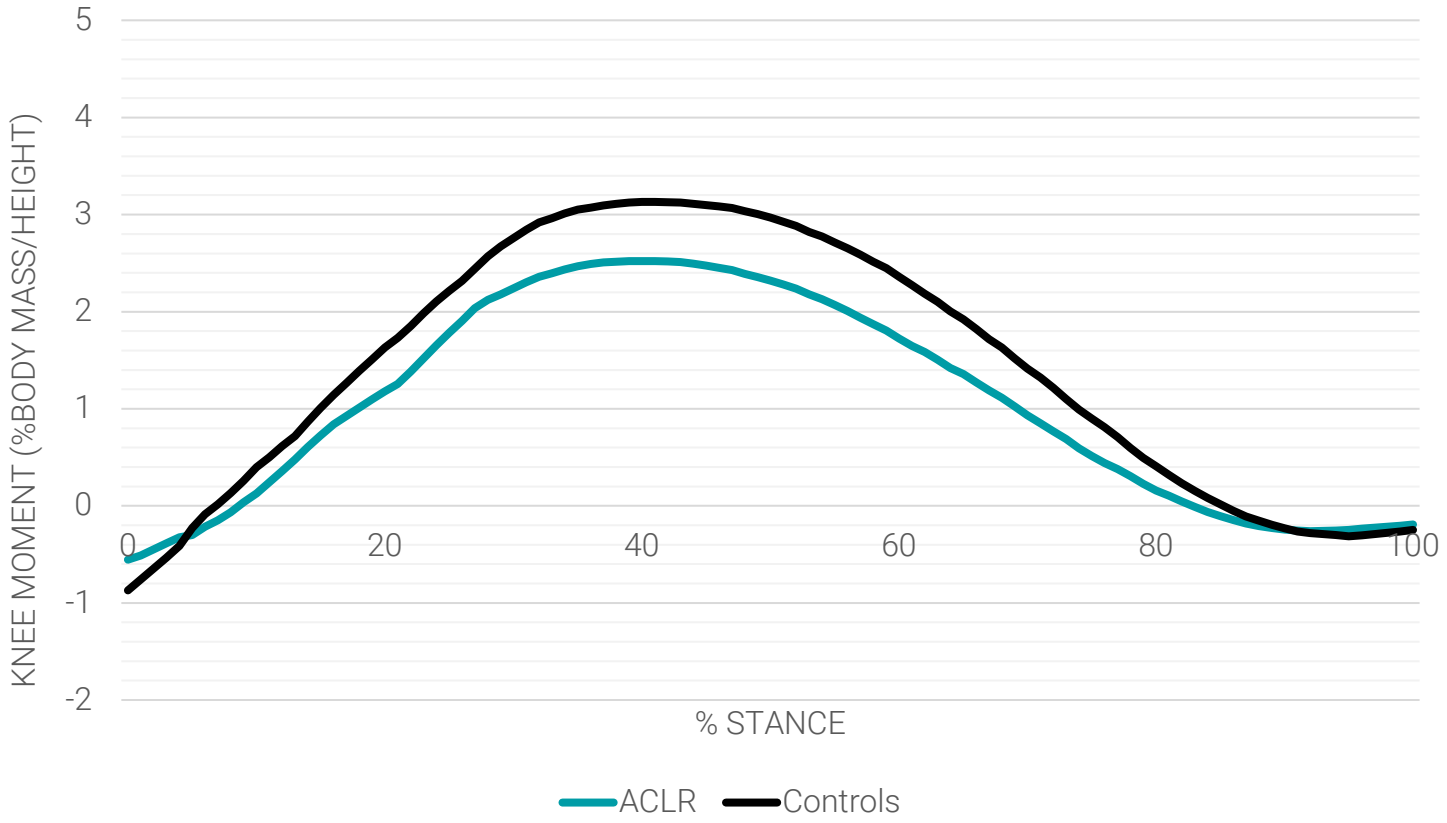
	ACLR	CONTROLS	
Age at time of surgery *(years)*	17.4 (2.1)	NA	
Time surgery to running assessment *(months)*	23.9 (7.0)	NA	
Height *(cm)*	176.0 (7.9)	175.8 (9.1)	*p=0.95*
Body mass *(kg)*	75.5 (12.2)	67.7 (10.1)	*p=0.08**
Sex *(% female)*	46.7%	53.3%	*p=0.71*
Moderate running speed *(m/sec)*	4.00 (0.57)	4.12 (0.64)	*p=0.45*
Fast running speed *(m/sec)*	4.79 (0.79)	5.20 (0.70)	*p=0.16**

**running speed and body mass treated as covariates in all between-group comparison*

RESULTS

KNEE FLEXION MOMENT

As expected, participants with ACLR ran with **lower maximum** and **slower rate of development of the knee flexion moment** and than controls throughout stance.



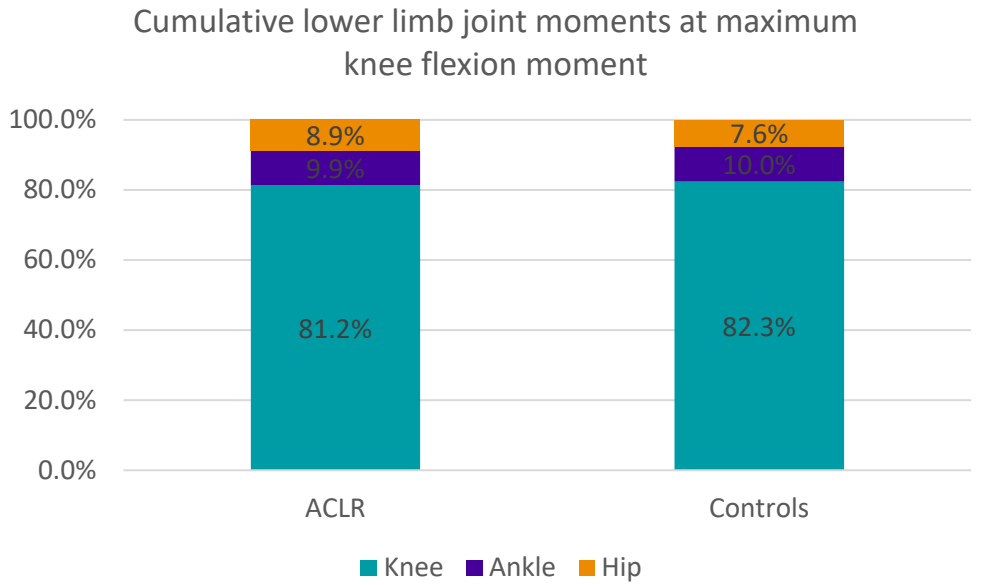
RESULTS

LOWER LIMB MOMENTS

At the time of the maximum knee flexion moment, other lower limb joint moments and ground reaction force were **not different between groups**.

	ACLR	Controls	
Vertical Ground Reaction Force *(N)*	248.4 (27.6)	254.7 (18.2)	p=0.53
Ankle Moment *(%BM/height)*	2.2 (0.6)	2.6 (0.5)	p=0.06
Hip Moment *(%BM/height)*	1.7 (0.6)	2.0 (0.5)	p=0.14

There was **no difference between groups** in contribution of lower limb joints to cumulative lower limb moment.



RESULTS

KINEMATICS

The only kinematic difference between groups was that participants with ACLR ran with **less excursion of trunk flexion.**

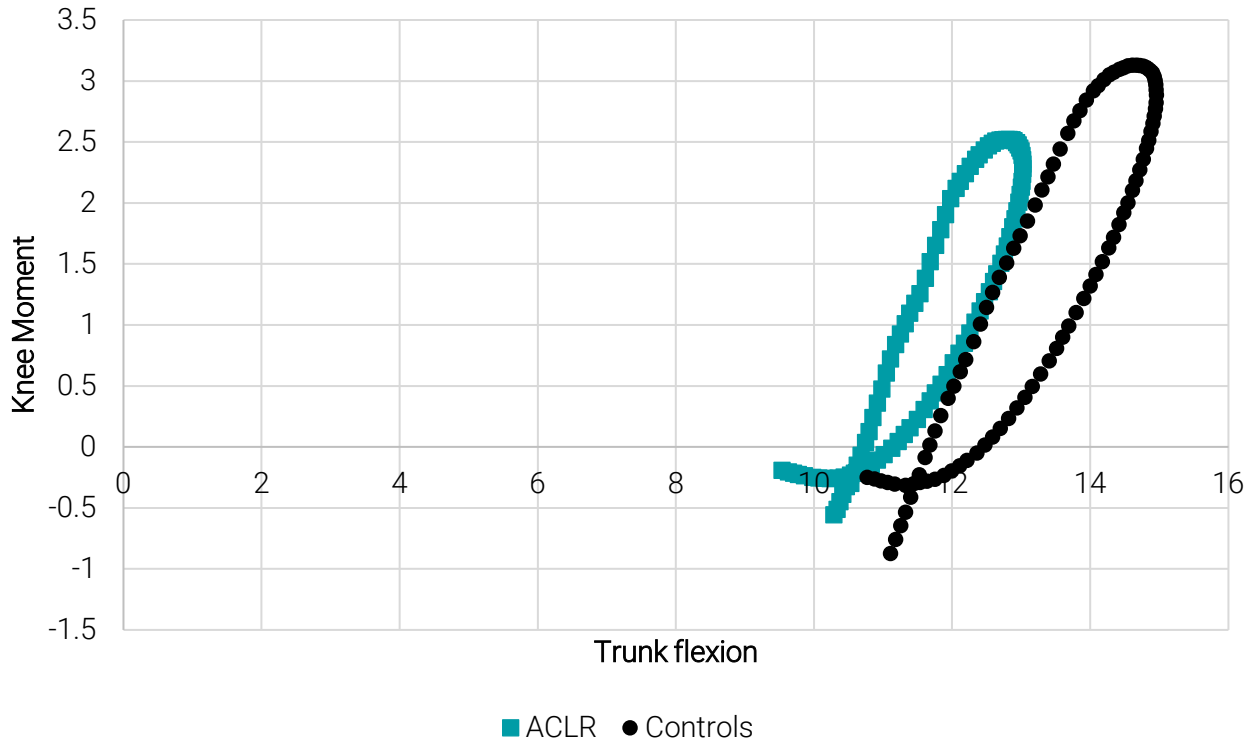
	ACLR	CONTROLS	
Ankle excursion (sagittal plane) *(degrees)*	11.4 (5.8)	11.9 (4.0)	*p=0.83*
Knee excursion (sagittal plane) *(degrees)*	33.0 (5.4)	32.3 (4.4)	*p=0.70*
Hip excursion (sagittal plane) *(degrees)*	6.1 (5.9)	7.0 (4.6)	*p=0.67*
Pelvic excursion (sagittal plane) *(degrees)*	2.8 (3.8)	1.6 (2.5)	*p=0.33*
Pelvic excursion (coronal plane) *(degrees)*	5.2 (3.0)	3.6 (3.1)	*p=0.17*
Trunk excursion (sagittal plane) *(degrees relative to lab)*	2.9 (1.0)	4.0 (1.5)	***p=0.04****
Trunk excursion (coronal plane) *(degrees relative to lab)*	4.6 (1.9)	4.0 (1.5)	*p=0.41*

**statistically significant*

RESULTS

COORDINATION BETWEEN TRUNK MOVEMENT AND KNEE FLEXION MOMENT

The pattern of movement between trunk movement and external knee moment was not different between groups.



DISCUSSION

Young patients (<20 years) who had returned to sport following anterior cruciate ligament reconstruction ran with knee and trunk biomechanics that were not the same as controls.

Concerning that common deficits in knee function after ACLR are present in this young, active cohort who are 2 years post-op and have returned to sport following ACLR.

Reduction of external knee moment in ACLR patients likely represents attempt to reduce demand for quadriceps to produce force, as is common in most activities that involve single limb landing.

(Johnston 2018, Pairot-de-Fonteny 2021)

DISCUSSION

This is the first study to identify altered trunk movements during running in a group of patients with ACLR, and we found that patients with ACLR ran with a more upright trunk.

Trunk positioning is an important determinant of knee joint moment. Therefore, altered trunk movements may represent the mechanism by which patients attempt to reduce the external knee moment.

(Kulas 2010, Waiteman 2022)

Altered trunk movements have been identified as a contributing factor in ACL injury, and the presence of post-operative aberrations in movement may increase risk of re-injury in a post-operative cohort.

(Hewett 2009, Hewett 2011,Song 2023)

Further research is warranted to develop a more thorough understanding of these findings of altered biomechanics on the risk of re-injury following ACLR.

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