The effect of surfaces on knee biomechanics during a 90-degree cut

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Background:

Anterior cruciate ligament (ACL) injuries are serious knee injuries that result in pain, instability, time away from sport and an increased risk of future injury

Most ACL injuries are non-contact in nature and occur during change of direction movements

Assessments following ACL injuries commonly occur on surfaces that do not represent the playing surface. This could have implication when considering injury risk and readiness to return to sport

The aim of this study was to determine whether there were differences in knee biomechanics when performing a 90 degree change of direction on two different surfaces.

Conclusions:

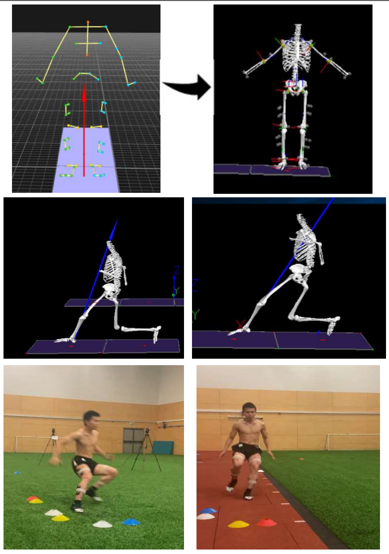
This study found significant differences when comparing a 90-degree change of direction on a running track surface compared to an artificial grass surface.

Variables which have been associated with ACL injury risk were increased on the running track surface compared to the artificial turf.

This is highlighting the importance of using a surface that is closer to the athletes' playing/training surface when assessing a player post ACL injury. This is to ensure that a true representation of ACL injury risk or readiness to return to sport is seen.

Methods:

- Participants included in this study were uninjured individuals. They performed a 90 degree change of direction on a running track surface and an artificial grass surface.
- Force plates (Gen 5, AMTI, USA) were embedded beneath the surfaces and participants had reflective markers placed on their body to represent their skeleton – this was captured with 29 infra-red motion capture cameras (Oqus 700, Qualysis AB, Sweden). Participants were provided with standardized footwear (Goletto VIII, Adidas, Germany) that were suitable on both surfaces
- Data was collected and labelled using Qualisys Track Manager (Version 2022.1). Once labelled the data was exported to Visual 3D (Version 6; C-motion Inc, USA). The model was derived from the static trial – this determined the local coordinate system for the different segments.
- The statistical analysis was performed using the Statistical Packages for Social Sciences (SPSS, Version 29.0.1.0, IBM corp., USA). A paired t-test was used to compare each variable measured on the track compared to each variable measured on the artificial grass to determine any significant differences (P<0.05).



Results:

- There were no significant differences in the kinematic variables (shown in table 1)
- There was a significantly increased knee extensor moment on the track compared to the artificial turf (P<0.05). The 95% confidence interval difference of the mean was from 0.06 to 0.41 and the effect size was 0.67 (95% CI 0.15 to 1.21). The posterior braking force was also significantly increased on the track compared to the artificial turf (P<0.05). The 95% confidence interval of the mean difference was from -0.18 to -0.02 and the effect size was -0.65 (95% CI -1.17 to -0.12).
- There was no significant difference in approach speed on the track (3.67 m/s ± 0.40) and the artificial grass (3.76 m/s ± 0.50).

Table 1.	Mean (SD)		P-Value
	Track	Artificial grass	
Maximum knee flexion	63.39 (5.15)	63.05 (5.31)	0.330
Initial contact knee flexion	25.05 (5.00)	25.68 (4.01)	0.243
Maximum knee adduction	1.60 (3.61)	0.80 (4.11)	0.106
Maximum knee abduction	-10.50 (4.17)	-11.24 (4.85)	0.147

Table 2	Mean (SD)		P-Value
	Track	Artificial grass	
Maximum knee extensor moment	2.81 Nm/kg (0.32)	2.57 Nm/kg (0.47)	0.006
Posterior braking force	-1.06 N/kg (0.19)	-0.96 N/kg (0.17)	0.008
Vertical ground reaction force	1.94 N/kg (0.18)	1.94 N/kg (0.13)	0.485

Future directions:

This study only considered discrete variables. In future, an analysis of the whole curve should be considered. This allows you to see differences in timings and the shape of the whole curve

This is a preliminary analysis of 6 participants knee extensor moment – differences can be seen in both the shape and time timing of the peak. This could have implications for assessing risk of ACL injury and return to sport.