Trunk and knee markerless kinematics during an unplanned change of direction in soccer players: are they reliable?

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Summary

The present study evaluated the reliability of a markerless motion analysis system in assessing unplanned change of direction (UCOD) kinematics in under-23 first league soccer players. Results showed moderate reliability for trunk and knee kinematic variables related with ACL injury risk. Measurement error was low, especially for trunk frontal and knee sagittal plane.

Introduction

The UCOD is frequently associated with ACL injuries [1]. The present study aimed to test the reliability of the UCOD trunk and knee kinematics, using a markerless motion analysis system, in under-23 first league soccer players.

Methods

Fourteen male under-23 first league soccer players, without a history of ACL injury, were evaluated performing 45º UCOD (side-step maneuver) in 2 sessions, with 1-2 weeks interval. Running speed was controlled at 4 to 5 m/s using infrared sensors, and the reaction time was 500 ms. The players wore the same clothes they usually wear in practice, and 8 Miqus cameras (Qualisys AB, Sweden) were used for video recording with a sampling frequency of 85 Hz. The data was processed using Theia3D software (Theia Markerless, Inc, Kingston - Ontario, Canada) with a cut-off frequency set at 10 Hz. The final model consisted of 17 rigid segments with 3 degrees of freedom for the ankle, knee, and hip joints and 6 degrees of freedom for the trunk. Event determination, lower limb joint angles (XYZ Cardan sequence) and trunk absolute angles were computed using Visual 3D software (HAS-Motion Inc., Kingston, Canada). The integrated and pointwise intraclass correlation coefficient (ICC) and standard error of measurement (SEM) were calculated [2], as well as the minimal detectable change (MDC). Results will be presented for the angles related with ACL risk of injury (knee abduction, flexion, and internal rotation joint angles and trunk lateral bending).

Results and Discussion

Except for trunk lateral bending, the selected kinematic variables related with ACL injury risk, showed moderate integrated ICCs (0.51<ICC< 0.66) (table 1). The pointwise ICC varied along the curve (Figure 1), particularly in the sagittal and transverse planes. Additionally, trunk frontal and knee sagittal plane presented low measurement error (SEM<5° and SEM%<9%). The findings of the present study are comparable to those obtained by De Bleecker et al. [3], although they evaluated different sport-specific movements using a marker-based system.

Table 1: Test-retest reliability of the right knee and trunk kinematics.

		ICC	SEM (°)	SEM%	MDC (°)
Trunk	**Frontal**	0.83	3	6%	8.3
	Sagittal	0.66	4.8	8%	13.4
Knee	**Frontal**	0.63	3.4	15%	9.3
	Transverse	0.51	5.7	16%	15.7

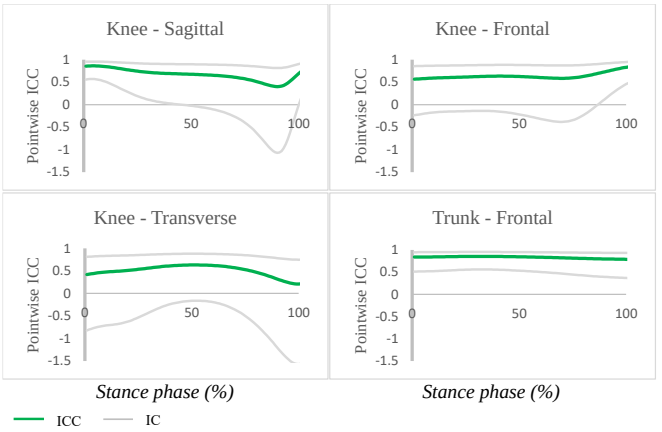

Figure 1: Pointwise ICC during the stance phase (0-100%).

Conclusions

The present study shows that most markerless UCOD kinematic variables related with ACL injury risk are only moderately reliable. Contrarily, measurement error was low, especially for trunk frontal and knee sagittal plane.

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