

EFFECTS OF GENDER ON KINEMATICS OF THE HIP, KNEE, AND ANKLE IN UNANTICIPATED DROPLANDINGS OF ADOLESCENT SOCCER PLAYERS

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INTRODUCTION

Female athletes participating in sports requiring highly dynamic movements are at four to six times greater risk of knee injury than their male counterparts (Ford, 2005). Several theories based on differences between genders in joint kinematics, hormones, and other variables have been offered to explain the disparity. For example, Ford *et al* (2003) found that high school aged female athletes displayed greater knee valgus angles than males during landing. However, few studies have tested adolescent subjects to establish whether kinematic differences also exist at a younger age, especially in unanticipated paradigms that replicate real game situations.

This purpose of this study was to identify kinematic differences between male and female adolescent soccer players that might be precursors of knee injuries. Our hypothesis was that male and female adolescent soccer players would display comparable lower extremity kinematics due to their similar skeletal structures.

METHODS

A cohort of 6 male (age = 10.7 years, height = 1.46 m, weight = 343 N) and 8 female (age = 10.3 years, height = 1.47 m, weight = 351 N) youth soccer players were recruited to participate. Each subject dropped 30.5 cm from an overhead bar landing on his or her dominant leg. Prior to landing, a set of lights directed the subject to complete one of

three tasks in random order: a forward run to the center (C), a side-step cut of 30° (SS), or a cross-over cut of 30° (XO, Figure 1). Subjects were instructed to give maximum effort on all tasks. Kinematic data for the landing leg was collected during the trials at 250 Hz using a six-camera motion capture system. Ground reaction forces acting on the landing leg were collected at 1250 Hz.

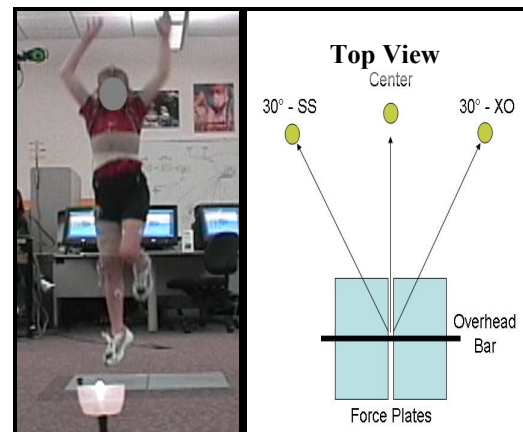


Figure 1. Subject preparing for landing (left), and diagram of landing tasks (right).

Hip, knee, and ankle kinematics were analyzed from 300 ms before initial ground contact to 300 ms after contact. Kinematic data from the instant that peak ground reaction force (pGRF) occurred were compared between genders. A 2x3 (sex x joint) Factorial Analysis of Variance was conducted within each task and each plane of motion: sagittal, frontal, and transverse. The α -level was set at 0.05 for all tests.

RESULTS

Significant differences were found between male and female subjects in frontal plane kinematics at pGRF in the center run ($p = 0.037$) and SS cut ($p = 0.014$) tasks (Table 2). In both cases, the male subjects tended to display greater hip abduction, knee varus, and ankle inversion angles. The most striking difference between groups was that male subjects landed with hips abducted approximately $7-11^\circ$ more than the females across all three tasks (Table 1). Differences at the knee and ankle were much more subtle.

No significant differences between groups were detected in the sagittal plane or transverse plane kinematic variables.

Table 1: Joint angles at pGRF

		Sagittal Plane		Frontal Plane		Transverse Plane	
		Male	Female	Male	Female	Male	Female
Center	Hip	-17 (13)	-16 (8)	10 (7)	3 (5)	3 (11)	8 (14)
	Knee	31 (12)	28 (11)	-1 (4)	2 (5)	-5 (2)	-5 (20)
	Ankle	-21 (6)	-22 (10)	2 (5)	0 (6)	3 (4)	5 (10)
XO	Hip	-18 (13)	-17 (10)	10 (6)	2 (6)	4 (9)	7 (14)
	Knee	33 (11)	28 (6)	2 (4)	1 (8)	-6 (17)	-5 (17)
	Ankle	-21 (9)	-20 (7)	1 (5)	2 (7)	1 (5)	4 (10)
SS	Hip	-17 (13)	-13 (19)	12 (7)	1 (8)	4 (10)	5 (15)
	Knee	33 (11)	28 (21)	0 (3)	1 (6)	-5 (5)	-7 (12)
	Ankle	-21 (9)	-10 (14)	1 (4)	-3 (3)	0 (4)	3 (10)

Table 2: Results of the factorial analysis of variance

Sagittal Plane		Frontal Plane		Transverse Plane	
P-value	Power	P-value	Power	P-value	Power
Center Task					
0.903	0.064	0.037 *	0.630	0.076	0.512
Crossover Task					
0.651	0.115	0.169	0.363	0.961	0.056
Sidestep Task					
0.412	0.195	0.014 *	0.762	0.909	0.063

* $P < 0.05$

DISCUSSION

This is the first study to look at an unanticipated task in middle school aged subjects. For the majority of the kinematic variables analyzed, no significant differences were observed. This was not

unexpected as there should be few skeletal or hormonal differences between the groups. Ford et al (2005) also found no differences in knee flexion angles in their cohort of 12-18 year old athletes. However, they did observe a difference in hip flexion angle between sexes that was not observed in the present study. This discrepancy may be due to differences in the study paradigm or subject population.

Unlike the current study, Landry et al (2005) observed no frontal plane differences between sexes in 14-18 year old adolescent soccer players. However, the significant differences between sexes occurred in the center and SS tasks, with none being found in the XO task. We had similar findings in the current study. Therefore it appears that there are sex and task related interactions.

Given that the frontal plane knee and ankle angles were similar, the differences in hip abduction angles between sexes suggest a difference in pelvic tilt at pGRF. This could indicate a difference in balance control strategy between sexes.

One of the most interesting qualitative findings of this study was that the unanticipated paradigm posed a significant challenge to our young subject group. Many subjects had a difficult time reacting immediately upon landing. This seems to validate our assumption that the unanticipated task more closely replicates game situations than many other paradigms.

REFERENCES

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