

**KINEMATIC & KINETIC DIFFERENCES BETWEEN MALE & FEMALE SOCCER PLAYERS**

<sup>1</sup>Kelly McKean, <sup>1</sup>Scott Landry, <sup>2</sup>Cheryl Hubley-Kozey, <sup>1</sup>Kevin Deluzio and <sup>3</sup>William Stanish  
<sup>1</sup>School of Biomedical Engineering, <sup>2</sup>School of Physiotherapy, Dalhousie University  
<sup>3</sup>Department of Surgery, Division of Orthopaedics, Dalhousie University  
 email: [kmckean@dal.ca](mailto:kmckean@dal.ca)

**INTRODUCTION**

Anterior cruciate ligament injuries occur 2-8x more often in females than males [1,2]. Over 70% of these injuries occur in a non-contact situation including cutting, pivoting and landing from a jump [3]. Several factors have been implicated in this predisposition including biomechanics [4]. The purpose of this study was to detect differences in kinetics and kinematics during cutting maneuvers that may contribute to this gender predisposition.

**METHODS**

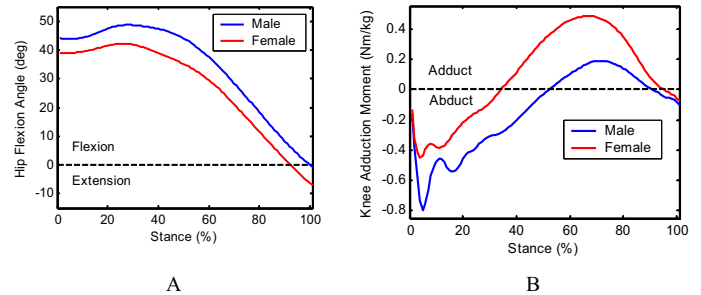
21 elite male and 21 elite female soccer players between the ages of 14-18 years underwent a complete 3D kinematic, kinetic and electromyographic (EMG) analysis of the lower limb during unanticipated running and cutting maneuvers. Hip, knee and ankle angles, forces and moments were collected during the stance phase of each maneuver. Subjects were instructed to run down the walkway of the lab at 3.5 ± 0.2 m/s. Just prior to their right foot landing on the force plate, a light system randomly directed the individuals to either 1) cut to the left (side-cut), 2) continue running straight or 3) cut to the right (cross-cut) until 5 successful trials were obtained for each direction. All cutting maneuvers were made at a 45-60° angle. The kinematic and kinetic waveforms for the entire stance phase of each task were analyzed using principal component analysis [5].

**RESULTS AND DISCUSSION**

There was no significant difference between males and females in age, body mass index (BMI), years of soccer experience or speed of the cutting maneuvers (Table 1). All players were injury free at the time of testing; however, many reported lower limb injuries previously in their soccer careers (M=62%, F=86%).

For the cross-cut and side-cut conditions principal component analysis revealed females exhibit a significantly smaller magnitude of hip flexion than males throughout stance (p=.01) (Figure 1A). In the cross-cut maneuver females also exhibited

a significantly larger magnitude knee adduction moment than their male counterparts (p=.03) (Figure 1B).



**Figure 1:** A) Females exhibit less hip flexion than males during cross-cuts & side-cuts (p=.01). B) Females exhibit a greater knee adduction moment than males during cross-cuts (p=.03).

**CONCLUSIONS**

The cross-cut was the most successful maneuver for identifying gender related differences in this elite soccer population. Females generated less hip flexion and a larger knee adduction moment than their male counterparts. These biomechanical differences may place the female ACL at greater risk for injury. Knowledge of these differences will aid in developing prevention programs to reduce non-contact ACL injuries in females.

**REFERENCES**

1. Arendt & Dick. *Am J. Sports Med* **23**:694-701, 1995.
2. Elias et al. *Med & Sci Sport Exer* **33**:359-367, 2001.
3. Nyland et al. *J Ortho & Sport Phys Ther* **20**:132-137, 1994.
4. Sigward et al. *Clin Biomech* **16**:952-3, 2001.
5. Deluzio et al. *Hum Movt Sci* **18**:701-711, 1999.

**ACKNOWLEDGEMENTS**

This study was funded by the Nike Sports Research Laboratory, Beaverton, Oregon.

**Table 1:** Demographics of elite males and female soccer players.

	Age	Weight	Height	BMI	Soccer	Speed (m/s)		
	(yrs)	(kg)	(m)	(kg/m <sup>2</sup> )	(yrs)	side	run	cross
<b>Males</b>	17.2 ± 0.8	69.6 ± 6.6	1.8 ± 0.0	22.1 ± 1.7	10.7 ± 1.7	3.5 ± 0.1	3.5 ± 0.1	3.5 ± 0.1
<b>Females</b>	16.9 ± 1.0	60.8 ± 5.5	1.6 ± 0.1	22.4 ± 1.8	9.8 ± 2.1	3.4 ± 0.1	3.5 ± 0.1	3.4 ± 0.1
<b>p-value</b>	.25	<.01	<.01	.63	.15		.22	