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Differences of Defense Distance Between Female Soccer and Basketball Athletes on Lower Extremity Biomechanics During Sidestep-Cutting

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SUMMARY

Anterior cruciate ligament (ACL) injuries often occur in women during cutting maneuvers to evade a defensive player. The soccer and basketball players often involve a rapid deceleration before a change of direction, like side-step cutting. The purpose of this study was to determine the differences of defense distance between female soccer and basketball athletes on lower extremity biomechanics during sidestep-cutting. Ten female collegiate soccer players and ten basketball players performed sidestep-cutting with two kinds of defense distances of a static defense opponent, while 3D kinematics and ground reaction forces were recorded during the early deceleration phase of side-step cutting. Peak values selected motion and force variables were submitted to a two-way (defense distances * sports) ANOVA. The results were indicated as: (1) in different type of sports: soccer players demonstrated a significantly greater peak knee internal-rotation angle, peak hip abduction angle, peak ankle abduction angle, and peak knee valgus moment compared with basketball players. Basketball players demonstrated greater peak ankle plantar-flexion angle compared with soccer players. (2) In different defense distances: longer defense distance demonstrated a significantly greater peak knee abduction angle to shorten defense distance. It was concluded that soccer athletes moved more stiffness and may had high-risk with non-contact ACL injures compared to basketball athletes during the early deceleration phase of the cutting maneuver.

INTRODUCTION

Anterior cruciate ligament (ACL) injury is a common and traumatic knee joint injury. In the United States, about 80,000 to 250,000 ACL injuries occur each year in young athletes [1]. Most ACL injuries occur via a non-contact episode. Of these injuries, approximately 70% occur in recreational and sporting activities, like basketball and soccer, which frequency need to suddenly stop or change direction of movement like stop-jumping or sidestep-cutting [2].

Female players have a higher risk of non-contact ACL injuries than male players at collegiate levels [3]. According to statistics of NCAA during 1988 to 2004, female basketball and soccer players who occurs non-contact ACL injuries were 63.8% and 52.7% [4]. Many previous studies have found that A variety of intrinsic and extrinsic factors have been proposed as contributing to the increased ACL injury rate in women include intrinsic factors: the small cross-sectional area of the ACL, greater knee laxity, greater guadriceps angle, and a narrower intercondylar notch; extrinsic factors: level of conditioning, level of muscle strength, and altered motor control strategies [5].

An intensity game in basketball or soccer, defense player play an important role. When during the play of offense, players need to use different way, like side-cutting, to cross over the defender and this kind of movement will increase the rate of non-contact ACL injuries [6]. So the distance of defender may let the players to change the device during sidestep-cutting.

The purpose of this study was to discuss differences of defense distance between female soccer and basketball athletes on lower extremity biomechanics during sidestep-cutting. It may provide significant information for the development of prevention programs for noncontact ACL injuries. We hypothesized that different type of sports in selected were using significant different devices when making a sidestep-cutting task.

METHODS

Subject

A total 20 female intercollegiate division one athletes (10 basketball player and 10 soccer player) between 18 and 22 years of age with professional training more than 5 years and without known history of knee disorders were recruited as subjects for this study. The mean age, body mass, and height of the basketball' and soccer's subjects were 19.9 ± 1.3 and 19.9 ± 1.3 years, 67.4 ± 8.1 and 55.5 ± 4.1 kg, and 173.2 ± 6.5 and 160.8 ± 5.7 meters.

Data collection

For each subject, three-dimensional (3D) lower limb kinematic, and 3D ground reaction force (GRF) data were recorded by Vicon Nexus 1.81 for the right (contact) leg during the execution of 10 sidestep-cutting (two different distance, each one 5 trial) maneuvers. A successful trial necessarily required the contact phase of the movement to occur in the center of a force plate (KISTLER 9281, Switzerland, 60cm 90cm, 1000Hz), within the field of view of a 10-camera high-speed (250Hz) Vicon Motion System(MX13+ Oxford Metrics Ltd., England).

Eighteen retroreflective markers were attached on the right and left lower extremity joint. Four retroreflective markers were attached on thigh, shank, MP1 and MP5 for tracking marks.

Cutting angles were required to be between 35° and 55° from the original direction of motion, with this range demarcated (with tape) by lines on the floor, originating at the center of

the force plate. Subjects were required to continue running following sidestep execution for approximately five steps, with a trial deemed successful if the initial foot contact following the cutting action fell within this prescribed range [7].

A female defender was standing at 0.2 and 1meter far away from the force plane and playing the pose just like basketball's defender.

Data analysis

The data of sidestep-cuttings were analyzed by Visual3D software, and all lower extremity kinematic and kinetic variables were submitted to a two-way (defense distances * sports) ANOVA by using SPSS 19.0. For all statistical analyses, an alpha level of P = 0.05 was used to test for statistical significance.

RESULTS AND DISCUSSION

The research found that (Table 1) in different sports, soccer players demonstrated a significantly greater peak knee internal-rotation angle, peak hip abduction angle, peak ankle abduction angle and peak knee valgus moment; basketball players demonstrated greater peak ankle plantar-flexion angle. The results shown that, soccer players had higher ACL injury risk [8, 9]. Peak knee valgus moment was associated with initial contact hip flexion and internal rotation position during sidestep movements [7]. It may coursed by the difference shoes and playing courts they used to. The soccer field always covered by lawns, it's more wet and soft than the basketball field covered by woods. So, playing soccer need to wear spikes to prevent slip and fall, and that was the reason why soccer players' supporting foot used to stiffer than basketball players'. Different type of sports had different type of motion control. Training programs need to modify to fit the real situation on the court, and the risk of injury will be decreased. Neuromuscular control effects, muscular strength, timing and recruitment, visible and clearly evident within subsequent joint motions and loads [10]. Training programs need to be focused on neuromuscular controlling to reduce the risk of ACL injury.

In different distances of defender, longer defense distance demonstrated a significantly greater peak knee abduction angle to shorten defense distance. The results were due to subjects' expectation. They expected that if the defender will move, more close to the defender, the possible moving range of the defender will be decreased. So, face to the short distance defender, subjects did a smooth movement during sidestep-cutting.

CONCLUSIONS

Female soccer players may have high risk of ACL non-contact injury during sidestep-cutting task. For that, training soccer athletes need to focus on improved hip neuromuscular control and flexibility.

ACKNOWLEDGEMENTS

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Table 1: Mean Absolute and Normalized of Peak Lower Extremity Joint Angle and Knee Valgus Moment.

	Sports		Distances of defender	
	Soccer	**Basketball**	**0.2m**	**1m**
Hip abduction angle (°)	21.37 ± 4.49 [a]	16.90 ± 3.98	19.29 ± 4.80	18.98 ± 4.84
Knee abduction angle (°)	3.43 ± 2.66	5.85 ± 2.95	4.45 ± 2.88	4.82 ± 3.24 [b]
Knee internal-rotation angle (°)	8.27 ± 5.31 [a]	0.77 ± 5.92	4.59 ± 6.74	4.45 ± 6.88
Knee valgus moment (Nm/kg/m)	1.70 ± 0.58 [a]	1.23 ± 0.29	1.48 ± 0.52	1.45 ± 0.52
Ankle plantar-flexion angle (°)	96.47 ± 3.07 [a]	103.22 ± 5.26	99.61 ± 5.28	100.09 ± 5.75
Ankle abduction angle (°)	18.73 ± 5.36 [a]	10.52 ± 4.81	14.62 ± 6.63	14.64 ± 6.60

[a] Significantly different between sports. (p<.05)

[b] Significantly different between distances of defender. (p<.05)