Gender Differences in Knee and Hip Joint Kinematics and Kinetics During Cross-Over Cutting Task

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SUMMARY
The aim of this study was to investigate the knee and hip joint kinematics and kinetics during 90° cross-over cutting task on artificial turf. The difference in kinematic and kinetic variables between female and male subjects was at the knee joint, with no differences detected at the hip for cross cut task. There were significant differences in the joint powers at the knee and hip. We suggested that female soccer players might change the strategy of landing.

INTRODUCTION
Most non-contact knee injuries occur during dynamic landing, sudden deceleration, and cutting activities, and these activities most often occur during sports with intermittent actions such as soccer, basketball, volleyball or handball[1, 4]. These injuries are also more frequent on artificial turf than on natural grass, and more frequent in real games compared to practice sessions and the incidence of anterior cruciate ligament injuries being nearly four times higher on artificial turf than grass[2]. Most of gender difference research has focused on side cutting, otherwise there is very few research about cross cutting movement and even less on artificial turf condition. Therefore, the aim of this study was to investigate the knee and hip joint kinematics and kinetics during 90° cross-over cutting task in artificial turf.

METHODS
We were recruited twenty collegiate right leg dominant soccer players (10 male, age:17±0.4years, height:175.5±4.8cm, weight: 61.8±5.1kg; 10 female, age:19.2±0.4years, height:163.8±5.9cm, weight: 55.7±4.4kg) who have been without serious knee injuries or disorder in the previous six months. A three-dimensional motion analysis and ground reaction force were used during the stance phase of the 90° cross-cutting maneuver after heading jump. To record three-dimensional lower extremity movements, six-cameras and a 200-Hz VICON motion analysis system (T-40, Oxford Metrics Ltd., Oxford, United Kingdom) were used. The VICON plug in gait marker set was used, which consisted of 16 lower limb markers. These markers were placed at the following locations: left and right anterior superior iliac spines (ASIS); posterior superior iliac spine (PSIS); left and right thigh; left and right lateral epicondyle of the knee; left and right tibia; left and right lateral malleolus of the ankle; left and right calcaneous; left and right second metatarsal head. Ground-reaction force data were recorded at 2000 Hz using an AMTI force platform (BP-600900, Advanced Mechanical Technology Inc., Watertown, USA) that was covered by artificial turf.

RESULTS AND DISCUSSION
The first difference in kinematic variables between female and male subjects was at the knee joint, with no differences detected at the hip during the cross cut. Male subjects demonstrated larger flexion angles than did female subjects for the duration of the cross cut contact phase on the artificial turf. This result are similar to Scott’s research result[3]. The second difference was a kinetic variable between genders also was at the knee joint, while there were no differences detected at the hip. Most gender differences were in the sagittal plane in ACL research during the cross cut task. A previous study has shown that hip flexion angle and moment in cross cut are greater in male players at the hip joint. However, in this study we didn’t observe any differences between the genders at the hip joint throughout contact phase. These differences may caused both the surface condition and direction of cross cutting. There were significant differences in the joint power at the knee and hip. A difference between male and female players knee and hip joint power for the cross cut were identified(Figure 1) in the early landing phase. While the opposite was observed in the females the maximum power was in the hip joint then in the knee. It is expected that if the maximum power is first experienced in the hip then there will be also a large joint power experienced in the knee.

CONCLUSIONS
Biomechanical lower limb differences between genders in collegiate soccer players were recognized while performing cross cut associated affecting ACL injuries. Above all, differences between males and females knee flexion angle, flexion moment, joint power and hip joint power were shown for the 90°cross cut on the artificial turf in our study. We suggest that female soccer players might change the strategy of landing.
ACKNOWLEDGEMENTS
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REFERENCES

Table 1: Average(±SD) hip and knee peak joint angle and peak moment during contact phase

<table>
<thead>
<tr>
<th></th>
<th>Peak Angle(degree)</th>
<th>Peak moment(Nm/kg)</th>
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<tbody>
<tr>
<td></td>
<td>Flexion</td>
<td>Adduction</td>
</tr>
<tr>
<td>Knee</td>
<td>Male</td>
<td>66.67±7.44</td>
</tr>
<tr>
<td></td>
<td>female</td>
<td>58.56±6.53</td>
</tr>
<tr>
<td>hip</td>
<td>Male</td>
<td>59.48 ± 9.24</td>
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<tr>
<td></td>
<td>female</td>
<td>59.95±10.67</td>
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Bolded number indicates significant differences at α=0.05