INCREASING KNEE FLEXION IN LANDING TASKS DOES NOT REDUCE KNEE MOMENTS

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SUMMARY
It has been suggested in the literature that increasing knee flexion angles during landing tasks may reduce the risk of non-contact anterior cruciate ligament (ACL) injuries. The aim of this study was to test the recommendation for increased knee flexion during sporting tasks to reduce injury risk [4, 5]. It was hypothesized that increased knee flexion would result in reduced knee moments. The technique modification program was based on one by Dempsey et al.[3]. It consisted of a 6 week programs with drills designed to move from closed to open tasks. Participants received visual and oral feedback during the session. Training focused on increasing knee flexion and maintaining a forward facing upright torso.

INTRODUCTION
Anterior Cruciate Ligament (ACL) injuries are a severe, debilitating injury that occurs all too often during team sports. The majority of these injuries occur with no contact to the athlete, during sidestep cutting and landing tasks [2]. Though the ACL’s primary function is to prevent anterior tibial translation it is also loaded by internal rotation and valgus moments at the knee [6]. Combining internal rotation moments with anterior drawer forces produces high ACL loads below 10° of knee flexion, while the same is true for valgus moment and anterior drawer forces from 10° - 50° of knee flexion. Combined with the extended knee postures observed during injury [2, 7] these results have led to the recommendation for increased knee flexion during sporting tasks to reduce injury risk [4, 5].

The aim of this study was to test the recommendation for increased knee flexion during landing tasks. It was hypothesized that increased knee flexion would result in reduced knee moments.

METHODS
Twenty two male team sports athletes were recruited to participate in this study. All participants were experienced in performing functional landing tasks through their respective team sport. Five participants withdrew from the study because of external time constraints.

Participants underwent full three dimensional motion analysis pre and post training [3]. An inverse dynamic model was used to calculate 3D knee loading and kinematics during the landing phase of landing tasks. This phase ran from initial foot contact to double the time from initial foot contact to the peak ground reaction force. Maximal knee angles were identified as well as at foot contact and at peak valgus and internal rotation moment. Peak knee flexion, valgus and internal rotation moments were also identified. Pre- and post-intervention scores were compared using paired t-tests. Pearson correlations were performed between kinetic and kinematic variables found to be significantly different.

RESULTS AND DISCUSSION
Following training there was a reduction in maximal knee flexion angle (Table 1) which was correlated to an increased internal rotation moment ($r = 0.613, p = 0.009$) (Table 2). There was also an increase in the knee angle at peak internal rotation moment, however there were no other significant changes (Tables 1 & 2).

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Foot Contact</td>
<td>6.8 (7.1)</td>
<td>8.0 (6.2)</td>
<td>0.459</td>
</tr>
<tr>
<td>Max</td>
<td>57.0 (14.5)</td>
<td>66.7 (17.9)*</td>
<td>0.010</td>
</tr>
<tr>
<td>Peak Valgus</td>
<td>25.7 (10.5)</td>
<td>30.9 (15.6)</td>
<td>0.250</td>
</tr>
<tr>
<td>Peak Internal Rotation</td>
<td>31.8 (9.9)</td>
<td>46.2 (21.1)*</td>
<td>0.017</td>
</tr>
</tbody>
</table>

* Significant difference at p < 0.05

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion</td>
<td>-2.07 (0.56)</td>
<td>-2.03 (0.392)</td>
<td>0.676</td>
</tr>
<tr>
<td>Valgus</td>
<td>0.41 (0.23)</td>
<td>0.32 (0.19)</td>
<td>0.244</td>
</tr>
<tr>
<td>Internal Rotation</td>
<td>-0.13 (0.05)</td>
<td>-0.20 (0.13)*</td>
<td>0.042</td>
</tr>
</tbody>
</table>

* Significant difference at p < 0.05
Despite the literature recommendation for increased knee flexion angle to reduce the risk non-contact ACL injury, the results from this study show that increasing knee flexion angle results in increased internal rotation moments. This increase in moment initially suggests that increasing knee flexion angle potentially raises the risk of injury as internal rotation moments load the ACL [6]. However, this conclusion warrants further analysis as the impact of knee moments on ACL loading is moderated by knee joint angle. The peak internal rotation moment in this study occurs well outside the knee angle range where it may highly load the ACL [6]. This suggests that the increase in moment may not result in an increased risk of injury. Further, the observed 15° increase in knee flexion angle at peak internal rotation moments also increases the potential for the biceps femoris to support the internal rotation moment, with an approximate doubling of the external rotation moment arm of both heads of biceps femoris [1]. As we did not measure muscle activation in this study we cannot conclusively comment on any potential increase in supports. Further work utilizing neuromuscular and stochastic modeling is required to understand the relationship between increased knee flexion and ACL load during sporting tasks.

CONCLUSIONS

Despite the increase in peak knee internal rotation moments associated with increasing knee flexion there may be no increase in risk of non-contact ACL injury as the peak moment occurred outside the knee angle range associated with high ACL load. Further work utilizing computer modeling techniques is required to better understand the relationship between knee angle and ACL loading in functional sporting tasks.

ACKNOWLEDGEMENTS

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REFERENCES