THE RELATIONSHIP BETWEEN KNEE VALGUS WHEN SQUATING AND DURING VERTICAL JUMP TAKEOFF AND LANDING

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INTRODUCTION

Anterior cruciate ligament (ACL) injuries are a major problem for today’s athletes as an estimated 1 in 3000 of the population experiences an ACL injury.

The knee valgus is viewed as a non favorable position as it has been linked to ACL injuries (Russell et al., 2006). This hazardous position can be observed not only during landing from a jump but also during the countermovement (squat) prior to the takeoff. Knee valgus is caused by a combination of hip adduction internal rotation and abduction external rotation of the lower leg as it is clear that in many jumpers the two knees come closer to each other. If the quantity of valgus experiences during a countermovement or a squat is related to that experienced during landing from a jump, a double legged squat test could be used as a screening tool prior to sports participation.

Thus, the purpose of the study was to investigate if a relationship exists between knee valgus observed during the countermovement prior to a vertical jump, knee valgus seen during landing, and knee valgus experienced during the downward phase of a squat.

METHODS

Sixteen active college students (8 males, 8 females) volunteered to participate in the study. Participants were excluded if they had any orthopedic condition that would prevent them from jumping.

Subjects were asked to do three squats and three maximal vertical countermovement jumps standing with the feet shoulder’s width apart. The order of the trials was balanced. Electromagnetic motion sensors (240 Hz, Polhemus Liberty) were used to calculate the distance between the knees during the jumps and squats.

Pearson product correlations were used to identify the relationship between the change in distance between the two knees during the downward phase of the takeoff phase and the downward phase during landing, the downward phase of the squat. Linear regression analyses were conducted to identify the predictability of the distance between the knees during landing from the distance between the knees during the squat and countermovement.

RESULTS AND DISCUSSION

Results showed significant correlations between the three variables (Table 1).

Table 1. Pearson production correlations between the three conditions

<table>
<thead>
<tr>
<th></th>
<th>Take off</th>
<th>Landing</th>
<th>Squat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take off</td>
<td>1</td>
<td>0.656*</td>
<td>0.959*</td>
</tr>
<tr>
<td>Landing</td>
<td>1</td>
<td>0.637*</td>
<td></td>
</tr>
<tr>
<td>Squat</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Significant at the 0.01 level (2-tailed)

Each variable had a strong positive correlation with the other two variables. This suggests valgus motion during the
countermovement meant valgus motion during landing as well as during a squat.

Linear regression analysis identified the average change in distance between the two knees during the countermovement jump as a significant predictor of the average change during landing from a jump (Figure 1). However, the $R^2$ value is relatively low (0.43) which suggests this variable by itself cannot predict the change in knee position during landing.

$$y = 0.456x - 1.8587$$  \quad $R^2 = 0.4307$

![Figure 1. The relationship between change position during countermovement and during landing.](image1)

Similar results were seen when attempting to predict the change in distance between the knees from the change in position during squatting ($R^2 = 0.41$, Figure 2).

$$y = 1.0385x + 4.8909$$  \quad $R^2 = 0.4063$

![Figure 2. The relationship between change position during squatting and during landing.](image2)

Linear regression analysis showed the change in knee position during the squat was a strong predictor of the change in position during the countermovement ($R^2 = 0.92$, Figure 3).

$$y = 1.086x + 0.7934$$  \quad $R^2 = 0.9201$

![Figure 3. The relationship between change position during squatting and during the countermovement.](image3)

The predictability of the change in distance during the countermovement from squatting suggests that when designing a field test squatting may replace the need to have the subjects do an actual countermovement jump to be tested.

**SUMMARY/CONCLUSIONS**

This study examined the ability to predict the change in distance between the knees during landing from a jump from the change during the countermovement and the change during the squat. This distance rather than actual knee valgus was used as it would be a measure that can be taken on the field. Both were significant predictors, however, neither factor by itself can predict the change during landing. Future studies should focus on multiple regression using factors as the height, weight, leg length, muscle strength, and other factors that can be measured in the field.

**REFERENCES**
