THE RELATION BETWEEN KNEE SEPERATION DISTANCE AND LOWER EXTERMITY KINEMATICS DURING A DROP LAND: IMPLICATIONS FOR CLINICAL SCREENING

Kathryn L. Havens, Susan M. Sigward, Wei-Cheng Cheng, Christine D. Pollard, Christopher M. Powers
Jacquelin Perry Musculoskeletal Biomechanics Research Laboratory
Division of Biokinesiology and Physical Therapy
University of Southern California, Los Angeles, CA, USA
email: khavens@usc.edu, web: www.usc.edu/go/mbrl

INTRODUCTION

Prospectively, three-dimensional knee abduction (valgus) angle during a drop land was found to be a predictor of anterior cruciate ligament injury risk in female athletes. [1] As a result, techniques have been developed to screen athletes for excessive frontal plane knee motion during drop land tasks in attempt to identify those at increased risk for injury.

Due to the time and expense related to assessment of three-dimensional joint kinematics, techniques assessing the extent to which the knees collapse medially have been adopted clinically. Techniques typically include measures of knee separation distance in the frontal plane during landing. While these measures have been used in several research studies to identify gender differences and to assess the effects of training, [2,3,4] it is not clear how they relate to abduction of the knee. Given the potential for transverse and frontal plane motion of the lower extremity to influence measures of knee separation distance, it is possible that these clinical assessments do not accurately represent knee frontal plane kinematics.

The purpose of this investigation was twofold: 1) to determine the relation between minimum knee separation distance and bilateral knee abduction angles and, 2) to determine the association between minimum knee separation distance and bilateral lower extremity transverse and frontal plane angles.

METHODS

Subjects consisted of 25 healthy, females athletes (ages 11 to 23 yrs) with no history of previous knee injury. Average height was 162.4 cm and average weight was 57.67 kg.

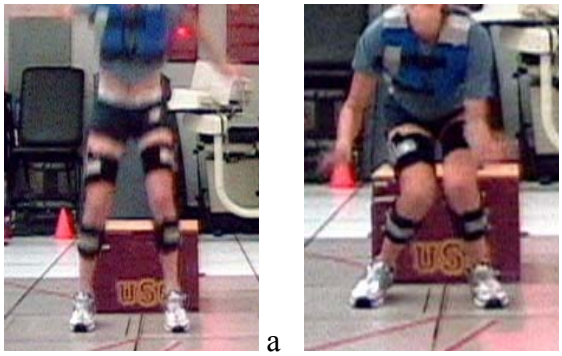

a b

Figure 1: Deceleration phase of a drop land, at foot contact (a) and maximum knee flexion angle (b)

Subjects performed a bilateral drop land from a 36 cm platform followed by a maximum vertical jump. Three-dimensional kinematics were collected using an 8 camera Vicon motion analysis system (250 Hz). Visual3D™ software (C-Motion, Inc., Rockville, MD, USA) was used to quantify three dimensional, 6 degree-of-freedom hip, knee, and ankle kinematics.

All data were analyzed during the deceleration phase of landing, defined as the time between foot contact and maximum knee flexion angle (Figure 1). Minimum knee separation distance was calculated as the distance between the right and left lateral femoral epicondyles in the frontal plane. Lower extremity transverse and frontal plane angles were identified bilaterally at the time of minimum knee separation. Right and left angular data were averaged to account for the contribution from each lower extremity to the knee separation distance. Data were average across three trials.

The independent variable of interest was minimum knee separation distance. Dependent variables included the average knee and hip frontal and transverse plane, and ankle frontal plane angles of both limbs.

Linear regression was used to determine the association between minimum knee separation distance and bilateral average knee frontal plane angle. Stepwise multiple regression was used to identify the best predictors of minimum knee separation distance during a drop land. Statistical analyses were performed using SPSS software (Chicago, IL). Significance levels were set at $P \leq 0.05$.

RESULTS

Bilateral average knee frontal plane angle was a significant predictor of minimum knee separation distance (R=0.573, R^2 =0.328, P=0.003; Figure 2). The association was negative, indicating that greater knee abduction angles were associated with smaller knee separation distances.

Figure 2. **Knee separation distance vs. Knee frontal plane angle**

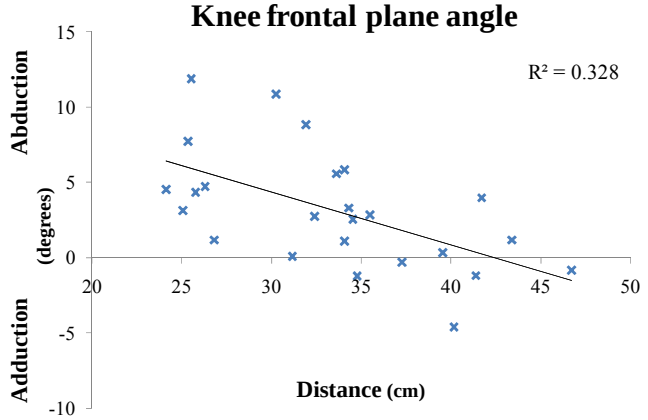
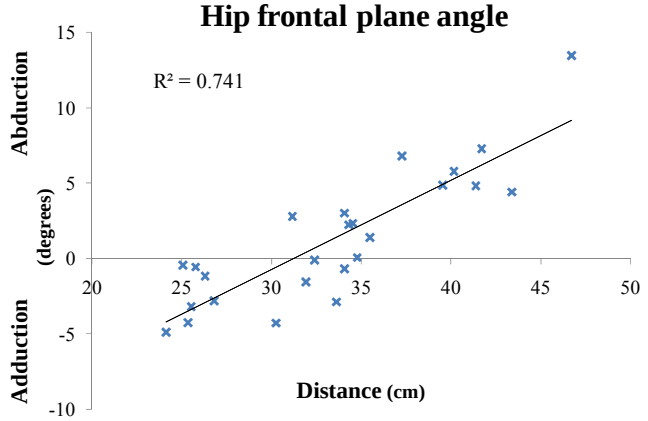


Figure 3. **Knee separation distance vs. Hip frontal plane angle**



Of the dependent variables, average bilateral hip frontal plane angle was the only predictor of minimum knee separation distance (R= 0.861, R^2 = 0.741, P < 0.001; Figure 3). In general, greater hip abduction angles were associated with greater knee separation distances.

DISCUSSION

Bilateral average knee frontal plane angle explained only 33% of the variance in minimum knee separation distance, suggesting that it is not a good indicator of knee abduction angle during a drop land. Minimum separation distance appears to be a better indicator of bilateral average hip frontal plane angle as it was the only predictor of knee separation distance to enter into the regression equation, explaining 74% of the variance.

CONCLUSIONS

Measures of knee separation distance during bilateral landing tasks appear to provide information regarding medial collapse of the lower extremities. However, they are more indicative of frontal plane hip motion. Caution must be taken when relating these measures to knee abduction angles.

REFERENCES

1. Hewett TE, et al. *Am J Sports Med* 33, 492-501, 2005
2. Ford KR, et al. *Am J Sports Med* 33, 1745-50, 2005
3. Barber-Westin SD, et al. *Am J Sports Med* 33, 1-8, 2005
4. Noyes FR, et al. *Am J Sports Med* 33, 197-207 2005

ACKNOWLEDGEMENTS

This study was funded by the National Institutes of Health (R01 AR053073-02).