INTRODUCTION

Approximately 70% of all ACL injuries are caused by non-contact mechanisms and the ACL injury rates in females have been reported to be 4-6 times greater than males competing in the same sports (Hewett et al., 2005). Boden et al. (2000) suggested that ACL injuries occur more commonly during unilateral landings rather than bilateral landings, typically during deceleration, lateral pivoting, or landing tasks that are often associated with high external knee joint loads.

Although ACL injuries can occur during unilateral and bilateral landings, Pappas et al. (2007) suggested that the observed kinematic difference in unilateral landings increased injury risk. They attributed this to a decreased base of support and increased demand on the lower extremity musculature to absorb the impact. However, they did not report any kinetic measures, and all subjects performed landings from a 40 cm height. Conversely, landings from a height equal to individuals’ maximum jump height may more closely simulate reality. Therefore, the purpose of this study was to determine whether females and males utilize different landing strategies (kinematic and kinetic) during unilateral and bilateral landings from a height equal to their individual jumping abilities.

METHODS AND PROCEDURES

Nine males and eleven females participated in this study. All were recreationally active and free from musculoskeletal injury. Each subject was asked to perform unilateral and bilateral drop landings from a box height equal to their maximum jump height. Five trials of each task were recorded.

Three-dimensional kinematic data were collected using a seven-camera Motion Analysis Eagle system (200 Hz), and force data were collected with an AMTI force platform (1000 Hz). Three-dimensional joint kinematics and kinetics were calculated, touchdown angles, range of motion (ROM), peak moments, and joint work were extracted for each plane. The peak moment and joint work parameters were normalized by body mass*body height*landing height. A repeated measures ANOVA was performed for each dependent variable (p < 0.05).

RESULTS AND DISCUSSION

There was a significant interaction between task and gender for hip adduction angle at touchdown. Subjects exhibited increased abduction during unilateral landings in order to shift their center of mass over the stance leg and prevent pelvic drop to the contralateral side. However, it was unclear why males exhibited a greater increase in hip abduction than females during unilateral landings. At the knee, subjects performed unilateral landings with significantly less knee flexion at touchdown and subsequent ROM (Figure 1). These findings were consistent with Pappas et al. (2007) who suggested that a more extended knee during unilateral landings may be a compensatory mechanism to more effectively utilize the quadriceps in absorbing the impact of landing. Unilateral landings were also characterized by decreased knee
abduction at touchdown, and subsequent ROM. Thus, there is an apparent attempt to increase stability by limiting motion at the knee, which may increase injury risk during an unbalance landing (Decker et al., 2003).

![Figure 1. Mean knee flexion and adduction angles for males (grey) and females (black) single (solid) and two leg (dashed) landings.](image1)

Analysis of the sagittal plane joint work (Figure 2) revealed a significant task by gender interaction for sagittal ankle work. During bilateral landings females performed more work (36%) than males (28%). However, during unilateral landings males and females performed similar amounts of work at the ankle (males 44%, females 45%). This increase in ankle work during unilateral landings was accompanied by a significant decrease in knee work by both males (-10%) and females (-13%). At the hip, males exhibited a 6% decrease while females exhibited a 4% increase in sagittal plane work. However, this difference was not statistically significant.

![Figure 2. Mean sagittal plane joint work. † indicates significant gender difference. * indicates landing type difference. ‡ indicates significant interaction.](image2)

**SUMMARY**

Unilateral landings were characterized by significant differences in hip and knee kinematics that have been linked to increased injury risk (Boden et al., 2000; Hewett et al., 2005). The ankle musculature was utilized more for impact absorption during unilateral landing, which required increased joint extension at touchdown and may increase injury risk during an unbalanced landing.

**REFERENCES**


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