EFFECTS OF AGE GROUP ON LANDING MECHANICS IN THE ADOLESCENT FEMALE BASKETBALL PLAYER

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INTRODUCTION

Female athletes may be 2.4 to 9.7 times more likely to sustain an anterior cruciate ligament (ACL) injury than males (Arendt et al., 1995; Gwinn et al., 2000). The majority of ACL injuries (78%) are from non-contact injuries such as planting, cutting, or landing from a jump (Noyes et al., 1983). In a retrospective survey on female basketball players, 58% reported landing from a jump when the injury occurred (Gray et al., 1985). The ACL is most susceptible to injury when the body is in forward flexion, hip adduction, internal rotation, 20-30° of knee flexion, external rotation of the tibia, and foot pronation (Ireland et al., 1997). Females are more likely than males to land with these risky characteristics, especially increased knee valgus (Chappell et al., 2002; Ford et al., 2003) and decreased knee flexion (Chappell et al., 2002). A combination of biomechanical, neuromuscular, hormonal, and anatomical differences may contribute to gender differences in ACL injury and landing mechanics.

Jump-training programs that include stretching, plyometrics, and weight lifting have been shown to not only decrease varus and valgus moments at the knee, but also decrease the rate of non-contact ACL injuries (Hewett et al., 1996; Hewett et al., 1999).

Research studies have yet to evaluate athletes of different age groups. Identifying when these landing differences occur during age may indicate when training programs should be implemented to have the greatest impact on decreasing the risk of ACL injury.

METHODS

Forty-two female basketball players (14 sixth graders, 17 ninth graders, and 11 twelfth graders) without history of knee injury participated in this study. Athletes completed a five-minute warm-up on a stationary bike prior to testing. Static measurements obtained were height, weight, hip width, femur length, tibial femoral angle, and navicular drop. Knee extension and flexion strength was measured using a Cybex isokinetic dynamometer at 180°/s. Abductor hip strength was measured using a hand-held dynamometer affixed to an anchoring station.

Three-dimensional motion analysis system (Motion Analysis, Santa Rosa, CA) recorded the movement of the hip, knee, and ankle, as defined by the Helen Hayes marker set, while performing a drop-landing from a height of .40m. Signals from the Bertec force platform were collected at 1200 Hz and synchronized with kinematic data (Wilson et al., 2000).

Statistics were calculated using ANOVA.

RESULTS AND DISCUSSION

All athletes performed forefoot-to-rearfoot landings and the group mean landing phase
times were not different between groups (p>0.05). At initial contact 6th grade athletes landed with significantly more knee valgus than 9th grade (p<0.05). (Figure 1)

![Figure 1: Frontal Plane Motion at Initial Contact (Positive values indicate hip and knee varus, and ankle supination. Negative values indicate hip and knee valgus, and foot pronation.)](image)

The maximum range of motion in the frontal plane was not different among the three groups (p>0.05). All three age groups landed in a more extended position at initial contact comparable to results of Decker et al. (2003) and Huston et al. (2001). The peak joint moments were not different in the frontal plane (p>0.05), but were different in the sagittal plane at the knee between participants in 6th and 12th grade (p<0.05). (Figure 2)

![Figure 2: Peak Sagittal Knee Moments](image)

Hip abduction strength, q-angle, navicular drop, and quadriceps/hamstring strength were not different among the three groups (p>0.05). The peak braking force was also less in 6th grade than 9th grade participants (p<0.05).

**SUMMARY**

All three age groups tended to demonstrate landing mechanics that may place them at risk for injury: knee valgus on contact with a more erect position. These results suggest that implementation of jump-training programs may benefit female athletes as young as 6th grade if the goal is specifically to alter these kinematic factors. Younger participants may be already demonstrating mechanics that may be a risk factor for ACL injury.

**REFERENCES**


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