BIOMECHANICAL SYMMETRY DURING DROP JUMP AND SINGLE-LEG HOP LANDING IN UNINJURED ADOLESCENT ATHLETES

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BACKGROUND
Symmetry of strength, thigh girth and hop distance is often used as a benchmark in return to sport testing. Using symmetry as a gold standard has been translated into biomechanical testing; however, kinematic and kinetic symmetry during dynamic tasks in adolescents without lower extremity injury is not well understood. The purpose of this study was to assess symmetry in uninjured adolescent athletes during double and single-leg landing tasks.

METHODS
36 uninjured athletes (ages 7-15 years, mean 12.4, SD 2.4; 47% female) completed vertical drop jump (DJ) and single-leg hop (SLH) for distance tasks; lower extremity kinematics and kinetics were collected through 3-D motion analysis using a 6 degree-of-freedom model; 2-3 trials per participant per side were analyzed. Differences between dominant and non-dominant limbs from initial contact to peak knee flexion were examined using statistical parametric mapping (SPM), a methodology for performing statistics on time series data. The SPM method allows differences between dominant and non-dominant limbs to be evaluated for statistical significance at all time points throughout the landing movement.

RESULTS
During both DJ (Figure 1) and SLH (Figure 2), the dominant limb tended to be more internally rotated at the hip throughout landing, but the asymmetry was significant only for short periods early in landing during the DJ (p<0.05) and at mid-landing in the SLH (p=0.01). Additionally, the dominant hip tended to have less abducted positioning throughout both tasks, but differed significantly only shortly after initial contact in the SLH landing (p=0.04). The dominant limb ankle was less inverted (p<0.001) with a lower external inversion moment (p<0.001) during early to mid-landing in the DJ, and less everted (p=0.04) with higher external inversion moment (p=0.05) early in SLH landing. The only asymmetry observed in either task in the sagittal plane was slightly higher external ankle flexion moments (p=0.05) just after initial contact in the DJ. No asymmetries were detected in peak vertical ground reaction force or knee kinematics/kinetics for either task.

CONCLUSION/SIGNIFICANCE
Uninjured adolescent athletes exhibited only slight asymmetries during double and single-leg landing, primarily at the hip and ankle in the frontal and transverse planes. The hip may perform larger adjustments to accommodate center of mass location, while the ankle fine-tunes the landing as the closest segment to the ground. This study supports that normal biomechanics are symmetric during double and single-leg landing. Biomechanical symmetry is therefore a reasonable target in return to sport assessment.

While only small regions of statistically significant asymmetry were identified, it is possible that greater asymmetries are present within individuals. In the grouped analysis, asymmetry towards the dominant side for one individual could offset asymmetry towards the non-dominant side of
another individual. In future analysis, we will examine the magnitude and significance of within-subject asymmetry.

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