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Fatigue has a Different Effect on the Biomechanics of Drop Vertical Jump

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Summary:
Female amateur recreational basketball players are likely to have the increased risk of noncontact ACL injury after fatigue, and the effect of fatigue is greater in recreational players than in college athletes.

Abstract:
INTRODUCTION: Fatigue is one of the risk factors in noncontact anterior cruciate ligament injury. The purpose of the present study was to examine and to clarify the effects of fatigue on the biomechanics of drop vertical jump (DVJ) in female recreational players compared to female college athletes.
METHODS: Fifteen female college athletes (mean age = 20.0±1.5 yrs) and ten female recreational players (mean age = 20.9±1.2 yrs) participated. All the subjects were basketball players. Tegner activity scales were level 9 in college athletes and 7 in recreational players. An informed consent form approved by Institutional Review Board of our university was obtained in each subject. The subjects performed double-legged drop landing. Drop landing tasks were jumping from a 30-cm high box to a distance of 50% of their height away from the box, down to force plates, and immediately rebounding for a maximal vertical jump on landing. The fatigue protocol consisted of the subject performing double-legged squats, with arms parallel to the ground, to a depth of 90° knee flexion. The fatigue was operationally defined as the point when the subjects could not accomplish the fatigue protocol. In addition, we checked Rating of Perceived Exertion (RPE) score to know their level of fatigue. Greater than 17 in RPE is a good indicator for the appropriate fatigue status. Before data collection, participants received instructions about performing DVJ. After performing DVJ several times, three trials were recorded for each subjects before fatigue protocol. After the protocol, three trials were also recorded. DVJ in each subject was captured using a motion analysis system. The third trial data before fatigue and the first trial data after fatigue were analyzed. The motion of markers was recorded by Qualisys Track Manager Software (version 2.7). To calculate knee kinematics and kinetics, Visual 3D (C-motion Company) was utilized. Knee flexion angle at initial contact (IC), peak knee flexion angle, knee abduction angle at IC, peak knee abduction angle, knee internal rotation angle at IC, and peak knee internal rotation angle, were adopted as kinematic parameters. Knee internal rotation was defined as tibial rotation with respect to the femur. Peak knee flexion, abduction, and internal rotation moment within 40 milliseconds from IC were adopted as kinetic parameters. Simultaneously, frontal and sagittal view video data were acquired using standard HD video cameras to evaluate Landing Error Scoring System (LESS). As a statistical analysis, the data on dominant side were compared between before and after fatigue in each group using two-tailed Paired t-test. The statistical significance level was set at P=0.05.
RESULTS: LESS was significantly worse after fatigue than before fatigue in both groups. However, kinematic and kinetic differences were not detected in female athletes, while knee abduction angle at IC and peak knee abduction moment within 40 milliseconds were significantly greater after fatigue than before fatigue in recreational players.
DISCUSSION: According to the previous studies, rapid valgus development within 40 milliseconds after IC was seen in the timing of the ACL injury. From the present study, after fatigue protocol, the significant increase of the knee

abduction angle and moment was observed in female recreational players. Fatigue may have different effects between female college athletes and recreational players.