Sports Medicine & Movement Laboratory

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Evaluation of the Relationships Between Hormonal, Biomechanical, and Neuromuscular Risk Factors for Anterior Cruciate Ligament (ACL) Injury

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ABSTRACT

Background: Female athletes are 2-9 times more likely to tear their anterior cruciate ligament (ACL) than their male counterparts, and approximately 10% of female athletes will tear their ACL during their career. Over the past 20 years, research has focused on creating clinical tests and injury prevention programs that target modifiable risk factors, such as neuromuscular control and biomechanics. Even though these programs have been widely implemented, the injury rate amongst female athletes remains high. Recently, relaxin, a peptide hormone similar in structure to insulin, was identified as interfering with structural integrity of female ACLs but not in males.

Purpose: The purpose of this study was to determine the relationship between biomechanical, neuromuscular, and hormonal ACL injury risk factors. This study will give physicians insights into whether these risk factors can be treated independent of each other or if a multifactorial analysis is needed.

Study Design: Prospective cohort study.

Methods: Twenty-two female athletes (21.7±3.7 yrs.; 64.8±8.2 kg; 1.8±0.3 m) participated. While equipped with various sensors, participants performed a single leg squat (SLS), drop vertical jump (DVJ), and single-leg crossover dropdown (SCD). Kinematic data were collected at 100 Hz using an electromagnetic tracking system. Ground reaction force data were collected at 1000 Hz using a Bertec force plate. Electromyographic data were collected at 1000 Hz using a Delsys system. Blood samples were collected when serum relaxin concentrations (SRC) peaked and processed using a Quantikine Human Relaxin-2 Immunoassay. Statistical analyses were performed using Pearson product-moment correlations.

Results: During the all three clinical tests, significant correlations were observed between kinematics and kinetics, muscle activations and kinematics, muscle activations and kinetics, and SRC and kinematics. During the DVJ and SCD, significant correlations were observed between SRC and muscle activations. During the SCD, significant correlations were observed between SRC and kinetics.

Conclusion: Examining these relationships gives insight into the mechanism of ACL injury. Ultimately, these findings reveal that hormonal, biomechanical, and neuromuscular risk factors are not independent of each other and therefore, should not be treated as such. This study calls for sports medicine personnel to seek a more holistic approach when evaluating injury susceptibility in female athletes.

This abstract is a brief overview of a manuscript submitted for publication. The full manuscript will be sent to you once it is accepted for publication.

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