Hormonal Contraceptives Reduce Ligament Laxity and Protect Against Injuries in Female Athletes

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Summary

Female athletes face a 3 to 9 times higher risk of ACL rupture than males, potentially due to hormonal influences. Relaxin receptors, found only on female ACLs, may contribute to increased joint laxity and injury risk. This study examined how hormonal contraceptive (HC) use affects ligament mechanics in professional and collegiate female basketball, volleyball, and soccer players. Participants were divided into HC and non-HC groups, with kinematic measures and ligamentous injuries tracked throughout the season. Non-HC athletes demonstrated greater hip flexion and knee valgus rotation at single legged landing task ($p<0.01$ and $p<0.05$, respectively), both linked to higher ACL injury risk. Additionally, HC athletes had significantly fewer ligamentous injuries ($p<0.05$) than non-HC athletes. The findings suggest that hormonal contraceptives may influence biomechanics in ways that reduce ligamentous injury risk in female athletes.

Introduction

Female athletes are at a 3 to 9 times greater risk of rupturing their anterior cruciate ligament (ACL) compared to similarly trained males playing the same sport [1]. Relaxin receptors have been detected on female but not male ACLs, suggesting the same hormone that loosens the pubic symphysis during parturition may also predispose women to ligament injury via increased joint laxity. Hormonal contraceptives alter hormone levels in females, potentially leading to differences in kinematics and consequently affecting the risk of ligament injuries in female athletes.

Methods

Professional and Division-1 collegiate female basketball, volleyball, and soccer players in United States were recruited (n=72) and divided into two groups based on their HC status (HC vs non-HC; 40 and 32, respectively). A knee ligament arthrometer was used to quantify knee laxity by applying a 30-lb anterior force to the tibia. Subsequently, athletes performed single-legged drops from a 12-inch block using their dominant foot, repeating the task five times. Lower body kinematics during the drops were captured using XSENS Awinda inertial measurement units (IMUs). Three specific timepoints during the landing phase were analyzed: initial foot contact, peak ground reaction force, and maximum knee flexion. One-way ANOVA was used to compare differences in outcome measures between the two groups of athletes. Ligamentous injuries were continually tracked throughout their season. Chi-square analysis was used to compare ligamentous injuries between the two groups.

Results and Discussion

Athletes on HC demonstrate greater tibial displacement compared to non-HC athletes ($p<0.05$). Non-HC athletes showed significantly greater hip flexion angle during the initial contact of the landing ($p<0.01$) and significantly greater knee adduction during the maximum knee flexion of the landing phase ($p<0.05$) compared to HC athletes, Figure 1. Athletes on HC had significantly fewer ligamentous injuries than non-HC athletes ($p<0.05$). Athletes not on hormonal contraceptives had increased 'valgus collapse' of the knee at maximum flexion and higher hip flexion at initial contact, both of which has previously been identified as potential risk factors for ACL rupture [2].

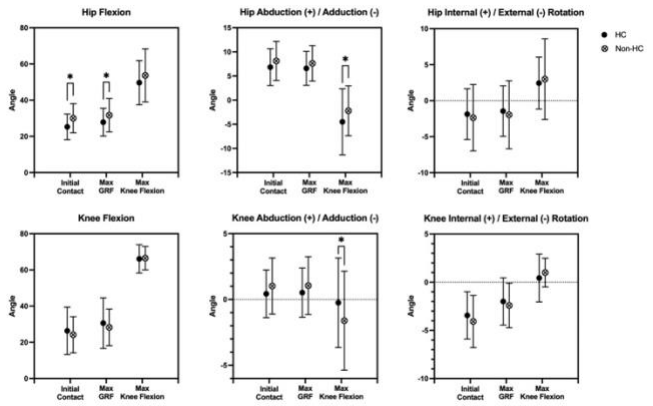

Figure 1: Hip and knee kinematics of HC and Non-HC group during three phases (initial contact, maximum ground-reaction force, and maximum knee flexion) of single-legged drop.

Conclusions

The present study advances our knowledge of the underlying pathophysiological mechanisms of ligamentous injuries and how hormonal contraceptives modulate the response of the musculoskeletal system.

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References

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