COMBINED EFFECTS OF FATIGUE AND ANTICIPATION ON LANDING MECHANICS: CENTRAL AND PERIPHERAL CONTRIBUTIONS TO ACL INJURY RISK

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INTRODUCTION

Despite the ongoing evolution of training methods geared towards preventing ACL injuries, injury rates and the associated sex-disparity in these rates have not diminished.[1] We therefore contend that current strategies continue to exclude key components of the injury mechanism and in particular those synonymous with the inherently random nature of sports participation. Neuromuscular fatigue and unanticipated movement tasks have both been shown in isolation to induce significant and potentially hazardous modifications in lower limb control during dynamic sports postures.[2,3] The combined effects of these factors however, which are not independent within the sporting context, remain unclear. Considering fatigue is known to manifest both centrally and peripherally, poor decisions, reactions and hence movement responses indeed appear feasible in the presence of fatigue. With this in mind therefore, the purpose of the current study was to examine the combined effects of fatigue and decision making on 3D lower limb mechanic during dynamic landing tasks.

METHODS

Twenty four female (21.4 ± 2.1 yrs) NCAA Division 1 athletes had 3D lower limb kinematics quantified during anticipated (AT) and unanticipated (UT) single leg (left and right) landing tasks, both before and during exposure to a generalized fatigue protocol. Jump direction immediately following contact with a force plate was governed by a series of light stimuli, activated prior to and during (300ms following initial take-off) the pre-land (flight) phase of AT and UT tasks respectively. For the fatigue trials, subjects performed a continuous series of three single leg squats on a randomly determined limb, immediately followed by the randomly ordered landing task. This cycle was repeated until squats were no longer possible, with this point defined as maximum fatigue (100%).

Subject-based peak stance (0% - 50%) phase 3D lower limb joint angles were then calculated across pre-fatigue trials, and subsequently for trials denoting 100% and 50% of maximal fatigue. Two legged landing trials were dispersed throughout the protocol as a means of estimating and comparing fatigue levels. Specifically, mean maximum jump heights for pre-fatigue trials were first determined, following which similar measures calculated for 50% and 100% jump trials and represented as a percentage of the mean pre-fatigue value. These data were subsequently considered as covariates within the ensuing statistical analyses. All data were then submitted to a 3-way mixed design ANCOVA, testing for the main effects of fatigue time, decision and leg (dominant and non-dominant), and subsequent interactions between these factors. Planned comparisons of specific mechanical variables were made within the analyses, affording a Bonferroni corrected alpha level of 0.006 to be adopted as our level of significance.

RESULTS AND DISCUSSION

UT induced significant increases in peak hip internal rotation and knee abduction and internal rotation, and decreases in hip and knee flexion compared to AT. Significant decreases in hip and knee sagittal plane, and increases in all hip and knee out of plane rotations were also observed in the presence of fatigue. Furthermore, fatigue induced increases in peak knee abduction and internal rotation were more pronounced in UT compared to AT tasks (Figure 1). Limb was not observed to demonstrate a significant main effect, or interact with other main effects for any of the dependent factors submitted to the analyses.

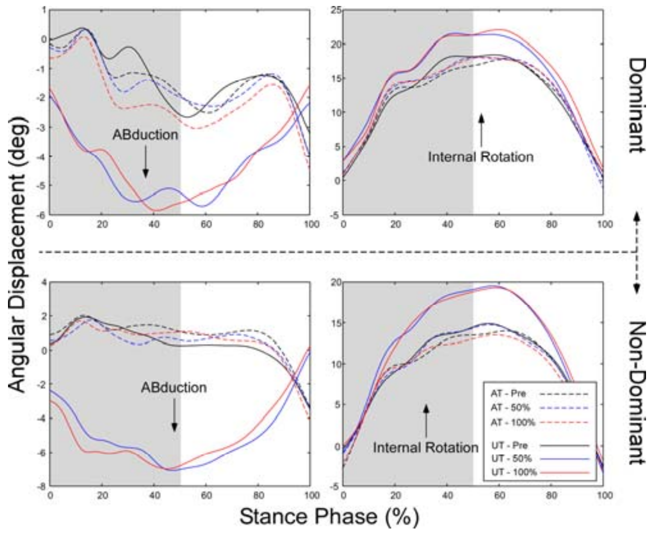

Figure 1: Combined fatigue and decision effects on knee rotations.

CONCLUSIONS

The combined effects of neuromuscular fatigue and decision making present as a potentially high-risk scenario during dynamic landing tasks. The interaction between these factors further suggests that ACL injury during dynamic sports postures may stem from fatigue induced modifications in both central and peripheral processing pathways. Whether this mechanism implicates specifically through poor decisions, reactions or execution however, or via a combination of these factors, remains unknown. Elucidation of this relationship appears crucial to the ongoing development of more successful ACL injury preventative measures.

REFERENCES

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