EXAMINING LOWER EXTREMITY RANGE OF MOTION AND MOVEMENT VARIABILITY CHANGES DUE TO FOCUS OF ATTENTION DURING LANDING

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INTRODUCTION & PURPOSE

Attentional focus (AF) has been explored among a variety of motor skills providing evidence that external AF promotes automaticity and enhanced performance [6]. External focus of attention is distinguished from internal focus such that external focus is directed toward movement effect rather than body movement [8]. Movement variability provides a means of assessing functional characteristics of the neuromotor system, where normal functioning is suggested to occur within optimal limits, while excessively high or low movement variability is indicative of system dysfunction [2,4,5]. Additionally, the ability of the motor system to vary, or broadly distribute, internal loads is thought to reduce the risk of injury, and increase adaptation to a wider array of stimuli [2,4,5].

Viewing movement variability as an inherent and functional element of the neuromotor system provides an avenue for investigating injury susceptibility [2,4,5]. Landing has been explored due to a high incidence of injury in athletic performance, and the ability to experimentally control task demands [3,4]. Examinations of lower extremity function during landing have demonstrated equivocal findings among variables, with the influence of AF instructions on injury risk remaining unexplored [3,4,5,6].

The purpose of this research was to examine the effects of AF instructions on landing kinematics, exploring strategies for reducing injury risk. Movement variability was used to assess neuromotor functioning and the ability of the motor system to vary internal loads.

METHODS

Eleven participants, (7 male, 4 female; age 23.5±13.2years; height 1.8±0.1m; mass 71.5±3.5kg) free from previous lower extremity injury were examined. Informed consent was obtained prior to participation as approved by the Research Ethics Board at the affiliated institution.

Participants completed ten bilateral drop landings from a 60cm pylonometric box under three counterbalanced AF conditions (External, Internal, Control). Participants were instructed to land on the ground with both feet simultaneously. Each participant began under the control condition, with no additional instruction. Under each AF landing condition, participants were instructed to either “focus on reducing the impact on your feet” (Internal AF), or “focus on reducing the impact on the ground” (External AF).

ROM at each lower extremity joint (hip, knee, and ankle) were calculated from minimum vertical center of mass (vCOM) velocity (peak downward velocity during drop), to the point vCOM reached zero (Figure 1). ROM variability was expressed using coefficient of variation (CV%; sd/mean * 100). Comparisons were made via 3x3 (Joint x AF) mixed model ANOVAs, with repeated measures on AF and Sidak post-hoc contrasts, via SPSS 20.0 (α=0.05). Degrees of freedom were adjusted using the Huynh-Feldt method where appropriate. Separate comparisons were carried out among joint ranges of motion and ROM variability in the sagittal and frontal planes.

RESULTS

Differences in sagittal plane ROM were detected among AF conditions (F2,60=7.87, p<0.001, η2=0.208), but were not observed among AF conditions in the frontal plane, (F1,64.49,443)=1.736, p=0.191, η2=0.055; Figure 2: Left). Neither the sagittal nor the frontal plane demonstrated ROM variability differences among AF conditions (F1,68.50,429=1.366, p=0.262, η2=0.044; F1,75.42,633=4.136, p=0.058, η2=0.095, respectively; Figure 2: Right). Interaction was not observed between AF condition and lower extremity joint for ROM and ROM variability in the sagittal plane (F2,30)=0.141, p=0.867, η2=0.027), but were detected in the frontal plane (F2,30)=2.209, p=0.091, η2=0.091; Figure 3: Right).

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DISCUSSION & CONCLUSIONS

Differences in lower extremity joint ROM among AF conditions demonstrated that participants adopted new landing strategies when instructed to reduce impact upon landing. Kinematic differences were observed in the sagittal plane, where greater ROM among lower extremity joints suggest that participants employed greater hip and knee flexion, and greater ankle dorsiflexion, absorbing landing impact via greater joint ROM [1].

Despite kinematic alterations in landing mechanics, changes in lower extremity joint ROM variability were not observed in the sagittal plane, nor were changes observed in ROM and ROM variability in the frontal plane. This may suggest that although kinematic changes occurred when landing following instruction, motor control was not significantly influenced by the manner in which participants were instructed to land [2].

Examination of lower extremity joint ROM variability was significantly greater at the knee, relative to the hip and ankle, in both the sagittal and frontal planes. This highlights the importance of the knee joint in modulating landing impact, but also demonstrates the susceptibility of this joint to injury, inferred from the large varus-valgus ROM in the frontal plane [1,3]. It is for this reason that the knee joint draws attention in research, seeking to better understand non-contact mechanisms of injury during landing [1,3,4]. The observed increase in lower extremity joint ROM variability in agreement with previous literature, where the biarticular muscles crossing the hip joint are associated with greater degrees of freedom and subsequent greater movement variability [4].

With knee control is the consideration of landing kinetics, which are not included in the present investigation. Given the goal of the AF instructions in reducing landing impact, future investigations should include kinetic variables when controlling AF in landing. This will provide greater insight into lower extremity tissue loading, of particular concern in understanding lower extremity injury when controlling kinematics during landing [1,3,4].

Examination provided a biomechanical examination of the influence of AF instructions on landing mechanics. Although kinematic changes did not translate into significant alterations in movement control, AF instructions may provide an avenue for future research in injury prevention.

REFERENCES