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 functioning during landing have demonstrated equivocal findings among variables, with the influence of AF instructions on injury risk remaining unexplored [3,4,5].

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. Eleven participants, (7 male, 4 female; age 23.5 ± 1.2 years; height 1.8 ± 0.1 m; mass 71.5 ± 3.5 kg) free from previous lower extremity injury were recruited. 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 60 cm platform, and were instructed to land on the ground with both feet simultaneously. Each participant began under the control condition, with additional instruction conditions included in the present investigation. Given the goal of the AF instructions in controlling AF in landing. This will provide greater insight into lower extremity joint ROM and 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].

METHODS

Differences in sagittal plane ROM were detected among AF conditions (F[2, 60] = 7.87, p < .001, η² = .208), but were not observed among AF conditions in the frontal plane, (F[1, 64.49, 44.43] = 1.736, p = .191, η² = .055; Figure 2: Left). Neither the sagittal nor the frontal plane demonstrated ROM variability differences among AF conditions (F[1, 68.51, 50.429] = 1.366, p = .262, η² = .044; F[1, 75.52, 63.33] = 1.136, p = .558, η² = .095, respectively; Figure 2: Right). Differences among lower extremity joints were not observed for ROM variability in the sagittal plane (F[2, 30] = .411, p = .687, η² = .027), but were detected in the frontal plane (F[2, 30] = 22.209, p = .001, η² = .591; Figure 3: Right)

Interaction was not observed between AF condition and lower extremity joint ROM variability in the sagittal plane (F[4, 60] = .912, p = .463, η² = .057; F[3, 30] = 0.52, 0.492 = 0.061, p = .986, η² = .004, respectively; or the frontal plane (F[3, 29], 44.43] = .383, p = .784, η² = .025, F[3, 50] = 52.63 = .007, p = .006, respectively).

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].

Examining lower extremity joint differences, ROM 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]. 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 progression of injury in lower extremity ROM variability is 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].

Worth note 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 mechanisms when controlling AF in landing.

The present 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