INTRODUCTION

Hamstring muscle strains are one of the most common injuries during athletic activities: especially in those requiring bursts of sprinting such as football, soccer, rugby, and track and field. Previous literature has indicated that the hamstring muscles are most prone to strain during the latter portion of swing phase of the sprinting gait cycle. The increased propensity for muscle strain in this portion of the gait cycle is most likely the result of rapid muscle lengthening while the muscle is eccentrically contracting, which can result in microscopic damage to the muscle fibers. Previous animal study has demonstrated that muscle activation and stretching are potential mechanisms for muscle strains. Moreover, it has been reported that extension of the knee during the late sprinting swing phase is generated by the moment created by rapid hip flexion to produce forward movement of the lower extremity as well as the whole body. This dual forceful flexion of the hip and extension of the knee has been demonstrated to be the most critical point for hamstring strain injuries. Injury generally occurs at the musculotendinous junction.

Although the mechanism of hamstring strain injury during sprinting has been investigated and described by several previous researchers, it is still unclear whether or not sprinting at one’s maximum speed provides the highest susceptibility for damage. For example, a number of studies reported that hamstring strain injuries are extremely common in rugby and soccer in which players run at different speeds in addition to sprinting at their maximum speed2-4. Thus, the purpose of this study was to identify kinematic differences specifically at the hip and knee joint during the late swing phase at both a maximum and sub-maximum sprinting speed.

RESULTS

A total of ten recreational runners (18-28 years old) with no history of lower extremity injuries in the past six months were tested. Only runners who could run faster than 6.825m/s for men and 6.125m/s for women were recruited. Those speeds were equivalent to 70% of the maximum speed. All subjects trained sprinting on a treadmill and had no history of lower extremity injuries. The increased muscle strain injury is created not only by lengthening of the muscle, but also through muscle activation. Therefore, future research needs to be completed to establish the difference in muscle activation between the two running speeds through electromyographic (EMG) analysis. Second, this study did not show the actual amount of hamstring lengthening, which is a critical factor for hamstring strain injuries. Therefore, future research needs to be completed to determine the change in the length of the hamstring during the sprinting gait cycle between the two running speed conditions.

DISCUSSION

This study demonstrated that significant difference exists between maximum and sub-maximum sprinting speeds in terms of lower extremity kinematics, specifically the angles of hip and knee joint in the late swing phase. During sprinting, high loads in a sprinting sprinting speed, the hip is flexed more than the sub-maximum speed and the hamstring was stretched; however, during the sub-maximum speed, the knee was in a more extended position which also lengthens the hamstrings. In addition, the subjects demonstrated a longer stride length during the sub-maximum speed. It appears likely that the forward movement of the whole body during sprinting was achieved by different strategies: forceful hip flexion with more steps in the maximum speed, and extending the knee with less hip flexion resulting in a longer stride length in the sub-maximum speed. However, both sprinting speeds produced lengthening of the hamstrings during the late swing phase which could result in muscle strain injuries. The results of this study indicate the potential importance of a slow return to even sub-maximum activity following injury in order to prevent reinjury.

This study has several limitations. First, the function of the hamstring was analyzed only from joint angle data. As the previous study showed, muscle strain injury is created not only by lengthening of the muscle, but also through muscle activation. Therefore, future research needs to be completed to establish the difference in muscle activation between the two running speeds through electromyographic (EMG) analysis. Second, this study did not show the actual amount of hamstring lengthening, which is a critical factor for hamstring strain injuries. Therefore, future research needs to be completed to determine the change in the length of the hamstring during the sprinting gait cycle between the two running speed conditions.

REFERENCES


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