

## FUNCTIONAL DIFFERENCES IN THE HAMSTRING MUSCLES DURING ECCENTRIC HIP EXTENSION AND KNEE FLEXION EXERCISE

Ono, T. 1), Okuwaki, T. 2) & Fukubayashi, T. 3)

1) Graduate School of Sports Sciences, Waseda Univ., Japan

2) Japan Institute of Sports Sciences, Japan

3) Faculty of Sports Sciences, Waseda Univ., Japan

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### Introduction

The hamstring muscles, which are frequently injured during football and rugby, work synergistically to produce hip extension and/or knee flexion torque. However, it has been demonstrated that each hamstring muscle has inherent morphological features, leading to different functional properties even in the case of a single joint movement. Purpose of this study was to clarify the activation patterns among hamstring muscles during hip extension and knee flexion exercises by electromyography (EMG) and muscle functional magnetic resonance imaging (mfMRI).

### Methods

6 male volunteers performed the hip extension exercise generally called “Stiff-leg deadlift” loaded at 60% of their body weight. Another 7 male volunteers performed the knee flexion exercises with unilateral limb at 120% of 1 repetition of maximum (1RM). EMG activity during each exercise was recorded for the biceps femoris long head (BFlh), semitendinosus (ST), semimembranosus (SM), and gracilis (G) muscles; mfMRI T2 values and cross-sectional areas (CSA) of the same muscles were measured at rest, immediately after, 2 and 7 days after the exercise.

### Results & Discussion

EMG of the BFlh and SM were significantly higher than that of the ST and G during hip extension, and the T2 value and CSA changes in the SM showed a significant increase immediately after the exercise. During the knee flexion exercise, EMG of the ST and G was significantly higher than that of the SM, and T2 value and CSA changes in the ST and G were significantly higher than in the BFlh and SM after the exercise. These findings support selective recruitments of the BFlh and SM muscles during the hip extension, and the ST and G during the knee flexion.

### Conclusion

The activation patterns among hamstring muscles during hip extension and knee flexion exercise were nonuniform for the respective muscles.

### References

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2. Ono, T. et al. (2011). *Res Sports Med*, 19(1): 1-11.