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Muscle EMG activity distribution between the hamstring heads during high-speed running in high elite athlete with a history of hamstring strain injury

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INTRODUCTION:
Hamstring muscle strain injury (HSI) is the most prevalent injury in running-based elite level sports. After initial HSI, alterations in muscle activity may occur and influence the risk of reinjury. Bilateral differences in distribution of hamstring muscle activity dur-ing submaximal voluntary contraction have been observed in previously injured ath-letes despite the completion of rehabilitation and the absence of symptoms (1,2). During sprint running, the alteration of muscle activity in previous HSI compared to the uninjured limb is unclear (3,4). This study aimed to compare the hamstring activity distribution between the two lower-limbs in a maximal sprint after a previous unilat-eral HSI.
METHODS:
Ten elite athletes (age: 26.5±2.7years, height: 171.6±6.6cm, weight: 68.5±6.7kg) participating in Olympic, World and European events in athletics, rugby sevens and bobsleigh were included in this study. They reported unilateral HSI in average 3.3 ±1.6 years before testing. They performed two 40-m maximal sprints during which surface electromyographic electrodes (EMG) were used to estimate muscle activation of the biceps femoris long (BFlh) and short (BFsh) heads, the semitendinosus (ST) and the semimembranosus (SM). Sprint EMG was normalized to the EMG activity during MVIC. Mean EMG activity during the stance and swing phases were calculated for each muscle. The ratio of EMG activity between the hamstring muscles was calculated as the mean activity of the considered muscle divided by the sum of the activities of all muscle heads of the same limb. A linear mixed model by permutation was performed to compare the ratio of EMG activity between the uninjured (NI) and HSI limb.
RESULTS:
No significant difference was observed between limbs for both the swing and stance phases for mean EMG activity and EMG activity ratio. The mean (±SD) EMG activity ratios during the swing phase for HSI side and NI side were 23.7±5.6% and 24.4±3.7% for BFlh, 28.0±6.9% and 27.6±7.2% for BFsh, 24.5±3.2% and 27.8±8.5% for SM, and 23.7±7.9% and 20.2±7.6% for ST, respectively. During the stance phase for HSI and NI side, ratios were 26.2±5.6% and 27.6±5.6% for BFlh, 29.7±7.5% and 29.5±10.6% for BFsh, 18.7±6.0% and 20.5±7.5% for SM, and 25.4±6.1% and 22.4±6.6% for ST, respectively.
CONCLUSION:
The present study demonstrated that the mean and the distribution of EMG activity were not different during sprinting between injured and non-injured lower limbs. The tailored rehabilitation and training contents adopted by elite athletes may limit the alteration of muscle EMG activity. Further studies considering force-length and force-velocity properties, which influence muscle EMG activity in dynamic contractions, are required to strongly conclude on the muscle activity distribution within injured limb.

1) Avrillon et al., J Appl Physiol, 2020
2) Opar et al., J Electromyogr Kinesiol, 2013
3) Presland et al., Sports Med, 2021
4) Higashihara et al., J Sport Sciences, 2019
5) Silder et al., Clin Biomech, 2010

Topic: Biomechanics

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