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Corticospinal excitability during motor imagery

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We investigated whether corticospinal excitability during the imagery of an action with an external object was influenced by actually touching the object. In the first experiment, corticospinal excitability was assessed by motor evoked potentials (MEPs) in the first dorsal interosseous (FDI) muscle elicited by transcranial magnetic stimulation over the contralateral motor cortex during imagery of squeezing a ball (4cm) - with or without passively holding the ball. The MEPs amplitude during the imagery when the ball was held was larger than that when the ball was not held. The MEPs amplitude was not modulated just by holding the ball. In the second experiment, we examined MEPs during imagery of pinching a small ball (2cm) - with or without passively holding the ball. The MEPs amplitude in agonist muscle during the imagery when the ball was held was larger than that when the ball was not held. These findings suggest that passively holding objects increased corticospinal excitability during motor imagery of handling the object.

Functional differences in the activity of hamstring muscles with increasing running speed

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In this study, we examined hamstring muscle activation during different running speeds, so as to provide scientific data to better understand the functional characteristics of each hamstring muscle. Eight healthy male track and field athletes (20.1 ± 1.1 years) performed treadmill running at 50%, 75%, 85%, and 95% of their maximum velocity. Lower extremity kinematics of the hip and knee joint were calculated. The surface electromyographic activities of the biceps femoris (BF) and semitendinosus (ST) muscles were also recorded. Increasing the running speed from 85% to 95% significantly increased the activation of the hamstring muscles during the late swing phase (BF, $p < 0.05$; ST, $p < 0.01$), while lower extremity kinematics did not significantly change. During the middle swing phase, the activity of the ST was significantly greater than that of the BF at 75%, 85%, and 95% running speed ($p < 0.001$, $p < 0.01$, and $p < 0.05$, respectively). Statistically significant peak activation time differences between the BF and ST were found during 95% running ($p < 0.05$ at stance phase, $p < 0.01$ at late swing phase). Significant

differences in the activation patterns between the BF and ST muscles were observed as the running velocity increased, indicating that complex neuromuscular coordination patterns occurred during the running cycle at near maximum sprinting speeds.

Factors influencing individual difference in the jump performance enhancement induced by counter-movement

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The execution of a counter-movement prior to the main exercise, during which the muscle fibers work almost isometrically by leaving the task of storing and releasing elastic energy to tendon (muscle-tendon interaction) enhances the performance outcome. The purpose of the present study was to reveal musculotendinous factors influencing individual differences in the performance enhancement. Sixteen healthy males performed jumps using only the ankle joint with and without a counter-movement. During the exercise, an ultrasonography technique was used to record the fascicle behavior of the gastrocnemius muscle, and the tendon length change was computed. These data were combined with tendon force to calculate the mechanical work done by the fascicles and tendon. The mechanical work done by muscle-tendon unit increased with the execution of the counter-movement, and its magnitude was correlated with the extent of increase in the elastic energy utilized by the tendon ($r=0.60$, $p<0.05$), but not with the size of difference in the mechanical work done by the fascicles. The elastic energy utilized by the tendon was not correlated with tendon stiffness determined separately. These results indicate that the greater performance enhancement by a counter-movement is derived from the better usage of elastic energy through muscle-tendon interaction during the stretch-shortening cycle, regardless of the tendon properties.