Post activation potentiation
Modulating factors and mechanisms for muscle performance

av

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Akademisk avhandling

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Introduction: Acute enhancements of muscle contractile properties and performance subsequent to a maximal or near maximal conditioning contraction are often termed post activation potentiation (PAP). Although still controversial, PAP is commonly linked to enhancements in the myosin regulatory light chain phosphorylation, leading to improvements in the excitation–contraction coupling. The PAP seen after a conditioning task often coexists with fatigue and is known to depend on strength level, muscle fiber type and age. Less is known about how factors such as static and dynamic changes in muscle length affect PAP, and on the relative contribution of contractile and tensile components to PAP.

Aim: To enhance our understanding of how, and under what conditions, a single maximal isometric contraction affects plantar flexor muscle contractile performance, and other muscle tendon properties, in power athletes.

Methods: Supramaximal twitches were evoked via electrical stimulation of the tibial nerve of athletes before and on several occasions after a 6-second maximal voluntary isometric contraction (6-s MVIC) in both static muscle, and during passive muscle lengthening and shorting at different angular velocities. Several contractile variables were measured from the twitches. The effects of a 6-s MVIC on Achilles tendon stiffness was calculated from torque and ultrasonography based measurements of tendon length at two submaximal contraction intensities. Overall stiffness index was calculated by analyzing the passive lengthening torque/angle curve. Results: A single MVIC enhanced muscle contractile properties and electromechanical delay for up to 5 minutes. Plantar flexor twitch variables such as peak twitch, rate of torque development and rate of torque relaxation were enhanced during shortening compared to lengthening muscle actions, and in an extended as compared to a flexed knee position. Achilles tendon stiffness and overall stiffness index were not significantly modulated by a single 6-s MVIC.

Conclusion: The results of this thesis imply that functional enhancements from a 6-s conditioning MVIC would mainly come from improvements in contractile rather than tensile components. Stiffness changes should be monitored in future PAP-related studies since they may still occur after more extensive conditioning protocols than the current one. Improvements in contractile components subserving muscle strength after a conditioning MVIC suggests that enhancements in muscle power after a conditioning task should be greatest in fast concentric muscle actions, though still present in muscle lengthening. Conditioning should be performed in a position where full activation is easy to achieve and tailored to match an athlete or group of athlete’s current status and characteristics, maximizing performance in a specific sport event.

Keywords: Potentiation, twitch, triceps surae, knee angle, stiffness, length changes, electromechanical delay
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