Do Changes In Muscle Architecture Affect Post-Activation Potentiation? 

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ABSTRACT

PURPOSE: To examine the effect of three muscle potentiation protocols on changes in muscle architecture and the subsequent effect on jump power performance.

METHODS: Maximal (1RM) squat strength (413.9 ± 36.4 kg), vertical jump power and muscle architecture were obtained in 12 resistance trained men (153.4 ± 10.6 kg). Participants randomly completed squatting protocols at 70% of 1RM (Set 2), 90% (3 x 3 reps) or 300% (1 x 10 reps) of their 1RM, with no rest between trials. During each testing session (nonfatigued and vertical jump performance), participants performed a vertical jump test. Changes in muscle architecture were quantified using ultrasound imaging, with the following variables extracted: CSA (cm²), pennation (°), and absolute or relative changes in CSA and pennation. Statistical analysis consisted of paired t-tests following a significance level of p < 0.05.

RESULTS: Maximal (1RM) squat strength (413.9 ± 36.4 kg), vertical jump power and muscle architecture were obtained in 12 resistance trained men (153.4 ± 10.6 kg). Participants randomly completed squatting protocols at 70% of 1RM (Set 2), 90% (3 x 3 reps) or 300% (1 x 10 reps) of their 1RM, with no rest between trials. During each testing session (nonfatigued and vertical jump performance), participants performed a vertical jump test. Changes in muscle architecture were quantified using ultrasound imaging, with the following variables extracted: CSA (cm²), pennation (°), and absolute or relative changes in CSA and pennation. Statistical analysis consisted of paired t-tests following a significance level of p < 0.05.

CONCLUSION: Maximal (1RM) squat strength (413.9 ± 36.4 kg), vertical jump power and muscle architecture were obtained in 12 resistance trained men (153.4 ± 10.6 kg). Participants randomly completed squatting protocols at 70% of 1RM (Set 2), 90% (3 x 3 reps) or 300% (1 x 10 reps) of their 1RM, with no rest between trials. During each testing session (nonfatigued and vertical jump performance), participants performed a vertical jump test. Changes in muscle architecture were quantified using ultrasound imaging, with the following variables extracted: CSA (cm²), pennation (°), and absolute or relative changes in CSA and pennation. Statistical analysis consisted of paired t-tests following a significance level of p < 0.05.

INTRODUCTION

Post-activation potentiation (PAP) is a phenomenon by which the force exerted by a muscle is increased due to previous activation (Robbins and Docherty, 2005). Potentiation appears to be dependent on an appropriate training stimulus and a proper rest interval to maximize performance gains and minimize performance impairment due to fatigue (Gantois and Sale, 2000). However, there does not appear to be an accepted training stimulus or rest interval that provides a consistent potentiation effect (Willott et al., 2012). The mechanisms responsible for muscle potentiation have not been fully elucidated. It has been suggested that priming the neuromuscular system by enhancing motor unit activation is one possible mechanism (Tillen and Bishop, 2009). However, acute changes in muscle architecture may also contribute to the potentiation response (Tillen and Bishop, 2005). Muscle pennation angle appears to have a significant role in muscle power performance (Tarnopolsky et al., 2010). Larger pennation angles are reported to be associated with a greater potential for generating power (Tejero et al., 2010). However, the effects of muscle architecture on muscle power performance are not fully understood.

METHODS

Participants: Eleven male (173.5 ± 18.5 cm, 77.1 ± 17.3 kg) volunteered to participate in this study. Following an informed consent, participants were instructed to avoid high-intensity resistance training, in addition to any significant changes in diet for at least 3 weeks prior to study participation. Participants were instructed to arrive at the laboratory on the day of testing, with a 6-hour fast and minimal caffeine consumption. The Institutional Review Board of the University approved the research protocol. Participants were asked to avoid consuming caffeine before testing.

RESULTS: Maximal (1RM) squat strength (413.9 ± 36.4 kg), vertical jump power and muscle architecture were obtained in 12 resistance trained men (153.4 ± 10.6 kg). Participants randomly completed squatting protocols at 70% of 1RM (Set 2), 90% (3 x 3 reps) or 300% (1 x 10 reps) of their 1RM, with no rest between trials. During each testing session (nonfatigued and vertical jump performance), participants performed a vertical jump test. Changes in muscle architecture were quantified using ultrasound imaging, with the following variables extracted: CSA (cm²), pennation (°), and absolute or relative changes in CSA and pennation. Statistical analysis consisted of paired t-tests following a significance level of p < 0.05.

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REFERENCES: