Acute Neurophysiological Responses to Resistance Training; Evidence of a Shortened Super Compensation Cycle and Early Neural Adaptations

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Abstract : Introduction: Neural adaptations following resistance training interventions have been widely investigated, however the evidence regarding the mechanisms of early adaptation are less clear. Understanding neural responses from an acute resistance training session is pivotal in the prescription of frequency, intensity and volume in applied strength and conditioning practice. Therefore the primary aim of this study was to investigate the time course of neurophysiological mechanisms post training against current super compensation theory, and secondly, to examine whether these responses reflect neural adaptations observed with resistance training interventions. Methods: Participants (N=14) completed a randomised, counterbalanced crossover study comparing; control, strength and hypertrophy conditions. The strength condition involved 3 x 5RM leg extensions with 3min recovery, while the hypertrophy condition involved 3 x 12 RM with 60s recovery. Transcranial magnetic stimulation (TMS) and peripheral nerve stimulation were used to measure excitability of the central and peripheral neural pathways, and maximal voluntary contraction (MVC) to quantify strength changes. Measures were taken pre, immediately post, 10, 20 and 30 mins and 1, 2, 6, 24, 48, 72 and 96 hrs following training. Results: Significant decreases were observed at post, 10, 20, 30 min, 1 and 2 hrs for both training groups compared to control group for force, ($p < .05$), maximal compound wave; ($p < .005$), silent period; ($p < .05$). A significant increase in corticospinal excitability; ($p < .005$) was observed for both groups. Corticospinal excitability between strength and hypertrophy groups was near significance, with a large effect ($\eta 2 = .202$). All measures returned to baseline within 6 hrs post training. Discussion: Neurophysiological mechanisms appear to be significantly altered in the period 2 hrs post training, returning to homeostasis by 6 hrs. The evidence suggests that the time course of neural recovery post resistance training occurs 18-40 hours shorter than previous super compensation models. Strength and hypertrophy protocols showed similar response profiles with current findings suggesting greater post training corticospinal drive from hypertrophy training, despite previous evidence that strength training requires greater neural input. The increase in corticospinal drive and decrease inl inhibition appear to be a compensatory mechanism for decreases in peripheral nerve excitability and maximal voluntary force output. The changes in corticospinal excitability and inhibition are akin to adaptive processes observed with training interventions of 4 wks or longer. It appears that the 2 hr recovery period post training is the most influential for priming further neural adaptations with resistance training. Secondly, the frequency of prescribed resistance sessions can be scheduled closer than previous super compensation theory for optimal strength gains.

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