Effects of Contralateral Overflow and Acupuncture on Handgrip Strength Modulation

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Abstract:

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Introduction: Musculoskeletal rehabilitation techniques often aim to enhance muscle recruitment, increase strength, and reduce fatigue. The overflow phenomenon enhances motor responses in contralateral homologous muscles during high-intensity contractions (270% of maximal voluntary isometric contraction, MVIC). Acupuncture, by stimulating specific points, can modulate muscle activity through neural mechanisms.

Objective: To evaluate the effects of acupuncture (HT3, HT7) on force generation and recovery from neural fatigue, with or without overflow induction, during isometric wrist flexion.

Methods: A total of 152 right-hand-dominant subjects (18–30 years) were divided into five groups: control (CG), acupuncture (AG), overflow (OG), bilateral acupuncture with overflow (AbOG), and unilateral acupuncture with overflow (AuOG). Handgrip strength was assessed using a dynamometer (DIGI-II-SH5003-Saehan) before and after a fatigue protocol (3 isometric contractions of 6s with 9s rest). The protocol was repeated after 20 minutes in the CG. In AG, HT3 and HT7 were stimulated bilaterally for 20 minutes before repeating the fatigue protocol. In OG, overflow was induced through simultaneous wrist flexion and handgrip contractions. AbOG and AuOG combined acupuncture with overflow before reassessing strength. MVIC of wrist flexion was measured 10 minutes post-protocol. Statistical analysis used MANOVA (p<0.05).

Results: Baseline (BL) strength decreased in the third contraction across all groups (p<0.0001). In CG, strength further declined during the second test (p<0.0001). In AG, acupuncture reduced handgrip strength both within trials (p<0.0001) and compared to BL (p<0.005). In OG, male subjects' left limbs showed reduced strength (p<0.0001), but right limbs and female subjects exhibited increased strength in later contractions (p<0.005). In AbOG and AuOG, male subjects and left limbs showed significant strength reductions (p<0.0001), similar to AG (p<0.005).

Conclusion: Overflow attenuates strength loss due to neural fatigue. Acupuncture at HT3 and HT7 reduces handgrip strength but does not interfere with the overflow effect.

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