Changes in Neural Excitability Following 6-week of Balance Training in Individuals with Chronic Ankle Instability

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Context: Individuals with chronic ankle instability (CAI) often struggle with balance issues due to changes in the central nervous system (CNS). Specifically, difficulties in modulating spinal reflexive excitability and enhancing corticospinal excitability contribute to poor balance, indicating challenges in transferring control to supraspinal centers. A recent study found that a single session of balance training could positively impact the CNS, improving spinal reflexive excitability modulation and corticospinal excitability in CAI patients. However, there is limited research on the effects of long-term balance training on neural excitability in CAI individuals. Therefore, this study aimed to investigate the effects of a 6-week balance training program on spinal reflexive excitability modulation, corticospinal excitability, and balance performance in CAI individuals. **Methods:** 28 participants with CAI (F:16, M:12, 22.5±2.8yrs, 171.1±9.0cm, 77.3±19.6kg) were randomly assigned to the balance training group (BAL) or control group (CON). We assessed their spinal reflexive excitability modulation using Hoffmann-reflex (H-reflex) testing in prone and single-limb stance positions. Corticospinal excitability was measured during single-leg balance using transcranial magnetic stimulation (TMS), assessing motor evoked potential (MEP), active motor threshold (AMT), and cortical silent period (CSP). Balance function was evaluated by performing single-leg balance on a force plate to measure center of pressure (COP) variables. The BAL group underwent a 6-week progressive balance training program, engaging in sessions three times a week for 20-30 minutes each. Training comprised static (single-leg stance with eyes open and closed) and dynamic exercises (hop and stabilization, hop and reaching). Statistical analysis utilized separate 2x2 mixed-model analysis of variances (ANOVA) to examine the interaction effect of group (BAL and CON) x time (baseline and post-training) on each variable. Cohen's d effect sizes were calculated to determine the significance of differences, with significance set at $P<0.05$. **Results:** There was a significant group x time interaction in CSP ($F=19.63$, $P=0.01$). A large effect size ($d=0.49$[0.25, 1.20]) suggested that CSP was significantly shorter at post-testing (72.4±30.4) in BAL when compared to baseline (100.7±38.8). Furthermore, a significant group x time interaction was present for modulation of spinal reflexive excitability ($F=8.06$, $P = 0.01$). There was a moderate effect size (d =.88, [0.08, 1.63]) indicating that post-testing (44.0±21.8) spinal reflexive excitability modulation was greater than the result of baseline (29.5±35.2) in BAL. **Conclusions:** Balance training resulted in a decrease in cortical silent period (CSP), indicating enhanced corticospinal excitability among individuals with CAI. It was also observed that spinal reflexive excitability modulation was improved after balance training. The balance-related neurosignature of individuals with CAI might be restored with 6-week of balance training. Clinically, these alterations following balance training could suggest why balance training has been successful in preventing recurrent ankle sprains as well as improving balance performance in individuals with CAI.

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