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Association of Corticospinal Excitability with Dynamic Postural Control in Individuals with Chronic Ankle Instability

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Context: Diminished dynamic postural control during the Star Excursion Balance Test (SEBT) has been commonly observed in patients with chronic ankle instability (CAI). Clinical interventions to improve deficits in dynamic postural control during SEBT performance demonstrated by patients with CAI cannot be adequately prescribed without understanding what mechanical and neuromuscular factors contribute to the functional deficiency during the test. However, there is little evidence to investigate contributing factors that may explain diminished dynamic postural control in patients with CAI.

Objective: Determine what mechanical and neuromuscular factors explain diminished dynamic postural control in patients with CAI.

Design: Descriptive study.

Setting: Research laboratory.

Patients or Other Participants: Twenty participants with self-reported CAI (11M, 9F; 21.95±3.73yrs; 171.36±9.04cm; 83.18±21.77kg) scoring less than an established cut-off score (67.3%) of the anterior reach of the SEBT (SEBT-A) volunteered.

Interventions: Participants completed assessments of neuromuscular and mechanical joint stability.

Main Outcomes: Seven outcome variables were measured within four neuromuscular constructs:1) spinal reflex excitability of the soleus muscle assessed with the Hoffman reflex normalized to muscle response; 2) maximum voluntary isometric contraction strength of the plantar flexors; 3) corticospinal excitability of the soleus assessed using active motor threshold, motor evoke potentials (MEP) normalized to muscle response, and cortical silent period evaluated with transcranial magnetic stimulation; and 4) static postural control assessed with the mean of time-to-boundary minima in the anterior-posterior (TTB-AP) and medial-lateral directions (TTB-ML). Four variables were quantified in three mechanical constructs: 1) ankle joint laxity measured as anterior-posterior displacements and inversion-eversion rotation from the tibial-calcaneal bone linkage using ankle arthrometer; 2) weight bearing ankle dorsiflexion range of motion (WB-DF) using the weight bearing lunge test; and 3) open kinetic chain goniometric measurements of active ankle dorsiflexion. A multiple liner regression was performed to determine the influence of selected predictor variables on dynamic postural control on the SEBT-A. Significance was set *a priori* at $P<0.05$.

Results: The combination of all predictor variables explained 65% of the variance in the SEBT-A score ($R^2=0.65$, $P=0.22$). The strongest predictor of the variance in the SEBT-A score was normalized MEP of the soleus ($R^2=0.20$, $P=0.04$).

Conclusion: Decreased corticospinal excitability may negatively influence dynamic postural control in participants with CAI. Interventions targeting soleus corticospinal excitability may be beneficial to produce the optimal outcomes to improve dynamic postural control deficits during the SEBT-A in participants with CAI.

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Key Words: *Soleus; Sensorimotor Control; Balance; Ankle Injury*