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Plantarflexor Muscle Fatigue in People with Multiple Sclerosis Impairs Standing Balance

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Keywords

Multiple Sclerosis, Fatigue, Biosensors

Abstract

Background

People with Multiple Sclerosis (PwMS) experience fatigue differently than those without MS due to weakness, ataxia, and spasticity. This fatigue can play a role in balance during activities of daily living. Poor balance control poses a health concern for PwMS, resulting in falls, limiting independence, and reducing quality of life.

Objectives

To test the effects of motor fatigue on static postural balance control in PwMS compared to healthy controls (HC).

Methods

Eighteen PwMS and fifteen age-matched HCs underwent a fatiguing protocol consisting of a sustained maximum voluntary contraction of plantarflexor muscles for one minute. Plantarflexors were chosen for the fatigue assessment as these muscles significantly contribute to ankle strategy utilization in standing balance control. Standing balance data were collected immediately before and after implementing the fatiguing protocol using a single APDM wearable sensor placed on the lumbar spine to objectively capture postural sway (PS). Balance was measured as the area of PS while standing eyes-open on a flat firm surface for 30 seconds per trial.

Results

Increases in trunk sway during static PS tests were found statistically significant in PwMS after the fatiguing task. PwMS showed the greatest changes post-fatigue in trunk range of motion, velocity, jerk and the root mean square of the sway angle in the coronal plane after the fatiguing protocol ($p<0.05$), while HCs showed no significant changes.

Conclusion

Observed mediolateral sway instead of anteroposterior sway may be due to the unilateral fatiguing protocol. The increase in trunk sway in PwMS after PF fatiguing is consistent with impaired control of PS. This increased truncal sway also indicates decreased dependence on ankle strategy and increased hip strategy use to control stance posture. This type of "truncal ataxia" in PwMS exhibits a shift to using hip torque rather than fatigued ankle torque to control standing balance.