INCREASED LOWER LIMB MUSCLE COACTIVATION AND ITS RELATIONSHIP WITH GAIT PERFORMANCE AND METABOLIC COST IN PATIENTS WITH HEREDITARY SPASTIC PARAPARESIS

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Introduction

The aim of this study is to determine the level of coactivation of agonist-antagonist lower limb muscles during gait and its relationship with muscle spasticity, gait performance and metabolic cost in individuals with hereditary spastic paraparesis (HSP).We hypothesized increased lower limb muscle coactivation in patients that may reflect a primary deficit linked to lower limb spasticity and influence the energetic cost during walking.

Methods

20 patients with HSP and 20 controls were included in the study. The severity of the disease and the level of spasticity were rated using the SPRS scale and Ashworth subscale [1]. An optoelectronic motion analysis system with 8 infrared cameras and 2 dynamometric platforms was used to record kinematic and kinetic data. Surface myoelectric signals were recorded using a wireless system. Patients and controls were asked to walk barefoot along a straight walkway. 22 reflective spherical markers were attached on the anatomical landmarks [2] and 4 bipolar surface electrodes were placed on the right leg on the tibialis anterior (TA), soleus (SOL), vastus lateralis (VL) and biceps femoris (BF). We computed ankle and knee antagonist muscle coactivation indexes (CI) throughout the gait cycle and during stance (ST) and swing (SW) subphases. Energy consumption (TEC) and energy recovery (R-step) were also measured. Furthermore, correlation analysis between coactivation indexes and clinical variables, kinematic, kinetic, and energetic parameters were estimated.

Results

Increased coactivation indexes of both knee and ankle muscles throughout the gait cycle and during the subphases of gait were observed in patients compared with controls (Figure 1,2). Energetic parameters were significantly higher in patients than in controls (Figure 3). Both knee and ankle muscle coactivation indexes were positively correlated with both knee and ankle spasticity and energy consumption and both negatively correlated with energy recovery ($P<0.05$).

Conclusion

Positive correlations between the Ashworth score and lower limb muscle coactivation suggest that abnormal lower limb muscle coactivation in patients with HSP reflects a primary deficit linked to lower limb spasticity [3]. Furthermore, these abnormalities negatively influence metabolic cost during walking. These results may be useful for evaluating the pharmacological and rehabilitative treatments aimed at reducing the requirement for excessive antagonist muscle coactivation and restraining spasticity in these patients.

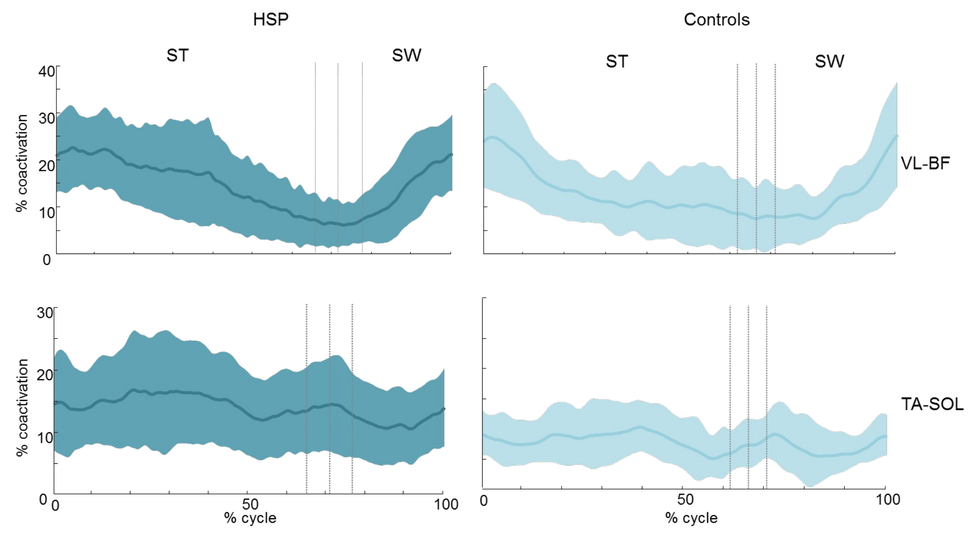


Figure 1. Knee and ankle muscle coactivation profiles during gait cycle

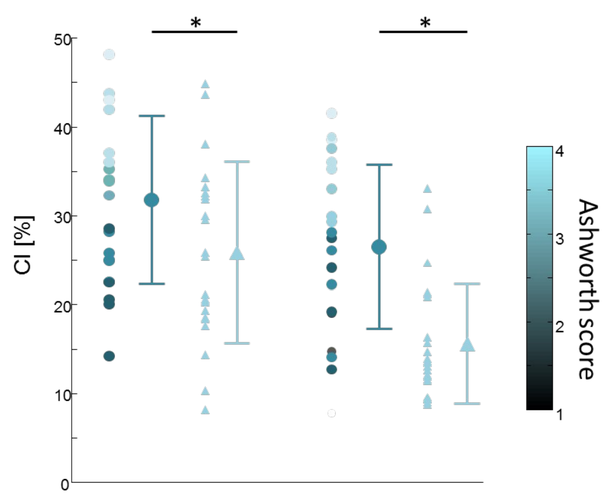


*Figure 2. Knee and ankle muscle coactivation indexes during gait cycle and subphases (*P<0.05)*

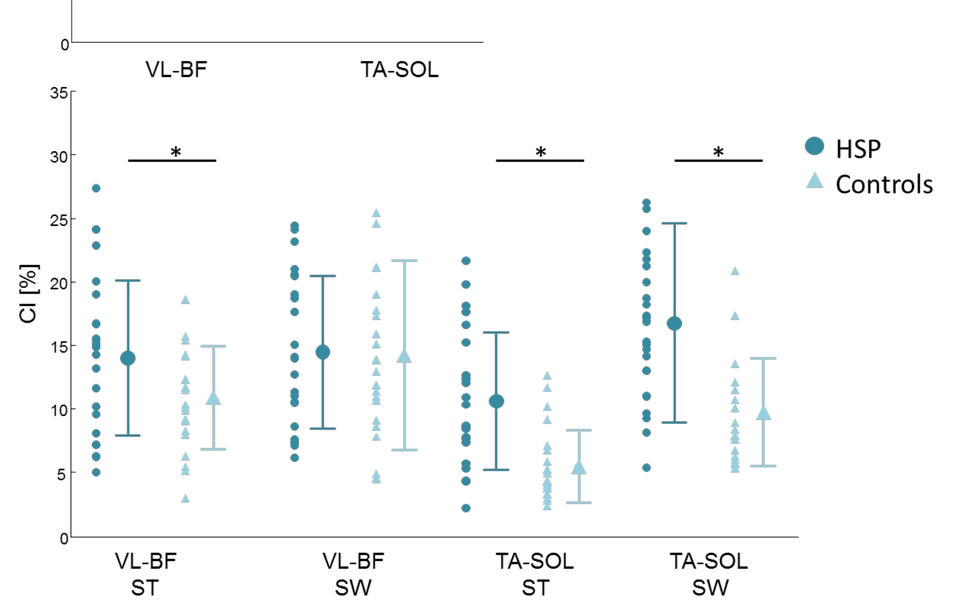
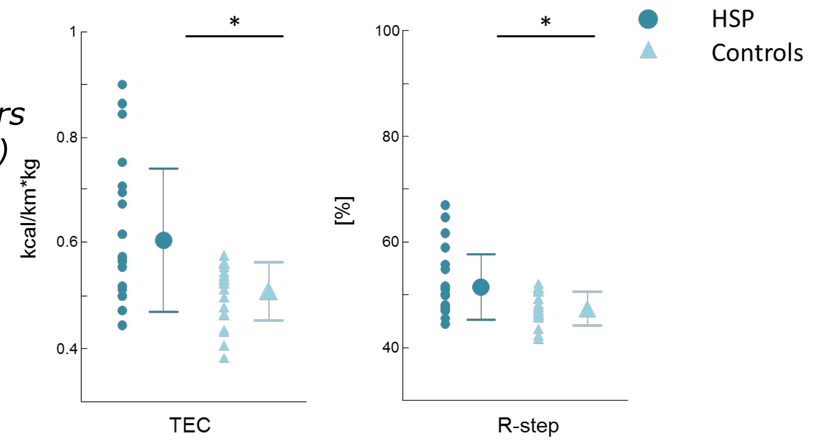


*Figure 3. Energetic parameters (*P<0.05)*



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