EFFECT OF TRICEPS SURAE MUSCLE-TENDON UNIT MECHANICAL PROPERTIES ON GAIT STABILITY AND ADAPTABILITY IN OLDER FEMALE ADULTS

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INTRODUCTION

Ageing induces a gradual degradation in the human neuro-motor system resulting in decreased mobility and locomotor performance (Beijersbergen *et al.*, 2013). Moreover, inadequate recovery responses following tripping have been associated with age-related deteriorations in ankle plantar flexion moment output (magnitude and rate) in the push-off phase (Pijnappels *et al.*, 2004). Therefore, the objective of this study was (1) to examine if gait stability and adaptability during perturbed walking is associated with TS muscle strength and Achilles tendon (AT) stiffness in older female adults, and (2) to determine whether elderly with different TS muscle strength capacities show an altered dynamic stability control during perturbed walking, and (3) whether gait plasticity is preserved in old age.

METHODS

Thirty-four older female adults (65±7yrs) experienced unexpected trip perturbations to the swing phase of the right leg while walking on a treadmill (Süptitz *et al.*, 2013). Using a motion capture system (VICON; Oxford, UK) the margin of stability (MoS) and base of support (BoS) were assessed at touchdown (TD) of the perturbed leg and at each following six recovery steps. In order to examine the reactive adaptation potential, the MoS at TD of the perturbed leg was examined in eight unexpected perturbation trials. In an additional session, TS muscle strength and AT stiffness were determined using simultaneous ultrasonography and dynamometry. Pearson correlations were used to inspect the relationship between TS MTU mechanical properties and dynamic stability parameters (both MoS and BoS) of the recovery steps in first perturbation trial. A median split was implemented to classify the subjects into two groups based on their TS muscle strength (strong: n = 16; weak: n = 18).

RESULTS

The strong group had about 42% higher voluntary isometric plantarflexion moments and 33% higher AT stiffness than the weak group (138±22Nm vs. 97±10Nm; 588±156Nmm^{-1} vs. 441±129Nmm^{-1}; $p<0.01$). The gait perturbation reduced the MoS at TD of the perturbed leg (-0.10±0.08m) compared to baseline unperturbed walking, indicating instability. The strong group needed three recovery steps to return to MoS baseline and the weak group was unable to return to baseline level within the analysed six recovery steps. Significant correlations between both TS muscle strength and AT stiffness, and MoS and BoS at TD of the first recovery step were found ($0.41<r<0.68$; $p<0.05$). After eight gait perturbations, both groups were able to adapt their reactive response to the perturbation (increasing MoS at TD), with no between-group differences.

DISCUSSION

The current data suggest that TS muscle strength and AT stiffness partly limit dynamic gait stability control after an unexpected perturbation during walking in older female adults. Recovery stepping behaviour seems to be less effective in weaker older adults, which is explained mainly by the reduced ability to effectively increase the BoS after perturbations. However, independent of TS MTU mechanical properties, older adults seem to be able to improve their reactive response.

CONCLUSION

TS MTU mechanical properties partly limit dynamic stability during perturbed walking in older adults, but they preserve their gait plasticity independent of their TS muscle strength. Thus, in order to reduce falls risk, older adults may benefit from interventions increasing TS muscle strength and tendon stiffness, and by improving reactive recovery responses via repeated gait perturbations.

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ABSTRACT SUBMISSION INFORMATION

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