Arthrogenic Muscle Inhibition in Bilateral Peroneal Muscles of Individuals with Unilateral Chronic Ankle Instability

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Summary

This study aimed to investigate the presence of arthrogenic muscle inhibition (AMI) in the peroneal muscles of individuals with chronic ankle instability (CAI). A total of 63 individuals with unilateral CAI and another 63 without CAI performed maximal voluntary isometric contraction (MVIC) and superimposed burst (SIB) tests. Our study observed the presence of AMI in both the affected and unaffected peroneal muscles of individuals with CAI, with higher levels of AMI in the affected limbs compared to the unaffected limbs. Therefore, bilateral peroneal strength rehabilitation should be implemented among individuals with unilateral CAI to mitigate the effects of AMI on both sides.

Introduction

Ankle sprains are one of the most common musculoskeletal injuries [1]. Ankle sprains lead to an unexplained reduction in ankle eversion strength, with AMI in peroneal muscles considered one of the underlying causes. The SIB technique can directly confirm the presence of AMI by revealing the muscle force decrease caused by AMI [2]. However, to our knowledge, no studies have yet confirmed the presence of AMI in the peroneal muscles of individuals with CAI during isometric ankle eversion using the SIB technique. This study aims to explore the presence and level of AMI in peroneal muscles among individuals with CAI by SIB technique.

Methods

Sixty-three people with CAI (21.3±1.5 years, 176.9±8.5 cm, 70.8±12.3 kg) and another sixty-three without CAI (22.5±2.2 years, 174.2±7.7 cm, 67.1±11.2 kg) conducted MVIC and SIB tests during ankle eversion, then fifteen people with CAI and fifteen without CAI were randomly invited to repeat the same tests to calculate the test-retest reliability. Electrical stimulation was applied to the peroneal muscles while the participants were performing MVIC, and the central activation ratio (CAR) was obtained by dividing MVIC torque by the sum of MVIC and SIB torques, representing the degree of AMI (Fig. 1). The test-retest reliability was determined using intra-class correlation coefficients (ICC) with a two-way mixed model. Two-way ANOVAs with repeated measures were used to detect the group × limb interaction and their main effects of CAR. The statistical significance was set at $p < 0.05$.

Results and Discussion

The intra-class correlation coefficients were 0.77 (0.45–0.92) and 0.92 (0.79–0.97) for the affected and unaffected limbs among people with CAI, and 0.97 (0.91–0.99) and 0.93 (0.82–0.97) for the controlled affected and unaffected limbs among people without CAI. The findings indicate that the SIB technique is reliable in measuring CAR in peroneal muscles during isometric ankle eversion.

Figure 1: Illustration of superimposed-burst test in peroneal muscles

Significant group × limb interaction was detected in the peroneal CAR (p=0.008). The CARs were lower among people with CAI in the affected and unaffected limbs, compared with those without CAI (affected limb=82.54±9.46%, controlled affected limb=94.64±6.37%, p<0.001; unaffected limb=89.21±8.04%, controlled unaffected limb=94.93±6.01%, p=0.016). The observed AMI may be attributed to the symptoms following ankle sprains, as altered afferent signals caused by swelling and pain have been shown to inhibit motor neuron activation.

The CARs in the affected limbs were lower than those in the unaffected limbs among people with CAI (p=0.023). The presence of AMI in the unaffected limbs of individuals with CAI may be attributed to a 'cross-over' effect in the central nervous system. Moreover, damage to mechanoreceptors limits maximal torque output by reducing the activation of γ motor neurons, which in turn affects bilateral muscle activity in unilateral joint injuries. The higher levels of AMI in the affected limbs of individuals with CAI may result from neural signal alterations, leading to adaptive muscle changes over time.

Conclusions

AMI may be a contributing factor to the decreased peroneal strength among people with CAI. Bilateral AMI rehabilitation should be performed even in those with unilateral CAI.

References

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