The effect of ankle bracing on motor unit behaviour in individuals with Chronic Ankle Instability

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Summary

Lateral ankle sprains are a common injury in sporting and general populations resulting in reported neuromuscular deficits. However, little is known about the effect of CAI on motor unit behaviour. This study analysed the motor unit behaviour of Peroneus Longus, Medial Gastrocnemius and Tibialis Anterior of individuals with CAI and healthy controls during a single limb balance task with and without an ankle brace. Differences in motor unit behavior and stability were evident between healthy participants and those with CAI and changes were observed when wearing an ankle brace.

Introduction

Approximately 70% of the general population experience at least one ankle sprain in their lifetime [1], with approximately 40% developing chronic ankle instability (CAI). Individuals with CAI are often reported to have neuromuscular deficits during functional tasks compared to control participants [2]. Decomposition EMG (dEMG) offers a more detailed view of motor unit (MU) behaviour and provides new information about neuromuscular control and associated demands placed upon the muscles. This study aimed to investigate the neuromuscular control, using dEMG, of individuals with CAI compared to individuals with no history of ankle sprains during a single limb stance task and to explore if ankle bracing alters MU behaviour.

Methods

Participants completed a 60 second, single limb stability task whilst wearing either a brace (ActyFoot, Enovis, USA) or no brace. CAI participants were defined as those that have previously experienced at least one lateral ankle sprain and scored <24 on the Cumberland Ankle Instability Tool (CAIT) [3]. Control participants scored ≥28 on the CAIT and had no history of ankle sprains.

Four-channel dEMG Trigno Galileo wireless sensors (Delsys Inc., Boston, USA) were attached to the skin over the Peroneus Longus (PL), Tibialis Anterior (TA) and Medial Gastrocnemius (MG). Two IMUs sensors (Trigno Avanti, Delsys Inc., Boston, USA) were attached to the pelvis and lateral shank. Upper, middle and lower MU (MU) firing rates and amplitudes were compared between groups and between brace conditions.

Results and Discussion

There were trends towards significance with CAI having greater middle ($p=0.08$) and lower ($p=0.07$) tertial MU firing rates for MG compared to the control group. For TA, mixed methods ANOVA revealed a significant interaction ($p=0.027$) with the brace significantly increasing the control group's lower tertial MU firing rates compared to no brace condition ($p<0.01$) (Table 1). For the CAI group and for the PL, the brace significantly increased middle tertial MU firing rates ($p=0.049$) and significantly decreased MU amplitude ($p=0.035$) compared to no brace. For control participants, the brace significantly increased MG lower and middle tertial MU firing rates compared to no brace ($p<0.05$). CAI group showed significantly larger pelvic ML ($p=0.023$) and AP ($p=0.014$) accelerations compared to the control group.

Conclusions

To the authors' knowledge this is the first study to show differences in MU behaviour in muscles associated with ankle stability between individuals with CAI and control participants along with differences in stability indicating possible neuromuscular deficits. The use of an ankle brace increased motor unit firing rates for both control and CAI participants indicating possible changes in neuromuscular control.

Acknowledgments

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References

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Table 1: Mean (SD) for motor unit behaviour for Peroneus Longus (PL), Tibialis Anterior (TA) and Medial Gastrocnemius (MG). a: significant interaction; *: differences between brace conditions (no brace and brace).

	Variables	Controls No Brace	Controls Brace	CAI No Brace	CAI Brace
PL	Middle Tertial (pps)	15.98 (3.7)	17.38 (5.3)	17.22 (5.5)*	17.14 (3.7)*
	Peak amplitude	$1.00x^{-3}$ ($1.00x^{-3}$; $2.00x^{-3}$)	$1.00x^{-3}$ ($1.00x^{-3}$; $2.00x^{-3}$)	$4.00x^{-4}$ ($2.00x^{-4}$; $6.00x^{-4}$)*	$3.00x^{-4}$ ($1.00x^{-4}$; $4.00x^{-4}$)*
TA	Lower Tertial (pps)[a]	9.00 (2.8)	11.71 (3.8)	11.40 (4.4)	9.93 (3.2)
MG	Middle Tertial (pps)	8.79 (6.7; 10.2)*	10.60 (9.2; 13.5)*	10.72 (9.08; 13.2)	11.01 (8.9; 13.5)
	Lower Tertial (pps)	5.90 (5.4; 7.2)*	8.29 (6.7; 9.8)*	8.16 (6.4; 11.3)	8.31 (6.2; 10.3)