Conference or Workshop Item

Title: The influence of 6 weeks of maximal eccentric plantarflexor training on muscle-tension mechanics

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Version: Abstract

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THE INFLUENCE OF 6 WEEKS OF MAXIMAL ECCENTRIC PLANTARFLEXOR TRAINING ON MUSCLE-TENDON MECHANICS.

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Introduction

Resistance training can influence muscle-tendon properties including strength, flexibility, stretch tolerance and muscle-tendon stiffness; however the specific influence of eccentric-only training is unknown. Therefore, the aims of the present study were to examine the effects of a 6-week maximal eccentric resistance training programme on isometric plantarflexor moment (MVC), dorsiflexion range of motion (ROM), stretch tolerance (peak passive moment), muscle and tendon stiffness and running economy.

Methods

Thirteen recreationally active men (age = 20.0 ± 0.9 yr, mass = 75.9 ± 8.5 kg, height = 1.8 ± 0.1 m) volunteered for the study after giving written informed consent; ethical approval was granted from the University of Northampton. Training was performed twice weekly for six weeks and consisted of 5 sets of 12 repetitions of 3-s maximal eccentric contractions at $10°\cdot s^{-1}$ from 20° plantarflexion to 10° dorsiflexion. Maximal isometric plantarflexor moment, dorsiflexion ROM, stretch tolerance, and muscle, tendon and muscle-tendon unit (MTU) stiffness were measured using isokinetic dynamometry, real-time ultrasound and 3D motion analyses before and after the training. Running economy (VO_2) was determined at a running speed equating to $70\%VO_{2max}$ using online gas analysis. Repeated measures t-tests were used to determine significant differences between pre- and post-training data, significance accepted at $p<0.05$.

Results

A significant increase in plantarflexor MVC (47.1%; $p<0.01$), dorsiflexion ROM (41%; $p<0.01$) and stretch tolerance (108%; $p<0.01$) was found after training, while no change was found in MTU stiffness (passive moment at the same joint angle) using dynamometry (2.5%; $p>0.05$). Analysis of ultrasound data revealed a significant decrease in muscle stiffness (20.6%; $p<0.05$) and increase in tendon stiffness (27.7%; $p<0.01$). These mechanical changes were not sufficient to influence running economy (0.5%; $p>0.05$).

Discussion

While the training-induced increase in plantarflexor strength was expected, the substantial increases in ROM, stretch tolerance and tendon stiffness, and the reduction in passive muscle stiffness, were important and novel findings. Interestingly, when measured during passive stretch, MTU stiffness remained unchanged while tendon stiffness increased and muscle stiffness decreased. These disparate findings have clear implications for testing methodologies, and indicate that imaging techniques must be utilised in order to examine the effects of interventions on specific tissues. As the training clearly enhanced the capacity of the muscle to tolerate both tissue loading and deformation, which are commonly associated with muscle strain injury, these data have clear implications for both muscular performance and injury risk.