SIX WEEKS OF MAXIMAL ECCENTRIC KNEE EXTENSOR TRAINING AFFECTS MUSCLE-TENDON MECHANICS AND MUSCLE DAMAGE

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Introduction

Strength training can influence muscle-tendon mechanics and architecture, and provide a protective effect from exercise-induced muscle damage; however more data are required describing the specific influence of eccentric training. Therefore, the aims of the present study were to examine the effect of 6 weeks of maximal eccentric knee extensor training on these properties.

Methods

Thirteen recreationally active participants (age = 28.3 ± 1.7 yr, mass = 73.5 ± 14.6 kg, height = 1.7 ± 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 and consisted of 5 sets of 12 repetitions of 3-s maximal knee extensor isokinetic eccentric contractions at $30°\cdot s^{-1}$ from 180° to 90° knee extension. Maximal isometric and eccentric knee extensor moment, range of motion (ROM), stretch tolerance, VL thickness and fascicle angle, and tendon and muscle-tendon unit (MTU) stiffness were measured using isokinetic dynamometry and real-time ultrasonography before and after the training. Creatine kinase (CK) concentration and delayed onset muscle soreness (DOMS) were also measured before and 24 h after a 20-min downhill run (16° decline).

Results

A significant increase in isometric (21.6%; p<0.05) and eccentric (28.1%; p<0.01) strength, ROM (6.6°; p<0.01), stretch tolerance (83.6%; p<0.01), VL thickness (7.8%; p<0.01) and fascicle angle (9.2%; p<0.01) was found after training; changes in VL thickness and fascicle angle were strongly correlated (r=0.96: p<0.01). While no change was found in MTU stiffness (slope of the passive moment curve) using dynamometry (-5.8%; p=0.45), ultrasound data revealed a significant increase in VL tendon stiffness (8.7%; p<0.01). Although CK concentration after downhill running increased significantly before (103.2%; p<0.01) and after (42.1%; p<0.05) training, the increase in CK was significantly lower following the training (p<0.05), with subjects also reporting minimal DOMS within the knee extensors.

Discussion

The substantial increases in strength were accompanied by increases in both muscle size and pennation. Moreover, significant increases in ROM and stretch tolerance were observed, indicating a dual benefit to the eccentric training. An increase in tendon stiffness was observed, which will likely impact muscle-skeleton force transfer, and ultimately influence movement capacity. However, importantly this was not accompanied by a change in whole MTU stiffness, suggesting that MTU measurements may miss tissue-specific adaptations. Finally, the attenuated CK and DOMS response after training has clear implications for both muscular performance and injury risk.

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