ACUTE ADAPTATION OF MUSCLE-TENDON UNIT STIFFNESS FOLLOWING REPEATED DAMAGING EXERCISE BOUTS
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It is well established that exhausting stretch-shortening cycle (SSC)-type exercises induce a marked alteration of neuromuscular function (e.g., 2), together with the development of symptoms related to inflammatory processes. However, recovery is faster and symptoms are reduced when the damaging exercise is repeated. This acute adaptation has been referred to as the repeated bout effect (see 3). While the conditions required to induce a protective adaptation are fairly well understood, the underlying mechanisms are less clear. Several theories have been proposed, and potential mechanisms may be located at the neural, mechanical and inflammatory levels. Mechanical adaptations could include an increase in muscle-tendon unit (MTU) stiffness, to protect contractile elements against excessive mechanical strain. Long-term training studies have provided evidence for this adaptation (4). Conversely, Ishikawa et al. (1) have only observed a transient increase of passive stiffness following a single damaging exercise bout, with return to baseline level occurring within one week. Therefore, the purpose of this experiment was to investigate acute adaptation in MTU stiffness following two repeated damaging exercise bouts.

Eight physically active subjects (3 females) performed a hopping task on a force plate until exhaustion, at an intensity set to 65% of maximal ground reaction force. This first exercise bout (B1) was repeated 2 weeks later (B2). Plantar flexors passive resistance torque (PR) to dorsiflexion (-20°/s), optimal angle for isometric torque production, eccentric torque (-20°/s) at optimal angle and active stiffness (average rate of eccentric torque development) were measured before, after (AFT), and 4 days (4D) after B1 and B2.

After B1, PR increased (P<0.01) and was still elevated at 4D (P<0.01). Before B2, PR tended to decrease as compared to 4D B1, but was still elevated as compared to the values measured before B1 (P<0.05). After B2, PR remained elevated at AFT (P<0.01) and 4D (P=0.05). On average, eccentric torque was higher during B2 as compared to B1 (P=0.05). Optimal angle was also significantly reduced during B2 as compared to B1 (P<0.05). Finally, neither time nor exercise bout did affect active stiffness.

These results suggest that an increase in passive stiffness could partly account for the acute adaptation to damaging SSC-type exercise. Such mechanical adaptation could be involved in the shift of optimal angle towards longer MTU length and the increase of eccentric torque at optimal angle. The origin of this mechanical adaptation could be located within the tendinous tissues. Further studies are required to confirm this hypothesis.


Keywords: Eccentric Exercise, Fatigue, Stretch-Shortening Cycle