MONITORING MUSCLE-TENDON ADAPTATION IN ELITE ATHLETES: PRELIMINARY DATA FROM A 1-YEAR LONGITUDINAL INVESTIGATION

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Introduction

Muscles and tendons adapt to mechanical loading (Arampatzis et al., 2007). However, different time courses of adaptation in response to training (Mersmann et al., 2016) may lead to discordance within the muscle-tendon unit (MTU), potentially increasing the risk of injury. In this study, we monitored the triceps surae (TS) MTU mechanical properties in elite jumpers over one year of training and competing, in order to detect potential training-induced discordance between muscle and tendon adaptation.

Methods

This preliminary analysis is part of an ongoing nationwide study on the TS MTU adaptation of more than 30 jumpers (long jump, triple jump, high jump and pole vault) of the German national team. Maximum ankle plantarflexion moment and Achilles tendon (AT) stiffness of nine jumpers (23±3y) and one jumper 10 months post Achilles tendon reconstruction, were regularly assessed over 1 year at their respective Olympic training centres, using a mobile device (dynamometry and ultrasonography; TEMULAB®, Protendon, Aachen, Germany). Both time course and coefficients of variation (CV) of muscle and tendon adaptation were evaluated.

Results

On average, 16 measurements were conducted for these first 10 athletes. Both TS muscle strength and AT stiffness were higher in the take-off leg (average: 371±58Nm and 874±113N/mm, respectively) compared to swing leg (348±44Nm/kg; 812±110N/mm). In both legs, the relative changes of TS muscle strength and AT stiffness over one year showed similar patterns, meaning that changes in TS muscle strength were followed by changes in AT stiffness, with CVs of 8.9±2% and 12.9±4.9% respectively. However, following AT reconstruction, TS muscle strength but not AT stiffness was consistently lower in the affected leg (average over all data points: 1.8±0.2Nm/kg; 503.7±90.7N/mm) compared to the healthy leg (3.4±0.2Nm/kg; 496.8±33.1N/mm), despite intensive training.

Discussion

Our results indicate limb-specific differences of both TS muscle strength and AT stiffness due to training, with higher values for the take-off leg compared to the swing leg. Over one year there was a concordant adaptation of TS muscle strength and AT stiffness in both legs, suggesting a low tendon injury risk due to discordance within TS MTU. Following AT reconstruction, a consistent deficit in TS

muscle strength but not AT stiffness was seen compared to the healthy leg, meaning that AT rupture and reconstruction could be risk factors for irreversible discordance within TS MTU.

References

Arampatzis et al. (2007). J Exp Biol, 210, 2743-2753.

Mersmann et al. (2016). J Appl Physiol, 121, 893-899.

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