28th ECSS Anniversary Congress, Paris/France, 4-7 July 2023

An initial exploration of muscle-tendon unit properties in highly trained female netballers and runners

Newbould, S., Dinsdale, A., Whitehead, S., Walker, J., Nicholson, G.

Leeds Beckett University

INTRODUCTION:
Muscle-tendon interaction during movement can be categorised into energy conservation or power amplification/attenuation strategies (1), and the mechanical and morphological properties of male athletes' tendons adapt to these loading demands (2). Although previous research observed no differences in tendon properties between female endurance runners and inactive controls (3, 4), little is known about these properties in females undergoing habitual power amplification-type loading, such as that experienced by team sport athletes. Therefore, this study investigated Achilles' tendon (AT) properties in trained female endurance runners and netballers.
METHODS:
An observational investigation of 7 national level female netballers (16.2 ± 4.5 years netball training experience) and 7 female runners (8.3 ± 2.9 years training) was conducted. AT thickness was assessed at rest using B-mode ultrasound. The AT moment arm was calculated using the tendon excursion method. Participants performed graded isometric ankle plantar flexion contractions on a Cybex dynamometer until a voluntary maximum was reached, whilst dynamic ultrasound recorded displacement of the gastrocnemius medialis myotendinous junction. From each contraction plantar flexion moment, AT force, elongation, and strain were calculated. AT stiffness was defined as the slope of the AT force-elongation relationship (from 20-100% of maximum force). Mean differences (MD) with 95% confidence intervals (CI), Student's t-tests, and Hedge's g effect sizes (ES) were used to assess differences in AT properties between groups.
RESULTS:
Netballers displayed a significantly greater maximal plantar flexion moment (MD 58.1 N.m-1, CI 35.5-80.7 N.m-1, ES 2.81, $p<0.001$), AT force (MD 822.4 N, CI 294.4-1350.5 N, ES 1.70, $p=0.008$), AT elongation (MD 5.70 mm, CI 0.40-11.07 mm, ES 1.17, $p=0.044$), and AT thickness (MD 0.69 mm, CI 0.08-1.30 mm, ES 1.24, $p=0.031$). No significant differences were found in maximal strain, stiffness, length, or moment arm.
CONCLUSION:
The greater AT thickness of the netball group suggests that the power amplification-type loading demands inherent to netball training (i.e., jumping, landing) have a hypertrophic effect on the tendon. Additionally, the greater maximal plantar flexion moment, and hence AT force experienced by the netballers may also contribute to this hypertrophic stimulus. This adaptation may be protective in nature, as increased thickness (and presumably cross-sectional area) would reduce peak operating stress and enhance the safety factor of the tendon. Despite differences in AT thickness, no differences in strain or stiffness were found, corroborating earlier findings of uncoupled mechanical and morphological properties (2). These results provide evidence that the AT can adapt to high intensity loading in females.

1. Roberts and Azizi, J Exp Bio, 2011
2. Wiesinger et al., PLOS One, 2016
3. Magnusson et al., Int J Exp Path, 2007
4. Westh et al., Scand J Med Sci Sport 2008

Topic: Biomechanics

Presentation Poster