ACHILLES TENDON IS MECHANOSENSITIVE IN OLD ADULTS: A 1.5 YEAR RESISTANCE TRAINING INTERVENTION

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INTRODUCTION

The aging tendon experiences general degeneration in its structure and function, which is usually described through a diminished ability to adapt to environmental stress as a consequence of deteriorated tissue homeostasis. Tendons of older adults have shown to increase their stiffness after medium-term (12-14 weeks) exercise interventions foremost through an increased Young's modulus, rather than tendon hypertrophy (Reeves *et al.*, 2003). Nonetheless, there is limited knowledge about the time-adaptive response relationship of tendons experiencing long-term (years) mechanical loading interventions. Therefore, the current study investigated if the older human Achilles tendon (AT) exhibits mechanosensitivity by altering its material and/or morphological properties in response to a long-term mechanical loading exercise intervention.

METHODS

Thirty-four older female adults (age: 65±7 y) voluntarily took part in a medium-term (14 weeks; n=21) strength training intervention using high AT strain cyclic loading (isometric plantarflexion contractions with 90% of MVC for five sets of four repetitions 3 times a week as provided by Arampatzis *et al.*, 2007) or a control group (n=13). A sub-group of the intervention group (n=12) continued the exercise for 1.5 years (long-term intervention). In order to analyse the AT stiffness and Young's modulus in vivo, ultrasonography and dynamometry were used simultaneously. Tendon cross-sectional area (CSA) was determined along the whole free AT by using custom routines on image sequences obtained through magnetic resonance imaging.

RESULTS

Following 14 weeks of resistance training, the intervention group had a significantly ($p<0.05$) increased ankle plantarflexor muscle strength (141.5±36.2 vs 116.3±30.8 Nm at baseline), together with a 23% higher AT stiffness (598.2±141.2 Nmm^{-1} vs 488.4±136.9 Nmm^{-1} at baseline), 20% greater Young's modulus (1.63±0.46 GPa vs 1.37±0.39 GPa at baseline) and a homogenous hypertrophy along the entire free AT (approximately 6%). However, despite continuing the strength training intervention for 1.5 years, no further alterations in the muscle strength and tendon properties were found. The control group had no differences neither in muscle or tendon biomechanical properties between measurement time points.

DISCUSSION

The aged AT appears to be able to increase its stiffness in response to medium-term (14 weeks) mechanical loading exercise through changes in both material and morphological properties. Continuing strength training seems rather to maintain, than cause any further adaptive modifications in tendon properties, which indicates that in ageing tendons the time-adaptive response relationship to mechanical loading is non-linear.

CONCLUSION

In conclusion, the current study gives evidence that the human AT preserves its mechano-sensitivity in old age and seems to have the capability to increase its stiffness by changing both its material and dimensions and may thereby tolerate higher mechanical loading due to a reduced strain and stress it experiences during tensile loading.

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