Bilateral kinetic, kinematic, neuromechanical, and muscle-tendon properties of habitual runners

av

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Akademisk avhandling

Avhandling för doktorsexamen i idrottsvetenskap vid Gymnastik- och idrottshögskolan, som enligt beslut av rektor kommer föras offentligt fredagen den 4 juni 2021 klockan 13:00, i Zoom, vid Gymnastik- och idrottshögskolan, GIH, Stockholm.

Opponent: Professor John Rasmussen
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Abstract:

Achilles tendon overuse-related injuries are a frequent problem to habitual runners. Such injuries occur more often unilaterally and their etiology is associated to overloading of the tendon tissue. Inter-limb differences during running are a possible cause for overloading due to eventual differences in the mechanical loading provided to each limb. Furthermore, inter-limb differences in Achilles tendon properties were found in athletes due to sport-induced differences in the mechanical loading and in non-athletes due to limb preference. Currently, inter-limb differences in the Achilles properties of habitual runners is unknown. The present thesis investigated the existence of inter-limb differences in biomechanical, neuromechanical and Achilles tendon properties in habitual runners. In Study I, thirteen triathletes performed a cycle-run simulation while vertical ground reaction force (GRFv), lower limb kinematics and triceps surae and tibialis anterior activation were evaluated bilaterally during the start, mid and end stages of the 5 km running segment. In Study II, GRFv, lower limb kinematics, triceps surae and tibialis anterior activation and Achilles tendon strain were evaluated bilaterally in habitual runners at two running speeds (2.7 m.s-1 and 4.2 m.s-1). In Study III, spatiotemporal variables, vertical (kVert) and limb (kLimb) stiffness and center of mass (COM) kinematics were evaluated bilaterally in habitual runners at the same running speeds adopted in Study II. In Study IV, maximal plantarflexion isometric force, triceps surae activation and activation ratios, and Achilles tendon morphological, mechanical and material properties were evaluated bilaterally in habitual runners. In Study I the Soleus activation was lower in the preferred limb from 53.4% to 75.89% of the stance phase (p<0.01, ES range = 0.59 to 0.80) at the end stage of running. In Study II, hip extension velocity was greater in the non-preferred limb from 71% to 93% of the stance phase (p<0.01) during running at 4.2 m.s-1 while no other inter-limb differences were observed. In Study III, no inter-limb differences were observed in spatiotemporal, kVert and kLimb at investigated running speeds. However, COM horizontal velocity was greater from 67% to 87.40% of stance phase (p<0.05, ES >0.60) when the non-preferred limb was in contact with the ground. In Study IV, no inter-limb differences were observed in triceps surae activation nor Achilles tendon properties. The activation ratios of MG and SOL, however, were observed to correlate in the preferred limb only.

In summary, neuromuscular and kinematic inter-limb differences were observed when healthy, non-injured habitual runners performed in running conditions similar to their ecological conditions. Moreover, the Achilles tendon seems to adapt similarly among limbs of habitual runners, while triceps surae activation strategies might differ between limbs. Findings of inter-limb differences occurring during running may result in overloading during running and therefore might be implicated in the etiology of Achilles tendon overuse-related injuries in habitual runners. Findings of similar tendon properties among limbs suggest both limbs have similar chances of incurring in the injury process.

Coaches and clinicians might improve current preventive strategies for Achilles tendon overuse-related injuries by monitoring tendon properties and running biomechanical and neuromuscular variables bilaterally across the season.

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