GIH THE SWEDISH SCHOOL OF SPORT AND HEALTH SCIENCES

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 försvaras offentligt
fredagen den 4 juni 2021 klockan 13:00,
i Zoom, vid Gymnastik- och idrottshögskolan, GIH, Stockholm.

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Jacques, Tiago Canal: Bilateral kinetic, kinematic, neuromechanical, and muscle-tendon properties of habitual runners.
Avhandlingsserie för Gymnastik- och idrottshögskolan Nr 19 (2021)

Abstract:

Achilles tendon overuse-related injuries are a frequent problem to habitual runners.Such injuries occur more often unilaterally and its etiology is associated to overloadingof the tendon tissue. Inter-limb differences during running are a possible cause for overloaddue to eventual differences in the mechanical loading provided to each limb. Furthermore,inter-limb differences in Achilles tendon properties were found in athletes dueto sport-induced differences in the mechanical loading and in non-athletes due to limbpreference. Currently, inter-limb differences in the Achilles properties of habitual runnersis unknown. The present thesis investigated the existence of inter-limb differencesin biomechanical, neuromechanical and Achilles tendon properties in habitual runners.In Study I, thirteen triathletes performed a cycle-run simulation while vertical groundreaction force (GRFv), lower limb kinematics and triceps surae and tibialis anterior activationwere evaluated bilaterally during the start, mid and end stages of the 5 km runningsegment. In Study II, GRFv, lower limb kinematics, triceps surae and tibialis anterioractivation and Achilles tendon strain were evaluated bilaterally in habitual runnersat 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 wereevaluated bilaterally in habitual runners at the same running speeds adopted in Study II.In Study IV, maximal plantarflexion isometric force, triceps surae activation and activationratios, and Achilles tendon morphological, mechanical and material properties wereevaluated bilaterally in habitual runners. In Study I the Soleus activation was lower inthe preferred limb from 53.4% to 75.89% of the stance phase ($p<0.01$, ES range = 0.59to 0.80) at the end stage of running. In Study II, hip extension velocity was greater inthe non-preferred limb from 71% to 93% of the stance phase ($p<0.01$) during running at4.2 m.s-1 while no other inter-limb differences were observed. In Study III, no inter-limbdifferences were observed in spatiotemporal, kVert and kLimb at investigated runningspeeds. However, COM horizontal velocity was greater from 67% to 87.40% of stancethe phase ($p<0.05$, ES >0.60) when the non-preferred limb was in contact with theground. In Study IV, no inter-limb differences were observed in triceps surae activationor Achilles tendon properties. The activation ratios of MG and SOL, however, were observedto correlate in the preferred limb only.

In summary, neuromuscular and kinematic inter-limb differences were observed whenhealthy, non-injured habitual runners performed in running conditions similar to their ecological conditions. Moreover, the Achilles tendon seem to adapt similarly amonglimbs of habitual runners, while triceps surae activation strategies might differ betweenlimbs. Findings of inter-limb differences occurring during running may result in overloadduring running and therefore might be implicated in the etiology of Achilles tendonoveruse-related injuries in habitual runners. Findings of similar tendon propertiesamong limbs suggest both limbs have similar chances of incurring in the injury process.

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

Keywords:
ISBN: 978-91-986490-0-0
http://urn.kb.se/resolve?urn=urn:nbn:se:gih:diva-6678

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