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Observation of the Achilles Tendon and Gastrocnemius Muscle's Passive Stiffness During an Incremental Running Protocol

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Abstract

Objective: Passive stiffness, a biomechanical parameter, has a potential influence on running economy, thus playing a pivotal role in performance. This study aimed to quantify passive stiffness of the Achilles tendon and gastrocnemius muscle using myotonometry throughout an incremental running protocol.

Methods: Twenty-one male participants underwent a multistage incremental test (Bordeaux test) on a treadmill until exhaustion. Passive stiffness of the gastrocnemius muscle and Achilles tendon was measured using a MyotonPRO device. Measurements were taken before, during, and after the incremental test.

Results: Our findings indicated that passive stiffness of the medial gastrocnemius decreased at rest between prerun and postrun assessments (-20.12 N·m-1, P = .012). Furthermore, during the test, stiffness increased at low intensity (at 50% of maximal aerobic speed: +104.8 N·m-1, P = .042), returning to baseline values as intensity increased.

Conclusions: Throughout an incremental running protocol, both Achilles tendon and gastrocnemius muscle stiffness initially increased and then decreased with escalating percentages of maximal aerobic speed. A deeper understanding of stiffness in running can inform more effective recommendations for runners' strengthening and training.

Keywords: biomechanics; myotonometry; rheology; viscoelasticity.

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