NON-UNIFORM DISPLACEMENT WITHIN RUPTURED ACHILLES TENDON DURING ISOMETRIC CONTRACTION


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ABSTRACT

Achilles tendon (AT) fascicles originate from the triceps surae muscle [medial gastrocnemius, lateral gastrocnemius, and soleus]. Recent studies have provided evidence that non-uniform movement of AT fascicles during muscle contractions is part of healthy tendon function, while patients with Achilles tendon rupture (ATR) show more uniform inter-fascicle movement. The aim of the present study was to investigate tendon displacement patterns in non-surgically treated patients 14-months after acute ATR, and to classify patients into groups based on their AT displacement patterns. We hypothesized that ruptured AT would show a more uniform displacement pattern compared to the contralateral AT and expected different displacement behaviors in different cluster groups.

Twenty patients were tested. Sagittal images of AT were acquired using B-mode ultrasonography during ramp contractions at a torque level corresponding to 30% of the maximal isometric plantarflexion torque of the uninjured limb. A speckle tracking algorithm was used to track proximal-distal movement of the tendon tissue at 6 antero-posterior locations. Two-way repeated measures ANOVA for peak tendon displacement was performed. K-means clustering was used to classify patients according to AT displacement patterns.

The difference in peak relative displacement across locations was larger in the uninjured (1.29 ± 0.87 mm) than the injured limb (0.69 ± 0.68 mm), with a mean difference (95%CI) of 0.60 mm (0.14-1.05 mm, P<0.001) between limbs. For the uninjured limb, cluster analysis formed 3 groups, while 2 groups were formed for the injured limb.

The three distinct patterns of AT displacement during isometric plantarflexion in the uninjured limb may arise from subject-specific anatomical variations of AT sub-tendons, while the two patterns in the injured limb may reflect differential recovery after ATR with non-surgical treatment. Subject-specific tendon characteristics are a vital determinant of stress distribution across the tendon. Changes in stress distribution may lead to variation in the location and magnitude of peak displacement within the free AT. Quantifying internal tendon displacement patterns after ATR provides new insights into AT recovery.