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Do insertional and mid-portion Achilles tendinopathy display different material properties?

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We thank Zhang and colleagues for their letter to the editor which raises the question as to whether insertional and non-insertional (or mid-portion) Achilles tendinopathy have different “stiffness patterns”. This proposal is based on findings of greater ‘hardness’ in insertional Achilles tendinopathy in the study by Zhang et al (1), and lower ‘elastic modulus’ in the study by Coombes et al (2), which recruited participants with a clinical diagnosis of Achilles tendinopathy at either region. While plausible, there are several critical differences between the two studies that ought to be considered.

First, different methods were used in the two studies. Coombes et al (2) used ultrasound shear wave elastography, that estimates the shear modulus through the measurement of speed of the shear wave. Zhang et al (1) used strain elastography that involves a manual compression of the tissues with the ultrasound transducer. Since this technique measures only the strain and the stress field remains unknown, only qualitative measurements can be performed (3). In addition, Zhang estimated the elasticity in the transverse direction (ie tendon hardness), while we measured the shear modulus along the main axis (ie shortening/lengthening direction). Importantly, when applied to muscles, only the shear modulus measured along the main axis is correlated to stiffness (4). Considering the anisotropic properties of tendon, we do not recommend a direct comparison between the two studies.

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Second, different study designs and comparator groups were adopted, which may affect the generalisability of the results obtained. The study by Zhang et al (1) was a retrospective analysis of 37 patients with Achilles tendon pain who underwent strain elastography of both Achilles tendons (74 tendons). In their analysis, Zhang compared 16 tendons with insertional Achilles tendinopathy (22%) with 45 asymptomatic tendons (39%). The latter tendons were presumed to be healthy, although the authors acknowledge that early subclinical changes cannot be discounted. A further 13 tendons (18%) were reported to have mid-portion symptoms or combined mid-portion and insertional symptoms, although no data was presented for these tendons. Coombes et al (2) conducted a prospective, blinded study comparing 22 patients with clinically diagnosed Achilles tendinopathy with 28 healthy controls without tendon pain. Nineteen patients (87%) reported mid-portion symptoms and nine (41%) reported insertional symptoms (six had combined symptoms). Interestingly, 8 out of 9 patients with insertional symptoms were bilateral, compared to only 46% of patients with mid-portion symptoms. In the published analysis (2), the most affected leg (regardless of symptomatic region) was considered, although data for the Achilles mid-tendon and insertion regions were analysed separately.

In response to the query by Zhang, we conducted further analyses of our data to test the assertion that mid-portion tendinopathy (19 tendons) and insertional tendinopathy (17 tendons) display contrasting differences in material properties relative to healthy controls (56 tendons). Individual tendon data and the mean (SD) for each group are illustrated for the Achilles mid-tendon (Figure 1A) and the Achilles insertion (Figure 1B) regions. Mean differences (MD & 95% CI) were calculated relative to healthy controls. At the mid-tendon region, significantly lower SWV was observed for tendons with mid-portion symptoms compared to tendons from healthy controls (MD (95% CI): -0.93m/s (-1.58, -0.28), p=0.01), but not for tendons with insertional symptoms. At the insertion region, significantly lower SWV was observed for tendons with insertional symptoms compared to tendons from healthy controls (MD -1.46m/s (-2.50, -0.43), p=0.01), but not for tendons with mid-portion symptoms. To further explore potential reasons for discrepancy between the two studies, we examined whether differences existed between healthy controls and asymptomatic tendons in patients with unilateral Achilles tendinopathy (8 tendons). Significantly lower

SWV for the asymptomatic tendons was observed compared to healthy controls at the mid-Achilles region only (MD -0.93m/s (-1.79,-0.07), p=0.04).

<Suggested location for Figure 1A and 1B

Although limited in sample size and exploratory in nature, these findings indicate a region-specific reduction in SWV for both types of Achilles tendinopathy compared to healthy controls without tendinopathy. It also suggests that subclinical changes are present in the asymptomatic legs of patients with unilateral Achilles tendinopathy. In our study, patients with insertional tendinopathy almost exclusively had bilateral symptoms. It must be acknowledged that confounding factors, such as age and obesity may have impacted on these results. Description of potential confounders including sex, age, weight, body mass index as well as injury characteristics including duration and severity of symptoms is essential, however only age and sex were reported by Zhang.

We thank Zhang and colleagues for their comments and the opportunity to further examine our data. We conclude that lower SWV suggesting diminished shear modulus are consistent features of both insertional and mid-portion Achilles tendinopathy. Future study is needed to determine whether lower SWV observed in asymptomatic tendons may predispose to future Achilles tendinopathy.

Figure 1: Shear wave velocity measured at the (A) Achilles mid-tendon and (B) Achilles insertion regions for tendons from healthy controls (HC), or Achilles tendinopathy (AT) patients with mid-portion symptoms or insertional symptoms. Individual tendon values are represented by black circles. The mean and standard deviation for each group are represented by the open diamond and error bars respectively. Significant group differences are highlighted by asterisks.

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