

Comparison of UTE ratios based on magnetization transfer and T2 for quantification of Achilles tendinopathy

R. J. Hodgson¹, P. Wright², A. J. Grainger², P. O'Connor², D. McGonagle³, P. Helliwell³, P. Emery³, and M. D. Robson⁴

¹LMBRU, University of Leeds, Leeds, Yorkshire, United Kingdom, ²Leeds Teaching Hospitals NHS Trust, ³University of Leeds, ⁴University of Oxford

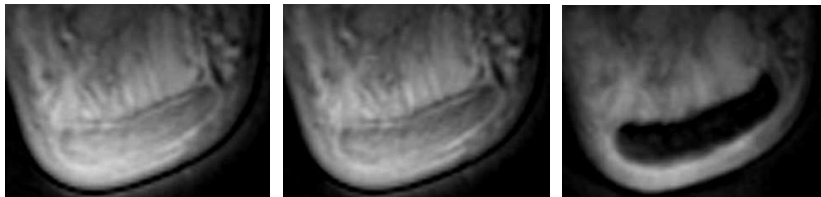
Introduction: The Achilles tendon is commonly involved in mechanical, degenerative and inflammatory disease. Ultrashort echo time (UTE) imaging allows the tendon to be directly imaged, even when normal or only mildly diseased [1]. Off resonance saturation has been used for introducing contrast into UTE images; near resonance this reflects T_2 whereas far from resonance magnetization transfer (MT) dominates [2]. Magnetization transfer in combination with T_1 mapping has been previously used to calculate the bound proton fraction in the tendon, which appears to be reduced in tendinopathy [3]. The aim of this work was to determine whether the Magnetization Transfer Ratio (MTR) is changed in tendon disease and to compare this with a similarly simple ratio based on T_2^* .

Methods: 12 patients with a clinical diagnosis of Achilles insertional tendinopathy and 14 healthy, asymptomatic volunteers were studied. Axial images of the Achilles tendon were acquired with a single-slice 2D UTE sequence 1cm above the superior calcaneus with $TR=140ms$, time between excitation and acquisition (TE_{eff}) = 0.07ms, flip-angle=30°. The field of view was 135mm and the slice thickness was 3mm. 320 radial acquisitions were acquired in a total of 1.5 minutes. Images were acquired with similar parameters and a saturation pre-pulse 10kHz off resonance with power equivalent to an 800° on-resonance pulse. The parameters were chosen so MT dominated, based on modelling of the direct saturation and magnetization transfer effects in healthy volunteers [3]. The flip angle was limited by the SAR. Another set of images was acquired without a pre-pulse but with $TE_{eff}=2ms$.

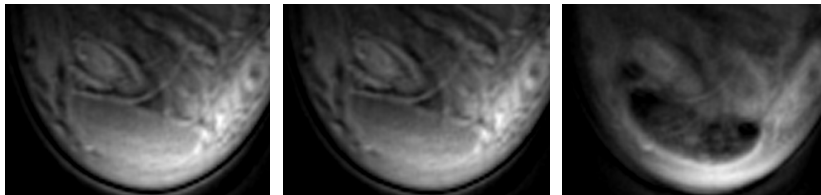
The entire Achilles tendon was outlined on the $TE_{eff}=2ms$ image and the mean signal intensity calculated for each image. The MTR and the ratio of the $TE=2ms$ to the $TE=0.07ms$ images (T_2R) was calculated. Differences between the SpA patients and the healthy controls were assessed using the Mann Whitney U test.

Results:

Control



Tendinopathy



TE=0.07ms

MT pulse

TE=2ms

	Tendinopathy patients (n=12)	Controls (n=14)	
MTR	0.11 (0.02)	0.11 (0.01)	Mean (sd)
	p=0.46		
T ₂ R	0.34 (0.10)	0.23 (0.04)	
	p=0.001		

Discussion: The T_2R measurement was significantly higher in the patients with tendinopathy compared to healthy controls consistent with an increase in the T_2^* of the tendon in tendinopathy. This is in keeping with previously reported high signal at echo times of 4-6ms in patients with mechanical disease [1,4]. T_2R is a simple measurement and was acquired in 3 minutes so is clinically feasible and may be a useful measurement of tendon disease. Alternatively, T_2^* could be estimated from images at several TE_{eff} [1].

There was no significant difference in the MTR between the tendinopathy patients and healthy controls, suggesting MTR is likely to be less useful for assessing insertional tendon disease. Although changes in the bound proton fraction have been previously reported in the Achilles tendon in disease, this may be due to a change in T_1 .

In summary, in this study, UTE measurements of the Achilles tendon based on T_2^* , but not MTR, were significantly greater in insertional tendinopathy.

[1] Robson MD et al. Clin Radiol 2004;59:727

[2] Du J. Man Reson Imaging 2010;28:527-31

[3] Hodgson RJ et al. ISMRM 2010

[4] Schick F et al. MAGMA 1995;3:103-7