

T2 mapping of the supraspinatus tendon: a feasibility study

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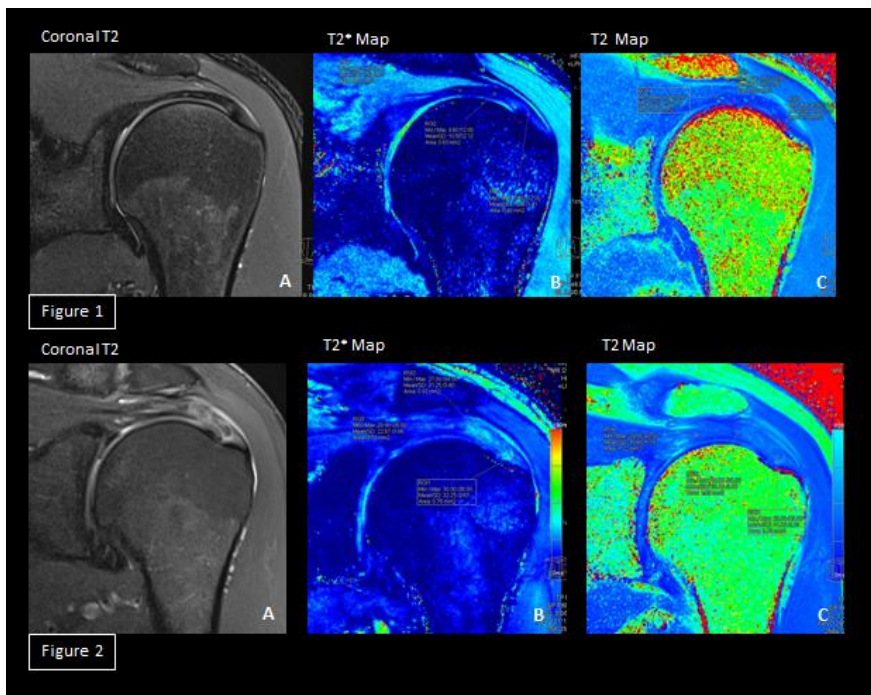
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Target Audience: Musculoskeletal radiologists and researchers as well as orthopaedic surgeons who are involved in the care of patients with rotator cuff disease.

Purpose: To see if T2 mapping can demonstrate differences between a normal and degenerated supraspinatus tendon.

Methods and Materials: 4 healthy volunteers (1 male and 3 female; mean age 31.5, range 29-33) and 4 clinical patients (3 male and 1 female; mean age 56.3, range 33-75), for a total of 8 shoulders, were scanned on a 3T scanner (MAGNETOM Skyra, Siemens Healthcare, Erlangen, Germany) using a dedicated 16 channel shoulder coil with the following protocol: 2D Multi-echo spin echo sequence with 5 echoes (TR/TE = 1000/9.9ms, Δ TE=9.9 ms flip angle= 180°, bandwidth=337 Hz/px, FOV=128 mm, resolution=0.5×0.5×3.0 mm³), 2D multi-echo spoiled GRE sequence with 6 echoes (TR=428 ms, TE=3.01 ms, Δ TE=6.33 ms, FA=60°, bandwidth =480 Hz/px, resolution=0.5×0.5×3.0 mm³), coronal fat suppressed T2-weighted (slice thickness=3 mm; TR range/TE range, 3500-4000/55-60), and sagittal fat-suppressed T2-weighted turbo-spin echo (slice thickness=3mm; TR range/TE range, 3500-4000/55-65). T2 and T2* maps were constructed inline by using pixelwise monoexponential nonnegative least squares fit analysis on the 3T scanner (MapIt, Siemens Healthcare, Erlangen, Germany). The healthy volunteers had no clinical or physical examination findings to suggest rotator cuff pathology. The clinical patients had medical histories and physical examination findings suggestive of rotator cuff pathology. The coronal and sagittal T2W images were reviewed for evidence of supraspinatus tendon pathology, including tendinosis, and partial thickness and full thickness tendon tearing. 3 equidistant regions of interest (ROIs) were placed in each tendon, one within the insertional fibers and two within the distal fibers along the lateral acromial margin, on the T2 and T2* maps of each patient at the level of the junction of the superior and middle greater tuberosity facets using a SyngoVia platform.

Results: There were no MR findings to suggest supraspinatus tendon pathology in any of the healthy volunteers. There were 2 patients with mildly retracted full thickness, incomplete tears, 1 patient with a mildly retracted partial thickness delaminating articular surface tear, and 1 patient with mild tendinosis in the clinical patient group. The mean± standard deviation of the values within the supraspinatus tendons calculated using the T2* maps in the normal volunteers was (12.9±2.6) ms and (16±6.8) ms when using the T2 maps [Fig 1]. The mean± standard deviation of the values calculated using the T2* maps in the clinical patients was 25.6±12.1 and 36.4±17.0 when using the T2 maps [Fig 2]. There was a statistically significant difference when comparing the T2* map values in the tendons of the healthy volunteers to the clinical patients ($p=0.002$) as well as when comparing the T2 map values between these 2 groups of patients ($p=0.001$). SNR was above the background noise level for the complete length of the tendon in both the GRE and MESE sequences in the first two echoes.



Discussion: Both T2* and T2 maps were able to show statistically significant differences between the tendons of healthy volunteers and in patients with suspected rotator cuff tendon pathology. As expected, the T2 values were larger than the T2* values. T2 mapping may be able to provide qualitative information on the status of the supraspinatus tendon that cannot be provided by conventional anatomic MR imaging. This gives the orthopaedic surgeons treating these patients a clearer picture of the quality of the tendon that they are planning on repairing as well as the likelihood for surgical success of the repair.

Conclusion: T2* and T2 maps have the potential to provide improved qualitative information on the status of the supraspinatus tendon. If substantiated in larger clinical studies, T2 mapping along with the morphologic findings provided by conventional MR imaging can provide a better understanding of the reparability of the injured tendon and, thus, the likelihood of success of the surgical repair.