

Quantitative T2*-Mapping of the Achilles Tendon using a Multi-Echo VTE SPGR-sequence at 3 Tesla: preliminary results.

Sebastian Apprich¹, Vladimir Juras¹, Oliver Bieri², Stefan Zbyn¹, and Siegfried Trattnig¹

¹Department of Radiology - MR Center of Excellence, Medical University of Vienna, Vienna, Austria, ²Division of Radiological Physics, University of Basel, Basel, Switzerland

Target audience

Musculoskeletal radiologists, orthopedic surgeons

Purpose

A new multi-echo (me) spoiled gradient echo sequence (SPGR) with an variable echo time (vTE) scheme (me -vTE-SPGR) enables quantitative MR imaging of tissues with very short T2 relaxation times (1) such as the Achilles tendon (AT). The purpose of this study was to compare the T2*-relaxation times of patients with an injured AT with intact AT in volunteers using this novel multi-echo VTE sequence at 3T.

Methods

Institutional Review Board approval and written, informed consent were obtained.

Ten patients (mean age 43.9 ±13.4 years) suffering from a painful AT and 10 age-matched, healthy volunteers (mean age 43.7 ±11.2 years) were examined with a 3T whole-body system, using an 8-channel knee coil. Morphological MRI included a sagittal T2-w fast spin echo sequence. T2* maps were calculated from an isotropic 3D me-vTE-SPGR-sequence (20 TE's from 0.8 to 20.1 ms) using a mono-exponential fit least square analysis. T2* values were manually assessed using a ROI analysis for the most severe pathology within patients and for the distal two-thirds of the AT in volunteers. All subjects completed the Achilles tendon Total Rupture Score (ATRS; 0-100 points). Statistical measures included an analysis of variance and Pearson-Correlation.

Results

Mean T2*-values in patients (8.0 ±4.7 ms, 95% CI 2.5-18.3 ms) differed statistically significant (P= 0.002) from mean T2*-relaxation times in healthy volunteers (2.6 ±0.6 ms, 95% CI 1.5-3.3 ms). Furthermore, a strong correlation was found between the clinical ATRS and mean T2*-values (Pearson coefficient - 0.846, R²= 0.72, P <0.001).

Morphological observation revealed 3 cases of achillotendinitis (thickening of AT, but no increase in signal intensity (SI)), 3 cases of thickened ATs with increase in SI (but not isointense to fluid), and 4 partially ruptured ATs (SI within the tendon isointense to fluid). Mean T2*-values for these cases were 3.6 ±0.5 ms, 7.1 ±0.4 ms, and 12.3 ±4.1 ms (Figure 1.), respectively.

Discussion

Conventional MRI sequences are not able to detect MR signal from tissues with short T2 relaxation times. The me-vTE-SPGR-sequence enables quantitative imaging of healthy ATs with short T2 relaxation as well as of injured ATs in which T2* relaxation times are prolonged due to increased water content and anisotropy of collagen fibers.

This new sequence might be in future a non-invasive predictive marker for the probability of a rupture of an AT tear as well as for a re-tear after surgery.

Conclusion

T2*-Mapping using a multi-echo VTE sequence is able to quantify changes in the water content and collagen fibre organisation of the injured AT.

References

1. Deligianni et al, High resolution Fourier-Encoded Sub-Millisecond Echo Time Musculoskeletal Imaging at 3T and 7T, MRM

Figure 1: Patient with partial rupture of Achilles tendon at the insertion zone. Note the increased T2*-relaxation times in the distal part of the AT.

