Correlation of Morphological Score (VIMATS) with Sodium MRI in Patients with Painful Achilles tendon

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Introduction

A quantitative MRI techniques such as T_2* mapping[1,2] and sodium MRI[3] provide valuable information on biochemical composition of the Achilles tendon (AT) tissue in various clinical conditions. Recently, a semi-quantitative morphological evaluation score of AT injuries has been introduced[4]. The aim of this study was to retrospectively correlate the semi-quantitative Vienna Morphological Achilles Tendon Score (VIMATS) with normalized sodium signal in order to demonstrate the relationship between morphological manifestation of AT problems and its biochemical composition (GAG content in this case).

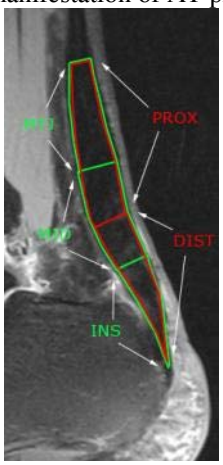

Figure1. Achilles tendon segmentation

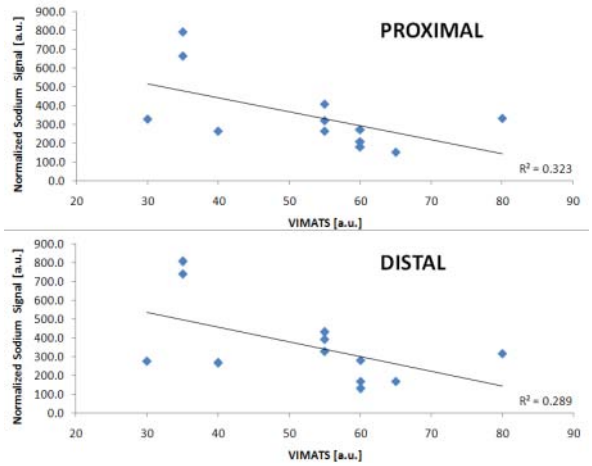

Figure 2. The correlation curves between VIMATS results and normalized sodium signal from proximal and distal half of the tendon

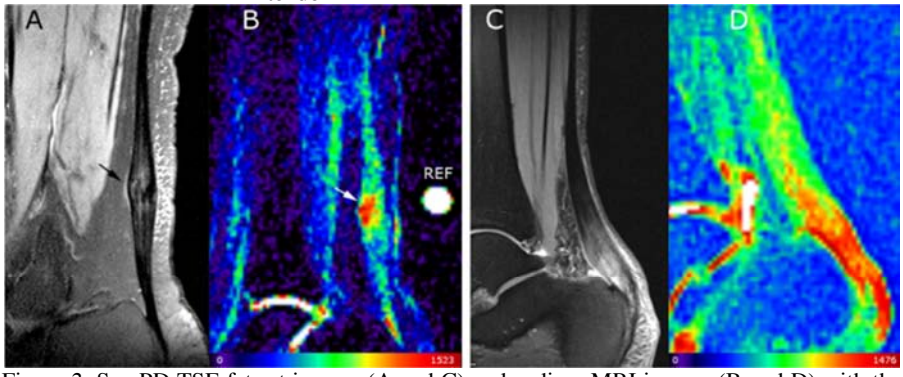

Figure 3. Sag PD TSE fat sat images (A and C) and sodium MRI images (B and D) with the VIMATS = 60 (A,B) and VIMATS = 30 (C,D).

Materials and Methods

Institutional Review Board approval and written, informed consent was obtained. In 26 consecutive patients (50 mean age ± SD 12.2 years; 7 female, 19 male) a total number of 28 painful ATs were examined on a 3T whole-body system, in prone position, using an 8-channel knee coil. MR morphological protocol consisted of a sagittal PD-w TSE sequence (TR 3970 ms, TE 26 ms, FOV 220x220 mm, TA 3:55 min), a sagittal T1-w SE sequence (TR 724 ms, TE 11 ms, FOV 220x220 mm, TA 3:22 min) and an axial T2-w TSE sequence (TR 6720 ms, TE 100 ms, FOV 170x170mm, TA 3:22 min). Sodium imaging was performed at 7T whole-body system using 2D-GRE sequence with the following parameters: TE 4.56; TR 33ms; matrix 128x128; FOV 20x20mm; slice thickness 6mm; FA 50°; BW 130Hz/px, TA 14:28 min. All subject were rated according to VIMAT Score. Sodium images were analyzed in three consecutive slices, in four regions each- insertion (INS), mid portion (MID) and musculo-tendon junction (MTJ), proximal half (PROX) and distal half (DIST) and the whole tendon (BULK) - Fig.1. Sodium signal was normalized to the signal from reference syringe with the known sodium concentration. Correlation between normalized sodium signal and VIMATS (0-to-100, worst-to-best) was calculated as Pearson correlation coefficient (P) in SPSS 19.0. Patients were divided into two groups according to localization of the lesion (in proximal or distal half).

Results

The mean VIMATS for 28 Achilles tendons was 47±23. The mean normalized sodium signal was 329±188 in BULK, 366±188 in INS, 327±182 in MID, 305±172 in MTJ, 300±165 in PROX and 356.1±203 in DIST. The Pearson's correlation coefficients for different regions were: P=-0.352 (BULK); P=-0.367 (INS); P=-0.316 (MID), P=-0.308 (MTJ), P=**-0.569** (PROX) and -0.268 (DIST) (Fig. 3). The sodium MRI examples of the patients with VIMATS score of 60 (A,B) and of 20 (C,D), respectively, are on the Figure 3. The correlation curve of BULK sodium values and corresponding VIMATS is depicted in the Figure 1.

Discussion

In this study we found moderate correlation between normalized sodium signal which is believed to be related to glycosaminoglycan content in cartilage and Achilles tendon and quantitative morphological VIMAT Score. Relative low correlations suggest that sodium MRI and VIMATS are complementary markers - VIMATS for macroscopic changes and the normalized sodium signal as a marker of GAG content increase due to accompanying or preceding degeneration Sodium imaging may have the potential to detect early stages of Achilles tendon degeneration and partial tear. **Acknowledgement**: Funding support provided by Austrian Science Fund (FWF) P 25246 B24

References 1. Filho et al. American Journal of Roentgenology 192 (3), pp. W117-W124; 2. Juras et al., European Radiology 23 (10), pp. 2814-2822 (2013); 3. Juras et al. Radiology 262 (1) pp. 199-205 (2013); 4. Apprich et al., Proc. Intl. Soc. Mag. Reson. Med. 21, 3472 (2013)