**Evaluation of Meniscal Pathology Using Quantitative Magnetic Resonance Imaging**

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**Purpose**: To evaluate the potential of T2, UTE-T2*, T1ρ, and UTE-T1ρ to diagnose meniscal pathology in cadaveric meniscal samples using a surgical reference standard.

**Methods**: *Samples*: 12 human cadaveric knees (donor age 62 ± 17.2 years, mean ± standard deviation) were used for this study. The menisci were harvested and 21 triangular meniscal slices were obtained, each of 5 mm thickness. *Reference Standard*: Using the surgical reference standard consisting of gross inspection and palpation, menisci were classified as normal, degenerated, or torn (**Figure 1, top row**). *Imaging*: MR imaging was performed at 3T in a solenoid coil after immersion in Fomblin to prevent dehydration and minimize tissue-air susceptibility artifacts and mounting in a MR compatible device to minimize motion artifacts. Menisci were oriented with circumferential fibers parallel to $B_0$, thus allowing optimal visualization of the radial tie fibers. Scanning was performed in an axial plane (perpendicular to $B_0$) and the quantitative imaging protocol consisted of a 2D-CPMG sequence (TR = 2000 ms, TE = 14, 27, 41, 55, 68, 82, 96, 109 ms, FOV = 5 cm, matrix = 320 x 256, slice thickness = 2 mm), a 2D-UTE sequence (TR = 100 ms, TE = 0.01, 0.1, 0.2, 0.4, 0.6, 0.8, 2, 4, 8, 12, 20 ms, FOV = 5 cm, matrix = 256 x 256, slice thickness = 2 mm), a 2D-T1ρ sequence (TR = 1500 ms, spin-lock time = 0, 5, 10, 20 ms, FOV = 5 cm, matrix = 256 x 256, slice thickness = 2 mm), and a 2D-UTE-T1ρ sequence (TR = 400 ms, spin-lock time = 0, 2, 5, 10, 20, FOV = 5 cm, matrix = 192 x 192, slice thickness = 2 mm). *Data Processing and Analysis*: T2, UTE-T2*, T1ρ, and UTE-T1ρ values were determined using nonlinear least square mono-exponential curve fitting of average signal intensities from the entire meniscus. In addition, pixel maps were generated. Differences in means were examined by one-way analysis of variance (ANOVA) with Tukey's multiple comparison post hoc test. Values were normalized to respective group means and plotted for illustrative purposes.

**Results**: Mean T2 values for normal, degenerated, and torn menisci were 20.2 ± 5.3 ms, 20.5 ± 1.5 ms, and 30.6 ± 4.0 ms, respectively. Mean UTE-T2* values for normal, degenerated, and torn menisci were 2.8 ± 0.9 ms, 6.1 ± 1.4 ms, and 6.5 ± 2.8 ms, respectively. Mean T1ρ values for normal, degenerated, and torn menisci were 14.6 ± 4.1 ms, 14.4 ± 6.5 ms, and 27.4 ± 4.6 ms, respectively. Mean UTE-T1ρ values for normal, degenerate, and torn menisci were 9.9 ± 3.1 ms, 10.0 ± 2.2 ms, and 26.0 ± 14.1 ms, respectively.

Post hoc test showed torn menisci demonstrated significantly higher mean T2, T1ρ, and UTE- T1ρ values compared with normal or degenerated menisci ($p < 0.05$). UTE-T2* values were significantly higher in degenerated and torn menisci compared with normal menisci ($p < 0.02$) (**Figure 1, bottom row and Figure 2**).

**Conclusion**: T2* values obtained with UTE sequences can delineate normal from degenerated menisci, thus complimenting conventional sequences. Torn menisci demonstrate higher T2, UTE-T2*, T1ρ, and UTE-T1ρ values compared with normal menisci.

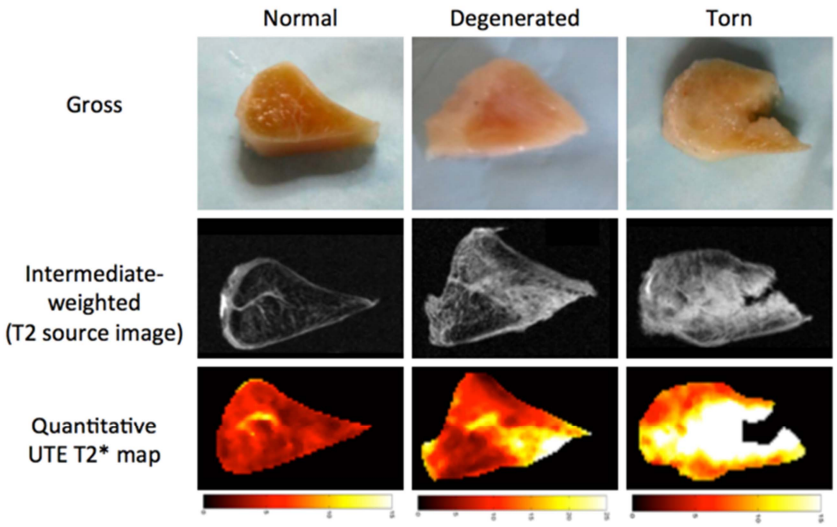


**Figure 1**. Gross, intermediate-weighted, and UTE-T2* pixel maps of normal, torn, and degenerated menisci.

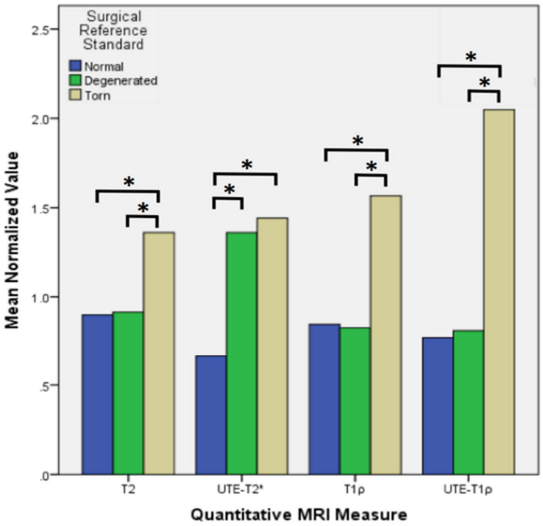


**Figure 2**. Box plot of results normalized to respective group mean. * = significant