Mono- and bi-exponential UTE-T2* longitudinal comparison of rotator cuff repairs augmented with or without autologous subacromial bursa tissue

Erica Y. Lee[1], Manickam Kumaravel[1], James M. Gregory[1], Payam Zandiyeh[1].
[1]University of Texas Health Sciences Center at Houston, Houston, TX

PURPOSE:

Rotator cuff repair (RCR) is associated with retear rates as high as 94%, prompting growing interest in biologics to improve outcomes. The subacromial bursa (SB), traditionally discarded during RCR, has emerged as a promising, easily accessible source of mesenchymal stem cells with superior tendon engraftment compared to bone marrow stromal cells. Quantitative MR (qMR) imaging – specifically T_2* analysis – offers a noninvasive means to monitor tendon integrity and healing. Although previous qMR studies of the supraspinatus tendon (SSP) have shown that T_2* is sensitive to changes in collagen content and correlates with clinical outcomes, there is a lack of in vivo randomized controlled trials (RCTs) on this topic. Furthermore, the biological composition of the SSP tendon suggests at least two sources of protons, thus, a bi-exponential T_2* decay model is more likely to reflect the state of the tissue than a mono-exponential decay model. This study presents the first known RCT to examine longitudinal mono- and bi-exponential T_2* changes in the SSP following RCR with or without SB augmentation. The aims were to determine whether T_2* values differ between the SB and control groups.

MATERIAL & METHODS:

As part of an RCT (NCT04634084), a total of 15 participants were recruited for this analysis, six of whom received RCR with SB. 3T MRI was acquired at 6 and 18 months following arthroscopic supraspinatus tendon (SSP) repair. Manual segmentation of the SSP tendon-muscle was performed on sagittal and coronal mDIXON images (slice thickness = 3 mm), which were co-registered to 3D-UTE T_2* images across 10 equally spaced echoes (TE_1 = 0.3 ms, TE_{10} = 18.3 ms). A single experienced rater (intra-rater ICC = 0.96) segmented all SSP under the guidance of an experienced musculoskeletal radiologist. Average T_2*$_{Mono}$, T_2*$_{Short}$, T_2*$_{Long}$, and fractional water (F_w) components were calculated from each segmentation.

RESULTS:

The average T_2* values of all participants pooled together were as follows: T_2*$_{Mono}$ = 18.7 ms ± 9.7 ms, T_2*$_{Short}$ = 5.1 ms ± 2.2 ms, T_2*$_{Long}$ = 17.9 ms ± 5.9 ms, and F_w = 44.1%. Among these, significant differences were detected between the SB and control groups across all T_2* outcomes. Additionally, no significant T_2* changes were found between timepoints, both across and within study groups.

CONCLUSION:

No significant differences in T_2* mono- and bi-exponential parameters were observed between SB-augmented and control RCR groups, nor were there significant longitudinal changes between the 6 and 18 month post-surgery.

CLINICAL RELEVANCE:

This preliminary analysis examines the impact of subacromial bursa (SB) augmentation on rotator cuff repair outcomes using bi-exponential T_2* analysis. Future work should investigate proximal and lateral tendon components separately.

Figure: Axial T2*maps of a) SB-augmented and b) control SSP 6 months after surgery.