

MRI Morphological and Quantitative Evaluation of Knee Allograft Repair at 3, 6 and 9 months Post-Op: Early Surveillance Demonstrates Nascent Physiological Incorporation of Allograft Material in Pain Free Patients

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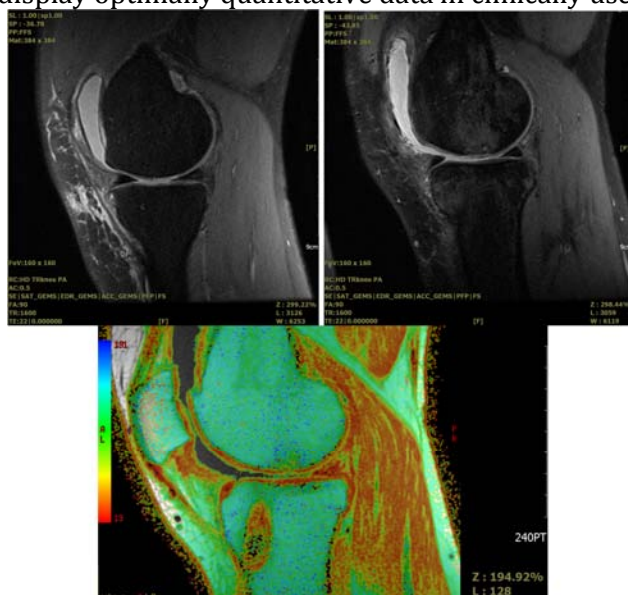
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Purpose: To: 1) Morphologically and quantitatively characterize the appearance/incorporation of allograft in patients who are status-post knee articular cartilage (AC) repair; 2) Compare patients who are pain free with those who are not.

Methods: Patients undergoing knee AC allograft (Biocartilage) procedures at our institution receive follow-up MRIs Q three months. All patients are scanned at 1.5 T (450W, GE) with a dedicated 8 channel knee coil. Morphological sequences include sagittal 2D PD FSFSE, 3D PD FS FSE and coronal FSEIR. Quantitative sequences include multi-echo and two-echo T2 Mapping. In addition, the 3D PD FS FSE sequences are segmented (Qmetrics), and 3D thickness maps are rendered from the segmented data sets. The morphological images are assessed for allograft fill, bony edema, osteophyte formation and the stability and integrity of the adjacent AC. The quantitative data sets are evaluated to assess the degree on allograft incorporation, specifically to determine the extent to which the allograft material has T2 and thickness map values similar or not to the native cartilage. These results are then correlated with each patient's pain score and function. Thus far, eight patients have had nine month follow-up MRIs.

Results: Thus far, all patients' allografts (N=8) show good fill morphologically at 3 months; the T2 Map values of the allografts at 3 months all have higher values relative to the native cartilage – even if the adjacent native cartilage is diseased – which indicates lower collagen and matrix organization. At three months, the thickness maps demonstrate good allograft fill. All patients thus far studied have improved pain scores and function relative to their pre-operative status. At 6 months, the morphological and thickness map data show improved allograft fill, with smoothing of the articular cartilage contours. The T2 map data of all patients indicate mild shortening of the values, especially at the scaffolding edges and the deepest layers, which suggests early organization of the allograft. Thus far, no patient studied at 6 months has worsening pain or clinical scores relative to the pre-operative and 3 month time points. At the 9 month time point, seven patients (N=7) have stable or improved morphological and thickness map data, as well as further decreasing T2 values; the zones of T2 shortening in these patients have broadened. One patient (N=1) at nine months has slight thinning of the allograft fill morphologically and on the segmented thickness maps; this patient's T2 values are stable (Fig 1). All patients at nine months have either stable or improved pain and function scores.

Conclusion: Initial results indicate that MRI morphological and quantitative data can be used to monitor patients who are post-allograft repair. Obviously, more longitudinal data are needed to verify the utility of MRI as a biomarker for allograft repair success or failure. Future work will include fusing thickness map and T2 data, to display optimally quantitative data in clinically useful renderings (Fig. 2).



3D Reconstructions of T2 maps

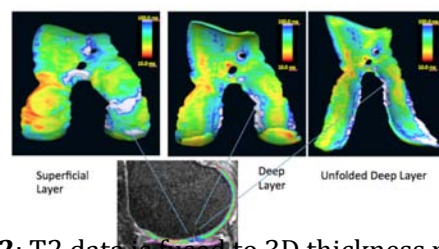


Fig 2: T2 data is fused to 3D thickness map derived from automated segmentation to generate a 3D T2 Map.
Courtesy: Jose Tamez-Pena

Fig 2: Top left image is of a patient with a discrete AC defect of the medial femoral condyle; top right image is the same patient 6 months post allograft repair; the image shows material fill in the prior defect. The bottom image is a T2 Map of the same patient, also 6 months post-op. The T2 Map demonstrates early AC incorporation and organization.