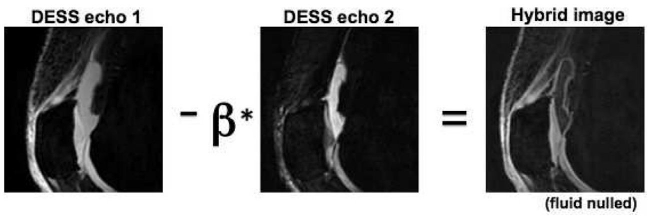
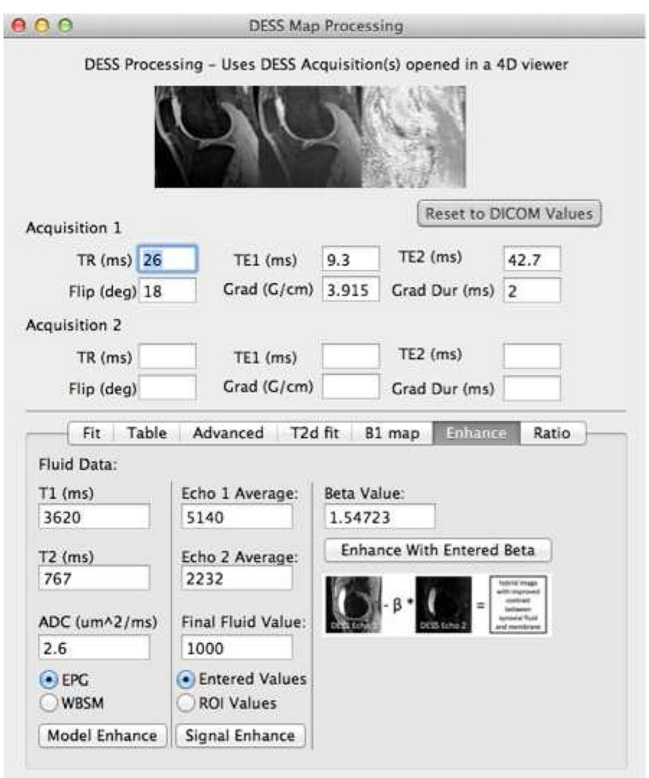
years) on a 3 Tesla MRI with a 16-channel knee coil. The modified DESS sequence includes a diffusion gradient between the two echoes to increase contrast between the thickened synovial membrane and synovial fluid. Scan parameters included: diffusion gradient = 10 cycles/pixel (slice encode direction); repetition time = 26 ms; echo times = 9.3 and 42.7 ms; matrix = 256 x 256; field of view = 16-18 cm, scan time ~ 5 minutes.

To optimize the contrast between the synovial membrane and fluid, a hybrid image was created as a linear combination of the two DESS echoes (Figure 1).

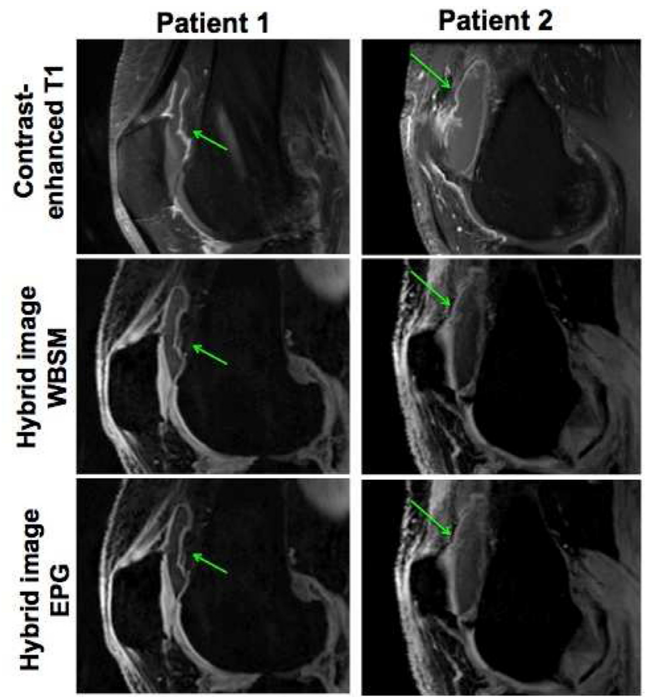


The weighting parameter β was determined to null the fluid signal in the hybrid image, as predicted by the Wu-Buxton signal model (WBSM) or extended phase graphs (EPG) signal model. For this calculation, literature values were assumed for the T1 = 3620 ms, T2 = 767 ms, and apparent diffusion coefficient (ADC) = 2.6 μm^2/ms of synovial fluid. Hybrid images were then created for each model with the OsiriX plug-in, shown in Figure 2.

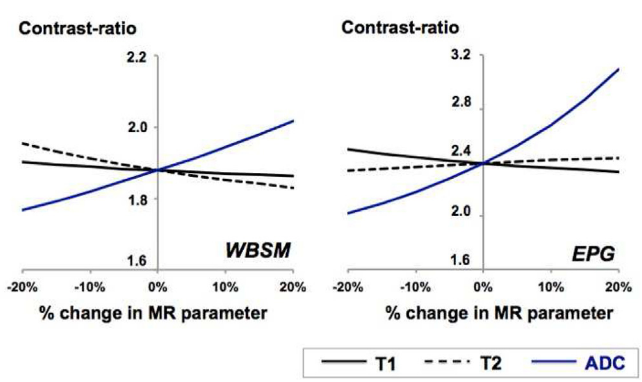


In each subject, the dominant area of synovitis was identified on the contrast-enhanced images and the same region was identified on the DESS images. Contrast ratios (membrane signal/fluid signal) were computed for the contrast-enhanced, EPG hybrid, and WBSM hybrid images. In five patients, we also assessed sensitivity of the contrast ratios to changes in the assumed T1, T2, and ADC.

Results: The optimal coefficients to null the predicted fluid signal were β = 1.38 for the WBSM model and β = 1.55 for the EPG model. In Figure 3, examples of the synovitis (arrows) are identified on the hybrid images and compared to the gold-standard contrast-enhanced images.



Mean contrast ratios across the ten subjects were 2.6 ± 0.8 for the contrast-enhanced images, 2.3 ± 0.9 for the hybrid WBSM images, and 2.5 ± 0.7 for the hybrid EPG images. Sensitivity analyses in five patients revealed the proposed technique to be robust across a range of assumed input parameters, although both WBSM and EPG models were most sensitive to the given ADC value (Figure 4).



Conclusions: The hybrid images created from a modified DESS acquisition and automated processing in OsiriX allowed clear delineation of the synovial membrane from fluid. These findings suggest the new imaging approach may allow reliable detection of synovitis without use of intravenous contrast agent.

376
SONOGRAPHIC ASSESSMENT OF HYALINE CARTILAGE THICKNESS IN THE KNEE AT DIFFERENT VIEWS DISTINCT FROM THE STANDARD VIEW WITH THE KNEE FULLY FLEXED IN PATIENTS WITH OSTEOARTHRITIS

S. Prabhakaran, A. Jayatilleke, M. Abraham, A. Checa. *Drexel Univ. Coll. of Med., Philadelphia, PA, USA*

Purpose: The standard sonographic technique to study the articular cartilage of the knee is performed with the knee fully flexed, a position that can be both painful and difficult to sustain for patients with osteoarthritis of the knees. A previous study performed on the right knee of twenty healthy volunteers showed good correlation between cartilage measurements obtained from the anterior aspect in full flexion to those from the anterior aspect with minimal flexion (140deg) and from the posterior aspect of the knee with it extended (r > 0.85). We

studied the correlation of sonographic measurements of the articular cartilage of the knee joint obtained from the posterolateral and posteromedial aspects to that obtained from the anterior aspect by the traditional method in patients with osteoarthritis of the knee.

Methods: We selected and studied the right knee of thirty one patients diagnosed with knee osteoarthritis, age ranging from 54 to 85 years who presented to our outpatient clinic. We used questionnaires to calculate Western Ontario and McMaster Ostoearthitis (WOMAC) scores and categorize patients into mild, moderate and severe osteoarthritis. and determined the correlation of the measurements to the severity of osteoarthritis. We excluded patients who could not extend the knee past 5 degrees or could not flex the knee beyond 135 degrees, patients with a knee effusion, and patients who had received an intra articular injection within the past month.

We measured the articular cartilage by the standard sonographic method using a GE Logiq e machine equipped with an 8-13 MHz linear transducer. We first measured cartilage thickness with the knee held in full flexion and at 140 degrees, at the medial and lateral aspects. We then measured the articular cartilage from the posterior aspect with the knee extended, over the medial and lateral condyles. We then compared the measurements obtained from the anterior aspect in full flexion to that obtained at 140 degrees and from the posterior aspect. We assumed a linear correlation between standard and posterior aspect measurements, hypothesized that a Pearson correlation coefficient greater than 0.77, corresponding to the lower bound of the 95% confidence interval of 0.6, would show satisfactory correlation between measurements.

Results: We demonstrated very good interobserver and intraobserver correlation between the two observers, with a correlation coefficient of 0.975 or higher at all sites. We compared the anterior and posterior measurements with Pearson correlation in both observers 1 and 2. Among the two observers, the greatest correlation for observer 1 was between the fully flexed anterolateral measurement to the posteromedial measurement with a Pearson correlation coefficient of 0.613, p-value = 0.000. Among measurements for observer 2, we found a Pearson correlation coefficient of 0.611, p-value = 0.000 between the fully flexed lateral and posteromedial measurements. We did not find correlation coefficients among the other measurements. We also noted that measurements from the posterior aspect appeared to be generally greater than those from the anterior aspect.

Conclusions: We did not find significant correlation between anterior and posterior measurements in patients with knee osteoarthritis. The highest correlation was found between anterolateral fully flexed and posteromedial measurements in both observers, with a Pearson correlation coefficient of 0.6. Posterior measurements, especially the posterolateral measurement appeared to be larger than anterior measurements indicating that posterior measurements of the articular cartilage by ultrasound may overestimate the cartilage measurements. We were unable to correlate the articular correlation with severity of osteoarthritis as majority of the patients had severe osteoarthritis (27/34 patients). Hence, although significant correlation between anterior and posterior measurements of the articular cartilage of the knee joint was observed in healthy volunteers, this was not the case in patients with osteoarthritis of the knee joint.

377

JOINT INCONGRUITY AND BIOMARKERS OF BONE METABOLISM AS PREDICTORS OF POST-TRAUMATIC ARTHRITIS IN MICE

T.J. Vovos [†], B.D. Furman [†], J.L. Huebner [†,‡], K.A. Kimmerling [†,§], G.M. Utturkar [†], L.E. DeFrate [†,§], V.B. Kraus [†,‡], F. Guilak [†,§], S.A. Olson [†].
[†] *Duke Univ. Med. Ctr., Durham, NC, USA;* [‡] *Duke Molecular Physiology Institute, Durham, NC, USA;* [§] *Duke Univ., Durham, NC, USA*

Purpose: Post-traumatic arthritis (PTA) develops predictably after articular fracture and may result from joint inflammation, hemarthrosis, or damage to the articular surface and residual joint instability or incongruity after injury. The MRL/MpJ "superhealer" mouse strain is protected from PTA and has reduced serum and synovial fluid levels of IL-1 and TNF-α acutely following fracture. The role of initial injury severity on PTA development following articular fracture is unclear. The objectives of this study were: 1) to measure acute and longitudinal displacement of the articular surface of the bone using in vivo microCT, and 2) to quantify serum bone markers following articular fracture. We hypothesized that quantitative measures of joint incongruity could predict PTA development and that MRL/MpJ mice would have an altered fracture healing response compared to C57BL/6 mice.

Methods: With an IACUC-approved protocol, male C57BL/6 and MRL/MpJ mice (n=12 each) were subjected to a closed articular fracture (fx) (Fig 1) of the lateral tibial plateau. Mice were sacrificed at 8wks post-fx, and arthritic changes were assessed in fractured and contralateral control knees (modified Mankin score). In vivo microCT was performed pre- and post-fx, and at 1, 4, and 8wks post-fx. Displacements of the articular surface of the bone, or Bone Surface Deviations (BSD), were quantified for the lateral and medial tibial plateau (Fig 1), defined as the displacement of the post-fx bone surface either outside (positive) or inside (negative) of the pre-fx bone surface (Fig 2). Blood was collected pre-fx, post-fx on day 4, and every 2wks to 6wks post-fx. Serum

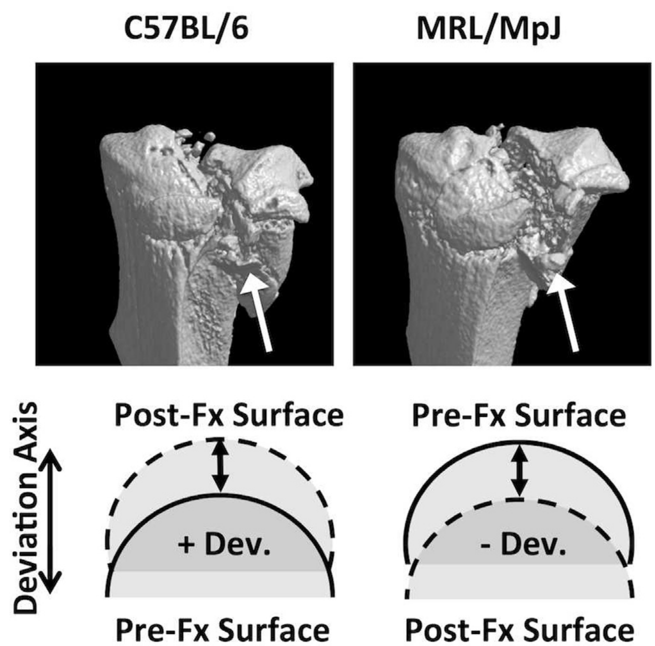


Figure 1(Top) Micro-CT images of representative fractures. (Bottom) Metrics of joint incongruity after intra-articular fracture. Reference surface = prefecture; test surface = post-fracture.

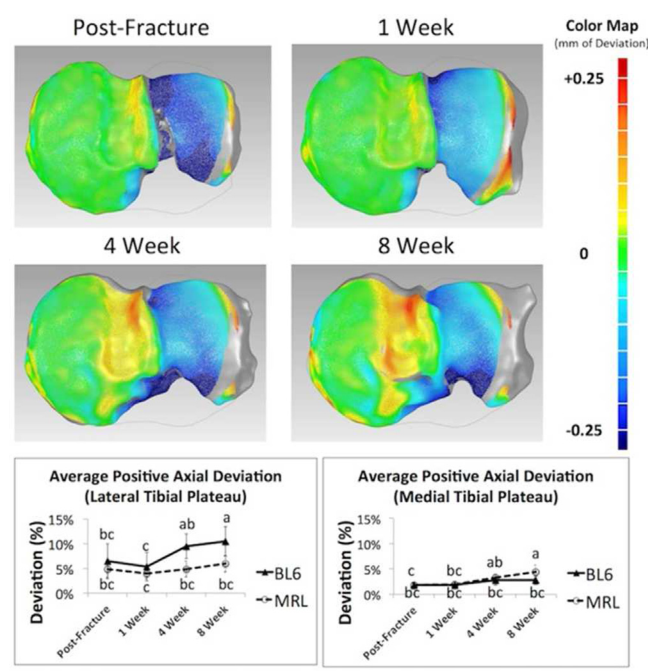


Figure 2(Top) Representative color map of axial deviation with fracture healing. (Bottom) Significant strain- wise differences in fracture healing to 8 weeks post- fracture *(data with different letters are significantly different).*