

## Assessment of Ankle Condition After Fixator Distraction for OA with T1p MRI: 8-10 Year Follow-Up

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### Introduction:

Patients under 50 years of age present a particularly difficult population to treat for post-traumatic osteoarthritis (PTOA). Options such as ankle fusion yield a significant incidence of adjacent joint arthritis and functional limitations with no subsequent options should failure occur. Total ankle arthroplasty is not as predictable as for hip and knee replacement, risking early revision of the implant and the associated complications at repeat surgery and suboptimal joint reconstruction results. A desirable alternative is natural joint preservation by restoring the joint space with joint distraction arthroplasty using external fixation to preserve the native joints through the most productive years.<sup>1</sup> MRI may play a key role in noninvasively assessing the joint longitudinally to determine bone and soft tissue status and when further revision may be necessary. The purpose of this study was to noninvasively evaluate the joint condition of subjects who underwent joint-preserving distraction arthroplasty in an 8-10 year follow-up study.

### Methods:

Among 29 subjects in an ankle distraction cohort (surgery between December 2002 and October 2006 plus two-year follow-up), 16 still had their native ankle joint at an average follow-up time of 8.8 years. Six subjects (ages at time of imaging 39 to 62 years) with no contraindications for MRI were recruited with IRB-approved consent for this study. At this 8-10 year follow-up visit, radiographs, CT scans, morphological MRI and quantitative T1p MRI were acquired for non-invasive evaluation of the intact joint. MRI evaluation was performed on a Siemens Tim Trio 3T scanner and consisted of T1-weighted (0.3mm x 0.3mm x 2mm slice resolution) and fat-suppressed T2-weighted (0.4mm x 0.6mm x 2mm slice resolution) FSE along with a 0.6mm isotropic 3D DESS acquisition with water excitation. Quantitative assessment of cartilage used a 3D GRE-based T1p-prepared pulse sequence<sup>2</sup> with 0.6mm in-plane resolution, 4mm slice thickness and spin-lock durations of 10/20/40/60 ms. Quantitative T1p maps were generated with nonlinear curve fitting at each pixel location. Profiles of T1p relaxation times in the joint were manually derived and computed over the discernable joint cartilage.

### Results:

Morphological imaging results showed cartilage and subchondral bone inhomogeneities returned to differing degrees in native ankles at 10-year follow-up, ranging from well-defined articular cartilage to focal eburnation and early stages of subchondral erosion and auto-fusion. Table 1 summarizes T1p relaxation times measured in the ankle joint of each of the six subjects, reflecting these disparate outcomes. Figure 1 depicts MRI of a subject demonstrating significant bone and cartilage changes as seen with T1p at 10 years, while Figure 2 shows a subject with cyst formation but remaining healthy cartilage on morphologic and T1p imaging.

### Discussion:

Ankle distraction surgery offers an effective alternative treatment for end stage OA without complicating later conversion surgeries or limiting patients' physical improvement. This study demonstrates that quantitative T1p is a feasible means to help gauge cartilage and joint condition in this population and may provide valuable insights for longitudinal assessment of joint health for long-term treatment planning. Future studies at additional time points would give insight into the processes leading to joint decline and eventual need for further intervention.

### References:

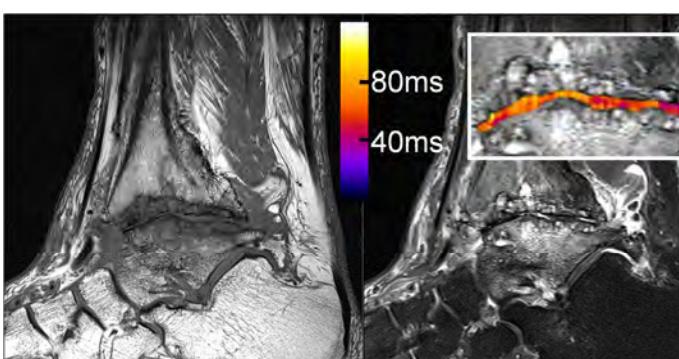
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### Acknowledgments:

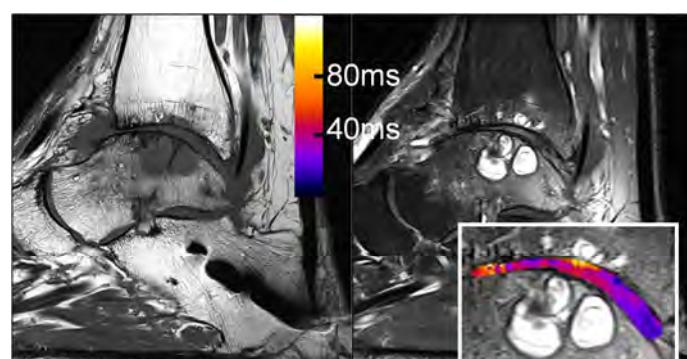
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**Table 1:** T1p relaxation times measured over manually drawn profile lines for all six subjects.

Subject #	T1p (ms) mean±S.D.
1	49.5 ± 10.9
2	41.4 ± 10.6
3	49.2 ± 18.1
4	55.8 ± 9.6
5	28.7 ± 14.0
6	45.0 ± 13.4



**Figure 1:** Subject #4 (62 y.o. male) at 10 years with T1 (left) and fat-suppressed T2 (right) imaging. T1p (inset and color scale) shows thin cartilage layer with considerably elevated relaxation suggestive of poor fibrocartilage condition.



**Figure 2:** Subject #6 (39 y.o. male) at 8 years. Acquired T1 (left) and fat-suppressed T2 (right) images show bone metabolic activity throughout the talus and tibial remodeling. T1p of joint cartilage (inset) shows relatively normal values with focal areas of elevation.