

## **Mutliparametric Imaging of Bone Architecture: A Pilot Study**

Mike Hazenfield, Kenneth L. Weiss, MD, Lisa Lemen, PhD, Babul Borah, PhD, Joel Sorger, MD, Bernie Dardzinski, PhD, Lisa Rehner, Paul Toney, Marty Molony

Department of Radiology, University of Cincinnati.

**Background:** Conventional measurements, such as bone mineral density (BMD) analysis, are imperfect predictors of osteoporotic fractures. 3-D bone architecture is a major determinant of bone strength. New technologies such as magnetic resonance microimaging ( $\mu$ MRI) permit in-vivo assessment of 3-D bone architecture at peripheral sites. Thus MRI derived parameters hold promise for improved risk prediction, fracture evaluation, and monitoring the response to therapeutic treatments.

**Purpose:** To establish feasibility of whole body and ultra-high resolution specimen CT and MR imaging, in order to investigate the correlation between vertebral fracture status and multi-site trabecular bone micro-architecture.

**Methods:** One deceased female was imaged with dual energy CT within 2 days of expiration. Subsequently, the cadaver was imaged with multi-parametric 1.5T MRI with additional ultra-high resolution of the spine and distal radius. The cadaver was then sectioned and ultra high resolution specimen imaging obtained with both 7T  $\mu$ MRI and  $\mu$ -CT.

**Results:** From the CT and MR whole body images we are able to determine that there were no osteoporotic fractures present. At 1.5T we were able to achieve an in-plane resolution of 195x195 microns. 7T  $\mu$ MR and  $\mu$ CT depicted specimen trabecular bone micro-architecture with spatial resolution reaching 74x74 microns and 50x50 microns, respectively.

**Conclusion:** We demonstrated the feasibility of correlative whole body and ultra high resolution bone specimen CT and MR imaging. At 1.5T, we were able to assess fracture status and trabecular architecture. At 7T we were able to attain higher resolution images approaching the “gold standard”,  $\mu$ CT. Currently, a five cadaver study is underway, using the protocols developed from this project to look at a number of parameters involving trabecular 3-D bone micro-architecture. If the different sites show a correlation in bone micro-architecture, then distal sites which are more easily imaged in-vivo, can be used as a biomarker to predict overall trabecular bone micro-architecture, and thus fracture risks in patients.