Validation of *in vivo* cancellous bone assessment using high resolution imaging and histologic examination

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Introduction

• Cancellous bone has a higher rate of bone remodeling
  – Cancellous bone mineral density (BMD) would be a better metric of acute skeletal change than cortical BMD

• Cancellous bone is less dense than cortical bone

• Small changes in marrow composition cause significant changes in cancellous BMD
Rational

• Cancer survivors experience a greater risk of fracture compared to the general population [Baxter, 2005]

• However, the effect of cancer treatment, especially the relationship between marrow fat (MF) and BMD, are not well known

• Changes in marrow composition can affect estimation of BMD and may confound true changes in cancellous BMD if the two types of marrow are not distinguished
Methods: Imaging & Histology

- 5 human cadavers were imaged with DECT and MRI within 24 hrs of death
- 21 vertebral bodies excised, imaged with µCT, and processed for H&E histology
Merge Histological data with Imaging
Results: Bone Marrow

- The AV/TV of 21 lumbar vertebrae ranged from 0.18 to 0.75 with a mean (SD) of 0.36 (0.18)

- There were moderate correlations between the AV/TV and the results of DECT and wfMRI ($r = 0.80$ and 0.77, respectively)
Results: Bone mineral

A. Mineral Influence on clinical BMD assessment

B. Marrow influence on clinical BMD assessment
Cadaver study - Discussion

• The increase of marrow fat (or adipogenesis) provides a biological process by which bone loss occurs;
  – If mesenchymal stem cells commit to marrow fat then osteoblastogenesis decreases

• Since CT scans are regularly given as part of the diagnosis, treatment and follow-up process, DECT could become very useful to the study of cancer survivors’ bone health

• Correcting for marrow composition can provide a more accurate estimate of the osseous density within a bone
Conclusion

• Marrow fat fraction intensities were validated with histologic quantification of adipocyte prevalence

• We established the feasibility of DECT to measure the impact of cancer treatment on MF and BMD

• MF and mcBMD should be considered independently when monitoring the adverse effects of cancer therapy

• The ability to correct for marrow composition makes DECT imaging of the entire human body able to accurately assess cancellous BMD heterogeneity
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References