

## Longitudinal Changes in Trabecular Bone Architecture Detected by Micro-MRI Based Virtual Bone Biopsy

F. W. Wehrli<sup>1</sup>, A.M. Popescu<sup>1</sup>, B. Vasilic<sup>1</sup>, B. K. Gomberg<sup>1</sup>, P. K. Saha<sup>1</sup>, B. Zemel<sup>2</sup>, B. Bunker<sup>1</sup>, A. C. Wright<sup>1</sup>, P.J. Snyder<sup>3</sup>, H. Peachey<sup>3</sup>

<sup>1</sup>Laboratory for Structural NMR Imaging, Radiology, University of Pennsylvania

<sup>2</sup>Medicine, University of Pennsylvania <sup>3</sup>Children's Hospital of Philadelphia, Philadelphia, PA

Estrogen depletion following menopause is accompanied by bone loss and architectural deterioration of trabecular bone (TB). Conversely, hormone replacement therapy (HRT) protects against such bone loss. Here we report preliminary data on the first *in vivo* detection of such skeletal changes in an ongoing study involving early postmenopausal women, half of whom are getting HRT and half who do not (controls), using a protocol whereby BV/TV as well as parameters expressing TB topology are quantified at the distal radius and tibia by means of a MRI-based virtual bone biopsy. DXA BMD at the spine and hip were measured as well. From the MR images acquired at 137x137x410  $\mu\text{m}^3$  voxel size, bone volume fraction maps were generated which were subvoxel processed to yield a final voxel size of 62x62x103  $\mu\text{m}$ . These images were binarized, skeletonized and subjected to 3D topological analysis. Skeletonization converts rods to curves and plates to surfaces. Parameters extracted comprised the volume density of curves (CURV) and surface voxels (SURF) as well as

composite parameters surface/curve ratio (S/C) and "erosion index" (EI). Apparent TB thickness (Tb.Th) was derived as well. Subjects were imaged at baseline and 11-13 months later. So far, 11 control and 5 HRT subjects afforded images of adequate quality. Relative differences from baseline were computed for each subject and the mean differences compared between groups. Measurements at the wrist indicated a relative decrease in CURV ( $p=0.01$ ) and decrease in EI ( $p=0.05$ ) in HRT relative to controls. Tb.Th was suggestive of being greater in the HRT group ( $p=0.08$ ). Other structural parameters were not different. These preliminary findings are consistent with the known protective effects of HRT ensuring maintenance of a more plate-like TB architecture. The observations in the radius were not paralleled by similar findings in the tibia. BMD, though not statistically significant, indicated the same protective effect of HRT. **This work suggests that MRI-based *in vivo* micromorphometry of trabecular bone may be useful for monitoring osteoporosis treatment.**