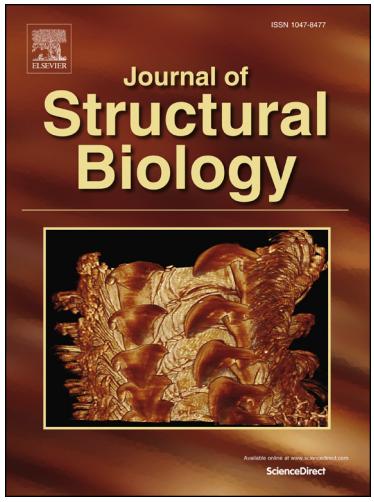

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PII: S1047-8477(18)30217-X
DOI: https://doi.org/10.1016/j.jsb.2018.08.006
Reference: YJSBI 7234

To appear in: *Journal of Structural Biology*

Received Date: 9 May 2018
Revised Date: 30 July 2018
Accepted Date: 6 August 2018

Please cite this article as: Gauthier, R., Langer, M., Follet, H., Olivier, C., Gouttenoire, P-J., Helfen, L., Rongiéras, F., Mitton, D., Peyrin, F., 3D micro structural analysis of human cortical bone in paired femoral diaphysis, femoral neck and radial diaphysis, *Journal of Structural Biology* (2018), doi: https://doi.org/10.1016/j.jsb.2018.08.006

3D micro structural analysis of human cortical bone in paired femoral diaphysis, femoral neck and radial diaphysis

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Abstract: Human bone is known to adapt to its mechanical environment in a living body. Both its architecture and microstructure may differ between weight-bearing and non-weight-bearing bones. The aim of the current study was to analyze in three dimensions, the morphology of the multi-scale porosities on human cortical bone at different locations. Eight paired femoral diaphyses, femoral necks, and radial diaphyses were imaged using Synchrotron Radiation µCT with a 0.7 µm isotropic voxel size. The spatial resolution facilitates the investigation of the multiscale porosities of cortical bone, from the osteonal canals system down to the osteocyte lacunar system. Our results showed significant differences in the microstructural properties, regarding both osteonal canals and osteocytes lacunae, between the different anatomical locations. The radius presents significantly lower osteonal canal volume fraction and smaller osteonal canals than the femoral diaphysis or neck. Osteocytes lacunae observed in the radius are significantly different in shape than in the femur, and lacunar density is higher in the femoral neck. These results show that the radius, a non-weight-bearing bone, is significantly different in terms of its microstructure from a weight-bearing bone such as the femur. This implies that the cortical bone properties evaluated on the femoral diaphysis, the main location studied within the literature, cannot be generalized to other anatomical locations.