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High-Speed Photography during Compression Testing Human Trabecular Bone PHILIPP THURNER, University of California Santa Barbara, JOHN LANGAN, JEFF SCOTT, MARIA ZHAO, Computational Sensors Inc., BLAKE ERICKSON, ZACHARY SCHRIOCK, GEORG FANTNER, PAUL HANSMA, University of California Santa Barbara — The mechanical properties of healthy and diseased bone are extensively studied. Most of this research is motivated by the immense costs in health care due to osteoporosis. To address the problem of assessing bone microarchitecture and concomitant microcracking behavior, we recently combined mechanical compression testing of trabecular bone with high-speed photography. In an exemplary study, we investigated healthy, osteoarthritic, and osteoporotic human vertebral trabecular bone. Bone samples were loaded along their principal load-bearing axis at high strain rates simulating boundary conditions as experienced in individuals during falls. Even at small global strains huge local deformations could be seen in the recorded high-speed photography frames. Moreover, strained trabeculae were seen to whiten with increasing strain, which could be associated with areas of high deformation using a motion energy filter. Presumably the effect seen is due to microcrack formation in these areas, similar to stress whitening in synthetic polymers. This hypothesis is currently tested applying en bloc microcrack staining and histology.

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