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Microstructural Analysis of Porcine Skull Bone Subjected to Impact Loading ALLISON RANSLOW, Penn State Computational Biomechanics Group, KIMBERLY THOMPSON, SIKHANDA SATAPATHY, U.S. Army Research Lab, RAUL RADOVITSKY, MIT Department of Aeronautics and Astronautics, REUBEN KRAFT, Penn State Computational Biomechanics Group — Fracture and damage of the skull remains one of the largest and most detrimental injuries in combat. Although skull fracture is a common injury, its mechanics are still unknown due to bone's complex structure, which spans the molecular level and macroscopic dimensions. Using finite element analysis of the microscopic architecture allows for a controlled evaluation of stress wave interactions, micro-crack growth, propagation and coalescence. To gain a better understanding of the microstructure and the mechanics of bone fracture under impact loading, thirty finite element models of small sections of a porcine skull were created. MicroCT scans of the skull were used to generate three-dimensional surface geometry meshes of various locations throughout the skull, from which volume meshes were developed. All samples were analyzed using finite element simulations, subjected to quasi-static compression. The output models allowed for a detailed understanding of the failure mechanics of the skull. Upon completion of the simulations, we found that although each sample was initially provided with the same material parameters, under stress, the structures behave very differently due to varying levels of porosity, causing the material response to change drastically with load.

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