Fracture Networks in the Human Calcaneus Due to Impact Loading

Rebecca A. Fielding*, Reuben H. Kraft†

*Computational Biomechanics Group, Department of Mechanical and Nuclear Engineering, The Pennsylvania State University
University Park, PA, 16802 USA
rafielding@gmail.com
http://www.mne.psu.edu/compbio/

† Computational Biomechanics Group, Department of Mechanical and Nuclear Engineering, The Pennsylvania State University
University Park, PA, 16802 USA
rhk12@engr.psu.edu
http://www.mne.psu.edu/compbio/

ABSTRACT

An underbody blast (UBB) is the detonation of a mine or improvised explosive device (IED) beneath a vehicle [1]. In recent military conflicts, the incidence of UBBs has led to severe injuries, specifically in the lower extremities [2]. The development of a biofidelic lower extremity model may lead to a better understanding of injury patterns and mechanisms. A computational finite element model of lower extremity was developed based on geometry made available in an anatomical repository. This geometry was compared to anthropometric survey data [3] to confirm that it closely matched the anthropometry of a 50th percentile male. A finite element model was then created using the geometry. The portion of the leg model below the knee was used in initial simulated comparisons to experimental data [4][5]. Impact was applied via a loading plate with vertical velocity of 5 m/s, 10 m/s, and 12 m/s. Following simulations, vertical stress was integrated across a section of the tibia. Resultant axial force was compared to experimental data. Results of these simulations fall within the range of available experimental data and represent advancement in lower extremity modeling capabilities. Fracture has also been modeled at 5 m/s, 10 m/s and 12 m/s and may be representative of injuries typical of underbody blast scenarios [6]. In an effort to characterize the simulated injury patterns, the assignment of Abbreviated Injury Scale [7] scores was attempted. The fracture patterns observed may offer insight into the necessary measures to protect against injury.

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