

The Use of *Macropus giganteus* as a Biomechanical Model of the Pediatric Thorax

Sabrina H. Lau¹, Richard W. Kent¹

¹University of Virginia

ABSTRACT

*A model of the pediatric thorax is required to study the influence of different restraint designs on a child's head trajectory during frontal impacts. Pediatric PMHS testing is difficult and historically there is little biomechanical data available so an animal model is a necessary tool for expanding the available knowledge of pediatric thoracic structural biomechanics. Last year at this conference we discussed the eastern grey kangaroo (*Macropus giganteus*) as a model of the pediatric thorax due to its anatomical and developmental similarities. This paper presents a comprehensive anatomical characterization of twelve kangaroo carcasses with whole-body mass similar to that of a human 6 year old (15-25kg) and describes a set of biomechanical experiments that both assesses the validity of the model and characterizes the thoracic response with loading conditions currently absent from the pediatric literature.*

The carcasses were obtained from the University of Adelaide, Australia. Anthropometrics of the kangaroo were compared with 6-year-old human data obtained from the Anthrokids database. Analysis of computed tomography (CT) scans taken at sub-mm slice resolution were used to compare human and macropus bone structures and organ size, morphometry, and position. The battery of biomechanical characterization experiments includes mid sternal hub impacts (Ouyang 2006) and CPR puck loading (Maltese et al. 2008), which can be compared to human pediatric data to assess the biofidelity of the macropus model, non-inertial table top thoracic belt loading (Kent 2004), which expand the blunt-hub response by defining thoracic stiffness under diagonal belt loading, and full scale sled tests with high-speed optical motion capture of an array of retro-reflective markers mounted on the thoracic spine and rib cage, which will define the thoracic response in an accelerated (i.e., impact) environment. Finally, a set of sub-structure and material characterization experiments is described, including rib bending tests, indentation tests, and micro-CT analysis.