An Assessment of *Macropus Giganteus* as a Biomechanical Model of the Pediatric Thorax

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ABSTRACT

*The interaction between the seat belt and the pediatric thorax is important since this interaction dictates the kinematic trajectory of the head. To better understand this interaction, animal surrogates that are anatomically similar to the human child have been considered for dynamic non-impact tests with various belt geometries. Animal primates are anatomically similar to humans in many respects, but they are high on the phylogenetic order, are difficult and not readily available to test, and their stature, mass, and age-size equivalence to humans would require both size and modulus scaling. Other animal surrogates, including porcine subjects, have been studied for thoracic and abdominal response, but their anatomical differences do not provide the geometric similitude required to study the complex loading of a seatbelt. This paper presents an anatomically and developmentally based investigation of the eastern grey kangaroo (*macropus giganteus*) and its feasibility as a biomechanical model of the pediatric human's chest.*

*The average adult stature and mass of a human is 175cm and 80kg, compared to 180cm and 90 kg for the kangaroo. At a height of 116cm (height of 6-year-old human) a kangaroo is 25% of adult sexual maturity, compared to 39% for the human, indicating that organ development and hence modulus may be similar. In contrast, no primate has a size-development relationship so close to the human. At this height, the kangaroo's chest circumference and chest depth are within 8% and 16% of the 6-year-old human. The masses of the liver, heart, lungs, and kidneys of the kangaroo are also reasonably representative of the human's at this developmental level. Several anatomical differences between human and kangaroo thoraces were noted, however, including a difference in clavicle length and morphology, the position of scapula, and the spinal column curvature. These differences are qualitatively less than those associated with other animal models, even primates. Furthermore, the age-size-developmental equivalence between humans and kangaroos avoids some of the difficulties associated with scaling. In the absence of pediatric human cadavers, it is concluded that *macropus *is the most appropriate available biomechanical model for studying the interaction between vehicle restraint systems and the 6-year-old human's chest.*