Improvement of Child Safety Restraints in Automobiles through New Pediatric Thoracic Spine Testing Protocol

F. John Polesak III[1], Francisco J. Lopez-Valdes[1]

University of Virginia - Center for Applied Biomechanics[1]

ABSTRACT

Currently, child safety restraint systems in automobiles are inadequately designed due to a lack of accurate test dummies. The modern test dummies used to develop safety restraints are ill-designed, specifically in the thoracic region, and do not sufficiently depict the reaction of a pediatric spine during an automobile collision. This study will develop new testing protocol for pediatric thoracic spines that will facilitate more accurate modeling of the spine. Due to ethical barriers of using spines from the younger population, the testing protocol will be developed and perfected using kangaroo spines, a valid surrogate for humans. Eventually, the protocol will be used with pediatric spines in order to gather data that will result in more accurate models of the pediatric spine, and subsequently, more accurate test dummies. This will then serve to develop more effective child safety restraint systems. Boundary conditions for the testing protocol have been developed after a literature search and review. It has been determined that the functional spinal unit will consist of four thoracic vertebrae, T5-T9. The modes of loading to be tested will be quasi-static flexion/extension under pure moment, and simple tension at a yet to be determined constant velocity. Currently, a custom testing fixture is being developed that will allow for pure moment bending and tensile tests. Achieving pure moment bending will require a strategic arrangement of weights, pulleys, and slides that will be able to translate two-dimensionally to prevent any reaction forces on the functional spinal unit. This test fixture will include load cells that will gather force and displacement data that will be used for better modeling the spine. These test data, progress on modeling the pediatric thoracic spine, an explanation of the refined testing protocol, and the design for our pure moment testing apparatus will be presented.