

A Biomechanical Assessment of the Structural Response to Dynamic Belt Loading of the Hybrid III 6yo Abdominal Insert

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ABSTRACT

The high rate of abdominal injuries, particularly in children, related to loading of the seatbelt in automotive impacts demands that crash dummies exhibit better biofidelity. Motivated by this field data, Rouhana et al, in 2001, constructed a silicone filled abdominal insert for the 50th percentile Hybrid III dummy to improve its biofidelity under a variety of loading conditions and sample pertinent data for the assessment of injury risk. In 2003 the task of developing a pediatric silicone filled insert for the Hybrid III 6 year old dummy was undertaken and is nearing completion. To assess the biomechanical response of this pediatric abdominal insert to frontal belt loading a sample insert was provided by Ford to the Center for Applied Biomechanics. These tests aimed to assess the biofidelity of the pediatric abdominal insert by comparing its loading response to that of the porcine pediatric abdomen model developed by Kent et al in 2006. In the same test fixture and under the same loading conditions, in-situ in the Hybrid III dummy, the abdominal insert was belt-loaded across the abdomen at five different binned velocities, three different belt angles, and in ramp-hold and ramp-release configurations. High speed video of each test as well as reaction force, belt force, displacement at the belt midline, acceleration at the belt midline and on the tabletop, as well as a dummy outputted chest deflection and lumbar forces were recorded. The data were analyzed and compared to Kent's porcine model in order to assess the biomechanical response of the abdominal insert. The porcine model generated an average dorsal reaction force of 5632 N at an average penetration depth of 44%, while the Hybrid III six year old dummy without an insert generated 2721 N average reaction force at an average penetration depth of 40%. Data from the ongoing study has revealed an improved response to abdominal loading in the Hybrid III dummy with the insert when compared to the response of the original Hybrid III abdominal loading response without the insert.