Computational Analysis of the Interaction of Q6 ATD and Roof Rail Mounted Side Curtain Airbag in the Second Row Rear Outboard Seating Positions

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Abstract

Side airbags (SAB) have become a standard feature in today's cars; however, little quantitative data exists to evaluate the overall effectiveness of SAB and the interaction with pediatric and adolescent occupants in the second row seating position. Conflicting data has been published with the respect to the effectiveness of different types of SAB in side impact crashes. Recent field data taken in Victoria, Australia would suggest that a combination of side curtain airbags and thoracic seat back mounted airbags greatly reduces odds of death and injury to adult occupants while thoracic seat back airbags alone show no statistical significant reduction in injury (D'Elia et al., 2013). However, full scale impact tests using the SIDIIs dummy indicates thoracic side airbags alone greatly reduces the risk of AIS 3+ injuries in all side impact crashes (Bohman et al., 2009). The objective of this study is to systematically look into the effectiveness and interaction of SAB in side impact crashes using computational models validated from simulated side impacts on an acceleration sled.

A second row, rear outboard seat of a generic 4-door sedan was isolated and constrained using vehicle finite element (FE) models downloaded from the National Crash Analysis Center (NCAC) vehicle model archives. A SIDIIs ATD FE model (LSTC, CA) was positioned (joint angles from the physical test) in this seating position, restrained by a 3-point lap-shoulder belt and validated against a physical sled test. A standard FMVSS 214 NCAP side impact pulse was applied uniquely using a split-four quadrant door setup on an Advanced Side Impact Simulator (ASIS) sled setup. The FE ATD's overall kinematics, HIC and chest displacement values were well within the range of the physical sled tests.

Using the validated setup, a Q6 FE ATD model (Humanetics, MI) was positioned (via a gravity drop) on a booster Child Restraint System (CRS) (FE model developed from laser scans of physical seats) and constrained with a 3-point lap shoulder belt. A roof rail mounted side curtain FE airbag was setup in a deployed-uninflated state adjacent to the interior door structure. A Design of Computer Optimization (DOCE) study was carried out with input design variables being seating position, torso angle, side impact pulse, CRS and the availability of a SAB. Overall dummy kinematics, head and neck loads along with thoracic injury measures were collected and compared with each of these different scenarios.

From these simulations it was seen that SABs play a significant role in defining head/upper torso kinematics and contact points of second row seated outboard occupants. Occupant seating position (torso angle and proximity to the SAB) also plays a role in defining IARV values. The

current study offers a better understanding to the interaction of pediatric occupants with a deploying SAB and provides valuable insight into developing pediatric specific mitigation systems.