

Injury Mechanics in Belt Restrained Children in Side Impact Crashes

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ABSTRACT

To facilitate successful development of side impact safety systems for rear seated passengers, vehicle safety system manufacturers must have an understanding of the factors that contribute to injury causation and mitigation. In particular, the needs of children should be considered, as they are frequently rear-row passengers. While specific injury patterns for side impact crashes are known, the injury mechanisms are not fully understood. Further data is needed on what components of the vehicle are involved in generating the described injuries, and how the body interacts with these components during the crash. The objective of this study was to define injury mechanisms for belt restrained children in side impact crashes, subsequently grouping them into General Injury Mechanism Scenarios (GIMS) that can be used to promote effective restraint development. To accomplish this, crash investigation data was gathered from the Partners for Child Passenger Safety (PCPS) and Crash Injury Research and Engineering Network (CIREN) databases. Inclusion criteria were as follows: 4-15 year olds, seated in the rear row, seatbelt restrained only, and with injuries scoring 2 or higher on the Abbreviated Injury Scale (AIS). Fifty-five cases met these criteria and were reviewed by a team of engineers and physicians. Factors such as crash conditions, occupant characteristics, restraint, injury, and interior contacts were examined. Injuries were analyzed according to the CIREN BioTab method, which allows one or more injury causation scenario for each injury and also associates specific physical components within the vehicle to the injury. For each case, the contact points associated with each injury were mapped on an interior mock-up. Qualitative analyses of the cases have revealed several patterns. Head, chest, and lower extremity injuries were most prevalent in near-sided occupants, and abdominal injuries occurred most often in far-sided occupants due to occupant contact with the belt. Center seated occupants sustained a variety of injuries including both head and abdominal injuries, influenced by the amount of lateral motion they undergo during the crash.