C36 Partial and Complete Ejection of Belt Restrained Occupants During Motor Vehicle Accidents

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The information being presented helps humanity by demonstrating that, with current vehicular designs, restrained individuals can be partially and even completely ejected from a vehicle during a rollover collision and other crash modes.

Understanding that ejection occurs to restrained occupants will encourage accident investigators conduct more thorough and accurate investigations. The presentation will impact the forensic science community by providing information that could also be used to help design safer vehicles and restraint systems to help eliminate this problem.

This presentation will help attendees understand that partial and complete ejection of belt restrained vehicular occupants can and do occur during motor vehicle collisions. Such ejections greatly increase the risk of injuries and death. Multiple real world case studies will be presented to demonstrate how and why these ejections occur.

Oftentimes, when police are investigating a motor vehicle accident where an occupant is ejected from the vehicle, they will indicate on the police report that the individual was not wearing their seat belt. That is, an assumption is made that ejection equates to non-belt usage. However, the evidence should be carefully examined before a determination regarding restraint usage is made.

Various conditions can lead to situations where individuals are wearing their seat belts, yet eject during a collision. The restraint system for an occupant goes beyond the seat belt itself. Generally, the restraint system in a modern vehicle includes seat belts (vehicle or seat mounted), airbags, the seats themselves, knee bolsters, doors, glazing, and other vehicle structures. Extensive damage or failure of any one of these structures may contribute to conditions that lead to ejection of a belt restrained occupant during an accident.

In rollovers, case studies will be presented that show failures of one or more of the components of the restraint systems. For pillar-mounted seat belts, pillar deformation during a rollover can induce slack into the belt system that can result in ejection. Failures in the seat belt retractor itself can also lead to additional slack and partial or complete ejection. Stronger roofs (pillars) and side glazing could help to mitigate these occurrences.

Ejection of belted occupants can also occur in other crash modes. In **rear-end collisions**, the seat back can collapse rearward from the inertial load of the occupant. Once this occurs, for a pillar-mounted belt system, the restraint system is compromised and the belt can no longer contain the occupant. The occupant can enter the survival space for the individual seated behind them, strike their body on a vehicular structure behind them, or be ejected through an open portal behind them. Seats with integrated belts help eliminate this problem due to their increased strength and the fact that the belt stays with the occupant. For pillar-mounted belts, stronger seats are neces- sary to mitigate this condition. In **side collisions**, seat belt buckles may release inertially or from false latching. Ejections also occur if the door opens during a collision. In **frontal collisions**, ejection can occur for a belt restrained occupant if the seat belt fails. Defects or damage to belt webbing fabric can lead to complete tears in the belt webbing.

In conclusion, current restraint system designs have failure modes that can result in partial and complete ejections of belt restrained occupants during real world collisions. There appears to be both a public and law enforce- ment perception that a restrained motor vehicle occupant will always be contained within the vehicle in a crash. The information being presented helps humanity by demonstrating that, with current vehicular designs, restrained individuals can be partially and even completely ejected from a vehicle during a rollover collision and other crash modes. Understanding that this occurs will help accident investigators conduct more thorough and accurate investigations. This information could also be used to help design safer vehicles and restraint systems to help eliminate this problem.

Partial Ejection, Complete Ejection, Belt Restrained Occupants

 ** Presenting Author*