C3 Front Occupant Injuries From Interior Intrusion by Rear Occupants

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The goal of this presentation is to present case studies that show some consequences of unrestrained adult-sized rear occupants that can cause intrusion into the frontal occupant compartment and cause fatal loading to the front seat occupants.

This presentation will impact the forensic science community by presenting case studies that demonstrate that not only heavy cargo, but also adult-sized unrestrained rear seat occupants, can have adverse consequences for the chance of survival of front seat occupants regardless of their seat belt use.

State law in Arizona requires front seat occupants to be seat belted. Children under 16 are required to use seat belts regardless of where they are seated, and children under five years must be seated in a child safety seat/booster. There are not any seat belt regulations on rear seat occupants who are 16 years or older.

A mid-sized Sport Utility Vehicle (SUV) traveled left of center and was involved in a head-on crash with a full-sized pickup as shown in Figure 1. From the crush, scene evidence, and the pickup Crash Data Recorder (CDR), the SUV's Delta V (change in velocity) was 36 to 38 mph and the pickup's Delta V was about 29 mph. Since the vehicles were both stopped at the point of impact, their speeds at impact approximately correspond with their Delta Vs.

Figure 1. The vehicles at rest.

The SUV's rear seat occupants were high school-aged, but their weights were in the 200 to 250-pound range. As seen in Figure 2, upon impact, the unrestrained rear seat occupants moved forward into the front seat backs. The seat backs were grossly deformed forward, intruding into the front occupant compartment to the degree that fatal injuries would be expected for the front seat occupants, regardless of seat belt use or airbag deployment.

In effect, the rear seat occupants used the seat backs and front seat occupants to dissipate their relative motion within the SUV. Therefore, had the front seat occupants been seat belted, the restraint loads for the front seat occupants would have more than doubled due to the additional unsecured mass of the rear seat occupants.

Interestingly, children were seated in the pickup's rear seat. As shown in Figure 3, even the mass of an eight-year-old is enough to cause sufficient seat back deformation to add to the restraint loading on a seat-belted front seat occupant.

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Figure 2. Occupant compartment intrusion in SUV.

Figure 3. Seat back deformation in pickup.

Clearly, it would not only be advantageous to secure cargo, but it would also seem highly beneficial from a public safety or societal cost point of view to advocate that rear seat adult-sized occupants be secured. This not only for their own safety benefit, but it is also in consideration of the safety of the front seat occupants. Indeed, this case study exemplifies how the front seat passengers might sustain serious and/or fatal injuries, caused unnecessarily, by the rear occupant interior intrusion into the frontal compartment.

Rear Occupants, Intrusion, Seat Back

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