C38 Injuries Caused by Air Bag-Induced Lower Extremity Flail

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The goal of this presentation is to present case studies that show some consequences of front passenger interaction between the occupant's lower extremities and deploying air bags.

This presentation will impact the forensic science community by presenting case studies that demonstrate a type of airbag injury that has not been previously recognized in the literature.

It is generally accepted that driver- and passenger-side airbags provide a net safety benefit in frontal automobile crashes. However, soon after airbags became more common in the fleet, accident investigators began to report airbag-related injuries, most of which involved minor injury, but also included some serious and fatal injuries.

There are two main categories of injury mechanisms related to airbag deployments: those that result from direct interaction with the airbag during punch out, which are characterized by localized high-force damage patterns; and, those that are caused by interaction with the airbag during the membrane phase, which ordinarily can be characterized as some type of flail. Often such flail injuries are upper extremity orthopedic injuries that result from the forearms being propelled by the deploying airbag into structures, such as the vehicle's roof, door, or dash. When the upper extremity is flung into the occupant's head and face, facial fractures, ocular injuries, and closed head injuries can also be part of the flail injury pattern.

It has been reported that lower extremities are not in the path of the deploying airbag, and it is therefore not surprising that airbag-related leg injuries have not been reported in the medical literature or identified in field accident investigations.[1] Certainly there are circumstances where the lower extremity can be injured interacting with a deploying airbag. Indeed, Huelke reported that a woman seated with her foot on the dash over the module sustained comminuted foot fractures during a frontal crash with deployment, which would be a punch out-type injury. To add to the understanding of the consequences of interaction between lower extremities and deploying airbags, two cases of lower extremity flail injuries are presented.

Case 1: A full-sized pickup turned left in front of an automobile during an intersection collision. The passenger described sitting with her feet on the dash. The collision was sufficient enough to warrant an airbag deployment. The top-mounted passenger-side airbag deployed and forcefully propelled the occupant's lower extremities into her facial area. The resultant forceful leg-to-head strike caused a brief loss of consciousness, a closed head injury, and, presumably due to bending while the lower extremities were propelled upward and backward, she also sustained a lower back injury.

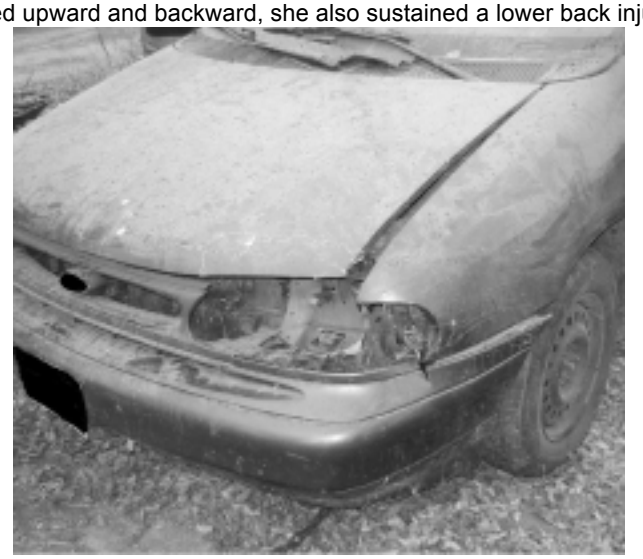

Figure 1. Vehicle damage from a deer impact.

Case 2: A vehicle vs. deer collision produced deployment of the frontal airbags. Analysis of the vehicle's damage, shown in Figure 1, as well as the impact speed and relative weight of the deer showed that the Delta V was less than 3mph. Clearly, with such a benign impact, the only mechanism of injury

would be related to the airbag deployment. Indeed, the driver and rear seat passengers were uninjured. However, the right front passenger sustained a brief loss of consciousness and extensive facial injuries, including a LeForte II fracture, with jaw, nasal and right orbital fractures. Later records showed that she also sustained disruption of her popliteal tendon and the lateral posterior knee capsule of her left knee.

Figure 2. Facial injuries of the passenger in the hospital and two years later.

The passenger was seated with her legs crossed so that her left ankle was on her right knee. In this position, the left leg was evidently in the path of the deploying mid-mounted passenger side airbag. It was concluded that the deploying passenger airbag forcefully propelled the lower leg at a catastrophic speed directly into the passenger's face, causing her extensive head and facial injuries as well as a twisting injury to her left knee. Therefore, this injury pattern could be characterized as a lower extremity flail injury due to airbag deployment.

An examination of two case studies was performed. In these case studies, prior to the subject accident, the right front occupant's lower extremities were located the vicinity of the airbag and/or airbag door. When the airbag deployed, the occupant's lower extremities were forcefully propelled rearward into the occupant's facial areas from interaction with the airbag during the membrane phase. The lower extremity flail-type injuries resulting from interacting with the airbag during the membrane phase resulted in not only lower extremity injuries, but also facial, head, and lower back injuries. In both of these case studies, the injuries sustained would not be expected had there been no interaction with the lower extremities.

Reference:

9. Huelke DF. An Overview of Air Bag Deployments and Related Injuries. Case Studies and a Review of the Literature. SAE Paper 950866, Society of Automotive Engineers, Inc.,

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Head and Face Injury, Lower Extremity Flail, Air Bag

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