C21 Evaluation of Roof-Mounted Side Curtain Airbags in Rollover Accidents

Michelle R. Hoffman, MS, Carley C. Ward, PhD, and Matthew A. Ivory, BS, 3720 E LaSalle St, Phoenix, AZ 85040*

After attending this presentation, attendees will understand how side curtain airbags protect occupants from head injury in side impact and rollover crashes.

This presentation will impact the forensic science community by explaining how roof-mounted side curtain airbags work and how to identify situations in which they have not performed in their intended manner.

History of Side Curtain Airbags: Roof-mounted inflatable side curtain airbags are designed to protect an occupant from ejection through a side window and prevent injurious head contacts to interior and exterior surfaces. They first appeared in passenger vehicles in the late 1990s.[1] They were used primarily for side impact protection.

The National Highway Traffic Safety Administration (NHTSA) tested vehicles in side impacts using a moving deformable barrier modeled after a passenger car of the 1970s. This test only examined forces on the crash test dummy's thorax and ignored forces on the dummy's head. In the early 2000s, the Insurance Institute for Highway Safety (IIHS) developed a side impact test that utilized a moving barrier that was higher than the one used in the NHTSA tests. This higher barrier was representative of a pickup or SUV. The new barrier made it possible for the crash test dummy to hit the striking barrier through the side window. In addition, the IIHS test examined the forces exerted on the dummy's head. It was felt that this new test would encourage the automakers to take advantage of the new technology of side impact head airbags. This technology was not in existence at the time that the NHTSA had created their side impact test.[2,3] The NHTSA followed IIHS's example and modified their side impact test to encourage the use of side curtain airbags. In the final rule on side impact protection (FMVSS 214), the NHTSA changed the side impact test requirements to include a lateral vehicle-into-pole impact in which the pole was positioned in line with the driver dummy's head.[4]

Side curtain airbags have also been improved upon to offer protection to occupants in the event of a rollover crash. In 2000, a major automaker offered an SUV with a side curtain airbag option that would deploy in rollover crashes. The side curtain airbags would trigger by a sensor that measured vehicle tilt and the bags would remain inflated for six seconds covering the side windows.[5] Since that time, many automakers have produced vehicles with side curtain airbags large enough to cover window openings and that remain inflated long enough to offer protection in a rollover-type crash. Recently, NHTSA's final rule on ejection mitigation (FMVSS 226) required all vehicles by September 2013 to be equipped with a curtain airbag that will deploy and offer protection in both side impacts and rollovers.[6]

Case Studies: To illustrate how side curtain airbags may fail to deploy in their intended manner, two cases are reviewed.

In the first case, the restrained left rear occupant of an SUV sustained fatal head injuries in a lateral impact and rollover crash. The side curtain airbags in the SUV did not deploy, allowing the occupant to become completely ejected. The question arose whether or not the side curtain airbag would have stayed inflated long enough to prevent the occupant's ejection and injury if it had deployed. Testing was conducted on exemplar side curtain airbags to determine the deployment path, size of the airbags, and time the bags would remain inflated. It was found that the side curtain airbag would remain inflated with enough pressure for a rollover event.

In the second case, the restrained right front passenger sustained fatal head injuries when she was partially ejected during a vehicle rollover crash. The vehicle was equipped with side curtain airbags that deployed but got stuck halfway down. A review of the NHTSA side crash tests demonstrated that this same problem had also occurred in New Car Assessment Program (NCAP) testing. Subsequent NHTSA NCAP side impact testing revealed that a design change had occurred that prevented this problem from occurring in later models. The issue in this case was what changes had been made to the side curtain airbags to eliminate the problem and would it have made a difference in the subject accident. Exemplar airbags from the early production and late production vehicles were obtained and examined. The later production side curtain airbags were changed by the addition of a plastic guard to prevent the airbag from snagging on interior components during deployment. This guard would have allowed the airbag to fully deploy in the subject accident.

Conclusions: Side curtain airbags are designed to protect an occupant from ejection through a side window and prevent injurious head contacts. They are quickly becoming an important part of automotive safety. An individual analysis must be performed to determine if they functioned properly.

References:

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 ** Presenting Author*

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Side Curtain Airbags, Side Impact, Rollover

 ** Presenting Author*