Verifying Effects of Safety Technology: Side Impact Airbags

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Introduction

There were over 5 million motor vehicle crashes (MVCs) in the United States in 2008, with over 30,000 fatalities [1]. Side impact airbags (including thorax, side, and curtain airbags) are becoming industry standards. To investigate the effects of safety equipment in vehicles, comparisons were made between similar Crash Injury Research and Engineering Network (CIREN) cases with and without side airbags and crash outcomes were evaluated [2]. CIREN is a program through the National Highway Traffic Safety Administration (NHTSA). Multiple trauma centers across the US enroll occupants who have sustained serious injuries in MVC's. Their crash, vehicle, occupant, and injury characteristics are then collected and studied to assess injury scenarios.

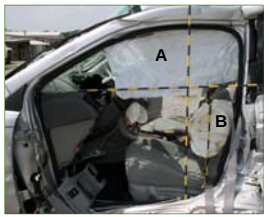


Figure 1. Example of deployed curtain (A) and side (B) airbags

Objective

The objective of this study was to investigate injury outcome differences for occupants with and without side impact airbags involved in near side MVCs using CIREN to analyze radiology and injury descriptions.

Methods

A twelve point scoring system was used to select CIREN cases similar to NHTSA regulatory crash test conditions [3]. Table 1 lists the similarity criteria for each of the 12 points. An adjusted vehicle speed was used for the side impact crash test vehicle Delta V because these tests were run using a specific speed for the moving deformable barrier, not for the vehicle itself. The equation used for determining the vehicle Delta V from the crash test is shown in Equation 1.

Equation 1. Calculating Adjusted Regulatory Speed for Side Comparison

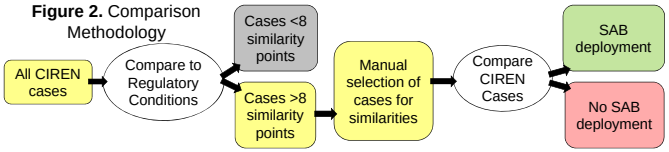
$$Adjusted\ Vehicle\ Speed = \frac{(Barrier\ Mass)*(Barrier\ Speed)}{Vehicle\ Mass + Barrier\ Mass}$$

Then, the CIREN cases with the most similarity points in comparison to regulatory cases, with key dissimilar similarity points for airbag deployment status were chosen for further analysis. Manual selection was used to identify cases with similar characteristics. Using these selected CIREN cases, the key differences between occupant outcomes were analyzed. The methodology steps are shown in Figure 2. Details about each set of comparison cases were investigated and the outcomes for the occupants were studied in reference to their airbag deployment status.

Table 1. Parameters for Regulatory Comparison

Field	Standard
Vehicle Type	*Passenger Car*
Crash Direction	*2~4 or 8~10 o'Clock*
Crash Type	*Left or Right*
Delta V	*> Adjusted regulatory speed*
Airbag Deploy	*Deployed*
ISS	*<7*
Seat Location	*Near Side*
Manual Belt Use	*Belted*
Gender	*Male or Female (not pregnant)*
Age	*> 18 years*
Height	*175 cm (+/- 10%)*
Weight	*75 kg (+/- 10%)*

Figure 2. Comparison Methodology



Results

Table 2. Comparing airbag and injury results for side impact cases

Case	Vehicle	Airbag Deployment		ISS	Fatality
1	Honda Civic	A. Side and Curtain		17	No
		B. None		66	No
2	Honda Accord	A. Side and Curtain		57	No
		B. None		66	Yes
3	Chevy Aveo	A. Side and Curtain		14	No
		B. None		34	No
4	Acura MDX	A. Side and Curtain		17	No
		B. None		34	No

Discussion

The first comparison examined an older driver with side/curtain airbag deployment in a higher speed crash with a lower injury severity score (ISS) and no head injuries versus a driver without side and curtain airbags suffering serious head and chest injuries with a higher ISS. Figure 3 shows the bilateral pulmonary contusion and aortic rupture suffered by the occupant without side and curtain airbags.

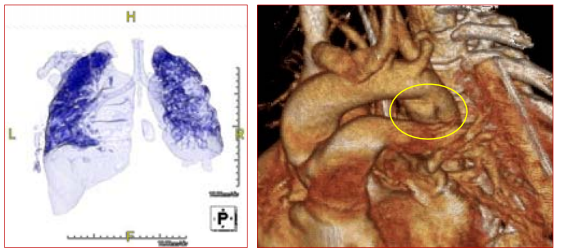


Figure 3. Bilateral pulmonary contusion and aortic rupture in occupant without side or curtain airbag deployment (comparison 1B)

The second case was fatal for the case occupant without side airbags, while the case occupant with side airbags was unbelted but had a lower ISS. The third and fourth cases listed the interior door surface and b-pillar as the contacts for occupants without side airbag deployment. Both of these case occupants suffered MAIS 4 chest injuries, while the case occupants with deployed side airbags suffered no internal chest injuries. An example of door contacts resulting in these chest injuries for occupants without side airbag deployment can be seen in Figure 4.

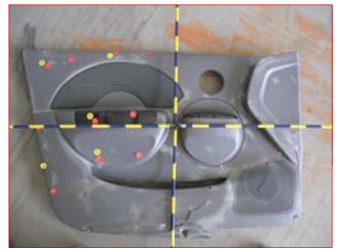


Figure 4. Occupant contacts (colored dots) to the left door resulting in injuries without side or curtain airbag deployment (comparison 3B)

Overall, more serious head and chest injuries were seen with occupants who did not have the benefit of deployed side and curtain airbags.

This study demonstrates a method for investigating crashes similar to regulatory conditions and each other, and differing in key ways to evaluate the benefits of safety systems. These methods will be useful in the future to examine other crash types and safety systems on an extended number of cases using both CIREN and NASS.

Conclusion

This study demonstrates that quantitatively-chosen case pairs provide unique and beneficial information regarding reduced injury severity for occupants involved in near side motor vehicle crashes.

Acknowledgements: This study was supported by the Toyota-Wake Forest University Crash Injury Research and Engineering Network (CIREN).

References

[1] National Highway Traffic Safety Administration, Traffic Safety Facts, 2008.
[2] National Highway Traffic Safety Administration, Crash Injury Research Engineering Network Coding Manual. 2008. p. 257.
[3] National Highway Traffic Safety Administration, Consumer Information, NCAP, Department of Transportation. 2008. p. 1-119.

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