

Remote Passenger Air Bag Serious Injury Investigation
Dynamic Science, Inc. (DSI), Case Number DS09002
1999 Isuzu Rodeo
Arizona
December 2008

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract This remote Passenger Air Bag Serious Injury Investigation focused on the air bag related injuries sustained by the 5-year-old male front right occupant of a 1999 Isuzu Rodeo. The crash occurred within a three-leg intersection. The Isuzu Rodeo was being driven by a 25-year-old female. There were five child occupants, ages 1 to 6, in the vehicle. The other vehicle was a 2003 Ford F-series pickup being driven by a 64-year-old male. The Ford made a left turn across the path of the subject vehicle. The front of the Isuzu struck the front of the Ford and the frontal air bags in the Isuzu deployed. The 5-year-old child sustained a C6/C7 transection with quadriplegia, a right tibia/fibula fracture, and abrasions to the neck, chest, and head. He was transported by air to a local trauma center by air ambulance where he was hospitalized in critical condition. He remained hospitalized for 55 days until he was transferred to a long-term care facility. The driver of the Isuzu and two occupants reported sustained minor injuries. The two remaining occupants did not sustain any injuries. The driver of the Ford complained of pain to his neck but refused medical treatment. The front right occupant of the Ford did not report any injuries.				
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BACKGROUND

This remote Passenger Air Bag Serious Injury Investigation focused on the air bag related injuries sustained by the 5-year-old front right occupant of a 1999 Isuzu Rodeo (**Figure 1**). The crash occurred within a three-leg intersection. The Isuzu Rodeo was being driven by a 25-year-old female. There were five child occupants, ages 1 to 6, in the vehicle. The 5-year-old male child occupied the front right seat. The other vehicle was a 2003 Ford F-series pickup being driven by a 64-year-old male. The Ford made a left turn across the path of the subject vehicle. The front of the Isuzu struck the front of the Ford and the frontal air bags in the Isuzu deployed.



Figure 1. Subject vehicle, 1999 Isuzu Rodeo (police photo)

The 5-year-old child sustained a C6/C7 transection with quadriplegia, a right tibia/fibula fracture, and abrasions to the neck, chest, and head. He was transported by air to a local trauma center by air ambulance where he was hospitalized in critical condition. He remained hospitalized for 55 days until he was transferred to a long-term care facility. The driver of the Isuzu and two occupants reported sustained minor injuries. The two remaining occupants did not sustain any injuries. The driver of the Ford complained of pain to his neck but refused medical treatment. The front right occupant of the Ford did not report any injuries.

This case was identified by DSI in an internet news article. The article cited the front row passenger air bag as the source for the serious injuries to a 5-year-old male child. The article was forwarded to the National Highway Traffic Safety Administration (NHTSA) Special Crash Investigations (SCI) office on December 24, 2008 and the case assigned on January 6, 2009. The police report and accompanying on-scene images were obtained on January 29, 2009.

SUMMARY

Crash Site

This two-vehicle crash occurred in December 2008 at 1636 hours. The crash occurred within a three-leg intersection. The through roadway was constructed of asphalt with one eastbound lane and one westbound lane divided by double yellow stripes. The other roadway had two travel lanes and was controlled by a stop sign. The roadways were dry in some places and wet in others from melting snow. The police photos show the roadway to be wet at the area of impact. The posted speed limit was 40 km/h (25 mph). The nearest reporting station indicated that the local temperature was 1 degree C (34 degrees F), the relative humidity was 60%, and the winds were 14 km/h (9 mph) out of the north. At the time of the crash, the sun's altitude above the horizon was between 4.8-6.5 degrees and the azimuth was 238 degrees East of North. Sunset occurred at 1710 hours.

Pre-Crash

The Isuzu was traveling eastbound at a driver-reported speed of 40-48 km/h (25-30 mph). The front right seat was occupied by an unrestrained 5-year-old male (02). The second row left seat was occupied by a 1-year-old male restrained in a child safety seat (03). The second row middle seat was occupied by a 3-year-old male (04) and a 5-year-old female (05) who were sharing a lap belt. The second row right seat was occupied by a restrained 6-year-old male (06). The driver was transporting the children to a day care center.

The Ford was traveling westbound and was being driven by a 64-year-old male. The front right seat was occupied by an adult male. This vehicle was being followed by a non-contact Chevrolet Suburban. The roadway east of the intersection was curved slightly to the right but straightened out prior to the intersection. The driver of the Ford stated to the police that the sun was blinding him as he approached the intersection. The sun's altitude and azimuth confirmed that the sun would be low on the horizon and in the driver's face at this point. The driver stated that he put on his turn signal but was afraid the vehicle behind him would not be able to see the signal and so he began the left hand turn to travel south.

Crash

The driver of the Ford continued the left hand turn into the eastbound travel lane. The driver of the Isuzu saw the truck turning at the last moment, but was unable to apply the brakes. The right front of the Ford impacted the front of the Isuzu (**Figure 2**). The impact resulted in the deployment of the frontal air bags in the Isuzu. The CDC-Only algorithm of the WinSMASH program computed a Total Delta-V of 20.0 km/h (12.4 mph). The lateral and longitudinal components were -18.8 km/h (-11.7 mph) and 6.8 km/h (4.3 mph), respectively. The Ford was redirected slightly in a counterclockwise direction; the Isuzu was redirected slightly in a clockwise direction. Both vehicles came to rest in the intersection with their front ends fully engaged; the Ford was facing east and the Isuzu was facing southwest.



Figure 2. Area of impact and final rest (police photo)

Post-Crash

The driver and front right occupant of the Ford exited the vehicle under their own power, and proceeded to check on the occupants of the Isuzu. The driver of the Ford stated to the police that he heard the driver of the Isuzu screaming that one of the children was not breathing. This was the 5-year-old who was seated in the front right seat (02). The driver of the Ford went to the aide of the child. He picked him up and gave him rescue breaths until he noticed that the child began breathing on his own. The fire department arrived after a short period of time and took control of the efforts.

The child sustained a C6/C7 transection with quadriplegia, a right tibia/fibula fracture, and abrasions to the neck, chest, and head. He was transported by air to a local trauma center where he was hospitalized in critical condition. He remained hospitalized for 55 days until he was transferred to a long-term care facility.

The driver of the Isuzu sustained a contusion to her right forearm. She was transported by ambulance to a local hospital for treatment. The second row left occupant (03) was transported to the hospital by his mother after complaining of pain to his right arm, neck and back. The first second row middle occupant (04) did not sustain any injuries and was released into her mother's custody. The other second row middle occupant (05) did not initially report any injuries. However, she complained of pain to her right arm the following day and it was determined that her right arm was fractured. She was transported to a local hospital by her parents where she was treated and released. The second row right seat occupant (06) sustained facial contusions when he struck the rear of the front seat. He was transported from the scene to a local hospital where he was treated and released.

The driver of the Ford complained of pain to his neck but refused medical treatment. The front right occupant did not report any injuries. Both vehicles were towed from the scene due to damage.

Vehicle Data - 1999 Isuzu Rodeo

The 1999 Isuzu Rodeo was identified by the Vehicle Identification Number (VIN): 4S2CK58DXX4xxxxxx. The Isuzu was equipped with a 4-cylinder, 2.2-liter engine, manual transmission, 4-wheel disk brakes, and 4-wheel drive. The manufacturer recommended tire size was P245/70R16. The vehicle mileage at the time of the crash was 183,939 km (114,298 miles).

Vehicle Damage

Exterior Damage

The Isuzu sustained moderate front end damage as a result of the impact with the Ford (**Figure 3**). The direct damage began at the left front bumper corner and extended laterally to the right. The grille was damaged and the hood was deformed. The right bumper corner was rotated outward. The Collision Deformation Classification (CDC) for this impact was 11FDEW2.

Interior Damage

There was minimal interior damage to the Isuzu. The doors appeared to remain operational. The windshield was cracked but the remaining glazing was intact. There were no indications of intrusion or integrity loss.



Figure 3. Frontal damage to Isuzu (police photo)

Manual Restraints

The Isuzu was equipped with 3-point manual lap and shoulder belts for all four outboard seating positions and a manual lap belt for the second row middle seat position. According to the police report, the driver, front right occupant, and second row right occupant were using the lap and shoulder belts. The second row left occupant was seated was restrained in a child safety seat; it is unknown if the child seat was secured to the vehicle. The two second row center occupants were sharing the lap belt.

Supplemental Restraint Systems

The Isuzu was equipped with redesigned “second generation” frontal air bags. Redesigned air bags are used in vehicles that have been certified to the unbelted sled test option instead of the unbelted crash test option in Standard No. 208. Redesigned air bags have less power than the air bags in earlier model years of that vehicle.

The driver’s air bag was located in the steering wheel hub and deployed during the impact with the Ford (**Figure 4**) The front right passenger’s air bag was located in the top of the instrument panel and deployed during the impact with the Ford. It is not known if there was any damage or contacts to the air bags.



Figure 4. Driver and front right passenger air bags (police photo)

Vehicle Data - 2003 Ford F150 pickup

The 2003 Ford F150 4-door extended cab pickup was identified by the VIN: 1FTRX18L13Nxxxxxx. The Ford was equipped with an 8-cylinder, 5.4-liter engine and 4-wheel drive. The vehicle was hauling hay in the cargo box and the box was covered by a fiberglass cap. The Ford sustained moderate front end damage as a result of the impact with the Isuzu. The direct damage began at the left front bumper corner and extended laterally to the right. The grille was damaged and the hood deformed. The CDC for this impact was 12FZEW1. The fiberglass cap came off the vehicle during the crash. It was located on the west side of the road near the intersection, but had probably been moved there from the roadway.

OCCUPANT DEMOGRAPHICS

	Driver	Front Row Right (02)
Age/Sex:	25/Female	5/Male
Seated Position:	Front left	Front right
Seat Type:	Bucket	Bucket
Seat Track Position:	Unknown	Unknown
Height:	163 cm (64 in)	120 cm (47 in)
Weight:	82 kg (180 lbs)	20 kg (44 lbs)
Alcohol/Drug Involvement:	None	None
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Right foot presumed to be on accelerator, left on floor	Unknown
Restraint Usage:	Lap and shoulder belt	None
	Second Row Left (03)	Second Row Middle (04)
Age/Sex:	1/Male	3/Male
Seated Position:	Second row left	Second row middle
Seat Type:	Bench with folding back	Bench with folding back
Seat Track Position:	N/A	N/A
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, unknown if used with child safety seat	Lap belt used with Occupant 05.

	Second Row Middle (05)	Second Row Right (06)
Age/Sex:	5/Female	6/Male
Seated Position:	Second row middle	Second row right
Seat Type:	Bench with folding back	Bench with folding back
Height:	107 cm (42 in)	109 cm (43 in)
Weight:	21 kg (47 lbs)	20 kg (45 lbs)
Body Posture:	Upright	Upright
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap belt used with Occupant 04.	Lap and shoulder belt

Occupant Injuries

Driver: Injury obtained from police report.

<u>Injury</u>	<u>AIS Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusion, right forearm	790402.1,1	Unknown	Unknown

Front row right occupant (02): Injuries obtained from discharge summary and emergency room records.

<u>Injury</u>	<u>AIS Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
C6/C7 transection with quadriplegia	640260.5,6	Passenger air bag	Certain
Right tibia/fibula fracture	853404.2,1 851605.2,1	Lower instrument panel	Probable
Abrasion, back of head	190202.1,8	Seat back	Probable
Abrasion, anterior neck	390202.1,5	Passenger air bag	Certain
Abrasion, chest	490202.1,9	Passenger air bag	Certain

Second row left occupant (03): No reported injuries. He complained of pain to right arm, neck and back.

Second row middle occupant (04): No reported injuries.

Second row middle occupant (05): Injury obtained from interviewee.

<u>Injury</u>	<u>AIS Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Fracture, right forearm	751800.2,1	Seat back	Probable

Second row right occupant (06): Injury obtained from interviewee.

<u>Injury</u>	<u>AIS Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Facial contusions	290402.1,0	Seat back	Probable

OCCUPANT KINEMATICS

Driver Kinematics

The driver was seated in an unknown posture. She was reported by the police to be wearing the lap and shoulder belt. Her right foot was presumably on the accelerator and the left on the floorboard. She did not attempt any evasive maneuvers. At impact with the Ford, she was displaced forward and slightly to the left. She loaded the lap and shoulder belt and probably contacted the deploying air bag. She sustained a contusion to her right forearm from an unknown source.

Front row right occupant (02) kinematics

The 5-year-old male front right occupant was seated in an unknown posture on a fabric covered bucket seat. Based on police photographs, the seat was adjusted to a position that appeared to be forward of the mid-track position. Based on the injury pattern, the lack of seat belt related type injuries, and an interview with the driver of the Ford, it was determined that the child was not wearing the manual lap and shoulder belt. At impact, the passenger air bag deployed and the child was displaced forward and slightly left. The deploying air bag interacted with child's chest resulting in abrasions to the anterior chest. The air bag expanded vertically and abraded the anterior aspect of the child's neck. The expansion of the air bag under the child's chin forced his head up and rearward. The hyperextension of the neck resulted in a complete C6/C7 transection and the resultant quadriplegia. The child's head was accelerated rearward and the back of his head probably contacted the right seat back, causing an abrasion to the back of his head. The child's right lower leg pivoted forward and upward in an arc and probably contacted the bottom of the right instrument panel,

which was the probable cause of the tibia/fibula fracture and contusions to the lower leg and ankle.

The driver of the Ford stated that the child was not breathing immediately after the impact. He picked the child up and gave him rescue breaths until he noticed that the child began breathing on his own. The fire department arrived after a short period of time and he passed the child off to them.

He was transported by air to a local trauma center by air ambulance where he was hospitalized in critical condition. He remained hospitalized for 55 days until he was transferred to a long-term care facility.

Second row left occupant (03) kinematics

The 1-year-old male second row left occupant was seated in an unknown posture in a forward facing child safety seat. It is unknown if the child seat was secured or used properly. At impact with the Ford, he was displaced forward and slightly to the left. It is not known if he contacted any interior objects. He was transported to a local hospital by his mother after complaining of pain to his right arm, neck and back.

Second row center occupant (04) kinematics

The 3-year-old male second row center occupant was seated in an unknown posture and was sharing the lap belt with Occupant 05. At impact with the Ford, he was displaced forward and slightly left. He did not sustain any injuries.

Second row center occupant (05) kinematics

The 5-year-old female second row center occupant was seated in an upright posture and was sharing the lap belt with Occupant 04. At impact, she was displaced forward and slightly left. She likely braced herself against the seat back. She did not report any injuries immediately after the crash, but it was later determined that she had fractured her right forearm. She was transported by her parents to local hospital where she was treated and released. She returned to the doctor's office 3-4 times to monitor the mending process.

Second row right occupant (06) kinematics

The 6-year-old male second row right occupant was seated in an upright posture and was using the lap and shoulder belt. At impact, he was displaced forward and slightly left and sustained facial contusions as he contacted the back of the front right seat. He was transported from the scene to a local hospital where he was treated and released.

Attachment 1. Scene Diagram

