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ON-SITE CHILD AIR BAG-RELATED SERIOUS INJURY INVESTIGATION

CASE NUMBER - IN98-031
LOCATION - IOWA
VEHICLE - 1997 DODGE CARAVAN
CRASH DATE - November, 1998

Submitted:

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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. <i>Abstract</i> This report covers an on-site investigation of an air bag deployment crash that involved a 1997 Dodge Caravan (case vehicle) and a 1997 Dodge Intrepid (other vehicle). This crash is of special interest because the case vehicle's unseated, "out-of-position," front passenger (10-year-old female) sustained critical head injuries from the deploying front right passenger air bag and survived the crash. The case vehicle was traveling east in the eastbound lane of a two-lane, undivided, city roadway. The Intrepid had been traveling south in the southbound lane of an intersecting, two-lane, undivided, city roadway, and preceded into the intersection after waiting for a northbound vehicle to turn left. The crash occurred within the four-leg intersection of the two roadways. The front of the case vehicle impacted the right side of the Intrepid, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's unseated, "out-of-position," front passenger was in the process of changing seats from the second seat right position to the front right seat. She was stepping with her right foot into the front right seat's foot well just prior to the crash. The unseated passenger was not using an available, active, three-point, lap-and-shoulder, safety belt system. According to her medical records, she sustained critical injuries which included: a critical nonanatomic brain injury, a small diffuse axonal injury (white matter shearing), a posterior subarachnoid hemorrhage, a fracture and contusion to her right thumb, a small laceration to her left thumb, and abrasions covering her entire face including her forehead, nose, lips, and chin. This occupant's primary brain injuries were caused by her contact with the case vehicle's front right passenger air bag. The driver (mother; 32-year-old female) was seated with her seat track located between its middle and rearmost positions, and her tilt steering wheel was located in its down-most position. She was restrained by her available, active, three-point, lap-and-shoulder, safety belt system and did not sustain any injuries as a result of this crash. The second seat left passenger (son; 3-year-old male) was restrained in a convertible child safety seat that was configured in its forward facing position. The child seat was secured to the vehicle. The second row bench seat had non-adjustable seat tracks and the seat backs. According to his medical records and the interview with the driver, he sustained an elbow abrasion and a contusion to his left upper hip. The back right passenger (son; 11-year-old male) was seated and his back bench seat had non-adjustable seat tracks and the seat backs. According to his medical records and the interview with the driver, he sustained a contusion to his left shin.					
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This on-site investigation was brought to NHTSA's attention on December 1, 1998, by a newspaper reporter's telephone call to an NHTSA regional office. This crash involved a 1997 Dodge Caravan (case vehicle) and a 1997 Dodge Intrepid (other vehicle). The crash occurred in November, 1998, at 7:00 p.m., in Iowa, and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's unseated, "out-of-position," front passenger [10-year-old, White (non-Hispanic) female] sustained critical head injuries from the deploying front right passenger air bag and survived the crash. This contractor inspected the scene on 7 December, the case vehicle on 8 December, and the Intrepid on 9 December, 1998. The case vehicle's driver was interviewed on 8 December, and the father of the Intrepid's driver was interviewed on 9 December, 1998. This report is based on the Police Crash Report, interviews with the case vehicle's driver and the father of the Intrepid's driver, conversations with the investigating police officer, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling east in the eastbound lane of a two-lane, undivided, city roadway and intended to continue in its easterly travel path after passing through an approaching four-leg intersection. The Intrepid had been traveling south in the southbound lane of an intersecting, two-lane, undivided, city roadway, and had stopped and waited while a northbound vehicle made a left-hand turn and traveled westbound at the four-leg intersection. The Intrepid accelerated southward, intending to continue its southerly travel path through the intersection. The case vehicle's driver did not have time to make any avoidance maneuvers prior to the crash. The crash occurred within the four-leg intersection of the two roadways; see **CRASH DIAGRAM** below.

The front of the case vehicle impacted the right side of the Intrepid, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle rotated approximately 40 degrees clockwise and came to rest in the intersection heading southeastward. The Intrepid rotated approximately 145 degrees clockwise and came to rest off the southeast corner of the intersection heading northwestward.

The 1997 Dodge Caravan was a front wheel drive, four-door, seven passenger minivan (VIN: 2B4FP253XVR-----). Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-1 (350)**. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 12.1 km.p.h. (7.5 m.p.h.), -12.0 km.p.h. (-7.5 m.p.h.), and 2.1 km.p.h. (1.3 m.p.h.). The case vehicle was towed from the scene due to disabling damage.

The case vehicle's contact with the Intrepid involved its entire front. Direct damage began at the front left bumper corner and extended, a measured distance of 146 centimeters (57.5 inches), along the bumper stopping 6 centimeters (2.4 inches) leftward of the front right bumper corner. Residual maximum crush was 8 centimeters (3.1 inches) at C₁. The case vehicle's wheelbase was unaltered from the crash. The case vehicle's front bumper fascia, grille, hood, and right headlight assembly were directly damaged and crushed rearward. None of the case vehicle's

tires were damaged, deflated, or physically restricted. Both the right and left headlight and turn signal assemblies sustained induced damage as well as the left fender.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each approximately 8 centimeters (3.1 inches) in width. The driver's air bag had no vent ports. The deployed driver's air bag was elliptical, with a height of 55 centimeters (21.7 inches) and a width of 65 centimeters (25.6 inches). An inspection of the driver's air bag fabric revealed faint black marks, smears, and smudges on the air bag's fabric, primarily along the right half.

The front right passenger's air bag was located in the middle of the instrument panel. An inspection of the front right air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The front right passenger's air bag was designed without any tethers or vent port. The deployed front right air bag was rectangular with a height of approximately 60 centimeters (23.6 inches) and a width of approximately 46 centimeters (18.1 inches). An inspection of the front right passenger's air bag fabric revealed several clear, body fluid stains and one light pink stain on the left side surface of the air bag's fabric from occupant contact. In addition, there was no obvious contact evidence on the front surface of the air bag.

Inspection of the case vehicle's interior revealed that there was evidence of occupant contact to the right portion of the center instrument panel. This instrument panel contact occurred after the "out-of-position" front passenger was redirected leftward and forward, after she impacted the deploying front right passenger air bag, as the case vehicle was rotating clockwise as a result of maximum engagement. In addition, there were some scratches/nicks noted to the steering wheel rim, but it is unclear if these were contact related. Furthermore, there were scuffs noted to the back surface of the second seat's seat back from contact by the back right passenger. Finally, the distance from the front instrument panel to the mid-point of the front right seat back was 74 centimeters (29.1 inches). The excursion of the front right passenger air bag was estimated as 34 centimeters (13.4 inches), leaving approximately 40 centimeters (15.7 inches) from the front surface of the air bag to the mid-point of the seat back.

The 1997 Dodge Intrepid Sport was a front wheel drive, four-door, five passenger sedan (VIN: 2B3HD46F6VH-----). Based on the vehicle inspection, the CDC for the Intrepid was determined to be: **03-RZEW-2 (80)** [residual maximum crush was 7 centimeters (2.8 inches) at C₄]. The WinSMASH reconstruction program, damage only algorithm, was used on the Intrepid's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 14.0 km.p.h. (8.7 m.p.h.), -2.4 km.p.h. (-1.5 m.p.h.), and -13.8 km.p.h. (-8.6 m.p.h.). The Intrepid was driven from the scene.

Immediately prior to the crash, the case vehicle's unseated, "out-of-position," front passenger [145 centimeters and 29 kilograms (57 inches, 65 pounds)] was in the process of changing seats from the second seat right position to the front right seat. She was stepping with

her right foot into the front right seat's foot well, with her head down (top of head leading) and turned slightly leftward. After the front right passenger air bag deployed, the "out-of-position," front occupant was found lying in the foot well area of the front right seat position.

The case vehicle's unseated, "out-of-position" passenger was not using an available, active, three-point, lap-and-shoulder, safety belt system because she was moving from the second seat right position to the front right passenger position at the time of the collision. In addition, the inspection of the front right seat belt webbing, "D"-ring, and latch plate showed no evidence of loading during this crash.

The case vehicle's driver indicated that her right foot was moving from the accelerator pedal to the brake pedal when the collision occurred. Because there were no avoidance maneuvers (other than the deceleration that results from removal of the driver's foot from the accelerator pedal) and the nonuse of any available restraints, the moving, "out-of-position," front passenger's position was essentially unchanged just prior to the crash. The case vehicle's impact with the Intrepid enabled the unseated, "out-of-position," front passenger to continue forward, with the top right side of her head leading, toward the 350 degree Direction of Principal Force as the case vehicle decelerated. The unseated passenger was contacted by the left side surface (i.e., as viewed from the front right seating position) of the deploying front right passenger air bag. The deploying front right air bag, in conjunction with the clockwise rotation that resulted from the case vehicle reaching maximum engagement, redirected this occupant's forward movement toward the right side of the center instrument panel. When the case vehicle came to rest, this "out-of-position" occupant was found, unconscious, in the foot well of the front right seat.

The unseated, "out-of-position," front occupant was transported by ambulance to a hospital. She sustained critical injuries and was hospitalized for thirty (30) days post-crash. The injuries sustained by her included: a critical nonanatomic brain injury, a small diffuse axonal injury (white matter shearing), a posterior subarachnoid hemorrhage, a fracture and contusion to her right thumb, a small laceration to her left thumb, and abrasions covering her entire face including her forehead, nose, lips, and chin (Note: the abrasions were more severe on the right side). This occupant's primary brain injuries were caused by her contact with the case vehicle's front right passenger air bag.

The case vehicle's driver [mother; 32-year-old, White (non-Hispanic) female; 163 centimeters and 68 kilograms (64 inches, 150 pounds)] was seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot moving from the accelerator pedal to the brake pedal, and both hands on the steering wheel. Her seat track was located between its middle and rearmost positions, her seat back was upright, and her tilt steering wheel was located in its down-most position.

The case vehicle's driver was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. The driver accompanied her injured daughter in an ambulance to a local medical facility. The case vehicle's driver did not sustain any injuries as a result of this crash.

The case vehicle's second seat left passenger [son; 3-year-old, White (non-Hispanic) male; 91 centimeters and 16 kilograms (36 inches and 35 pounds)] was restrained in a convertible child safety seat that was configured in its forward facing position. He was sitting upright with his feet dangling off the seat. In addition, the position of his hands are unknown. Although the child safety seat had been removed from the case vehicle prior to this contractor's vehicle inspection, the markings of the safety seat on the vehicle's second seat and the absence of occupant contact to the back of the driver's bucket seat, indicates that this child seat was secured to the vehicle, and the child was restrained by the seat's harness. Thus, the second seat left passenger had his back against the safety seat and was restrained by the available child seat's harness with harness retainer clip and "T"-shield. The second row bench seat had non-adjustable seat tracks and the seat backs.

The driver's 3-year-old son was taken to the hospital by his father in private transportation and was given a precautionary examination. He sustained minor injuries and was treated and released. According to his medical records and the interview with the driver, the injuries sustained by the case vehicle's second seat left passenger included: an elbow abrasion and a contusion to his left upper hip.

The case vehicle's back right passenger [son; 11-year-old, White (non-Hispanic) male; 152 centimeters and 39 kilograms (60 inches, 87 pounds)] was seated, reportedly leaning to his left, pointing out Christmas lights on houses to his younger brother in the second seat left position. His back was probably not against the seat back, his feet were on the floor, and his hands were pointing toward various houses. The back bench seat had non-adjustable seat tracks and the seat backs.

The back right passenger was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver's 11-year-old son was taken to the hospital by his father in private transportation and was given a precautionary examination. He sustained minor injuries and was treated and released. According to his medical records and the interview with the driver, the injuries sustained by the case vehicle's back right passenger included a contusion to his left shin.

The Intrepid's driver [19-year-old, White (non-Hispanic) female; 160 centimeters and 52 kilograms (63 inches, 115 pounds)] was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. The restraint usage for either the back left passenger [3-year-old, White (non-Hispanic) female; 91 centimeters and 16 kilograms (36 inches, 35 pounds)] or the back right passenger [3-year-old, White (non-Hispanic) female; 102 centimeters and 18 kilograms (40 inches, 40 pounds)] is unknown. None of the Intrepid's three occupants were transported to a medical facility because no injuries were reported. A day after the crash, however, the back right passenger complained of pain and swelling to her right forearm. Two days post-crash, an x-ray discovered a hairline fracture of either her radius or ulna.

The case vehicle was traveling east in the eastbound lane (**Figure 1**) of a two-lane, undivided, city roadway and intended to continue in its easterly travel path after passing through an approaching four-leg intersection. The Intrepid had been traveling south in the southbound lane of an intersecting, two-lane, undivided, city roadway, and had stopped and waited while a northbound vehicle made a left-hand turn and traveled westbound at the four-leg intersection. The Intrepid accelerated southward, intending to continue its southerly travel path through the intersection. The case vehicle's driver did not have time to make any avoidance maneuvers prior to the crash. The crash occurred within the four-leg intersection of the two roadways; see **CRASH DIAGRAM** below.



Figure 1: Case vehicle's eastbound path of travel; Note: white vehicle at left shows Intrepid's southbound path of travel (case photo #01)

The case vehicle's city roadway was straight and level at the area of impact. The pavement was bituminous. The roadway was bordered by 7.6 centimeter (3 inch) barrier curbs. No pavement markings were present. The estimated coefficient of friction was 0.70. There were no visible traffic controls. The statutory speed limit was 40 km.p.h. (25 m.p.h.). No regulatory speed limit sign was posted near the crash site. The Intrepid's city roadway was straight and level at the area of impact. The pavement was bituminous. The roadway was bordered by 7.6 centimeter (3 inch) barrier curbs. No pavement markings were present. The estimated coefficient of friction was 0.70. A regulatory **STOP** sign (Manual on Uniform Traffic Control Devices, R1-1) was located on both the north and south legs of the intersection. The statutory speed limit was 40 km.p.h. (25 m.p.h.). No regulatory speed limit sign was posted near the crash site. At the time of the crash the light condition was dark, but illuminated by overhead street lamps at the area of impact, the atmospheric condition was clear, and the road pavement was dry. Traffic density was light, and the site of the crash was urban residential.

The front (**Figure 2**) of the case vehicle impacted the right side (**Figure 3** below) of the Intrepid, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle rotated approximately 40 degrees clockwise and came to rest in the intersection heading southeastward (**Figure 4** below). The Intrepid rotated approximately 145 degrees clockwise, rolled backwards over the east barrier curb and onto the



Figure 2: Case vehicle's frontal damage from impact with Intrepid; Note: contour gauge present at bumper level (case photo #12)

tree plat and sidewalk, and came to rest off the southeast corner of the intersection heading northwestward.

CASE VEHICLE

The 1997 Dodge Caravan was a front wheel drive, seven passenger, four-door minivan (VIN: 2B4FP253XVR-----) equipped with a 3.0 liter, SOHC, SMPI, 12-valve, V-6 engine and a three-speed automatic transmission with the selection lever mounted on the steering column. Braking was achieved by a power-assisted, front disc and rear drum, four-wheel, anti-lock system. The case vehicle's wheelbase was 288 centimeters (113.3 inches), and the electronic odometer was rendered inoperable by the crash, but the driver estimated the case vehicle's total mileage at a little over 32,187 kilometers (20,000 miles).

Inspection of the vehicle's interior revealed adjustable front bucket seats with integral head restraints and non-adjustable bench seats were present for both the second occupant row and the back row. There were no head restraints for the second and back row seating positions. Continuous loop, three-point, lap-and-shoulder, safety belt systems were found at the six outboard seating positions, and a two-point, lap belt system at the back center position. Shoulder belt upper anchorages were available and adjusted in the full down position for the front and second row outboard seating positions. There were no shoulder belt upper anchorage adjusters for the third row outboard seat locations. The vehicle was equipped with knee bolsters for both the driver and front right passenger, neither of which were deformed. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver and front right passenger seating positions. Both frontal air bags deployed as a result of the case vehicle's frontal impact with the Intrepid.

CASE VEHICLE DAMAGE

The case vehicle's contact with the Intrepid involved its entire front (**Figure 2** above and **Figure 5**). Direct damage began at the front left



Figure 3: Intrepid's right-side damage; Note: yellow tape indicates width of direct damage (case photo #59)



Figure 4: Northwest view from beyond Intrepid's final rest position on east roadside of four-leg intersection's south leg (case photo #10)



Figure 5: Case vehicle's frontal damage and slight rightward shift viewed from right of front (case photo #25)

bumper corner and extended, a measured distance of 146 centimeters (57.5 inches), along the bumper stopping 6 centimeters (2.4 inches) leftward of the front right bumper corner. Residual maximum crush was 8 centimeters (3.1 inches) at C₁. The case vehicle's wheelbase was unaltered from the crash. The case vehicle's front bumper fascia, grille, hood, and right headlight assembly were directly damaged and crushed rearward. None of the case vehicle's tires were damaged, deflated, or physically restricted. Both the right and left headlight and turn signal assemblies sustained induced damage as well as both the left and right fenders and the right front door's forward seam.

Inspection of the case vehicle's interior revealed that there was evidence of occupant contact to the right portion of the center instrument panel (**Figure 6**). This instrument panel contact occurred after the "out-of-position" front passenger was redirected leftward and forward, after she impacted the deploying front right passenger air bag, as the case vehicle was rotating clockwise as a result of maximum engagement. In addition, there were some scratches/nicks noted to the steering wheel rim, but it is unclear if these were contact related. Furthermore, there were scuffs noted to the back surface of the second seat's seat back from contact by the back right passenger. There was



Figure 6: Case vehicle's deployed front passenger air bag showing no obvious occupant contact evidence on air bag's front surface; Note: occupant contacts to center instrument panel (case photo #39)

no evidence of intrusion to the case vehicle's interior, no evidence of compression to the energy absorbing sheer capsules in the steering column, and no deformation to the steering wheel rim. Finally, the distance from the front instrument panel to the mid-point of the front right seat back was 74 centimeters (29.1 inches). The excursion of the front right passenger air bag was estimated as 34 centimeters (13.4 inches), leaving approximately 40 centimeters (15.7 inches) from the front surface of the air bag to the mid-point of the seat back.

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-1 (350)**. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 12.1 km.p.h. (7.5 m.p.h.), -12.0 km.p.h. (-7.5 m.p.h.), and 2.1 km.p.h. (1.3 m.p.h.). The case vehicle was towed from the scene due to disabling damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained frontal air bags at the driver and front right passenger positions. Both air bags deployed as a result of the frontal impact with the Intrepid. The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of a single hexagonal cover flap made of thick vinyl with overall dimensions of 13 centimeters (5.1 inches) at the top horizontal seam, 17 centimeters (6.7ches) at the bottom horizontal seam, and 9 centimeters (3.5 inches) vertically. An

inspection of the air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each approximately 8 centimeters (3.1 inches) in width. The driver's air bag had no vent ports. The deployed driver's air bag was elliptical, with a height of 55 centimeters (21.7 inches) and a width of 65 centimeters (25.6 inches). An inspection of the driver's air bag fabric revealed faint black marks, smears, and smudges on the air bag's fabric (**Figure 7**), primarily along the right half.

The front right passenger's air bag was located in the middle of the instrument panel. There were two, symmetrical, "H"-configuration, modular cover flap. The cover flap was made of a thick vinyl over a sheet metal frame/liner which acted as the hinge point for the deploying flaps. The flap's dimensions were: 28 centimeters (11.0 inches) at the forward horizontal seam, 28 centimeters (11.0 inches) at the rear (i.e., toward the windshield) horizontal seam, 7 centimeters (2.8 inches) vertically for the upper flap and 7 centimeters (2.8 inches) vertically for the lower flap. The profile of the case vehicle's instrument panel was flush with the leading edge of the cover flap. An inspection of the front right air bag module's cover flaps and air bag revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The front right passenger's air bag was designed without any tethers or vent port. The deployed front right air bag was rectangular with a height of approximately 60 centimeters (23.6 inches) and a width of approximately 46 centimeters (18.1 inches). An inspection of the front right passenger's air bag fabric revealed several clear, body fluid stains and one light pink stain on the left side surface of the air bag's fabric from occupant contact (**Figures 8 and 9**). In addition,



Figure 7: Case vehicle's deployed driver air bag showing only faint marks, smears, and smudges, indicative of only possible occupant contact (case photo #35)

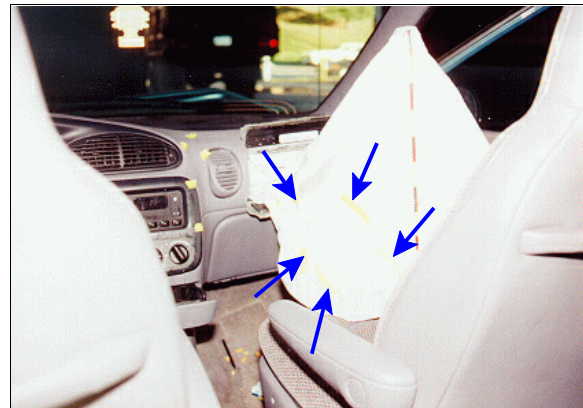


Figure 8: Case vehicle's deployed front right passenger air bag showing "out-of-position" passenger's contacts to air bag's fabric and center instrument panel; Note: tape and arrows outline area contacted on air bag's fabric and tape marks contact with center instrument panel (case photo #41)

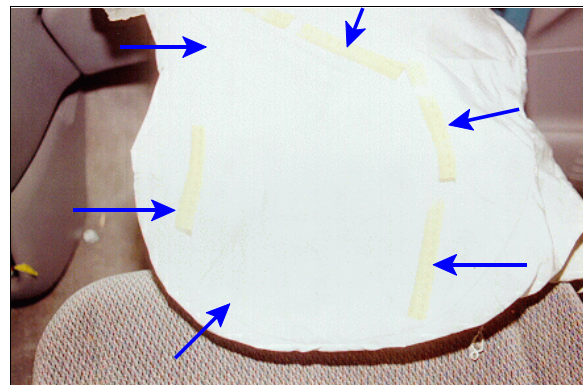


Figure 9: Close-up of the case vehicle's deployed front right passenger air bag showing unseated occupant's contact with left surface of air bag's fabric; Note: yellow tape and arrows outline perimeter of contact area (case photo #42)

there was no obvious contact evidence on the front surface of the air bag.

CHILD SAFETY SEAT



Figure 11: State specialist's photo of case vehicle's convertible child safety seat that was used to restrain second seat left passenger in case vehicle forward facing configuration (case photo #47)



Figure 10: State specialist's photo of case vehicle's convertible child safety seat showing how second seated left passenger in child seat was secured by safety belts (case photo #46)

The Convertible Child Safety Seat (CCSS) used by the case vehicle's Second Seat Left Passenger was in the forward facing position at the time of the crash. The seat was manufactured by Century and was identified by Model name "2000 STE". The child safety seat had been removed from the case vehicle prior to this contractor's vehicle inspection. Although the child safety seat had been removed, an inspection of the seat by an Iowa occupant protection specialist revealed that the convertible seat was designed with a three-point harness connected to a pullover shield which buckled between the child's legs. The seat was also equipped with a three-position pullover "T"-shield. Furthermore, the inspection reveal that the child safety seat was properly attached to the vehicle by the safety belts inserted through the seat's side slots (Figure 10), and its adjustable seat angle was in the semi-reclined position (Figure 11), an approved angle for toddlers weighing 9 to 18 kilograms (20 to 40 pounds). Inspection of the child safety seat's webbing and shield by the Iowa specialist reportedly showed no evidence of loading; however, the child safety seat occupant's father indicated the shield's latch plate had been bent and he had repaired it (Figure 12).

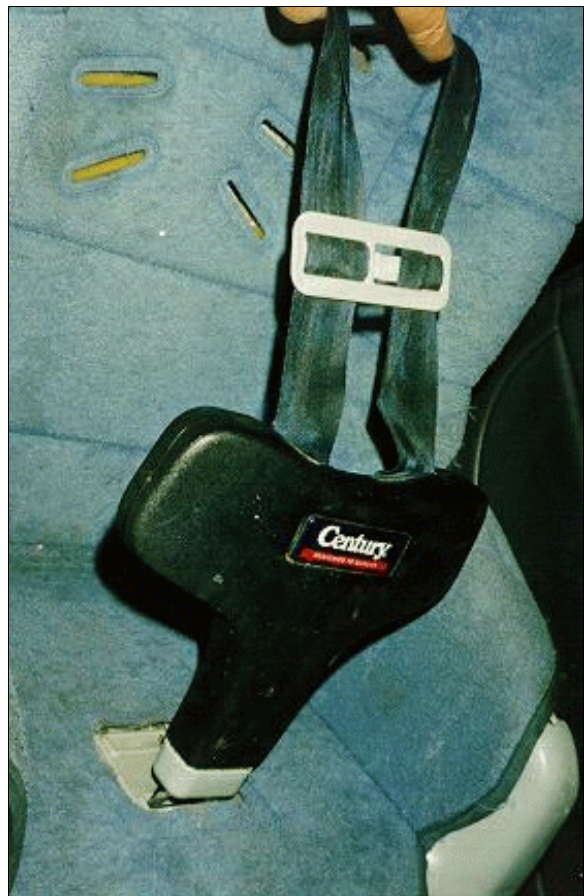


Figure 12: State specialist's photo of case vehicle's convertible child seat used to restrain second seat left passenger in forward facing configuration; Note: chest clip's location reflects how it was worn at time of crash (case photo #48)

Immediately prior to the crash, the case vehicle's unseated, “out-of-position,” front passenger [145 centimeters and 29 kilograms (57 inches, 65 pounds)] was in the process of changing seats from the second seat right position to the front right seat. She was stepping with her right foot into the front right seat’s foot well, with her head down (top of head leading) and turned slightly leftward. After the front right passenger air bag deployed, the “out-of-position,” front occupant was found lying in the foot well area of the front right seat position.

The case vehicle's unseated, “out-of-position” passenger was not using an available, active, three-point, lap-and-shoulder, safety belt system because she was moving from the second seat right position to the front right passenger position at the time of the collision. In addition, the inspection of the front right seat belt webbing, “D”-ring, and latch plate showed no evidence of loading during this crash.

The case vehicle's driver indicated that her right foot was moving from the accelerator pedal to the brake pedal when the collision occurred. Because there were no avoidance maneuvers (other than the deceleration that results from removal of the driver’s foot from the accelerator pedal) and the nonuse of any available restraints, the moving, “out-of-position,” front passenger’s position was essentially unchanged just prior to the crash. The case vehicle's impact with the Intrepid enabled the unseated, “out-of-position,” front passenger to continue forward, with the top right side of her head leading, toward the **350** degree Direction of Principal Force as the case vehicle decelerated. The unseated passenger was contacted by the left side surface (i.e., as viewed from the front right seating position) of the deploying front right passenger air bag. The deploying front right air bag, in conjunction with the clockwise rotation that resulted from the case vehicle reaching maximum engagement, redirected this occupant’s forward movement toward the right side of the center instrument panel. When the case vehicle came to rest, this “out-of-position” occupant was found, unconscious, in the foot well of the front right seat.

CASE VEHICLE “OUT-OF-POSITION” FRONT PASSENGER INJURIES

The unseated, “out-of-position,” front occupant was transported by ambulance to a hospital. She sustained critical injuries and was hospitalized for thirty (30) days post-crash. The injuries sustained by her included: a critical nonanatomic brain injury, a small diffuse axonal injury (white matter shearing), a posterior subarachnoid hemorrhage, a fracture and contusion to her right thumb, a small laceration to her left thumb, and abrasions covering her entire face including her forehead, nose, lips, and chin (Note: the abrasions were more severe on the right side). This occupant’s primary brain injuries were caused by her contact with the case vehicle’s front right passenger air bag.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury with loss of consciousness and some response to pain, GCS=5-7, with neurologic deficit (i.e., unequal pupils and diplopia)	160822.5 critical	Air bag, front right passenger's	Certain	Hospitalization records
2	Diffuse axonal injury (white matter shearing), small [Aspect = Unknown]	140628.5 critical	Air bag, front right passenger's	Certain	Hospitalization records
3	Hemorrhage, subarachnoid, over right tentorium ¹ cerebelli and adjacent to posterior supratentorial falx/ambiens cistern [Aspect = Unknown]	140684.3 serious	Air bag, front right passenger's	Probable	Hospitalization records
4	Fracture, nondisplaced, metacarpal right thumb	752002.2 moderate	Center instrument panel and below	Probable	Hospitalization records
5	Abrasion {air bag burns} covering entire face--right more severe than left	290202.1 minor	Air bag, front right passenger's	Certain	Hospitalization records
6	Contusion {ecchymoses} right thumb	790402.1 minor	Center instrument panel and below	Probable	Hospitalization records
7	Laceration, small, left thumb	790602.1 minor	Center instrument panel and below	Probable	Interviewee (driver)

¹ The following terms are defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:

cistern (sis'tern): a closed space serving as a reservoir for fluid; see also *cisterna*.

ambient c.: cisterna ambiens.

cisterna (sis-ter'na) pl. cister'nae: a cistern -- a closed space serving as a reservoir for lymph or other body fluid, especially one of the enlarged subarachnoid spaces containing cerebrospinal fluid.

c. am'biens: the subarachnoid space surrounding the midbrain; it connects the cisterna venae magnae cerebri with the cisterna interpeduncularis. Called also *c. mesencephalicum*.

c. basa'lis: *c. interpeduncularis*.

c. interpeduncula'ris: interpeduncular cistern -- a dilatation of the subarachnoid space between the cerebral peduncles; called also *basal cistern*.

c. mesencepha'licum: *c. ambiens*.

c. pon'tis: pontine cistern.

falx (falks) pl. fal'ces: a sickle-shaped organ or structure; used as a general term in anatomical nomenclature to designate such a structure.

f. cerebelli, f. of cerebellum: the small fold of dura mater in the midline of the posterior cranial fossa, projecting forward toward the vermis of the cerebellum [i.e., partitions the right and left cerebellar hemispheres (from the book: HUMAN ANATOMY, THIRD EDITION, by Van De Graaff, Kent M., William C. Brown Publishers)].

f. ce'rebri, f. of cerebrum: the sickle-shaped fold of dura mater that extends downward in the longitudinal cerebral fissure and separates the two cerebral hemispheres.

tentorium (ten-tor'e-am): an anatomical part resembling a tent or a covering.

t. cerebelli, t. of cerebellum: the process of dura mater that supports the occipital lobes and covers the cerebellum. Its internal border is free and bounds the tentorial notch; its external border is attached to the skull and encloses the transverse sinus behind.

The case vehicle's driver [mother; 32-year-old, White (non-Hispanic) female; 163 centimeters and 68 kilograms (64 inches, 150 pounds)] was seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot moving from the accelerator pedal to the brake pedal, and both hands on the steering wheel. Her seat track was located between its middle and rearmost positions, her seat back was upright, and her tilt steering wheel was located in its down-most position.

The case vehicle's driver was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Inspection of the driver's seat belt webbing revealed slight waffling in two places, but no evidence of loading to the "D"-ring or latch plate.

The case vehicle's driver indicated that her right foot was moving from the accelerator pedal to the brake pedal when the collision occurred. Because there were no avoidance maneuvers (other than the deceleration that results from removal of the driver's foot from the accelerator pedal) and independent of the use of her available restraints, the driver's pre-impact body position did not change just prior to the impact. The case vehicle's impact with the Intrepid enabled the case vehicle's driver to continue forward and slightly upwards toward the 350 degree Direction of Principal Force as the case vehicle decelerated. As a result she loaded her safety belts and the deploying driver air bag. There was no conclusive driver contact evidence on the air bag's fabric, although there were several black marks, smudges, and smears. In addition, there were similar marks, smudges, and smears on the steering wheel rim. As the case vehicle rotated clockwise, the driver most likely moved to her left and somewhat rearwards. At final rest, the driver exited the case vehicle under her own power, assisted the back right occupant in removing the second seat left passenger out of his child safety seat.

CASE VEHICLE DRIVER INJURIES

The driver accompanied her injured daughter in an ambulance to a local medical facility. The case vehicle's driver did not sustain any injuries as a result of this crash.

CASE VEHICLE SECOND SEAT LEFT PASSENGER KINEMATICS

The case vehicle's second seat left passenger [son; 3-year-old, White (non-Hispanic) male; 91 centimeters and 16 kilograms (36 inches and 35 pounds)] was restrained in a convertible child safety seat that was configured in its forward facing position. He was sitting upright with his feet dangling off the seat. In addition, the position of his hands is unknown. Although the child safety seat had been removed from the case vehicle prior to this contractor's vehicle inspection, the markings of the safety seat on the

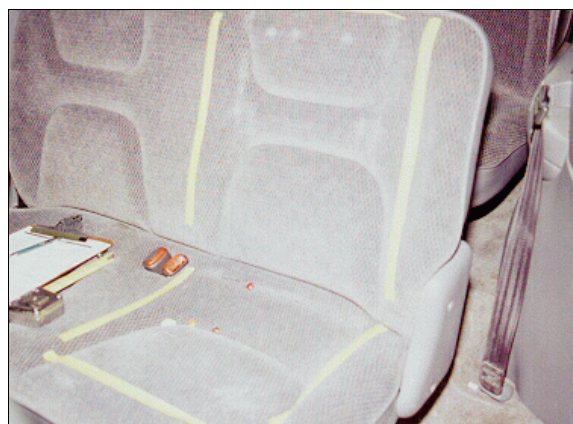


Figure 13: Imprint of child safety seat on fabric of case vehicle's second seat left; Note: child safety seat was not present during vehicle inspection (case photo #45)

vehicle's second seat (**Figure 13** above) and the absence of occupant contact to the back of the driver's bucket seat, indicates that this child seat was secured to the vehicle, and the child was restrained by the seat's harness. Thus, the second seat left passenger had his back against the safety seat and was restrained by the available child seat's harness with harness retainer clip and "T"-shield. The second row bench seat had non-adjustable seat tracks and the seat backs.

The case vehicle's driver indicated that her right foot was moving from the accelerator pedal to the brake pedal when the collision occurred. Because there were no avoidance maneuvers (other than the deceleration that results from removal of the driver's foot from the accelerator pedal) and independent of the use of the available restraints, the second seat left passenger's position was essentially unchanged just prior to the crash. The case vehicle's impact with the Intrepid enabled the second seat left passenger to continue forward and slightly upward toward the 350 degree Direction of Principal Force as the case vehicle decelerated. As a result, he loaded his child safety seat's harness, locking clip, and "T"-shield and, according to the child's father, the shield's latch plate was bent. His position would have shifted to the left and rearwards as the case vehicle rotated clockwise post-crash to final rest. At final rest the child remained in his child safety seat, most likely near his pre-crash posture.

CASE VEHICLE SECOND SEAT LEFT PASSENGER INJURIES

The driver's 3-year-old son was taken to the hospital by his father in private transportation and was given a precautionary examination. He sustained minor injuries and was treated and released. According to his medical records and the interview with the driver, the injuries sustained by the case vehicle's second seat left passenger included: an elbow abrasion and a contusion to his left upper hip.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion left elbow	790202.1 minor	Left side interior surface, excluding hardware and/or armrest	Probable	Emergency room records
2	Contusion left upper hip	890402.1 minor	Child safety seat	Certain	Interviewee (driver)

CASE VEHICLE BACK RIGHT PASSENGER KINEMATICS

The case vehicle's back right passenger [son; 11-year-old, White (non-Hispanic) male; 152 centimeters and 39 kilograms (60 inches, 87 pounds)] was seated, reportedly leaning to his left, pointing out Christmas lights on houses to his younger brother in the second seat left position. His back was probably not against the seat back, his feet were on the floor, and his hands were pointing toward various houses. The back bench seat had non-adjustable seat tracks and the seat backs.

The back right passenger was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. An inspection of this occupant’s seat belt webbing revealed one location of waffling, while the “D”-ring and latch plate did not show evidence of loading.

The case vehicle's driver indicated that her right foot was moving from the accelerator pedal to the brake pedal when the collision occurred. Because there were no avoidance maneuvers (other than the deceleration that results from removal of the driver’s foot from the accelerator pedal) and independent of the use of the available restraints, the back right passenger’s position was essentially unchanged just prior to the crash. The case vehicle's impact with the Intrepid enabled the back right passenger to continue forward and slightly upward toward the **350** degree Direction of Principal Force while loading his safety belts as the case vehicle decelerated. As the vehicle rotated clockwise from impact to final rest, this occupant most likely moved to his left and rearwards. The exact posture of this occupant at final rest is unknown but he was most likely near his pre-crash posture.

CASE VEHICLE BACK RIGHT PASSENGER INJURIES

The driver’s 11-year-old son was taken to the hospital by his father in private transportation and was given a precautionary examination. He sustained minor injuries and was treated and released. According to his medical records and the interview with the driver, the injuries sustained by the case vehicle's back right passenger included a contusion to his left shin.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion left shin {tibia, lower leg}	890402.1 minor	Seat back, second seat right passenger’s	Certain	Emergency room records

OTHER VEHICLE

The 1997 Dodge Intrepid Sport was a front wheel drive, five-passenger, four-door sedan (VIN: 2B3HD46F6VH-----) equipped with a 3.5 liter, SOHC, SMPI, 24 valve, V-6 engine and a four-speed automatic transmission. The case vehicle’s wheelbase was 287 centimeters (113.0 inches), and the odometer reading at inspection is unknown because the Intrepid was locked. The Intrepid was equipped with continuous loop, three-point, lap-and-shoulder, safety belt systems at the front and back outboard positions; and a two-point, lap belt system at the back center position. It was also equipped with driver and front right passenger supplemental restraints (air bags), neither of which deployed.

Direct damage to the Intrepid began at the rear edge of the right front door–near the right rocker panel, and extended rearward to the mid-point of the right rear wheel well. There was direct contact damage to the right rear wheel and tire (**Figure 3** above). The Intrepid’s right front

and right rear door panels, right rear wheel well, right rear wheel, right rear tire, and the right side rocker panel were directly damaged and crushed inward.

Based on the vehicle inspection, the CDC for the Intrepid was determined to be: **03-RZEW-2 (80)** [residual maximum crush was 7 centimeters (2.8 inches) at C₄]. The WinSMASH reconstruction program, damage only algorithm, was used on the Intrepid's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 14.0 km.p.h. (8.7 m.p.h.), -2.4 km.p.h. (-1.5 m.p.h.), and -13.8 km.p.h. (-8.6 m.p.h.). The Intrepid was driven from the scene.

The Intrepid's driver [19-year-old, White (non-Hispanic) female; 160 centimeters and 52 kilograms (63 inches, 115 pounds)] was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. The restraint usage for either the back left passenger [3-year-old, White (non-Hispanic) female; 91 centimeters and 16 kilograms (36 inches, 35 pounds)] or the back right passenger [3-year-old, White (non-Hispanic) female; 102 centimeters and 18 kilograms (40 inches, 40 pounds)] is unknown. None of the Intrepid's three occupants were transported to a medical facility because no injuries were reported. A day after the crash, however, the back right passenger complained of pain and swelling to her right forearm. Two days post-crash, an x-ray discovered a hairline fracture of either her radius or ulna.

