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ON-SITE AIR BAG FATALITY INVESTIGATION

CASE NUMBER - IN97-063
LOCATION - MISSISSIPPI
VEHICLE - 1994 DODGE CARAVAN
CRASH DATE - December, 1997

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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.

Technical Report Documentation Page

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On-site air bag deployment investigation involving a 1994 Dodge Caravan SE, minivan, with active, three-point safety belts and dual front air bags, and a 1994 Dodge Dakota, 4x2 club cab pick-up truck

16. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 1994 Dodge Caravan SE minivan (case vehicle) and a 1994 Dodge Dakota pickup truck (other vehicle). This crash is of special interest because the case vehicle's restrained, short statured driver (15- year-old female) sustained a fatal cervical injury from her deploying driver air bag as a result of a "high-speed", offset, head-on crash. The case vehicle was traveling south, up a hill, in the southbound lane of a two-lane, undivided, city street. The Dakota pickup had been traveling north, up a hill, in the northbound lane of the same roadway when it swerved into the southbound lane to pass a noncontact vehicle before coming over the hill crest. The crash occurred in the southbound lane of the roadway. The front of the case vehicle was impacted by the front of the Dakota pickup, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's driver was seated, with her seat track located between its middle and forward-most positions, and the steering wheel was located in its upmost position. She was restrained by her available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to the interview with the front right passenger (i.e., mother) and her medical records, a fatal cervical fracture at C_1 with transection of the proximal cervical spinal cord. In addition, she sustained an incomplete basilar skull fracture, a small subdural hematoma, subarachnoid hemorrhage involving the cerebellar hemispheres and the cerebrum, contusions to her right lung and liver, and multiple abrasions, contusions, and lacerations. This occupant's primary cervical injury was caused by her contact with the case vehicle's driver air bag. There were three other seated passengers in the case vehicle: front right (44-year-old female), second seat left (10-year-old male), and second seat right (11-year-old female). All three were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. The front right passenger's seat track was located between its middle and forward-most positions and the second seats were not adjustable. According to the mother's interview and their available medical records they sustained, respectively: a fractured right femur, a moderate nonanatomic brain injury, and abrasions and contusions; fractures to his right distal tibia, left distal radius, and right wrist–with dislocation, and abrasions and contusions; and a contused right lung, fractured left middle finger, lacerations to her left index finger and left shin, and abrasions and contusions.

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TABLE OF CONTENTS

IN97-063

Page No.

BACKGROUND 1

SUMMARY 1

CRASH CIRCUMSTANCES 5

CASE VEHICLE: 1994 DODGE CARAVAN SE 7
- CASE VEHICLE DAMAGE 8
- AUTOMATIC RESTRAINT SYSTEM 10
- CASE VEHICLE DRIVER KINEMATICS 12
- CASE VEHICLE DRIVER INJURIES 12
- CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS 15
- CASE VEHICLE FRONT RIGHT PASSENGER INJURIES 15
- CASE VEHICLE SECOND SEAT LEFT PASSENGER KINEMATICS 16
- CASE VEHICLE SECOND SEAT LEFT PASSENGER INJURIES 17
- CASE VEHICLE SECOND SEAT RIGHT PASSENGER KINEMATICS 18
- CASE VEHICLE SECOND SEAT RIGHT PASSENGER INJURIES 19

OTHER VEHICLE: 1994 DODGE DAKOTA PICKUP 20

CRASH DIAGRAM 22

SELECTED PHOTOGRAPHS

Figure 1:	Case vehicle's southbound travel path	5
Figure 2:	Dakota's northbound travel path in northbound lane	5
Figure 3:	Dakota's northbound travel path in southbound lane	6
Figure 4:	Dakota's pre-crash skid marks in southbound lane	6
Figure 5:	Case vehicle's frontal crush from front	7
Figure 6:	Dakota's frontal crush from front	7
Figure 7:	Case vehicle's frontal crush from left of front	7
Figure 8:	Dakota's frontal crush from left of front	7
Figure 9:	On-scene northward view of case vehicle and Dakota at final rest positions	7
Figure 10:	Overhead view of case vehicle's frontal damage	8
Figure 11:	Case vehicle's driver seating area showing massive intrusion	8

Page No.

SELECTED PHOTOGRAPHS (Continued)

Figure 12: Close-up of case vehicle's steering column showing shear capsule separation 9
Figure 13: Case vehicle's driver seating area showing steering wheel's intrusion into seat back 9
Figure 14: Close-up of case vehicle's driver knee bolster 9
Figure 15: Close-up of case vehicle's deformed glove box 10
Figure 16: Case vehicle's center and front right greenhouse areas 10
Figure 17: Case vehicle's deployed driver air bag 10
Figure 18: Close-up of contact evidence on case vehicle's deployed driver air bag 10
Figure 19: Case vehicle's deployed front right passenger air bag 11
Figure 20: Close-up of tears in top surface of case vehicle's deployed front right passenger air bag 11
Figure 21: Usage evidence on case vehicle's driver safety belt 12
Figure 22: Usage evidence on case vehicle's front right safety belt 15
Figure 23: Intrusion into case vehicle's left second seating area 16
Figure 24: Case vehicle's second seating area showing contact evidence on front seat backs 17
Figure 25: Close-up of contact evidence on back surface of case vehicle's driver seat back 17
Figure 26: Close-up of contact evidence on back surface of case vehicle's front right seat back 19
Figure 27: Dakota's front seating area showing massive intrusion 20
Figure 28: Dakota's deployed driver air bag 21

BACKGROUND

IN97-063

This on-site investigation was brought to NHTSA's attention on December 22, 1997 by a Sergeant with the Mississippi Highway Patrol. This crash involved a 1994 Dodge Caravan SE minivan (case vehicle) and a 1994 Dodge Dakota pickup truck (other vehicle). The crash occurred in December, 1997, at 5:35 p.m., in Mississippi and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's restrained, short statured driver [15- year-old, White (non-Hispanic) female; 157 centimeters (62 inches)] sustained a fatal cervical injury from her deploying driver air bag as a result of a "high-speed", offset, head-on crash. This contractor inspected the scene and vehicles on December 30, 1997. This contractor interviewed the case vehicle's front right passenger (i.e., mother of driver) on December 29, 1997. This report is based on the Police Crash Report, interviews with the case vehicle's front right passenger and the investigating police officer, scene and vehicle inspections, occupant kinematic principles, occupant medical records and driver's autopsy, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling south, up a hill, in the southbound lane of a two-lane, undivided, city street and intended to continue in its southbound path of travel. The Dakota pickup had been traveling north, up a hill, in the northbound lane of the same, two-lane, undivided, city street when it swerved into the southbound lane to pass a noncontact vehicle. The Dakota pickup was now traveling north in the southbound lane when it crested a hill. According to the investigating police officer, the Dakota pickup was drag racing the noncontact vehicle it was passing. According to the Police Crash Report, both vehicles were traveling approximately 113 km.p.h. (70 m.p.h.). Upon coming over the hill crest, the driver of the Dakota pickup braked, depositing approximately 50.0 meters (164 feet) of front skid marks prior to impact, in an attempt to avoid the crash. There was no indications that the case vehicle's driver made any avoidance maneuvers prior to the crash. The crash occurred in the southbound lane of the roadway.

The front of the case vehicle was impacted by the front of the Dakota pickup, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The crash was slightly offset toward the driver's side of each vehicle. The impact was so severe that the case vehicle was driven backwards, off the west side of the roadway, approximately 8.2 meters (27 feet) and rotated approximately 60 degrees counterclockwise. The case vehicle came to rest on the west roadside, heading southeast. Upon maximum engagement, the Dakota pickup rotated approximately 60 degrees counterclockwise off of the case vehicle and came to rest heading northwest primarily in the northbound lane.

The 1994 Dodge Caravan SE was a front wheel drive, three-door minivan (VIN: 2B4GH45R0RR------). The case vehicle was equipped with anti-lock brakes. Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-5 (0)**. 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: 89.5 km.p.h. (55.6 m.p.h.), -89.5 km.p.h. (-55.6 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The case vehicle was towed due to damage.

The case vehicle's contact with the Dakota pickup involved the entire front surface. Direct damage began 25 centimeters (9.8 inches) inward from the front right bumper corner and extended, a measured distance of 129 centimeters (50.8 inches), along the front bumper. Maximum crush was measured as 103 centimeters (40.6 inches) between C_1 and C_2. The wheelbase on the case vehicle's left side was shortened 54 centimeters (21.3 inches) while the right side was shortened 10 centimeters (3.9 inches). The case vehicle's front bumper, bumper fascia, grille, hood, radiator, left fender, and right and left head light and turn signal assemblies were directly damaged and crushed rearward. The case vehicle's left and right front tires were physically restricted, and the left front of the tire was deflated from the crash. Both the right and left fenders sustained induced damage. Remote buckling and vertical intrusion was also found on the left portion of the roof over the driver's seating area.

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 without any tethers. The driver's air bag had two vent ports, approximately 2.5 centimeters (1.0 inch) in diameter, located at the 11:30 and 12:30 o'clock positions. The deployed driver's air bag was round with a diameter of 57 centimeters (22.4 inches). There was a 7 x 13 centimeter (2.8 x 5.1 inch) vertically oriented area of contact evidence (i.e., blood and skin) readily apparent on the front surface of the driver's air bag, located just below the center of the air bag toward the 6 o'clock position [i.e., specifically 18 cm (7.1 in) inward from the 9 o'clock position and 6 cm (2.4 in) upward from the 6 o'clock position].

The front right passenger's air bag was located in the top of the instrument panel. An inspection of the front right air bag module's cover flap and air bag revealed that the cover flap opened at the designated tear points, and there was a scuff mark on the leading edge of the cover flap extending from just right of center to the right front corner, most likely from its interaction with the intruding dash panel. Furthermore, there were tears/punctures on the front right air bag module's top surface from contact with the crack windshield's glazing. The front right passenger's air bag was designed with two tethers, each 31 centimeters (12.2 inches) in width. The front right air bag had no vent ports. The deployed front right air bag was rectangular with a height of approximately 65 centimeters (25.6 inches) and a width of approximately 47 centimeters (18.5 inches). There was a 4 centimeter (1.6 inch) essentially circular area of skin transfer located toward the 5:30 o'clock position [i.e., specifically, 7 cm (2.8 in) below the bottom tether strap and 15 cm (5.9 in) leftward of the front surface's right edge].

Inspection of the case vehicle's interior revealed massive intrusion to the driver's seating area, including left instrument panel/knee bolster, steering assembly, and left toe pan. An inspection of the steering column's shear capsule showed it was completely collapsed/separated. The severe impact also caused the floor pan and sill to fold downward tilting the driver's seat closer to the steering column. The driver's seat track was torqued to the right with the left track in its original position and the right track moved rearward. As a result the bottom of the steering wheel's rim was deformed by the driver's torso. Furthermore, the left knee bolster was deformed from contact by the driver's left knee and the glove box door was scuffed and deformed by the front right passenger's knees. Also, there was a possible scuff to the right sun visor. Finally, the

lower portions of both front seat backs shows evidence of occupant contact by the lower extremities of the back left and back right passengers, respectively.

The 1994 Dodge Dakota is a rear wheel drive, 4x2, club cab, pickup truck (VIN: 1B7GL23X7RS------). Based on the vehicle inspection, the CDC for the Dakota pickup was determined to be: **12-FDEW-5 (0)** [maximum crush was 119 centimeters (46.9 inches) at C_1]. The WinSMASH reconstruction program, damage only algorithm, was used on the Dakota's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 89.1 km.p.h. (55.4 m.p.h.), -89.1 km.p.h. (-55.4 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The Dakota pickup was towed due to damage.

Immediately prior to the crash the case vehicle's driver [157 centimeters and 44 kilograms (62 inches, 98 pounds)] was seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot off the accelerator, and both hands on the steering wheel bracing for the crash. Her seat track was located between its middle and forward-most positions, the seat back was upright, and the tilt steering wheel was located in its up-most position.

The case vehicle's driver was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. There was no clear evidence of belt pattern bruising and abrasions to the driver's body, but the inspection of the driver's seat belt webbing and “D”-ring showed evidence of loading (i.e., blood on webbing, friction scrubs on the “D”-ring). In addition, it had been cut during the extrication process.

The case vehicle's driver made no avoidance maneuvers prior to the crash. This contractor believes that the absence of avoidance maneuvers was a result of the driver’s inexperience. As a result and independent of the use of her available safety belts, her pre-impact body position did not change just prior to impact. The case vehicle's impact with the Dakota pickup enabled the case vehicle’s driver to continue forward and slightly upward toward the case vehicle’s **0** degree Direction of Principal Force as the case vehicle decelerated. Because of the driver’s short stature [157 centimeters (62 inches) and resultant close proximity to the steering wheel and the position of the tilt steering column, the driver’s head and upper torso were well within the excursion area of the driver’s deploying air bag despite the use of her available restraints. The severity of the impact would have caused the driver’s inertia sensitive seat belt to lock up, preventing the driver from initially contacting the steering wheel. However, the extent of crush to the case vehicle’s front left caused the steering wheel and column to be pushed upward and rearward into the driver’s seating area. At maximum engagement the driver was entrapped between her seat back and the steering wheel. The steering wheel was deformed by the driver’s loading. As the case vehicle rotated counterclockwise off the Dakota pickup, the driver remained entrapped between the steering wheel, her seat back, and the left door panel. At final rest the case vehicle’s driver was still seated in her seat, slumped forward with her face in the collapsed air bag and entrapped between the steering wheel and seat back.

The driver sustained a fatal injury and was pronounced dead at the scene; however, she was transported by ambulance to the hospital for organ donation and autopsy purposes. Based on her autopsy and medical records, the injuries sustained by the case vehicle's driver included: a

cervical fracture at C_1 with transection of the proximal cervical spinal cord, an incomplete basilar skull fracture involving the posterior fossa, a small subdural hematoma near the cerebellar hemispheres, subarachnoid hemorrhage involving the cerebellar hemispheres, and a subarachnoid hemorrhage in the cerebrum. In addition, she sustained contusions to her right lung and liver; a contused chin and scalp; abrasions to her face, anterior neck (linear), and anterior chest; contusions to her right upper extremity; abrasions and lacerations to her left upper extremity; contusion, abrasions, and lacerations of the anterior surface of her right lower extremity; and contusion and lacerations to the anterior surface of left lower extremity. This occupant's primary cervical injury was caused by her contact with the case vehicle's driver air bag.

The case vehicle's front right passenger [44 year-old, White (non-Hispanic), female; 152 centimeters and 61 kilograms (60 inches, 135 pounds)] was seated, leaning towards the driver, in an upright posture with her back against the seat back, both feet on the floor, and both hands holding onto the center armrest. At the time of the vehicle inspection her seat track was located in its rearmost position, but her seat track had most likely been moved from between its middle and forward-most, pre-crash position during the extrication process. The seat back was upright.

The case vehicle's front right passenger (i.e., driver's mother) was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was evidence of belt pattern bruising and abrasions to the passenger's abdomen and chest, and the inspection of the front right passenger's seat belt webbing and "D"-ring showed evidence of loading (i.e., a friction scrub on the "D"-ring and webbing).

The front right passenger was transported by ambulance to the hospital. She sustained a serious injury and was hospitalized for five days post-crash. The injuries sustained by the case vehicle's front right passenger included: a fractured right femur, a nonanatomic brain injury with loss of consciousness at the scene, an abrasion to her right cheek, seat belt contusions over her sternum and lower abdominal wall, and contusions to the whole left side of her body.

The case vehicle's second seat left passenger [10-year-old, White (non-Hispanic) male; 137 centimeters and 30 kilograms (54 inches, 66 pounds)] was seated in an upright posture with his back against the seat back, his feet on the floor, and either both hands in his lap or more likely bracing for the crash. His seat track was not adjustable, and the seat back was upright.

The case vehicle's second seat left passenger was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was evidence of belt pattern bruising to the passenger's abdomen and left side of his neck, and an inspection of the passenger's three-point, safety belt system showed evidence of loading (i.e., a friction scrub on the "D"-ring and webbing). There was a significant amount of intrusion to this passenger's seating area.

The second seat left passenger was transported by ambulance to the hospital. He sustained serious injuries and was hospitalized for two days post-crash. According to his medical records and the interview with the case vehicle's front right passenger (i.e., mother), the injuries sustained by the second seat left passenger included: a comminuted fracture to his right distal tibia, a displaced fracture to his left distal radius, and a right wrist dislocation with accompanying chip

fractures. In addition, he sustained abrasions about the left side of his head and face; contusions about the left side of his head and forearm; and seat belt abrasions and contusions involving his left neck, center chest, and lower abdomen.

Immediately prior to the crash the case vehicle's second seat right passenger [11-year-old, White (non-Hispanic) female; 142 centimeters and 42 kilograms (56 inches, 92 pounds)] was seated in an upright posture with her back against the seat back, her feet on the floor, and both hands in her lap. Her seat track was not adjustable, and the seat back was upright.

The case vehicle's second seat right passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was evidence of belt pattern bruising to the passenger's abdomen and chest, and an inspection of the passenger's three-point, safety belt system showed evidence of loading (i.e., a friction scrub on the "D"-ring and webbing).

The second seat right passenger was transported by ambulance to the hospital. She sustained a serious injury and was hospitalized for two days post-crash. According to her medical records and the interview with the case vehicle's front right passenger (i.e., mother), the injuries sustained by the second seat right passenger included: a contused right lung and a fracture to her left middle finger. In addition, she sustained a laceration to her left index finger and left shin, and seat belt abrasions and contusions to her chest and abdomen.

CRASH CIRCUMSTANCES

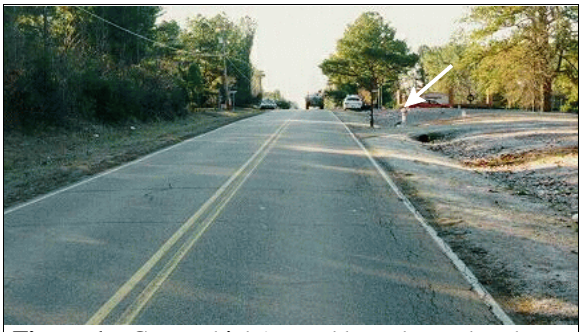


Figure 1: Case vehicle's southbound travel path up hill; Note: arrow marks approximate point of impact in southbound lane (case photo #01)

Figure 2: Dakota pickup's northward travel path in northbound lane up hill; Note: police vehicles mark location of hill crest (case photo #08)

The case vehicle was traveling south, up a slight hill, in the southbound lane of a two-lane, undivided, city street and intended to continue in its southbound path of travel (**Figure 1**). The Dakota pickup had been traveling north, up a hill, in the northbound lane of the same, two-lane, undivided, city street (**Figure 2**) when it swerved into the southbound lane to pass a noncontact vehicle. The Dakota pickup was now traveling north in the southbound lane when it crested a hill (**Figure 3** below). According to the investigating police officer, the Dakota pickup was drag racing the noncontact vehicle it was passing. According to the Police Crash Report, both vehicles were traveling approximately 113 km.p.h. (70 m.p.h.). Upon coming over the hill crest, the driver of the Dakota pickup braked, depositing approximately 50.0 meters (164 feet) of front skid

marks prior to impact, in an attempt to avoid the crash (**Figure 4**). There was no indications that the case vehicle's driver made any avoidance maneuvers prior to the crash. According to the case vehicle's front right passenger (i.e. mother of driver), the driver (daughter) had no time to react. The crash occurred in the southbound lane of the roadway.

Figure 3: Dakota pickup's northward travel path just south of hill crest to in southbound lane after passing noncontact vehicle; Note: police vehicles mark location of hill crest (case photo #09)

Figure 4: Dakota pickup's northbound travel path in southbound lane after cresting hill showing skid marks leading to point of impact (i.e., roadside arrow) in southbound lane (case photo #11)

The city roadway was straight and level (i.e., actual slope was 1.7%, positive to the south) at the location of the impact. The roadway was also level (i.e., actual slope was 1.8%, positive to the south) in the case vehicle's southward direction of travel; however, the Dakota pickup had a 3.4% grade positive to the north (i.e., an upgrade in the Dakota's direction of travel) prior to traversing the hill crest, but only a 1.7% grade (i.e., level), negative to the north, after cresting the hill near the area of impact. The pavement was bituminous, but traveled, and the width of the travel lanes for both vehicles was 3.0 meters (9.8 feet). The shoulders were not improved (i.e., grass). Pavement markings consisted of a double solid yellow centerline for both north and southbound traffic. In addition, solid white edge lines were present along the outside of both north and southbound lanes. The estimated coefficient of friction was 0.75, not including the slope. There were no visible traffic controls. The statutory speed limit was 72 km.p.h. (45 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 near 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 primarily urban residential. In addition, approximately 50 meters (164 feet) south of the crash site, there was a three-leg intersection at the top of the hill crest on the west side of the roadway for an entrance to a subdivision (**Figure 3**), and there was an intersecting residential driveway within a short distance just north of the crash site (**Figure 4**).

The front of the case vehicle (**Figures 5** and **7** below) was impacted by the front of the Dakota pickup (**Figures 6** and **8** below), causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The crash was slightly offset toward the driver's side of each vehicle. The impact was so severe that the case vehicle was driven backwards, off the west side of the roadway, approximately 8.2 meters (27 feet) and rotated approximately 60 degrees counterclockwise. The case vehicle came to rest on the west roadside, heading southeast. Upon maximum engagement, the Dakota pickup rotated approximately 60 degrees counterclockwise off

of the case vehicle and came to rest, partially blocking the north and southbound lanes, heading northwest primarily in the northbound lane (**Figure 9**).

Figure 5: Case vehicle's frontal damage with contour gauge present (case photo #14)

Figure 6: Dakota pickup's frontal damage with contour gauge present (case photo #58)

Figure 7: Case vehicle's frontal damaged, viewed from left of front, with contour gauge present (case photo #18)

Figure 8: Dakota pickup's severe frontal damage, viewed from left of front with contour gauge present (case photo #63)

Figure 9: On-scene northward view of the case vehicle and Dakota pickup at final rest positions; Note: Dakota's pre-crash skid marks and post-impact counterclockwise rotation of both vehicles (case photo #13)

CASE VEHICLE

The 1994 Dodge Caravan SE was a front wheel drive, seven-passenger, three-door minivan (VIN: 2B4GH45R0RR------) equipped with a 3.3L, V-6 engine and a transverse mounted, four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum, four-wheel, anti-lock system. The case vehicle's wheelbase was 285 centimeters (112.3 inches), and the odometer reading at inspection was 123,564 kilometers (76,779 miles).

Inspection of the vehicle's interior revealed adjustable front, box-mounted, bucket seats with integral head restraints; non-adjustable, box-mounted, bucket seats with integral head restraints were present in the second seating area; and a non-adjustable split bench seat with separate back

cushions but without head restraints was provided for the back seating positions. Continuous loop, three-point, lap-and-shoulder, safety belt systems were present at the front, second, and back outboard positions; and a two-point, lap belt system at the back center position. The front seat belt systems were equipped with manually operated height adjusters for the "D"-rings and both front adjusters were located in their down-most positions. The vehicle was equipped with knee bolsters for both the driver and front right passenger, both of which showed contact evidence (i.e., scuffing and deformation). 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 Dakota pickup.

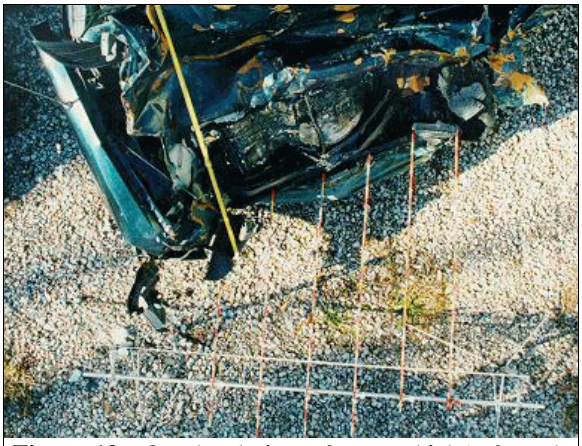


Figure 10: Overhead view of case vehicle's frontal damage with contour gauge present; Note: offset nature of crush profile (case photo #16)

CASE VEHICLE DAMAGE

The case vehicle's contact with the Dakota pickup involved a wide engagement of the entire front surface. Direct damage began 25 centimeters (9.8 inches) inward from the front right bumper corner and extended across the front bumper, a measured distance of 129 centimeters (50.8 inches), to the front left bumper corner. The direct contact damage consisted of both bumper level and override- type damage above the bumper. All six C-measurements were average according to NASS CDS protocol. For example, at C_2 the crush extended backwards 84 centimeters (33.1 inches) at bumper level and 101 centimeters (39.8 inches) above bumper. Maximum crush was measured as 103 centimeters (40.6 inches) above the bumper between C_2 and C_3 (**Figure 10**). The wheelbase on the case vehicle's left side was shortened 54 centimeters (21.3 inches) while the right side was shortened 10 centimeters (3.9 inches). The case vehicle's front bumper, bumper fascia, grille, hood, radiator, left fender, and right and left head light and turn signal assemblies were directly damaged and crushed rearward. The case vehicle's left and right front tires were physically restricted, and the left front of the tire was deflated from the crash. Both the right and left

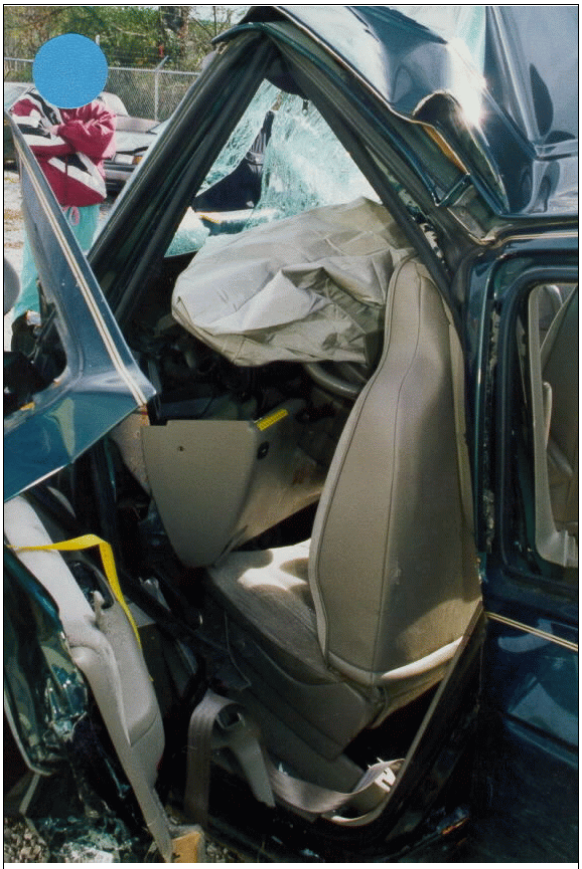


Figure 11: Case vehicle's driver seating area showing massive intrusion; Note: buckled roof and vertical intrusion around left "B"-pillar (case photo #26)

fenders sustained induced damage. Remote buckling and vertical intrusion was also found on the left portion of the roof over the driver's seating area (**Figure 11** above).

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FDEW-5 (0)**. 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: 89.5 km.p.h. (55.6 m.p.h.), -89.5 km.p.h. (-55.6 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The case vehicle was towed due to damage.

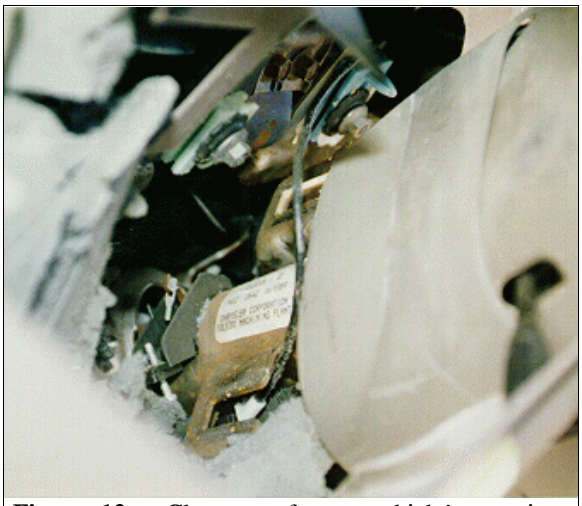


Figure 12: Close-up of case vehicle's steering column showing shear capsule separation (case photo #29)

Figure 13: Case vehicle's driver seating area viewed from left showing deployed air bag, air bag module's bottom cover flap, and deformed steering wheel rim against seat back (case photo #42)

Figure 14: Close-up of case vehicle's driver knee bolster showing contact evidence from driver's knee (case photo #27)

Inspection of the case vehicle's interior revealed massive longitudinal intrusion concentrated to the driver's seating area, including left "A"-pillar, left instrument panel/knee bolster, steering assembly, and left toe pan (**Figure 11** above). The distance between the steering wheel hub and the driver's seat back was reduced to 10 centimeters (3.9 inches). Integrity was lost through the windshield (split) and driver's and left second windows (disintegrated). An inspection of the steering column's shear capsule showed it was completely collapsed/separated (**Figure 12**). The severe impact also caused the floor pan and sill to fold downward tilting the driver's seat closer to the steering column. The driver's seat track was torqued to the right with the left track in its original position and the right track moved rearward. As a result the bottom of the steering wheel's rim was deformed upwards 1.5 centimeters (0.6 inches) by the driver's torso (**Figure 13**), instead of back/downwards as normally seen. Furthermore, the left knee bolster was deformed from contact by the driver's left knee (**Figure 14**) and the glove box door was scuffed and deformed by the front right passenger's knees (**Figure 15** below). It should also be noted that the right air vent on the passenger side was blown out, most likely during the front right passenger air bag's

deployment. Also, there was a possible scuff to the right sun visor (**Figure 16**). Finally, the lower portions of both front seat backs shows evidence of occupant contact by the lower extremities of the back left and back right passengers, respectively.

Figure 15: Case vehicle's impacted glove box door and front right knee bolster (case photo #38)

Figure 16: Case vehicle's center and front right greenhouse area showing cracked and holed windshield's glazing, displaced rearview mirror, and scuffed front right sun visor (case photo #36)

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 Dakota pickup. The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of symmetrical "H"-configuration cover flaps made of thick vinyl with overall dimensions of 18 centimeters (7.1 inches) at the horizontal seam and 6 centimeters (2.4 inches) vertically for both the upper and lower flaps. 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 without any tethers. The driver's air bag had two vent ports, approximately 2.5 centimeters (1.0 inch) in diameter, located at the 11:30 and 12:30 o'clock positions. The deployed driver's air bag was round with a diameter of 57 centimeters (22.4 inches). An inspection of the driver's air bag revealed a 7 x 13 centimeter (2.8 x 5.1 inch) vertically oriented area of contact evidence (i.e., blood and skin–**Figures 17** and **18**) readily

Figure 17: Case vehicle's deployed driver air bag showing (i.e., yellow tape) driver's contact area (case photo #40)

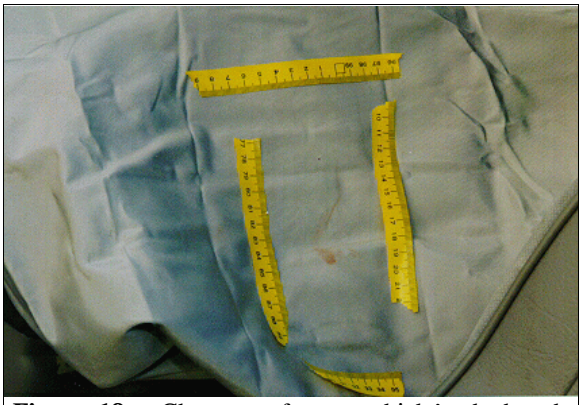


Figure 18: Close-up of case vehicle's deployed driver air bag showing skin transfer and blood smear (case photo #41)

apparent on the front surface of the driver's air bag, located just below the center of the air bag toward the 6 o'clock position [i.e., specifically 18 cm (7.1 in) inward from the 9 o'clock position and 6 cm (2.4 in) upward from the 6 o'clock position].

The front right passenger's air bag was located in the top of the instrument panel. There was a single, essentially rectangular, rearward hinged, modular cover flap. The cover flap was made of a thick vinyl over a thick cardboard type frame. The flap's dimensions were: 32 centimeters (12.6 inches) at the lower horizontal seam and 14 centimeters (5.5 inches) along both vertical seams. The profile of the case vehicle's instrument panel resulted in a 3 centimeter (1.2 inch) setback of the leading edge of the cover flap relative to the protruding right instrument panel. An inspection of the front right air bag module's cover flap and air bag revealed that the cover flap opened at the designated tear points, and there was a scuff mark on the leading edge of the cover flap extending from just right of center to the right front corner, most likely from its interaction with the intruding dash panel. Furthermore, there were several 1-2 centimeter (0.4-0.8 inch) tears/punctures on the front right air bag module's top surface from contact with the crack windshield's glazing (**Figures 19** and **20**). The front right passenger's air bag was designed with two internal tethers, each 31 centimeters (12.2 inches) in width. The upper tether was sewn to the front surface of the passenger air bag at a point that was approximately 21 centimeters (8.3 inches) below the top horizontal edge of the bag, and the lower tether was sewn approximately 15 centimeters (5.9 inches) above the bottom horizontal edge. There was a 29 centimeter (11.4 inch) separation between the two tethers. The front right air bag had no vent ports. The deployed front right air bag was rectangular with a height of approximately 65 centimeters (25.6 inches) and a width of approximately 47 centimeters (18.5 inches). Examination of the front right passenger air bag revealed a small, 4 centimeter (1.6 inch), essentially circular area of skin transfer located toward the 5:30 o'clock position [i.e., specifically, 7 cm (2.8 in) below the bottom tether strap and 15 cm (5.9 in) leftward of the front surface's right edge (**Figure 19**)]. The skin most likely came from the front right passenger's face during her maximum forward movement.

Figure 19: Case vehicle's front right passenger air bag showing skin transfer near bottom and windshield punctures (circled) near top (case photo #44)

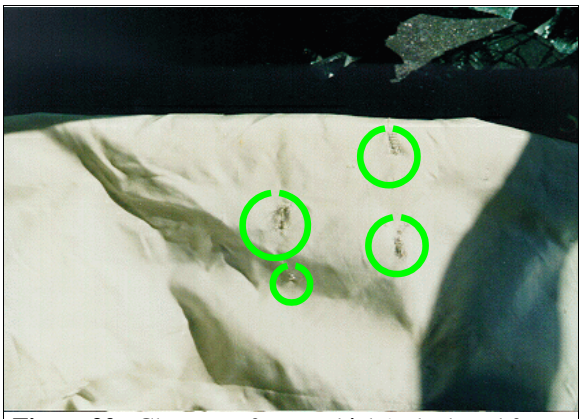


Figure 20: Close-up of case vehicle's deployed front right passenger air bag showing (highlighted) punctures near top of front surface from interaction with intruding windshield's glazing (case photo #45)

According to the front right passenger (i.e., mother), immediately prior to the crash the case vehicle's driver [15- year-old, White (non-Hispanic) female; 157 centimeters and 44 kilograms (62 inches, 98 pounds)] was seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot off the accelerator, most likely reaching for the brake pedal, and both hands on the steering wheel bracing for the crash. Her seat track was located between its middle and forward-most positions, the seat back was upright, and the tilt steering wheel was located in its up-most position.

The case vehicle's driver was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. There was no clear evidence of belt pattern bruising and abrasions to the driver's body, but the inspection of the driver's seat belt webbing and "D"-ring showed evidence of loading (i.e., blood on webbing, friction scrubs on the "D"-ring). In addition, it had been cut during the extrication process (**Figure 21**).

Figure 21: Case vehicle's driver safety belt showing (highlighted) friction scrub (case photo #31)

The case vehicle's driver made no avoidance maneuvers prior to the crash. This contractor believes that the absence of avoidance maneuvers was a result of the driver's inexperience. As a result and independent of the use of her available safety belts, her pre-impact body position did not change just prior to impact. The case vehicle's impact with the Dakota pickup enabled the case vehicle's driver to continue forward and slightly upward toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. Because of the driver's short stature [157 centimeters (62 inches) and resultant close proximity to the steering wheel and the position of the tilt steering column, the driver's head and upper torso were well within the excursion area of the driver's deploying air bag despite the use of her available restraints. The severity of the impact would have caused the driver's inertia sensitive seat belt to lock up, preventing the driver from initially contacting the steering wheel. However, the extent of crush to the case vehicle's front left caused the steering wheel and column to be pushed upward and rearward into the driver's seating area. At maximum engagement the driver was entrapped between her seat back and the steering wheel. The steering wheel was deformed by the driver's loading (**Figure 13** above). As the case vehicle rotated counterclockwise off the Dakota pickup, the driver remained entrapped between the steering wheel, her seat back, and the left door panel. At final rest the case vehicle's driver was still seated in her seat, slumped forward with her face in the collapsed air bag and entrapped between the steering wheel and seat back.

CASE VEHICLE DRIVER INJURIES

At the scene the case vehicle's driver was entrapped between the steering wheel and her seat back and had to be extricated from the vehicle. The driver sustained a fatal injury and was

pronounced dead at the scene; however, she was transported by ambulance to the hospital for organ donation and autopsy purposes. Based on her autopsy and medical records, the injuries sustained by the case vehicle's driver included: a cervical fracture at C_1 with transection of the proximal cervical spinal cord, an incomplete basilar skull fracture involving the posterior fossa, a small subdural hematoma near the cerebellar hemispheres, subarachnoid hemorrhage involving the cerebellar hemispheres, and a subarachnoid hemorrhage in the cerebrum. In addition, she sustained contusions to her right lung and liver; a contused chin and scalp; abrasions to her face, anterior neck (linear), and anterior chest; contusions to her right upper extremity; abrasions and lacerations to her left upper extremity; contusion, abrasions, and lacerations of the anterior surface of her right lower extremity; and contusion and lacerations to the anterior surface of left lower extremity. This occupant's primary cervical injury was caused by her contact with the case vehicle's driver air bag.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Transection of proximal cervical spinal cord with disruption of parenchyma and fracture of first cervical vertebra	640272.6 untreatable	Air bag, driver's	Certain	Autopsy
2	Fracture, incomplete, basilar, involving the foramen magnum	150200.3 serious	Air bag, driver's	Probable	Autopsy
3	Hemorrhage, subarachnoid, diffuse, involving right and left cerebellar hemispheres [Aspect = Posterior]	140466.3 serious	Air bag, driver's	Probable	Autopsy
4	Hematoma, subdural, 20 cc near right and left cerebellar hemispheres [Aspect = Unknown]	140652.4 severe	Air bag, driver's	Probable	Autopsy
5	Hemorrhage, subarachnoid, minimal, in cerebral cortex [Aspect = Unknown]	140684.3 serious	Air bag, driver's	Probable	Autopsy
6	Contusions right lung, up to 3 cm (1.2 in), location/lobe not specified	441406.3 serious	Steering wheel hub and/or spokes and rim	Certain	Autopsy
7	Contusions, multiple, inferior surface of liver, up to 10 cm (3.9 in)	541810.2 moderate	Steering wheel rim	Probable	Autopsy
8	Contusion {cephalohematoma}, diffuse, location not specified [Aspect = Unknown]	190402.1 minor	Roof	Probable	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
9	Contusion {hematoma} to rostrum of chin	290402.1 minor	Steering wheel hub and/or spokes and rim	Certain	Other: Medical Examiner's Report of Investigation
10	Abrasions right cheek	290202.1 minor	Air bag, driver's	Certain	Autopsy
11	Abrasions chin and left corner of mouth [Aspect = Inferior]	290202.1 minor	Air bag, driver's	Certain	Autopsy
12	Abrasions, linear, anterior neck	390202.1 minor	Air bag, driver's	Certain	Autopsy
13	Abrasions mid to left chest wall up to 16 cm (6.3 in) and inferior right chest wall, 4 cm (1.6 in) [Aspect = Whole]	490202.1 minor	Air bag, driver's	Probable	Autopsy
14	Contusions right anteromedial upper arm and anterior forearm	790402.1 minor	Air bag, driver's	Probable	Autopsy
15	Abrasions, 6 cm (2.4 in) posterior left forearm and dorsal left hand and digits	790202.1 minor	Left instrument panel and below	Probable	Autopsy
16	Lacerations dorsal left hand and digits	790602.1 minor	Left instrument panel and below	Certain	Autopsy
17	Abrasion, 4 cm (1.6 in), mid anterior right thigh	890202.1 minor	Steering column, undersurface	Possible	Autopsy
18	Contusions right anterior thigh, up to 14 cm (5.5 in), and left anterior thigh, up to 16 cm (6.3 in)	890402.1 minor	Steering wheel rim	Possible	Autopsy
19	Laceration, 10 cm (3.9 in), anterolateral left thigh	890602.1 minor	Left instrument panel and below	Certain	Autopsy
20	Contusion left anterior shin, up to 16 cm (6.3 in), and right shin, up to 14 cm (5.5 in)	890402.1 minor	Left instrument panel and below	Certain	Autopsy
21	Abrasion, 3 cm (1.2 in) anteromedial right shin	890202.1 minor	Left instrument panel and below	Certain	Autopsy
22	Laceration, 3 cm (1.2 in) anteromedial right shin	890602.1 minor	Left instrument panel and below	Certain	Autopsy

The case vehicle's front right passenger [44 year-old, White (non-Hispanic), female; 152 centimeters and 61 kilograms (60 inches, 135 pounds)] was seated, leaning towards the driver, in an upright posture with her back against the seat back, both feet on the floor, and both hands holding onto the center armrest. At the time of the vehicle inspection her seat track was located in its rearmost position, but her seat track had most likely been moved from between its middle and forward-most, pre-crash position during the extrication process. The seat back was in the upright position.

The case vehicle's front right passenger (i.e., driver's mother) was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was evidence of belt pattern bruising and abrasions to the passenger's abdomen and chest, and the inspection of the front right passenger's seat belt webbing and "D"-ring showed evidence of loading (i.e., a friction scrub on the "D"-ring and webbing–**Figure 22**).

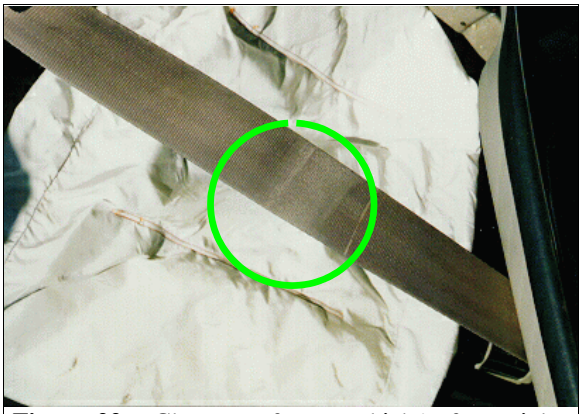


Figure 22: Close-up of case vehicle's front right safety belt showing friction scrub on webbing (case photo #47)

The case vehicle's driver made no avoidance maneuvers prior to the crash. As a result and independent of the use of her available safety belts, the front right passenger's pre-impact body position did not change just prior to impact. The case vehicle's impact with the Dakota pickup enabled the front right passenger to continue forward and slightly upward toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. Because of the front right passenger's short stature [152 centimeters (60 inches)] and resultant close proximity (i.e., seat between middle and forward-most position) to the right instrument panel, her head and upper torso were well within the excursion area of the deploying front right air bag despite the use of her available restraints. The deploying air bag contacted the passenger's head knocking her momentarily unconscious. The severity of the impact would have caused the front right passenger's inertia sensitive seat belt to lock up, preventing the her from initially contacting the right instrument panel; however, the intruding lower right instrument panel contacted the front right passenger's right knee causing her right femur fracture. As the case vehicle reached maximum engagement and rotated counterclockwise off the Dakota pickup, the front right passenger moved to her right contacting the right front door panel with her right side before rebounding back to her left, most likely contacting the intruding center instrument panel before the case vehicle came to a abrupt halt. At final rest the case vehicle's front right passenger presumably remained in her seat, leaning to the left, still momentarily unconscious.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was transported by ambulance to the hospital. She sustained a serious injury and was hospitalized for five days post-crash. The injuries sustained by the case vehicle's front right passenger included: a fractured right femur, a nonanatomic brain injury with

loss of consciousness at the scene, an abrasion to her right cheek, seat belt contusions over her sternum and lower abdominal wall, and contusions to the whole left side of her body.

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 at scene; awake, alert, and oriented on admission	160202.2 moderate	Air bag, front right passenger's	Probable	Hospitalization records
2	Fracture, severely comminuted, intra-articular {condylar}, right distal femur	851804.3 serious	Glove box door	Certain	Hospitalization records
3	Abrasion over cheek, not further specified [Aspect = Unknown]	290202.1 minor	Air bag, front right passenger's	Certain	Hospitalization records
4	Contusion over sternum	490402.1 minor	Torso portion of safety belt system	Certain	Hospitalization records
5	Contusion {bruising} on anterior abdominal wall, not further specified	590402.1 minor	Lap portion of safety belt system	Certain	Hospitalization records
6	Contusions {bruises} whole left side of body including arm and leg [Aspect = Whole]	990400.1 minor	Center instrument panel and below	Probable	Interviewee (same person)

CASE VEHICLE SECOND SEAT LEFT PASSENGER KINEMATICS

The case vehicle's second seat left passenger [10-year-old, White (non-Hispanic) male; 137 centimeters and 30 kilograms (54 inches, 66 pounds)] was seated in an upright posture with his back against the seat back, his feet on the floor, and either both hands in his lap or more likely up in front of him bracing for the crash. His seat track was not adjustable, and the seat back was in the upright position.

The case vehicle's second seat left passenger was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was evidence of belt pattern bruising to the passenger's abdomen and left side of his neck, and an inspection of the passenger's three-point, safety belt system showed evidence of loading (i.e., a friction scrub on the "D"-ring and webbing). There was a significant amount of intrusion to this passenger's seating area (**Figure 23** and **Figure 24** below).

Figure 23: Case vehicle's interior viewed from back showing intrusion into seating area occupied by second seat left passenger (case photo #51)

The case vehicle's driver made no avoidance maneuvers prior to the crash. As a result and independent of the use of his available safety belts, the second seat left passenger's pre-impact body position did not change just prior to impact. The case vehicle's impact with the Dakota pickup enabled the second seat left passenger to continue forward and slightly upward toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. The severity of the impact would have caused the second seat left inertia sensitive seat belt to lock up, preventing his torso from contacting the driver's seat back, but the passenger's right lower leg got caught under the driver's seat which was subsequently shoved backwards breaking his leg (**Figures 24** and **25**). Furthermore, the passenger's bracing attempt resulted in his left distal radius fracture. As the case vehicle reached maximum engagement and rotated counterclockwise off the Dakota pickup, the second seat left passenger initially moved to his right where he most likely sustained his right wrist lesions when he attempted to stop his forward movement by placing his right hand against the driver's right side armrest. As the second seat left passenger rebounded he subsequently contacted the intruding left side panel with the left side of his head and forearm. At final rest the case vehicle's second seat left passenger was presumably still seated in his seat leaning to the left momentarily dazed.

Figure 24: Case vehicle's second row seating area; Note: intrusion to left side and contacts to lower portion of front seat backs (case photo #50)

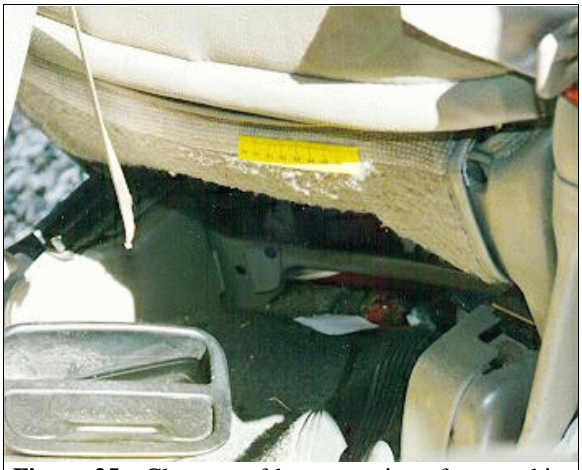


Figure 25: Close-up of lower portion of case vehicle's driver seat back showing evidence of contact by second seat left passenger (case photo #54)

CASE VEHICLE SECOND SEAT LEFT PASSENGER INJURIES

The second seat left passenger was transported by ambulance to the hospital. He sustained serious injuries and was hospitalized for two days post-crash. According to his medical records and the interview with the case vehicle's front right passenger (i.e., mother), the injuries sustained by the second seat left passenger included: a comminuted fracture to his right distal tibia (**Figure 25**), a displaced fracture to his left distal radius, and a right wrist dislocation with accompanying chip fractures. In addition, he sustained abrasions about the left side of his head and face; contusions about the left side of his head and forearm; and seat belt abrasions and contusions involving his left neck, center chest, and lower abdomen.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture, comminuted, mildly displaced, distal third right tibial shaft	853422.3 serious	Seat back, driver's	Certain	Hospitalization records
2	Fracture left distal radius with mild displacement	752804.3 serious	Seat back, driver's	Probable	Hospitalization records
3	Dislocation right carpal-metacarpal joints for 2nd, 3rd, 4th, and 5th fingers	750404.1 minor	Armrest for driver's seat	Possible	Hospitalization records
4	Laceration {avulsion "chip" fracture} right hand most likely involving the capitate and hamate bones	740600.2 moderate	Armrest for driver's seat	Possible	Hospitalization records
5	Abrasions about head, not further specified [Aspect = Unknown]	190202.1 minor	Noncontact injury source: flying glass	Possible	Hospitalization records
6	Contusion {bruise} left side of head	190402.1 minor	Left side window sill	Probable	Interviewee (other occupant)
7	Abrasions about left face	290202.1 minor	Noncontact injury source: flying glass	Possible	Hospitalization records
8	Contusion {bruise} on left side of neck	390402.1 minor	Torso portion of safety belt system	Certain	Interviewee (other occupant)
9	Contusion {bruising} chest, most likely mid-sternal area	490402.1 minor	Torso portion of safety belt system	Certain	Hospitalization records
10	Abrasions across lower abdomen	590202.1 minor	Lap portion of safety belt system	Certain	Emergency room records
11	Contusions across lower abdomen	590402.1 minor	Lap portion of safety belt system	Certain	Emergency room records
12	Contusion proximal lateral left forearm	790402.1 minor	Left side interior surface, excluding hardware and/or armrest	Probable	Hospitalization records

CASE VEHICLE SECOND SEAT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's second seat right passenger [11-year-old, White (non-Hispanic) female; 142 centimeters and 42 kilograms (56 inches, 92 pounds)] was seated in an upright posture with her back against the seat back, her feet on the floor, and both hands in her lap or more likely up in front of her bracing for the crash. Her seat track was not

adjustable, and the seat back was in the upright position.

Figure 26: Close-up of lower portion of case vehicle's front right seat back showing evidence of contact by second seat right passenger (case photo #56)

The case vehicle's second seat right passenger was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was evidence of belt pattern bruising to the passenger's abdomen and chest, and an inspection of the passenger's three-point, safety belt system showed evidence of loading (i.e., a friction scrub on the "D"-ring and webbing).

The case vehicle's driver made no avoidance maneuvers prior to the crash. As a result and independent of the use of her available safety belts, the second seat right passenger's pre-impact body position did not change just prior to impact. The case vehicle's impact with the Dakota pickup enabled the second seat right passenger to continue forward and slightly upward toward the case vehicle's **0** degree Direction of Principal Force as the case vehicle decelerated. The severity of the impact would have caused the second seat right passenger's inertia sensitive seat belt to lock up, preventing her from contacting the front right passenger's seat back, but the passenger's bracing attempt resulted in her left middle finger being fractured and her left index finger being lacerated (**Figure 24** above and **Figure 26**). Furthermore, the passenger's left shin contacted the left corner of the front right passenger seat back resulting in a laceration (**Figure 26**). As the case vehicle reached maximum engagement and rotated counterclockwise off the Dakota pickup, the second seat right passenger was initially thrown to the right side but subsequently rebounded back to the left as the case vehicle came to an abrupt halt. At final rest the case vehicle's second seat right passenger was presumably still seated in her seat leaning to the left momentarily confused.

CASE VEHICLE SECOND SEAT RIGHT PASSENGER INJURIES

The second seat right passenger was transported by ambulance to the hospital. She sustained a serious injury and was hospitalized for two days post-crash. According to her medical records and the interview with the case vehicle's front right passenger (i.e., mother), the injuries sustained by the second seat right passenger included: a contused right lung and a fracture to her left middle finger. In addition, she sustained a laceration to her left index finger and left shin, and seat belt abrasions and contusions to her chest and abdomen.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion, mild, right lung, involving mid lateral and lower medial lung fields	441406.3 serious	Torso portion of safety belt system	Probable	Hospitalization records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
2	Fracture mid shaft proximal phalanx of left middle finger	752404.1 minor	Seat back, front right passenger's	Possible	Hospitalization records
3	Abrasion to chest, not further specified	490202.1 minor	Torso portion of safety belt system	Probable	Emergency room records
4	Contusion {bruising} to left anterolateral chest wall	490402.1 minor	Torso portion of safety belt system	Possible	Emergency room records
5	Contusion {bruise} right breast	490402.1 minor	Torso portion of safety belt system	Certain	Interviewee (other occupant)
6	Abrasion across lower abdomen	590202.1 minor	Lap portion of safety belt system	Certain	Emergency room records
7	Contusion {bruising} transversely across abdomen	590402.1 minor	Lap portion of safety belt system	Certain	Hospitalization records
8	Laceration, superficial, over tip of left index finger	790602.1 minor	Torso portion of safety belt system	Possible	Hospitalization records
9	Laceration left shin, not further specified	890602.1 minor	Torso portion of safety belt system	Probable	Interviewee (other occupant)

OTHER VEHICLE

The 1994 Dodge Dakota is a rear wheel drive, 4x2, five-passenger, club cab, pickup truck (VIN: 1B7GL23X7RS------) equipped with a 3.9L, V-6 engine and a four-speed automatic transmission with overdrive. Braking was achieved by a power-assisted, front disc and rear drum, two-wheel, anti-lock system. The case vehicle's wheelbase was 332 centimeters (130.9 inches), and the odometer reading at inspection was 129,026 meters (80,173 miles).

Inspection of the vehicle's interior revealed adjustable front 40/60 bench seat with folding backs and integral head restraints; a non-adjustable back bench seat with folding backs but without head restraints for the back seating positions; 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 front center position. The front seat belt systems were not equipped with manually operated height adjusters for the "D"-rings. The Dakota pickup was equipped with a knee bolster for the driver's seat position only. Automatic restraint was provided by a Supplemental Restraint System

Figure 27: Dakota pickup's front seating area showing massive intrusion into driver's position (case photo #74)

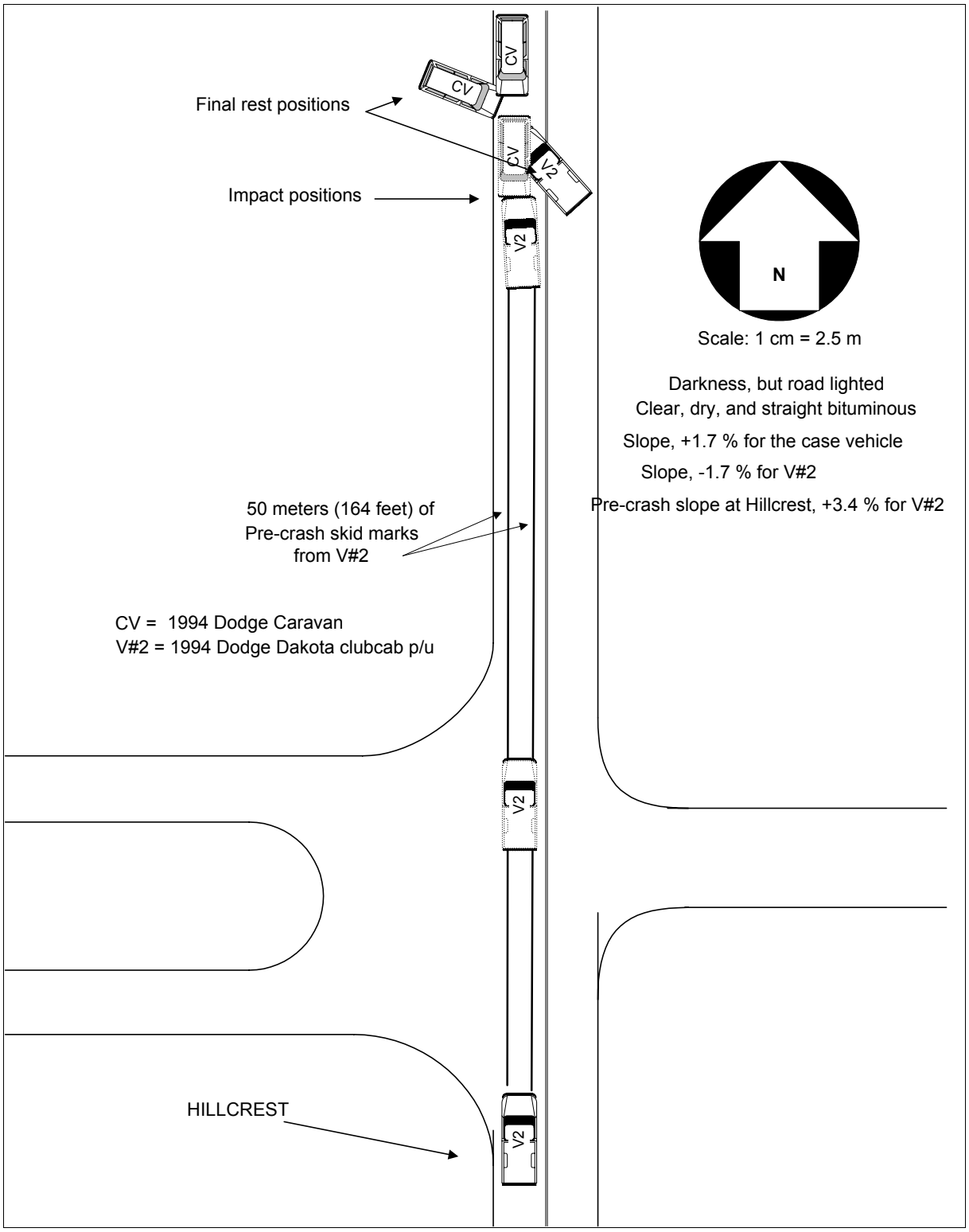
(SRS) that consisted of a frontal air bag for the driver only. The driver's air bag deployed as a result of the Dakota's frontal impact with the case vehicle (**Figure 27** above and **Figure 28**).

Figure 28: Dakota pickup's deployed driver air bag showing no residual evidence of contact (case photo #76)

The Dakota pickup's frontal impact with the case vehicle caused the entire front end to be crushed primarily straight back (**Figures 6** and **8** above). Direct damage started at the front left bumper corner and extended to the right 125 centimeters (49.2 inches) along the front bumper. Maximum crush was measured at 119 centimeters (46.9 inches) at C_1. The total field L was measured at 126 centimeters (49.6 inches). The wheelbase on the Dakota's left (driver's) side was shortened 92 centimeters (36.2 inches) while the right side was shortened 15 centimeters (5.9 inches). The Dakota's front bumper, bumper fascia, grille, hood, radiator, right and left headlight and turn signal assemblies, and left fender were directly damaged and crushed rearward. The Dakota's left and right front tires were physically restricted, and the left front of the tire was deflated from the crash. Both the roof above the driver's seat sustained induced damage as well and both the right and left fenders. Remote buckling was also found on both sides of the Dakota's regular truck bed, in front of the extended cab. The driver's energy absorbing steering column showed that the shear capsules were completely separated due to the crash severity and loading from the unrestrained driver.

Based on the vehicle inspection, the CDC for the Dakota pickup was determined to be: **12-FDEW-5 (0)**. The WinSMASH reconstruction program, damage only algorithm, was used on the Dakota's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 89.1 km.p.h. (55.4 m.p.h.), -89.1 km.p.h. (-55.4 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The Dakota pickup was towed due to damage.

According to the Police Crash Report, the Dakota pickup's driver [17-year-old, White (unknown if Hispanic) male] was not using his available, active, three-point, lap-and-shoulder, safety belt system. The driver was transported by ambulance to the hospital. He sustained police-report "B" (non-incapacitating-evident) injuries but his treatment status is unknown. The exact injuries sustained by the Dakota's driver are also unknown, but the driver was unable to give any statements to the police after the crash because of his injuries. In this contractor's opinion, based upon the limited available information, this driver's life was most likely saved by his deploying driver air bag.


CV
CV
CV
V2
V2
V2
V2
Final rest positions
Impact positions
50 meters (164 feet) of
Pre-crash skid marks
from V#2
CV = 1994 Dodge Caravan
V#2 = 1994 Dodge Dakota clubcab p/u
HILLCREST
N
Scale: 1 cm = 2.5 m
Darkness, but road lighted
Clear, dry, and straight bituminous
Slope, +1.7 % for the case vehicle
Slope, -1.7 % for V#2
Pre-crash slope at Hillcrest, +3.4 % for V#2