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ON-SITE CHILD AIR BAG-RELATED FATALITY INVESTIGATION

CASE NUMBER - IN98-030
LOCATION - ARKANSAS
VEHICLE - 1998 DODGE RAM 1500
CRASH DATE - November, 1998

Submitted:

January 30, 2003



Contract Number: DTNH22-94-D-17058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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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

1. <i>Report No.</i> IN98-030		2. <i>Government Accession No.</i>		3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> On-Site Child Air Bag-Related Fatality Investigation Vehicle - 1998 Dodge Ram 1500 Location - Arkansas			5. <i>Report Date:</i> January 30, 2003		
			6. <i>Performing Organization Code</i>		
7. <i>Author(s)</i> Special Crash Investigations Team #2			8. <i>Performing Organization Report No.</i> Task #s 0182 and 0276		
9. <i>Performing Organization Name and Address</i> Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1501			10. <i>Work Unit No. (TRAIS)</i>		
			11. <i>Contract or Grant No.</i> DTNH22-94-D-17058		
12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation (NRD-32) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003			13. <i>Type of Report and Period Covered</i> Technical Report Crash Date: November, 1998		
			14. <i>Sponsoring Agency Code</i>		
15. <i>Supplementary Notes</i> On-site air bag deployment investigation involving a 1998 Dodge Ram 1500, 4x2, two-door pickup truck, with manual safety belts and dual front redesigned air bags, a 1990 Dodge Caravan, and a 1993 Tempo GL					
16. <i>Abstract</i> This report covers an on-site investigation of an air bag deployment crash that involved a 1998 Dodge Ram 1500 pickup truck (case vehicle), a 1990 Dodge Caravan SE (1 st other vehicle), and a 1993 Ford Tempo GL (2 nd other vehicle). This crash is of special interest because the case vehicle was equipped with redesigned air bags with an on/off switch for the front right passenger air bag, and the case vehicle's front right passenger (8-year-old male) sustained a fatal cervical injury from contacting his deploying front right air bag. The case vehicle was traveling west in the outside lane of a five-lane, undivided, state roadway (i.e., the roadway had two westbound and two eastbound through lanes and one bi-directional, center, left-hand turn lane). The Dodge minivan was traveling north in the northbound lane of a two-lane, undivided, city street. The Ford was stopped heading south in the southbound lane at the four-leg intersection. The crash occurred in the four-leg intersection of the two roadways. The front of the case vehicle impacted the right front of the Dodge minivan, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Next, the case vehicle and the Dodge minivan side slapped. Both vehicles were redirected in a northwesterly direction. The front of the case vehicle impacted the front left bumper corner of the Ford with both vehicles coming to rest near impact. The Dodge minivan was redirected in a westerly direction and came to rest approximately 22 meters (73 feet) from its initial impact with the case vehicle, heading west in a parking lot. The case vehicle's front right passenger was seated with his seat track located in its rearmost position and was not using his available, active, three-point, lap-and-shoulder, safety belt system. Based on his emergency room medical records, he sustained a fatal atlanto-occipital dislocation [3 centimeter (1.2 inch) separation at C ₁] with a transection to his upper cervical spinal cord. In addition, he fractured and dislocated some of his front teeth and sustained contusions at his jaw/neck junction, abrasions across his neck from ear to ear, and abrasions to his left shoulder and upper arm. The case vehicle's driver (27-year-old male) was seated with his seat track located in its rearmost position, and the tilt steering wheel was located between its middle and upmost positions. He was improperly restrained by his available, active, three-point, lap-and-shoulder belt. He was wearing the shoulder portion under his left arm. He sustained minor, self-reported bruises to both knees.					
17. <i>Key Words</i> Redesigned Air Bag Deployment			Motor Vehicle Traffic Crash Injury Severity		18. <i>Distribution Statement</i> General Public
19. <i>Security Classif. (of this report)</i> Unclassified	20. <i>Security Classif. (of this page)</i> Unclassified		21. <i>No. of Pages</i> 14	22. <i>Price</i> \$7,800	

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This on-site investigation was brought to NHTSA's attention on November 25, 1998 by a Lieutenant with the investigating police agency. This crash involved a 1998 Dodge Ram 1500 pickup truck (case vehicle), a 1990 Dodge Caravan SE (1st other vehicle), and a 1993 Ford Tempo GL (2nd other vehicle). The crash occurred in November, 1998, at 3:52 p.m., in Arkansas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was equipped with redesigned air bags with an on/off switch for the front right passenger air bag, and the case vehicle's front right passenger [8-year-old, White (non-Hispanic) male] sustained a fatal cervical injury from contacting his deploying front right air bag. This contractor inspected the scene and vehicles on 9-10 December, 1998. This contractor interviewed the driver for the case vehicle on December 11, 1998. This summary is based on the Police Crash Report, interviews with the case vehicle's driver and 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 west in the outside lane of a five-lane, undivided, state roadway and intended to continue traveling westbound through a four-leg intersection, (i.e., the roadway had two westbound and two eastbound through lanes and one bi-directional, center, left-hand turn lane). The Dodge minivan was traveling north in the northbound lane of a two-lane, undivided, city street and intended to cross through the same four-leg intersection. The Ford was stopped heading south in the southbound lane at the intersection. The case vehicle's driver locked up the brakes and then tried steering to the right, attempting to avoid the crash. The Police Crash Report recorded 17.7 meters (58 feet) of skid marks from the case vehicle's front right tire. The crash occurred in the four-leg intersection of the two roadways; see **CRASH DIAGRAM** below.

The front of the case vehicle impacted the right front of the Dodge minivan, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The crash severity to the case vehicle was moderate [24-40 km.p.h. (15 to 25 m.p.h.)]. After the initial impact the case vehicle and the Dodge minivan side slapped, with the right rear corner of the Dodge minivan impacting the case vehicle's driver door. Both vehicles were redirected in a northwesterly direction. The case vehicle subsequently traveled northwestward and impacted the front left bumper corner of the Ford with its front bumper. The case vehicle came to rest heading north-northwest. The Dodge minivan was redirected in a westerly direction, traversed a curb, and came to rest approximately 22 meters (73 feet) from its initial impact with the case vehicle, heading west in a parking lot. The Ford was nudged slightly westward and came to rest near its original pre-crash position.

The 1998 Dodge Ram 1500 was a rear wheel drive, three-passenger, two-door pickup truck (VIN: 1B7HC16Y3WS-----). The case vehicle was not equipped with anti-lock brakes. The 1990 Dodge Caravan SE is a front wheel drive, seven-passenger, three-door minivan (VIN: 2B4FK4531LR-----). The 1993 Ford Tempo GL is a front wheel drive, six-passenger, four-door, sedan (VIN: 2FAPP36XXPB-----). The case vehicle and the Dodge minivan were both towed due to damage. The Ford was driven from the scene.

Based on the vehicle inspections, the CDCs for the primary impact were determined to be: **71-FDEW-2 (340)** for the case vehicle [maximum crush was 41 centimeters (16.1 inches)] and **2-RYEW-3** for the Dodge minivan [maximum crush was 27 centimeters (10.6 inches)]. The CDC for the Ford's sole impact was determined to be **11-FLEE-1** [maximum crush was 1 centimeter (0.4 inches)]. 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: 29.3 km.p.h. (18.2 m.p.h.), -27.5 km.p.h. (-17.1 m.p.h.), and +10.0 km.p.h. (+6.2 m.p.h.). The case vehicle's initial contact with the Dodge minivan involved the entire front. Direct damage extended from bumper corner to bumper corner, a measured distance of 161 centimeters (63.4 inches). The case vehicle's front end was shifted to the right approximately 10 centimeters (3.9 inches). The side slap contact was located at the crease of the driver's door just below the "A"-pillar. The direct damage width was 31 centimeters (12.2 inches). The case vehicle's third and final impact also involved the front bumper. Because the case vehicle's impact with the Ford was so minor, the exact location could not be distinguished along the front bumper. Based on the inspection of the Ford, there was no deformation to the case vehicle's front from its impact with the Ford.

Concerning the case vehicle, an inspection of the driver's air bag, which was located in the steering wheel hub, revealed that the cover flaps opened at the designated tear points, and there was no visible evidence of damage or contact to the air bag or the cover flaps. The front right passenger's air bag was located in the front 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 no evidence of damage during the deployment to the air bag's fabric. The top left corner of the cover flap was torn during the deployment causing the cover flap to be shifted slightly counterclockwise, and there was an unknown (i.e., source) area of oily transfer on the front right of the cover flap. The front right occupant's available medical records do not indicate that there was contact between this occupant and the cover flap. An inspection of the front right passenger's air bag fabric revealed skin evidence on the top and front surfaces along with a substantial amount of red/burgundy cloth transfer on the top, front, right side, and bottom surfaces of the air bag. The driver's air bag was designed with three tethers, and the front right passenger's air bag was designed without any tethers. The driver's air bag had one vent port, approximately 3.5 centimeters (1.4 inches) in diameter, located at the 12 o'clock position. The deployed driver's air bag was round, with diameter 59 centimeters (23.2 inches). The front right air bag had no vent ports. The deployed front right air bag was rectangular with a height of approximately 45 centimeters (17.7 inches) and a width of approximately 90 centimeters (35.4 inches). There was evidence of occupant contact (scuff) to the glove box door and a right hand imprint on the windshield of the case vehicle.

The case vehicle was equipped with an on/off switch for the front right passenger air bag. According to the owners manual when the key slot is turned to the vertical position (12-6 o'clock) the air bag is shut off and a circular light near the switch is illuminated. When the key slot is turned counterclockwise so it is in the lateral position (9-3 o'clock), the air bag is on and the light near the switch will be off. Based on this contractor's visual inspection, the key slot was turned to the lateral or **ON** position. According to the interview with the case vehicle's driver, he had bought the case vehicle used and driven it for approximately two months [approximately 4,023

kilometers (2,500 miles)] prior to the crash. The driver indicated that he had not noticed the air bag "On/Off" switch.

Immediately prior to the crash the exact posture of the case vehicle's front right passenger is unknown, but this occupant had been seated with the upper part of his back reclined against the seat back, his left foot hanging down over the front edge of the seat's cushion, his right foot on the floor, and his buttocks towards the front of the seat's cushion. According to the driver (i.e., father), the front right passenger had unbuckled his seat belt to get a paper out of his backpack, which was on the floor. He had retrieved the paper and had just sat back down and was about to grab for the seat belt when the crash occurred. His seat track was located in its rearmost position with the seat back slightly reclined (i.e., 21 degrees rearward of vertically perpendicular to the floor).

The case vehicle's front right passenger [117 centimeters and 20 kilograms (46 inches, 44 pounds)] was not wearing his available, active, three-point, lap-and-shoulder, safety belt system. In addition, the inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of his available safety belts, the front right passenger moved forward just prior to impact. The case vehicle's primary impact with the Dodge minivan, not only deployed the front right passenger air bag, but threw the front right passenger forward, making contact with the deploying air bag. The deploying air bag accelerated the child backwards with the vehicle's subsequent clockwise rotation and side slap sending him to the left most likely causing him to contact the driver's seat back. The case vehicle's impact with the Ford caused the front right passenger to move forward, coming to rest on the floor board in the center of the case vehicle.

The front right occupant was transported by ambulance to the hospital. He sustained fatal injuries and was pronounced dead 46 minutes post-crash. Based on emergency room medical records, the injuries sustained by the case vehicle's front right passenger included: an atlanto-occipital dislocation [3 centimeter (1.2 inch) separation at C₁] with a transection to his upper cervical spinal cord, fractured and dislocated front teeth, contusions at his jaw/neck junction, abrasions across the neck from ear to ear, and abrasions to the left shoulder and upper arm.

The case vehicle's driver [27-year-old, White (non-Hispanic) male; 170 centimeters and 77 kilograms (67 inches, 170 pounds)] was seated slightly reclined (i.e., 21 degrees rearward of vertically perpendicular to the floor) with his back against the seat back, both feet on the brake, and both hands on the steering. His seat track was located in its rearmost position. The inspection showed the tilt steering wheel was located between its middle and upmost positions; although, the driver stated he normally has it in the down most position. Inspection of the steering wheel's shear capsule showed no displacement.

The case vehicle's driver was improperly restrained by his available, active, three-point, lap-and-shoulder, safety belt system. He was wearing the shoulder portion under his left arm. The

driver rode in the ambulance with his son to the hospital. He sustained bruises to both knees but did not seek treatment.

CRASH CIRCUMSTANCES

The case vehicle was traveling west in the outside lane of a five-lane, undivided, state roadway (**Figure 1**) and intended to continue traveling westbound through a four-leg intersection, (i.e., the roadway had two westbound and two eastbound through lanes and one bi-directional, center, left-hand turn lane). The Dodge minivan was traveling north in the northbound lane of a two-lane, undivided, city street and intended to cross through the same four-leg intersection. The Ford was stopped heading south in the southbound lane at the intersection.

The case vehicle's driver locked up the brakes and then tried steering to the right, attempting to avoid the crash. The Police Crash Report recorded 17.7 meters (58 feet) of skid marks from the case vehicle's front right tire. The crash occurred in the four-leg intersection of the two roadways; see **CRASH DIAGRAM** below.

The State roadway was straight and level (i.e., actual slope was 1.3%, positive to the west) at the area of impact. The north and southbound lanes of the city street (Dodge minivan and Ford Tempo) were also straight but each had a grade. The south leg of the intersection (minivan) had a 3.6% grade positive to the north (i.e., an upgrade in the minivan's direction of travel) and the north leg of the intersection (Ford) had a 2.6% grade negative to the south (i.e., a downgrade in the Ford's direction of travel). The outside westbound lane in which the case vehicle was traveling in was 3.7 meters (12.0 feet) wide. The State roadway was bordered by 10.2 centimeter (4 inches) high mountable curbs. The pavement was bituminous on all four legs of the intersection. The east and westbound lanes were separated by a 3.5 meter (11.4 feet) wide bidirectional turn lane which was bordered on each side by a single solid yellow line on the outside and a single broken yellow line on the inside. The two westbound travel lanes were separated by a dashed white lane line. The estimated coefficient of friction at the primary point of impact was 0.65. The traffic controls for the east and westbound lanes consisted of NO PARKING, SCHOOL CROSSING and SPEED LIMIT signs along roadside. The posted legal speed limit for the case vehicle was 64 km.p.h. (40 m.p.h.) and 48 km.p.h. (30 m.p.h.) for the minivan and the Ford. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the road pavement was

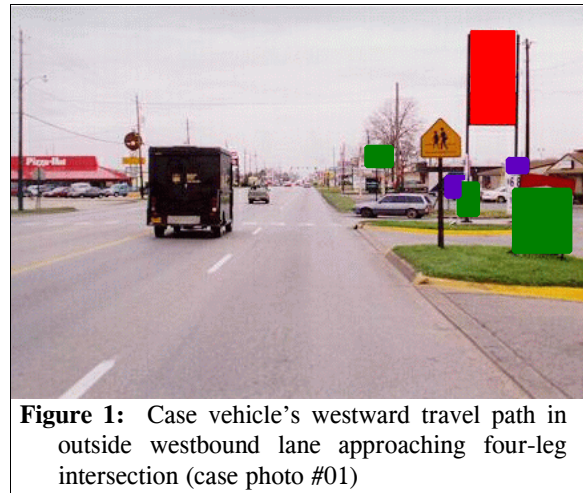


Figure 1: Case vehicle's westward travel path in outside westbound lane approaching four-leg intersection (case photo #01)

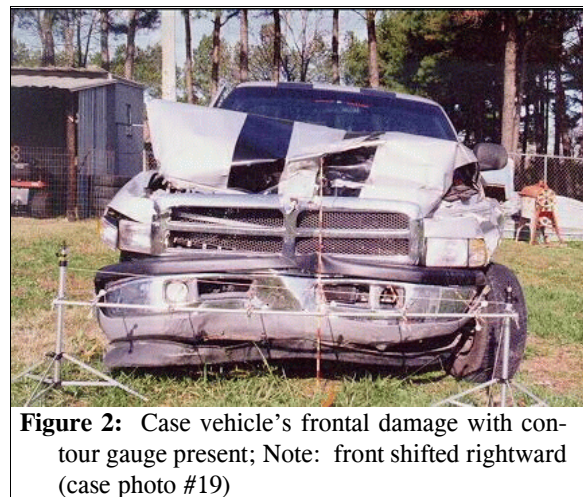


Figure 2: Case vehicle's frontal damage with contour gauge present; Note: front shifted rightward (case photo #19)

dry. Traffic density was heavy, and the site of the crash was urban commercial along the east and westbound highway.



Figure 3: Damage to Dodge Caravan's right side with contour gauge present (case photo #62)

The front of the case vehicle (**Figure 2** above) impacted the right front of the Dodge minivan (**Figures 3** and **4**) causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. After the initial impact the case vehicle and the Dodge minivan side slapped, with the right rear corner of the Dodge minivan impacting the case vehicle's driver door. Both vehicles were redirected in a northwesterly direction. The case vehicle subsequently traveled northwestward and impacted the front left bumper corner of the Ford with its front bumper (**Figure 5** and **Figures 6** and **7** below). The case vehicle came to rest heading north-northwest. The Dodge minivan was redirected in a westerly direction, traversed a curb, and came to rest approximately 22 meters (73 feet) from its initial impact with the case vehicle, heading west in a parking lot (**Figure 8** below). The Ford was nudged slightly westward and came to rest near its original pre-crash position.

CASE VEHICLE

The 1998 Dodge Ram 1500 was a rear wheel drive, 4x2, three-passenger, two-door, regular cab pickup truck (VIN: 1B7HC16Y3WS-----) equipped with a 5.2L, V-8 engine and a four-speed automatic transmission with overdrive. The case vehicle was not equipped with anti-lock brakes. The case



Figure 4: Dodge minivan's right side damage viewed along right string line (case photo #65)

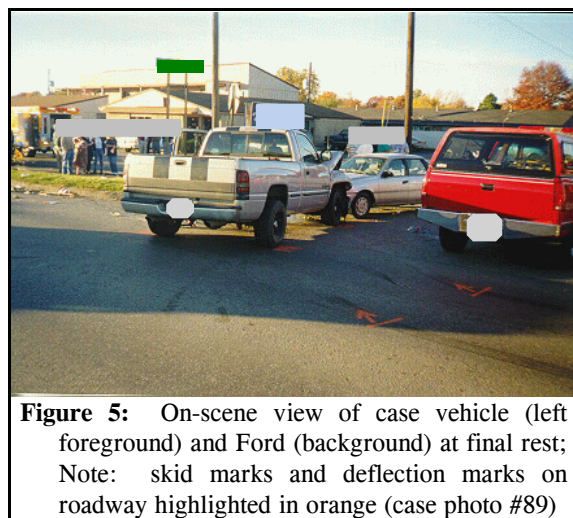


Figure 5: On-scene view of case vehicle (left foreground) and Ford (background) at final rest; Note: skid marks and deflection marks on roadway highlighted in orange (case photo #89)

vehicle's wheelbase was 301 centimeters (118.7 inches), and the odometer reading at inspection is unknown because the case vehicle was equipped with an electronic odometer.



Figure 6: On-scene view of case vehicle (at right) and Ford (at left) at final rest; Note: minimal damage to Ford (case photo #77)

Inspection of the vehicle's interior revealed adjustable split bench with separate seat back cushions with integral head restraints; continuous loop, three-point, lap-and-shoulder, safety belt systems at the front outboard positions; and a two-point, lap belt system at the front center position. The front seat belt systems were equipped with manually operated height adjusters for the "D"-rings. The vehicle was equipped with knee bolsters for both the driver and front right passenger. The case vehicle's front right passenger knee bolster/glove box door was scuffed. 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 Dodge minivan.

CASE VEHICLE DAMAGE

The case vehicle's initial contact with the Dodge minivan involved the entire front (**Figure 2** above and **Figure 9** below). Direct damage extended from bumper corner to bumper corner, a measured distance of 161 centimeters (63.4 inches). Residual maximum crush was measured



Figure 7: Ford Tempo's front left corner damage; Note: yellow tape marks area of direct damage (case photo #67)

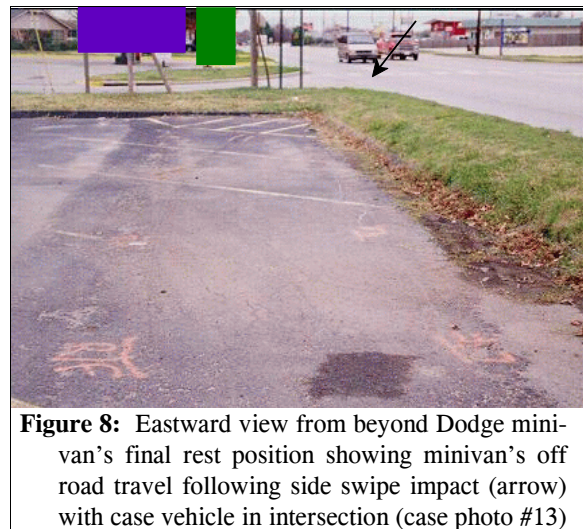


Figure 8: Eastward view from beyond Dodge minivan's final rest position showing minivan's off road travel following side swipe impact (arrow) with case vehicle in intersection (case photo #13)

as 41 centimeters (16.1 inches) at C₃. The front bumper fascia, grille, hood, and radiator were crushed rearward. The case vehicle's front end was shifted to the right approximately 10 centimeters (3.9 inches). The side slap contact was located at the crease of the driver's door just below the "A"-pillar. The direct damage width was 31 centimeters (12.2 inches) and the field L was 32 centimeters (12.6 inches). The case vehicle's third and final impact also involved the front bumper. Because the case vehicle's impact with the Ford was so minor, the exact location could not be distinguished along the front bumper (Figure 6 above). Based on the inspection of the Ford, there was no deformation to the case vehicle's front from its impact with the Ford. The case vehicle's wheelbase was unaltered from the crash. 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 right and left fenders.

Inspection of the case vehicle's interior revealed evidence of occupant contact (i.e., a scuff) to the glove box door from contact with the front right passenger's knees, and there was a small hand imprint to the windshield's glazing possibly from the front right passenger contacting it before he was redirected backwards by the deploying air bag (Figure 10). Furthermore, there was a long scuff towards the bottom of the front right door panel and a brush abrasion to the right front door sill. Finally, there was no evidence of compression of the energy absorbing shear capsules in the base of the steering column and no deformation to the steering wheel rim.

Based on the vehicle inspection, the CDC for the case vehicle's primary impact with the Dodge minivan was determined to be: **71-FDEW-2 (340)**. The CDC for the side slap impact was determined to be: **09-LPEN-1**. 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: 29.3 km.p.h. (18.2 m.p.h.), -27.5 km.p.h. (-17.1 m.p.h.), and +10.0 km.p.h. (+6.2 m.p.h.). The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a redesigned Supplemental Restraint System (SRS) that contained frontal air bags at the driver and front right passenger positions. Both air bags deployed

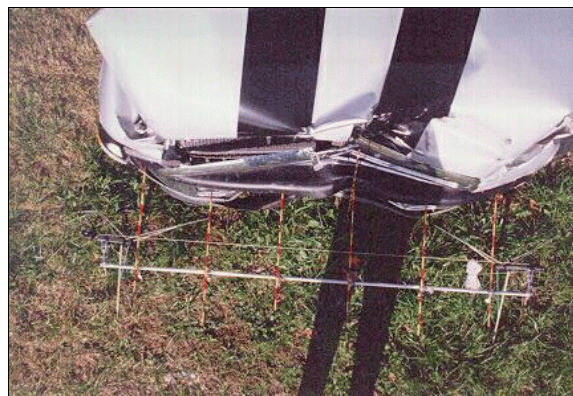


Figure 9: Overhead view of case vehicle's frontal deformation with contour gauge present (case photo #21)

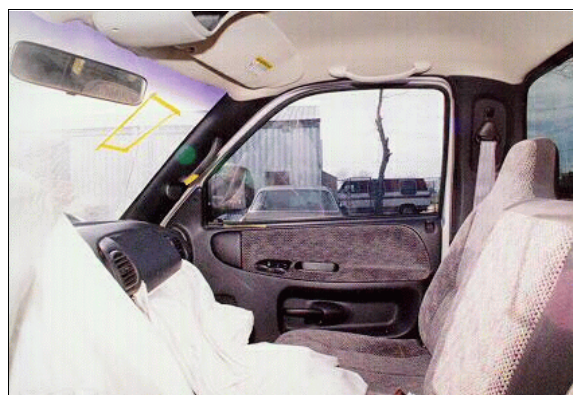


Figure 10: Case vehicle's front seating area showing deployed front air bags and contact evidence on right windshield's glazing and right front door sill (case photo #44)

as a result of the frontal impact with the Dodge minivan. The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of asymmetrical "H"-configuration cover flaps made of thick vinyl with overall dimensions of 14 centimeters (5.5 inches) at the horizontal seam and 10.5 centimeters (4.1 inches) vertically for the upper flap and 3 centimeters (1.2 inches) vertically for the lower flap. 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 three tethers, each approximately 8 centimeters (3.1 inches) in width. The driver's air bag had one vent port, approximately 3.5 centimeters (1.4 inches) in diameter, located at the 12 o'clock position. The deployed driver's air bag was round with a diameter of 59 centimeters (23.2 inches). An inspection of the driver's air bag fabric revealed no contact evidence readily apparent on the air bag's fabric (**Figure 11**).



Figure 11: Case vehicle's deployed driver air bag showing no obvious evidence of occupant contact (case photo #37)

The front right passenger's air bag was located in the middle of the instrument panel. There was a single, essentially rectangular, modular cover flap. The cover flap was made of a thick vinyl over a thin cardboard type frame. The flap's dimensions were 28 centimeters (11.0 inches) at the lower horizontal seam and 19 centimeters (7.5 inches) along both vertical seams. 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 flap and air bag revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag's fabric. The top left corner of the cover flap was torn during the deployment causing the cover flap to be shifted slightly counterclockwise, and there was an unknown (i.e., source) area of oily transfer on the front right of the cover flap (**Figure 12**). The oily transfer was approximately 11 x 6 centimeters (4.3 x 2.4 inches) in size and started at the leading edge of the cover flap. The front right occupant's available medical records do not indicated that there was contact between this occupant and the cover flap. The front right passenger's air bag was designed without any tethers. The front right air bag had no vent ports. The deployed front right air bag was rectangular with a height of approximately 45 centimeters (17.7 inches) and a width of approximately 90 centimeters (35.4 inches). An inspection of the front right passenger's air bag fabric revealed skin evidence on the top and front surfaces along with a substantial amount of red/burgundy cloth transfer on the top, front, right side, and bottom surfaces of the air bag. The examination also revealed some black scuffs from the underside of the cover flap to the left of the

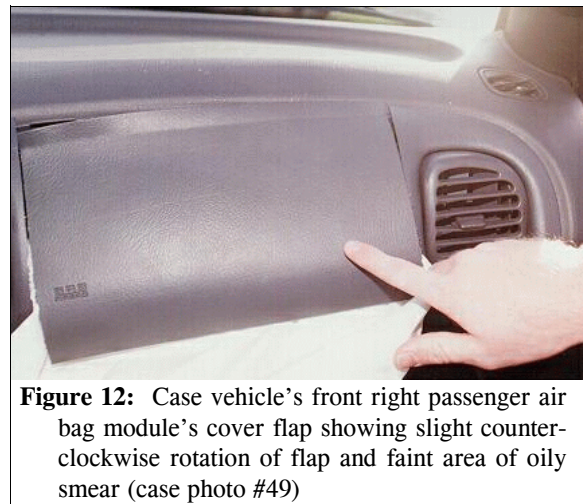


Figure 12: Case vehicle's front right passenger air bag module's cover flap showing slight counterclockwise rotation of flap and faint area of oily smear (case photo #49)

skin transfer on the top surface. The skin transfer to the top surface was approximately 26 centimeters (10.2 inches) wide and started approximately 9 centimeters (3.5 inches) down from the instrument panel and extended downwards onto the front surface an additional 38 centimeters (15.0 inches). The skin transfer on the front surface was 21 centimeters (8.3 inches) wide and started 8 centimeters (3.1 inches) in from the right edge (**Figure 13**).

The case vehicle was equipped with an on/off switch for the front right passenger air bag. According to the owners manual when the key slot is turned to the vertical position (12–6 o'clock) the air bag is shut off and a circular light near the switch is illuminated. When the key slot is turned counterclockwise so it is in the lateral position (9–3 o'clock), the air bag is on and the light near the switch will be off. Based on this contractor's visual inspection, the key slot was turned to the lateral or **ON** position (**Figure 14**).

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the exact posture of the case vehicle's front right passenger is unknown, but this occupant had been seated with the upper part of his back reclined against the seat back, his left foot hanging down over the front edge of the seat's cushion, his right foot on the floor, and his buttocks towards the front of the seat's cushion. According to the driver (i.e., father), the front right passenger had unbuckled his seat belt to get a paper out of his backpack, which was on the floor. He had retrieved the paper and had just sat back down and was about to grab for the seat belt when the crash occurred. His seat track was located in its rearmost position with the seat back slightly reclined (i.e., 21 degrees rearward of vertically perpendicular to the floor).

The case vehicle's front right passenger [117 centimeters and 20 kilograms (46 inches, 44 pounds)] was not wearing his available, active, three-point, lap-and-shoulder, safety belt system. In addition, the inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver braked, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of his available safety belts, the front right passenger moved forward just prior to impact. The case vehicle's primary impact with the Dodge minivan, not only



Figure 13: Front surface of case vehicle's deployed front right passenger air bag; Note: a large area of faint skin transfer is present (but not visible) in the upper right portion (case photo #47)



Figure 14: Case vehicle's "On/Off" switch controlling front right passenger's air bag; Note: switch was in **ON** position (case photo #42)

deployed the front right passenger air bag, but threw the front right passenger forward, making contact with the deploying air bag. The deploying air bag accelerated the child backwards with the vehicle's subsequent clockwise rotation and side slap sending him to the left most likely causing him to contact the driver's seat back. The case vehicle's impact with the Ford caused the front right passenger to move forward, coming to rest on the floor board in the center of the case vehicle.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right occupant was transported by ambulance to the hospital. He sustained fatal injuries and was pronounced dead 46 minutes post-crash. Based on emergency room medical records, the injuries sustained by the case vehicle's front right passenger included: an atlanto-occipital dislocation [3 centimeter (1.2 inch) separation at C₁] with a transection to his upper cervical spinal cord, fractured and dislocated front teeth, contusions at his jaw/neck junction, abrasions across the neck from ear to ear, and abrasions to the left shoulder and upper arm.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration {transection} upper cervical spinal cord with atlanto-occipital dislocation ¹	640274.6 untreatable	Air bag, front right passenger's	Certain	Emergency room records
2 3	Fracture {broken} and dislocation {loose} of most of front teeth	251402.1 251404.1 minor	Air bag, front right passenger's	Probable	Emergency room records
4	Contusion {ecchymosis} of jaw at junction with neck	290402.1 minor	Air bag, front right passenger's	Certain	Emergency room records
5	Contusion {bruise, ecchymosis} of neck, specifically on right side	390402.1 minor	Air bag, front right passenger's	Certain	Emergency room records
6	Abrasion across neck	390202.1 minor	Air bag, front right passenger's	Certain	Other: Coroner's photographs
7	Abrasion left shoulder and left upper arm	790202.1 minor	Air bag, front right passenger's	Certain	Other: Coroner's photographs

CASE VEHICLE DRIVER KINEMATICS

The case vehicle's driver [27-year-old, White (non-Hispanic) male; 170 centimeters and 77 kilograms (67 inches, 170 pounds)] was seated slightly reclined (i.e., 21 degrees rearward of

¹ According to the emergency room x-rays, the skull was now positioned 3 centimeters (1.2 inches) anterosuperior to the anterior arch of C₁.

vertically perpendicular to the floor) with his back against the seat back, both feet on the brake, and both hands on the steering. His seat track was located in its rearmost position. The inspection showed the tilt steering wheel was located between its middle and upmost positions; although, the driver stated he normally has it in the down most position. Inspection of the steering wheel’s shear capsule showed no displacement.

The case vehicle's driver was improperly restrained by his available, active, three-point, lap-and-shoulder, safety belt system. He was wearing the shoulder portion under his left arm.

The case vehicle's driver braked, attempting to avoid the crash. The driver’s braking may have caused him to brace his arms against the steering wheel just prior to impact. As a result of this attempted avoidance maneuver and the use of his available safety belts, the driver moved forward just prior to impact and loaded his safety belts. The case vehicle's primary impact with the Dodge minivan enabled the driver to continue forward, making contact with his deploying air bag. The driver rebounded backwards and leftward off the deploying air bag as the case vehicle was redirected to its right. When the case vehicle and the minivan side slapped, the driver most likely contacted the interior surface of the driver’s door. As the case vehicle came to stop as a result of contacting the Ford, the driver most likely moved forward, once again, toward the steering column. As the case vehicle came to rest the driver remained but his exact posture is unknown.

CASE VEHICLE DRIVER INJURIES

The driver rode in the ambulance with his son to the hospital. He sustained bruises to both knees but did not seek treatment.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusions bilateral knees	890402.1 minor	Knee bolster, driver’s	Probable	Interviewee (same person)

1ST OTHER VEHICLE

The 1990 Dodge Caravan SE was a front wheel drive, seven-passenger, three-door minivan (VIN: 2B4FK4531LR-----) equipped with a 3.0L, V-6 engine. Based on the vehicle inspection, the CDC for the Dodge minivan was determined to be: **2-RYEW-3** [maximum crush was 27 centimeters (10.6 inches)]. The WinSMASH reconstruction program, damage only algorithm, was used on the Dodge’s highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 31.4 km.p.h. (19.5 m.p.h.), -10.7 km.p.h. (-6.6 m.p.h.), and -29.5 km.p.h. (-18.3 m.p.h.). The Dodge minivan was towed due to damage.

2ND OTHER VEHICLE

IN98-030

The 1993 Ford Tempo GL is a front wheel drive, six-passenger, four-door sedan (VIN: 2FAPP36XXPB-----) equipped with a 2.3L, I-4 engine. Based on the vehicle inspection, the CDC for the Ford's sole impact was determined to be **11-FLEE-1** [maximum crush was 1 centimeter (0.4 inches)]. The Ford was driven from the scene.

The following material is taken from the book: FORENSIC PATHOLOGY, 2ND EDITION by Vincent J. DiMaio, M.D., and Dominick J. DiMaio, M.D., CRC Press, Boca Raton, Florida, 2001; Chapter Nine: Deaths Caused by Motor Vehicle Accidents, *Front Impact Crashes*, pages 282, 284, and 286.

Blunt force impact on the windshield, while not causing serious incised wounds, can, with enough force, produce fairly severe soft tissue injuries. ... In addition to the external injuries, impaction of the head with the frame of the car above the windshield can cause basilar skull fractures, closed head injury, and fractures of the neck. Basilar fractures tend to run along the length of the petrous ridges passing through the sella turcica ("hinge fractures"). Less common are ring fractures and multiple fracture lines of the base of the skull.

In neck injuries, the most common fatal injuries are upper cervical fractures or dislocation at the atlanto-occipital junction (Figure 9.4). This can result in either complete transection or crushing of the cord. In other instances, the cord is violently pulled down, with partial or complete avulsion of the brain stem, ventrally at the ponto-medullary junction.

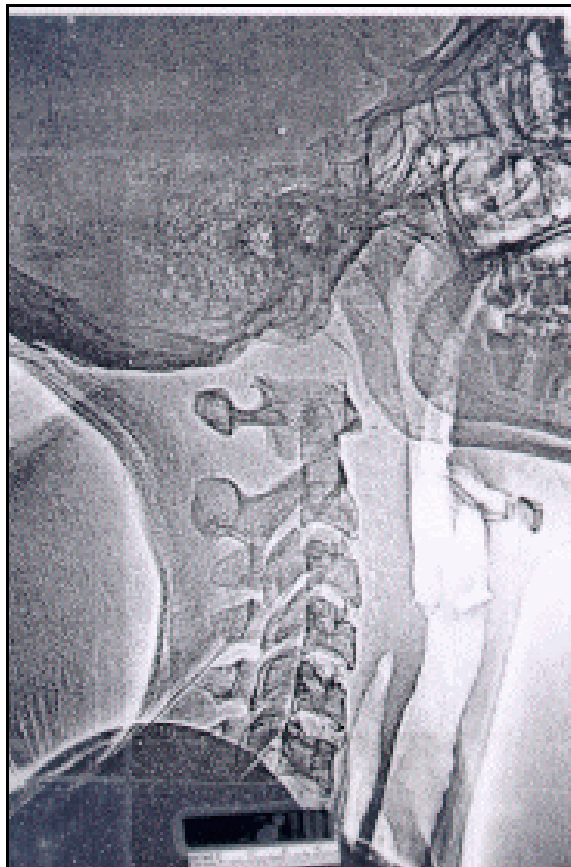


Figure 9.4: Fracture-dislocation of neck at atlanto-occipital joint

