TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER

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ON-SITE AIR BAG RELATED CHILD FATALITY INVESTIGATION

VERIDIAN CASE NO. CA00-010

VEHICLE - 1995 CHRYSLER CONCORDE

LOCATION - DELAWARE

CRASH DATE - MARCH 2000

Contract No. DTNH22-94-07058

Prepared for:

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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 of the involved vehicle(s) or their safety systems.

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17. *Abstract*

This on-site investigation focused on the fatal injury mechanisms of an 11 year old front right passenger seated in a 1995 Chrysler Concord. The Chrysler was involved in a multiple collision crash event with a 1996 Dodge Intrepid and a 1999 Oldsmobile Cutlass The vehicles were all equipped with Supplemental Restraint Systems. The Chrysler Concord was stopped at an intersection and struck in the rear by the Dodge Intrepid, at a high rate of speed. This impact displaced the Chrysler forward and caused it to rotate counterclockwise into the opposing travel lane. A second impact occurred with the left frontal area of the Oldsmobile Cutlass impacting the right frontal area of the Chrysler. The force of the multiple impact event warranted the deployment of the Supplemental Restraint Systems in all three vehicles. The Chrysler's 11 year old front right passenger was seated in-close proximity to the front right passenger air bag module and was struck by the deploying bag. As a direct consequence, the child sustained fatal cervical spine and spinal cord injuries.

The Special Crash Investigations (SCI) team at Veridian Engineering was informed of the crash on March 14, 2000 by the Fatal Accident Reconstruction Unit of the Delaware State Police. Veridian SCI subsequently informed the Crash Investigations Division of the National Highway Traffic Safety Administration (NHTSA) and an on-site investigation was assigned the same day. All vehicles were impounded by the Delaware State Police pending the completion of the investigation.

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BACKGROUND

This on-site investigation focused on the fatal injury mechanisms of an 11 year old front right passenger seated in a 1995 Chrysler Concord. The Chrysler was involved in a multiple collision crash event with a 1996 Dodge Intrepid and a 1999 Oldsmobile Cutlass The vehicles were all equipped with Supplemental Restraint Systems. The Chrysler Concord was stopped at an intersection and struck in the rear by the Dodge Intrepid at a, police reported, high rate of speed. This impact displaced the Chrysler forward and caused it to rotate counterclockwise into the opposing travel lane. A second impact occurred with the left frontal area of the Oldsmobile Cutlass impacting the right frontal area of the Chrysler. The force of the multiple impact event warranted the deployment of the Supplemental Restraint Systems in all three vehicles. The Chrysler's 11 year old front right passenger was seated in-close proximity to the front right passenger air bag module and was struck by the deploying bag. As a direct consequence, the child sustained fatal cervical spine and spinal cord injuries.

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SUMMARY

Crash Site

This three-vehicle crash occurred during the early evening hours of March, 2000. At the time of the crash, it was dark and the area was illuminated by an overhead street light. The weather was not a factor. The crash occurred at the 3-leg intersection of a two-lane north/south road and a two-lane east/west road, **Figure 1**. The primary road was north/south in direction. Paved shoulders, measuring 3 m (10 ft) in width, bordered the respective travel lanes. There was a negative grade (>2%) in the southbound direction. The crest of the grade was located 760 ft

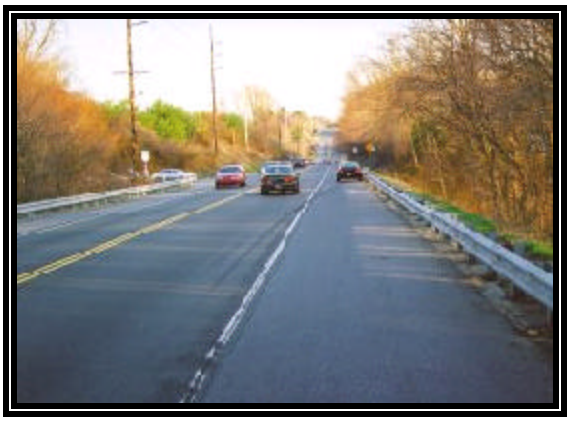

Figure 1: Southbound trajectory view of the 3-leg intersection.

north of the intersection. Reduced or obscured visibility along the roadway was not a causative factor in the crash. The east/west roadway intersected the primary road from the east. Traffic at the intersection was controlled by a stop sign for traffic in the westbound direction. The speed limit in the area of the crash was 72 km/h (45 mph).

Pre-Crash

The 1995 Chrysler Concord was southbound driven by a 49 year old male. The vehicle was stopped, anticipating a left turn, to travel east on the intersecting road. The traffic volume was moderate and the driver was waiting for northbound traffic to clear before executing the turn. The driver's daughters, age 11 and 14, were the front right and rear right passengers, respectively. All the occupants of the Chrysler were restrained at the time of the crash by the vehicle's 3-point lap and shoulder belt systems. The 1996 Dodge Intrepid was southbound driven by an unrestrained 20 year old male. An unrestrained 23 year old male was the front right passenger. Coincident to the southbound vehicles, the 1999 Oldsmobile Cutlass was several hundred meters (yards) south of the intersection. This vehicle was northbound driven by a 31 year old male. He was restrained by the vehicle's 3-point lap and shoulder belt system.

CRASH

Figure 2 is a schematic of the crash scene. The first impact occurred when the driver of the Dodge Intrepid failed to recognize the stopped Chrysler Concord in sufficient time and struck the vehicle in an offset front-to-rear configuration. The offset impact configuration caused the Chrysler to begin to rotate counterclockwise and to be displaced forward and leftward into the opposing travel lane. The Barrier Equivalent delta V of the Chrysler's rear damage was 59.0 km/h (36.7 mph). The Dodge also rotated counterclockwise and slid approximately 26 m (84 ft) southwestward to rest. The Dodge came to rest facing northward against an earth embankment, bordering the roadway. Contact with the positive slope of the embankment caused the Dodge to come to rest prematurely, effectively shortening its post impact travel.

Investigation at the crash scene identified two skid marks located in the southbound lane. The beginning of the marks located the approximate point of impact and defined the post-impact trajectory of the respective vehicles. The outboard tire mark, attributed to the right front tire of the Dodge, measured 7.2 m (23.5 ft) and was directed southwestward toward the vehicle's final rest position.

The inboard tire mark was attributed to the right rear tire of the Chrysler. The mark measured 7.5 m (24.5 ft) and was also directed to the southwest. However, the width of the tire mark increased as the vehicle skidded forward over the mark's length. This change in the mark's width indicated the Chrysler was rotating counterclockwise during its forward displacement. The vehicle had rotated approximately 60 degrees CCW, relative to the road at the end of the tire mark. The counterclockwise rotation exposed the right frontal aspect of the vehicle to northbound traffic.

During the elapsed time of the first crash event, the northbound Oldsmobile traveled into the mouth of the intersection. The second impact occurred with the left aspect of the Oldsmobile's front plane striking the right aspect of the Chrysler's front plane in a 12/2 o'clock impact configuration. The second impact occurred approximately 11 m (35 ft) south of the initial impact. The force of the frontal impact caused the deployment of the vehicles' respective Supplemental Restraint Systems. The Barrier Equivalent delta V of the Chrysler's frontal damage was 33.7 km/h (20.9 mph).

The impact arrested a portion of the Chrysler's southward momentum and accelerated the vehicle's counterclockwise rotation. The Chrysler came to rest in the southbound lane, facing southwestward, approximately 7 m (24 ft) from the second impact. The combination of the impact and a clockwise steering maneuver redirected the Oldsmobile to the northeast. The vehicle's post-impact trajectory was defined by a 10.9 m (35.7 ft) skid mark attributed to the left front tire. The tire mark led to the vehicle's final rest position. The Oldsmobile came to rest in the mouth of the intersection, facing northeastward approximately 22 m (71 ft) from the second impact.

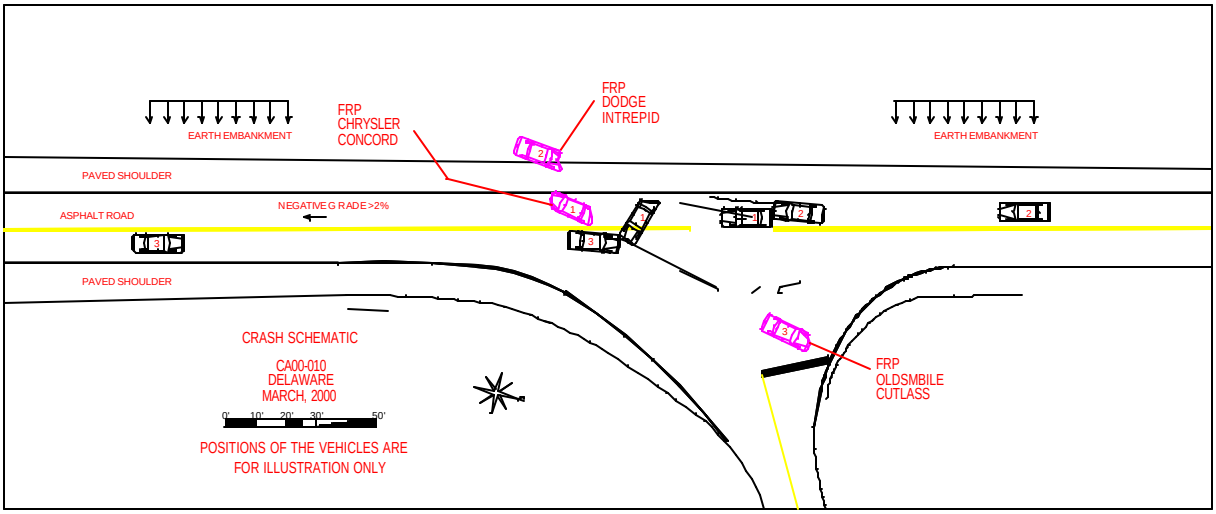

Figure 2: Crash scene schematic.

Post-Crash

The driver of the Chrysler Concorde estimated the police and EMS personnel arrived on-scene within six minutes of the crash. The occupants of the Chrysler remained in the vehicle during that time. The nature and extent of the vehicular damage required extrication of the front right and rear right occupants. The driver had no recollection of the second impact and believed he had a momentary loss of consciousness. When he regained his faculties, he found the front right passenger slumped to the left over the center console. She was unresponsive. The driver was a firefighter with emergency medical training. He ascertained the gravity of his daughter's condition and stabilized her head by applying traction until the arrival of EMS.

The occupants of the Chrysler were removed for the vehicle and immediately transported to a Level 1 Trauma Center located within 10 miles of the scene. The front right passenger was unresponsive through her transport and upon admission to the Emergency Room. Resuscitive efforts were unsuccessful and the patient was pronounced dead approximately 69 minutes post-crash. The cause of death was listed as blunt impact to the head with injuries to the cervical spine and spinal cord.

The Chrysler's driver and rear right passenger were admitted into the hospital overnight for observation. The driver indicated his injuries consisted primarily of unspecified contusions about the chest as a result of contact with the 3-point restraint and driver air bag. The rear right passenger was treated for shock, multiple unspecified contusions and a suspected right femur fracture. The femur fractured proved to be negative.

The driver and front passenger of the Dodge Intrepid fled the scene on foot. They were apprehended a short time later by the investigating police. The driver tested positive for alcohol with a BAC of 0.12%. Both occupants complained of minor unspecified lacerations but neither required medical attention. The driver of the Oldsmobile reportedly sustained a minor laceration to the right finger and palm. He did not seek medical treatment.

1995 CHRYSLER CONCORDE

The 1995 Chrysler Concorde was identified by a Vehicle Identification Number : 1C3HD56F6SF (production sequence deleted). The vehicle was configured as a 4-door sedan and had a manufacture date of 2/95. The vehicle's power train consisted of a 3.5 liter, V-6 engine linked to a 4-speed automatic transmission. The transmission shift selector was mounted in the center console. The hydraulic brakes were equipped with a 4-wheel anti-lock system. The vehicle's mileage was not recorded during the inspection.

Vehicle Exterior

The Chrysler Concorde sustained impact damages to the back and front planes as a result of the multiple impact crash event. **Figure 3** is a rear view of the vehicle. The back plane sustained 94 cm (37 in) of direct contact damage. The direct contact began 18 cm (7 in) left of center and extended to the right corner of the rear bumper. The nature of the damage was indicative of a direct bumper to bumper impact with a subsequent override, as the Dodge drove through the impact. The crush profile (direct and induced damage) measured across the rear bumper reinforcement bar was as follows: C1=28 cm (11 in),

Figure 3: View of the rear impact damage.

C2=51 cm (20 in), C3=74 cm (29 in), C4=91 cm (36 in), C5=109 cm (43 in), C6=124 cm (49 in). The width of the crush profile measured 152 cm (60 in). The 6 o'clock direction of the impact force deformed the rear structures of the vehicle forward into the occupant compartment. The trunk space was collapsed. The roof in the area of the right C-pillar buckled vertically. The right rear axle was displaced forward approximately 39.4 cm (15.5 in). The left rear axle location was undisturbed. The backlight disintegrated during the impact. The right rear door was jammed shut by the deformation. The right front door was also jammed by the impact damage but was later opened during extrication. Intrusion into the rear right occupant space was an estimated 25 cm (10 in) longitudinal and 13 cm (5 in) vertical. The Collision Deformation Classification (CDC) was 06-BZEW-6. The total delta V of the impact calculated by Barrier Model of the WINSMASH program was 59.0 km/h (36.7 mph). The longitudinal and lateral components of the delta V were +58.1 km/h (+36.1 mph) and +10.2 km/h (+6.4 mph), respectively. The corrected PDOF was an estimated 190 degrees.

The Chrysler's direct frontal damage began on the right front corner and extended across the entire 152 cm (60 in) frontal width of the vehicle, **Figure 4**. The 2 o'clock direction of the impact force deformed the vehicle's frontal structures rearward into the engine compartment. The structures forward of the radiator support plane then sheared off as the Oldsmobile drove through the impact. The crush profile measured at front bumper mounting locations on the sub-frame were as follows: C1=48 cm (19 in), C6=33 cm (13 in). The location of the right frontal axle remained unchanged by the frontal impact. The left front axle was displaced rearward, foreshortening the left wheelbase 14.0 cm (5.5 in). The hood shifted rearward and buckled. The rearward hood shift fractured the lower outboard aspects of the windshield. The left front and rear doors remained closed during the impact and were operational upon inspection. The CDC of the frontal impact was 02-FDEW-2. The total delta V calculated by the Barrier Model of the WINSMASH program was 33.7 km/h (20.9 mph). The longitudinal and lateral components of the delta V were -21.7 km/h (13.5 mph) and 25.9 km/h (16.1 mph), respectively. A corrected PDOF of 50 degrees was used in the analysis.

Figure 4: Left lateral view of the frontal damage.

Vehicle Interior

The vehicle's front seating positions were cloth covered bucket seats with reclining seat backs. The left front seat was equipped with a six-3way power adjustment package. Inspection of the seat track indicated the seat was in the full rear position. Electrical power to the interior was disabled due to the forces of the crash, therefore the seat track position was unchanged from its at-crash position.

The front right seat was adjusted manually. The seat was adjusted to an estimated full forward position.

Floorpan deformation resultant to the rear impact restricted the adjustment of the seat. It could not be moved, therefore the seat track position had not been changed from its at-crash position. In this forward position, the leading edge of the seat cushion was in-line with the trailing edge of the instrument panel, **Figure 5**. The horizontal distance from the edge of the right front air bag module to the seat back measured 61.7 cm (24.3 in). The forward position of the seat was a causal factor in the front right occupant's fatal injury.

Figure 5: Interior view depicting the forward track position of the right seat.

The rear bench seat collapsed forward and upward as a result of the rear impact. Intrusion at the right rear seat was an estimated 25 cm (10 in) longitudinal and 13 cm (5 in) vertical.

Manual Restraints

The four outboard seating positions of the Chrysler were equipped with continuos loop, 3-point lap and shoulder restraint with a sliding latch plate. The inertial retractors were located in the base of the B-pillar. The driver's belt was stowed upon initial inspection. The left shoulder belt upper adjustable (D-ring) was in the full down position. Evidence of historical use was identified on the latch plate consistent with the age and mileage of the vehicle. The belt was extended into a simulated buckled configuration. Evidence of use during this crash was identified on the restraint webbing in the areas of the latch plate hardware and D-ring. The physical evidence identified during the inspection indicated the driver was properly restrained at the time of the crash and loaded the restraint system.

The front right restraint webbing was cut away from the occupant by EMS personnel during the extrication process. The latch plate was buckled in the inboard anchor at inspection and the section of cut webbing was looped through the hardware. The cut section measured 108.0 cm (42.5 in), 31.8 cm (12.5 in) extended over the lap and 76.2 cm (30.0 in) extended over the occupant's torso, **Figure 6.** The webbing section attached to the outboard lower anchor measured 43.2 cm (17.0 in). The webbing in the area of latch plate hardware loop was creased and stressed. The right shoulder belt upper adjustment was in the full down position. Inspection of the surface of the D-ring revealed a witness mark, on its aft edge, indicative of restraint loading. The evidence identified during the inspection indicated the front right occupant was properly restrained and loaded the restraint system

Figure 6: View of the front right restraint.

Supplemental Restraint System

The driver air bag was configured in the typical manner in the center hub of the steering wheel. The module was flush with the plane of the steering wheel rim. The two spoke rim was not deformed and there was no displacement of the steering column shear capsules. The air bag had deployed from an H-configuration module cover. The cover flaps were symmetrical and measured 16.6 cm x 6.4 cm (6.5 in x 2.5 in), width by height. The driver air bag measured 61 cm (24 in) in its deflated state. It was tethered and vented through the porous fabric of the bag. There was no direct evidence of occupant contact on the face of the bag. A greasy, "wax-like", transfer on the perimeter and back side of the bag in the 9 to 12 o'clock sector was identified. The transfer occurred from contact with the steering wheel rim during deployment.

Two points of driver contact to the left bolster panel were identified. A 6.3 cm x 5.8 cm (2.5 in x 2.3 in) scuff was located 20 cm (8 in) left of steering column centerline, 38 cm (19 in) above the floor. A 3.8 cm x 7.6 cm (1.5 in x 3.0 in) scuff, 56 cm (22 in) above the floor, was located 18 cm (7 in) right of column center line. The nature and location of the scuff marks were consistent with contact from the driver's respective lower extremities.

The front right passenger air bag module was a top-mount configured in the right aspect of the instrument panel. The module cover flap was constructed of vinyl, approximately 16 mm (5/8 in) thick, and measured 36 cm x15 cm (14 in x 6 in), width by length. The vinyl flap was backed by sheet metal. Upon deployment, the sheet metal permanently deformed, forming a hinge, as the cover flap rotated open. There was no evidence of occupant contact to the cover flap.

The face of the front passenger air bag measured 53 cm x 61 cm (21 in x 24 in), width by height. The bag extended 41 cm (16 in) from the module in its deflated state. The bag was tethered by a single strap sewn across the full width of the bag's face. The air bag vented through the membrane's porous fabric.

Figure 7: Front right passenger air bag.

Subtle evidence of direct occupant contact was identified on the right aspect of the bag's face, **Figure 7**. The evidence consisted of two regions of blood smear transferred during contact with the child's face. The child sustained a large abrasions over her right eye and cheek and lacerations of the right eyelid and external ear. A 13 cm (5 in) smear was located 14 cm (5.5 in) above the tether stitching and began 18 cm (7 in) left of the outboard side panel. The smear extended laterally to the right. A 3 cm (1 in) smear was located 23 cm (9 in) above the tether stitching and was centered 15 cm (6.0 in) left of the outboard side panel.

A large area of dispersed dirt and vinyl transfers was noted on the upper aspect of the bag's outboard side panel. The area measured approximately 30 cm x 15 cm (12 in x 6 in) and began on the upper perimeter of the side panel. A large spray of discharge, from the front right passenger air bag, was identified on the trim panel covering the right A-pillar, **Figure 8**. The area of discharge measured 8.9 cm x 18 cm (3.5 in x 7 in), width by height and began 15 cm (6 in) above the instrument panel. The location of the spray corresponded to the location of the transfers on the side panel of the bag. The forward position and kinematic pattern of the child altered the deployment path of the bag to the right. The generate discharge on the pillar was evidence of this altered deployment.

Figure 8: Discharge spray on the right A-pillar.

A 6 mm (1/4 in) crack was identified on the glove box door. The crack was located 30 cm (12 in) right of vehicle center and 46 cm (18 in) above the floor. The crack was a result of probable contact with the front right passenger's left lower extremity.

1996 DODGE INTREPID

The 1996 Dodge Intrepid was identified by a Vehicle Identification Number : 2B3HD46TXTH (production sequence deleted). The vehicle's manufacture date was of 2/96. The vehicle's power train consisted of a 3.3 liter, V-6 engine linked to a 4-speed automatic transmission. The vehicle was equipped with a Supplemental Restraint System that consisted of driver and front right passenger air bags. The air bags deployed as a result of an above threshold crash event. The odometer read 171,928 km (106,834 miles) at inspection.

Figure 9 is a left view of the Dodge Intrepid. The vehicle sustained 92.7 cm (36.5 in) of direct contact damage to its front plane. The direct contact began 16.5 cm (6.5 in) right of centerline and extended to the left corner of the front bumper. The combined direct and induced damage extended across the entire 152 cm (60 in) frontal end width of the Dodge. The crush profile measured at the elevation of the bumper reinforcement was as follows: C1=51 cm (20 in), C2=53 cm (21 in), C3=43 cm (17 in), C4=33 cm (13 in), C5=10 cm (4 in), C6=0. The 12 o'clock direction of the impact force deformed the front

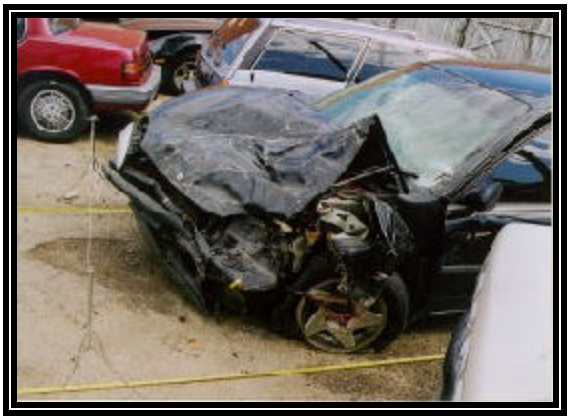

Figure 9: Left lateral view of the Dodge.

bumper and the left sub-frame rearward into the engine compartment. The left front fender and hood were buckled. The rearward displacement of these components contacted and fractured the windshield. The left side wheelbase was foreshortened 14.0 cm (5.5 in). The right wheelbase dimension was unchanged. The left front hinge pillar shifted rearward approximately 2 cm (1 in). The left front door opened during the crash. It could not be closed due to the left side deformation. The left rear and right side doors remained closed and were operational. The left aspect of the roof buckled in the area of the B-pillar.

The Dodge impacted and then underrode the Chrysler, as the vehicles reached maximum engagement. The offset rear impact displaced the Chrysler forward and rotated the vehicle counterclockwise. The Dodge drove through the impact due its southward momentum and slid to final rest. Contact damage was noted on the forward aspect of the left front door. The damage extended 31.8 cm (12.5 in) aft of the hinge pillar. This damage occurred during vehicle separation as the Dodge drove through the impact and the Chrysler rotated away. The nature of the total damage indicated the vehicles did not reach a common velocity in the crash. The Collision Deformation Classification was 12-FYEW-2. The total delta V calculated by the Barrier Model of the WINSMASH program was 32.4 km/h (20.1 mph). The longitudinal and lateral components of the delta V were -32.0 km/h (-19.9 mph) and -5.6 km/h (-3.5 mph), respectively.

1999 OLDSMOBILE CUTLASS

The 1999 Oldsmobile Cutlass was identified by the Vehicle Identification Number (VIN): 1G3NB52J4XC6 (production sequence deleted). The vehicle's power train consisted of a 3.1 liter, V-6 engine linked to a 4-speed automatic transmission. The hydraulic brakes were equipped with a 4-wheel anti-lock system. The vehicle was equipped with a Supplemental Restraint System that consisted of redesigned driver and front right passenger air bags. The air bags deployed as a result of the frontal impact. The investigating officer reported the vehicle's mileage was approximately 4800 km (3000 miles). **Figure 10** is a left three-quarter view of the vehicle.

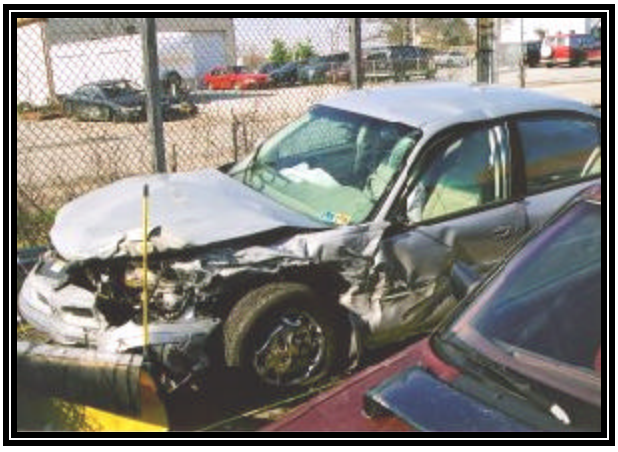

Figure 10: Left front three-quarter view of the Oldsmobile.

The frontal plane of the Oldsmobile sustained 46 cm (18 in) of direct contact damage. The direct contact began 28 cm (11 in) left of center and extended to the left corner of the front bumper. The undeformed end width measured 152 cm (60 in). The crush profile measured at the elevation of the bumper reinforcement was as follows: C1=23 cm (9 in), C2=13 cm (5 in), C3=7 cm (3 in), C4=5 cm (2 in), C5=0, C6=0. This contact extended along the left side of the vehicle to

approximately the B-pillar location, 259 cm (102 in) aft of the front plane. The left side damage was consistent with end-swipe contact between the Oldsmobile and Chrysler in the later stages of the impact. The hood and left front fender buckled and shifted rearward. The rearward shift of these components fractured the left lower aspect of the windshield. The left front rim was bent and the tire aired out. The left wheelbase was foreshortened 3.3 cm (1.3 in). The left front door shifted rearward and was jammed shut. The remaining doors were operational. The left center aspect of the roof buckled in the area of the B-pillar. The Barrier Model of the WINSMASH program calculated a total delta V of 21.1 km/h (13.1 mph). The longitudinal and lateral components were -21.1 km/h (-13.1 mph) and 0 km/h, respectively. The CDC of the damage was 12-FLEW-1.

1995 CHRYSLER CONCORDE

Occupant Demographics

	Driver	*Front Right Passenger*	*Rear Right Passenger*
Age/Sex:	49 year old/male	11 year old/female	14 year old/female
Height:	178 cm (70 in)	142 cm (56 in)	estimated 155 cm (61 in)
Weight:	106 kg (235 lb)	50 kg (110 lb)	estimated 45 kg (100 lb)
Restraint Use:	Manual 3-point lap & shoulder belt	Manual 3-point lap & shoulder belt	Manual 3-point lap & shoulder belt
Usage Source:	Inspection	Inspection	Police Report
Medical Treatment:	Treated & Released	Fatal cervical spine injuries	Treated & Released

FRONT RIGHT PASSENGER INJURIES

Injury	***Injury Severity (AIS 90)***	***Injury Mechanism***
Laceration and sprain of posterior atlanto-axial membrane w/ sprains of posterior atlanto-occipital membrane and alar ligaments; Contusions of the upper cervical spinal cord and cervico-medullary junction; Confluent epidural, patchy subdural and subarachnoid hemorrhage of cervical spinal cord	Maximum (640230.6,6)	Front right passenger air bag

Intra-ventricular hemorrhage, right	Severe (140678.4,1)	Front right passenger air bag
Contusion of the Brain (left temporal gyrus and Corpus Callosum left side)	Serious (140614.3,2)	Front right passenger air bag
Contusions of the Brainstem (Pons and Medulla)	Serious (140204.5,8)	Front right passenger air bag
Thin layered sub-arachnoid hemorrhage of brain, NFS	Serious (140684.3,9)	Front right passenger air bag
Sub-scalpular contusions (right and left frontal regions)	Minor (190402.1,5)	Front right passenger air bag
Lacerations of the galea aponeurotica and pericranium, NFS	Minor (190600.1,9)	Front right passenger air bag
Multiple abrasions of the face (right cheek) and forehead	Minor (290202.1,1) Minor (290202.2,7)	Front right passenger air bag
Multiple contusions of the forehead and right ear	Minor (290402.7) Minor (290402.1)	Front right passenger air bag
Multiple sub-scalpular contusions - left and right frontal regions	Minor (190402.1,5)	Front right passenger air bag
Laceration of the right eyelid	Minor (297602.1,1)	Front right passenger air bag
Laceration of the right external ear	Minor (290600.1,1)	Front right passenger air bag
Epistasis - nose bleed	Minor (251090.1,4)	Front right passenger air bag

Note: the following injuries were identified in the State of Delaware Medical Examiner's Final Diagnoses of Autopsy.

FRONT RIGHT PASSENGER KINEMATICS AND INJURY

Immediately prior to the crash, the occupant was restrained and seated in a forward track position. The occupant responded to the 6 o'clock direction of the first impact force by initiating a rearward trajectory with respect to the vehicle. The occupant loaded and compressed the front right seat back, as the vehicle accelerated forward. As the Chrysler was displaced into the intersection, the seat back and seat cushion released the energy stored as a result of the compression, and caused the occupant to rebound forward. The occupant initiated a forward trajectory. As the vehicle began to rotate counterclockwise, this forward trajectory displaced the occupant in a 1 to 2 o'clock direction with respect to the vehicle. The child contacted and loaded the 3-point lap and shoulder belt evidenced by the transfer marks identified

on the restraint hardware. As the child's torso became arrested by the 3-point restraint, the unrestrained inertia of her head caused the head/neck complex to flex forward and down.

At the time of the second impact, the front right occupant was out-of-position, forward with respect to the vehicle. The child's forward position placed the child within the normal deployment path of the front right passenger air bag. The force of the 2 o'clock impact caused the deployment of the vehicle's Supplemental Restraint System. The child responded to the impact force by continuing to load the 3-point restraint. The out-of-position occupant altered the deployment path of the bag to the right, evidenced by the air bag's discharge spray on the right A-pillar.

The child's head was rotated slightly down and turned partially to the left at contact with the front right passenger air bag. The deploying air bag contacted the child in the face and head. The upward air bag expansion abraded and contused the child's cheek and forehead, and lacerated the right eyelid and right external ear. Contact evidence identified on the face of the air bag was consistent with these injuries. The continued expansion of the air bag caused a hyper-extension of child's head/neck. The rapid upward head rotation and neck extension caused the laceration and sprains of the posterior atlanto-axial and atlanto-occipital membranes and alar ligaments. Examination of the cervical spine revealed it was extensively contused with confluent epidural subdural and subarachnoid hemorrhage within this region. The brainstem was also contused as a direct result of contact with the deploying air bag. The child then rebounded rearward into the seat and slumped to the left, where she was found. The child was pronounced dead 69 minutes post-crash.