TRANSPORTATION SCIENCES
Crash Data Research Center

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VERIDIAN ON-SITE AIR BAG RELATED CHILD PASSENGER FATALITY INVESTIGATION
VERIDIAN CASE NO. CA01-029
VEHICLE: 1997 MITSUBISHI MONTERO
LOCATION: FLORIDA
CRASH DATE: MAY 2001

Contract No.
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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 are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

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

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16. *Abstract* This on-site crash investigation focused on the nature and severity of injuries sustained by a 3 year old male front right passenger of a 1997 Mitsubishi Montero sport utility vehicle. The Montero was equipped with frontal air bags for the driver and front right passenger positions. The full frontal area of the Montero impacted the rear of a stopped recycler truck. The impact resulted in moderate damage to the Montero and deployment of the frontal air bag system. The child passenger was displaced forward out-of-position by the pre-crash braking. The anterior chin and neck areas were struck by the air bag module cover flap and the expanding front right air bag which resulted in extensive soft tissue abrasions and contusions, a complete fracture between C1 and C2 with a laceration of the spinal cord, a laceration of the trachea, fractures of the hyoid bone and maxilla., and thoracic injuries. He was removed from the vehicle by the driver and was transported to a local hospital where he expired within 30 minutes of the crash. The Montero was towed from the scene of the crash. The driver and rear seat child passenger were not injured.			
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BACKGROUND

This on-site crash investigation focused on the nature and severity of injuries sustained by a 3 year old male front right passenger of a 1997 Mitsubishi Montero sport utility vehicle **(Figure 1)**. The Montero was equipped with frontal air bags for the driver and front right passenger positions. The full frontal area of the Montero impacted the rear of a stopped recycler truck. The impact resulted in moderate damage to the Montero and deployment of the frontal air bag system. The child passenger was displaced forward out-of-position by the pre-crash braking. The anterior chin and neck areas were struck by the air bag module cover flap and the expanding front right air bag which resulted in extensive soft tissue abrasions and contusions, a complete fracture between C1 and C2 with a laceration of the spinal cord, a laceration of the trachea, fractures of the hyoid bone and maxilla., and thoracic injuries. He was removed from the vehicle by the driver and was transported to a local hospital where he expired within 30 minutes of the crash. The Montero was towed from the scene of the crash. The driver and rear seat child passenger were not injured.

Figure 1. 1997 Mitsubishi Montero.

The May crash was identified by NHTSA through a media search and assigned to the Veridian SCI team on May 22, 2001. Veridian established cooperation with the investigating police officer and coordinated an on-site investigation of the crash on May 24. The Mitsubishi was towed to a police impound lot where it was retained in its crash condition for SCI inspection. The refuse truck was located at the regional company depot and inspected. The autopsy report for the child passenger was obtained from the regional Medical Examiner's office.

SUMMARY

Crash Site

The crash occurred in May 2001 on a two-lane county road in a residential/school area during daylight hours. In the vicinity of the crash site, the asphalt road surface was delineated by a broken yellow centerline, forming two lanes; a 3.7 m (12.1') wide westbound lane and a 3.6 m (11.8') wide eastbound lane. There were no stabilized shoulders as the earth and patchy grass extended to the edge of the travel lanes. Located immediately west of the crash site was a four leg intersection of a local street and a driveway to a elementary school.

Figure 2. Eastbound view of the crash site.

The east/westbound traffic flow through the intersection was not regulated by traffic controls. Traffic entering the county road was regulated by stop signs. The county road was straight and level which afforded driver's a clear site line. The weather was clear and all environmental surfaces were dry. The speed limit was posted at 48 km/h (30 mph). There was no physical evidence at the crash scene. The crash site was identified by the painted final rest wheel positions of the involved vehicles. **Figure 2** is an eastbound view of the approach to the crash site.

Vehicle Data

1997 Mitsubishi Montero

The subject vehicle, a 1997 Mitsubishi Montero Sport LS, was a four-door sport utility vehicle that was manufactured on 12/96 and identified by vehicle identification number (VIN) JA4LS31P7VP (production number deleted). The Montero was equipped with a 3.0 liter, V-6 engine linked to a 4-speed automatic overdrive transmission with a console mounted transmission selector. The vehicle platform was two-wheel (rear) drive with four-wheel disc brakes and anti-lock (ABS). The Montero was equipped with 265/70R15 Dunlop Rover Touring LT tires that were mounted on 38 x 17.8 cm (15x7.0") six spoke alloy wheels. The vehicle was also equipped with OEM-type running boards that extended the full length of the sills.

The interior of the Montero was configured with front bucket seats with adjustable head restraints, manual seat track, height, and recline adjustments. The three passenger rear seat was a split bench with 60/40 (right side wide) forward folding seat backs. Power equipment included outside rear view mirrors, windows, and door locks. Two rear facing infant safety seats were positioned in the rear of the vehicle in the left and center rear positions. These seats were restrained by the available restraint systems, however, they were not occupied at the time of the crash.

1990 Lodal ECO Recycler Truck

The struck vehicle in this crash was a 1990 recycler truck **(Figure 3)** that was manufactured by Lodal Incorporated of Kingsford, MI. The Model No. was ECO-3030. The truck was a forward control configuration with the two passenger low-mounted cab positioned forward of the steer axle. The rear axle was equipped with single tires/wheels and the Gross Vehicle Weight Rating (GVWR) was 13,608 kg (30,000 lb). The power train consisted of a 5.9 liter diesel engine linked to an automatic transmission with a automatic braking mode (front brakes only) for the neutral transmission position. The vehicle identification number was 1L9EH67B1LK (production number deleted). The odometer reading at the time of the SCI inspection was 247,065 km (153,523 miles).

Figure 3. Lodal Recycler Truck

The body of the recycler truck was designed with a series of bins that were open at the top aspect that were accessible from both sides of the truck. Mounted to the rear of the body was a wire mesh basket that was framed with 5x5x0.2 cm (2x2x3/16") angle iron. The basket measured 213.3 cm (84.0") laterally

and protruded 121.9 cm (48.0") aft of the rear of the truck body, and extended 154.9 cm (61.0") in height. This basket was designed to transport recycled plastic containers. The rear panel of the basket was hinged at the bottom which served as a downward folding door to unload the recycled material. A yellow rotary caution light was mounted on top of the body at the rear aspect of the truck. It was reported by the investigating officer that this light was activated at the time of the crash.

Crash Sequence

Pre-Crash

The recycler truck was operated by a 40 year old female driver. She was operating the vehicle on her assigned route which required frequent stops as she traveled in an easterly direction on the county road. On her approach to the impending crash site, the driver decelerated the recycler truck and stopped approximately 50 m (160') west of the elementary school driveway for a pick-up at a private residence. The driver stopped the vehicle in the travel lane and placed the automatic transmission in the neutral position. In this position, the front service brakes were automatically activated to hold the vehicle in its stopped position. The rear mounted overhead amber flashing caution light was activated. The driver began to exit the recycler truck as it was struck in the rear by the Mitsubishi.

The 31 year old female driver of the 1997 Mitsubishi Montero was traveling in an easterly direction on the county road at an estimated speed of 48 km/h (30 mph). The recycling truck was stopped forward of the Montero. The driver of the Montero was apparently distracted from her driving task and failed to detect the stopped recycling truck in sufficient time to avoid the impending crash. She braked immediately prior to the crash, however, there was no evidence of braking on the asphalt road surface. The Crash Schematic is attached as **Figure 16**, Page 15.

Crash

The full frontal area of the Mitsubishi Montero **(Figure 4)** impacted the recycling basket that was mounted on the rear of the straight truck **(Figure 5)**. The front bumper of the Montero initially engaged the lower aspect of the basket then underrode the basket as the grille, hood face, and upper radiator support panel of the Montero crushed to maximum engagement. The lower rear aspect of the truck's basket crushed to a maximum residual value of 35.2 cm (13.875") while the left corner of the Montero's radiator support was crushed to a depth of 39.1 cm (15.4") The resultant direction of force were 12 o'clock for the Mitsubishi and 6 o'clock for the struck recycler truck. The crash was outside the scope of the WinSMASH reconstruction program due to the crush of the manufactured basket. A barrier equivalent speed of 21.0 km/h (13.0 mph) was generated for the Montero using the barrier mode of the damage algorithm. The frontal impact deployed the Mitsubishi's frontal air bag system. The air bag system probably deployed late in the crash sequence due to the "soft" crash that involved the underride damage to the Montero and the crush to the basket unit of the recycler truck.

The Montero came to rest near the point of impact centered within the eastbound travel lane. Based on the police documented final rest position for the recycler truck, the driver drove the vehicle forward and

stopped with the right side tires near the south edge of the road. There were no tire marks on the asphalt road surface to support the impact positions of the involved vehicles.

Figure 4. Full frontal damage to the Mitsubishi.

Figure 5. Damage to the rear basket of the recycler truck.

Post-Crash

The driver of the Mitsubishi immediately exited the vehicle and removed the front right child passenger from the Montero. The child was placed on the roadside adjacent to the vehicle. Rescue personnel arrived on scene and initiated Cardiopulmonary Resuscitation (CPR). The child was transported by ambulance to a local hospital where he expired following arrival, approximately 30 minutes post-crash.

Vehicle Damage

Exterior - 1997 Mitsubishi Montero

The Mitsubishi Montero sustained moderate severity frontal damage as a resulted of it's front-to-rear impact sequence with the rear of the stopped recycler truck. The front bumper of the Montero initially impacted then underrode the basket that was mounted to the rear of the truck. The direct contact damage to the bumper fascia was 154.9 cm (61.0"), which extended the full width of the component. The top of the bumper fascia was backed by a formed sheet metal support, however, this support was not structural such as a bumper beam. The front frame rails extended forward of this panel and terminated at the fascia. The rails were not crushed. The fascia support was crushed rearward to a maximum depth of 29.4 cm (11.6") located 31.0 cm (12.2") inboard of the left corner **(Figure 6)**. The fascia panel partially separated from this support and returned forward toward it's original position. The crush profile at the level of this bumper fascia support was as follows: C1 = 28.1 cm (11.1"), C2 = 29.5 cm (11.6"), C3 = 26.5 cm (10.4"), C4 = 29.0 cm (11.4"), C5 = 28.7 cm (11.3"), C6 = 19.2 cm (7.6"). This profile did not represent the displacement of the bumper system, therefore the profile was not used for the WinSMASH program.

The hood face and upper radiator support crushed as the bumper underrode the basket of the recycling truck. The Mitsubishi's hood latch was damaged, however, it remained latched during the crash. Maximum crush was 39.1 cm (15.4) located at the left corner of the radiator support **(Figure 7)**. The crush profile at the upper radiator support as follows: C1 = 39.1 cm (15.4"), C2 = 36.3 cm (14.3"), C3 = 24.3 cm (9.6"), C4 = 18.9 cm (7.4"), C5 = 23.0 cm (9.1"), C6 = 18.5 cm (7.3").

Figure 6. Close-up view of the Montero's bumper fascia support.

Figure 7. Lateral view of the front left corner of the Montero.

The impact resulted in damage to the front bumper system, the grille, hood, both headlamp and turn signal assemblies, both front fenders, the radiator support panel, and the inner fender assemblies. There was no glazing damage to the Montero. All four doors remained closed during the crash and were fully operational post-crash. The Collision Deformation Classification (CDC) for this event was 12-FDEW-2.

Interior - 1997 Mitsubishi Montero

The interior damage to the Montero was minor and was associated with air bag deployment and occupant contact. There was no intrusion of the passenger compartment.

The driver's air bag deployed from the steering wheel mounted module. The driver was contacted by the deploying air bag as evidenced by a tissue transfer to the lower left quadrant of the bag. The unrestrained driver subsequently loaded the air bag and steering assembly as she responded to the 12 o'clock impact force. Her loading force against the steering assembly resulted in compression of the energy absorbing steering column as evidenced by 3.2 cm (1.25") of shear bracket separation **(Figure 8)**.

Figure 8. Right shear bracket separation.

The front right child passenger of the Montero was unrestrained. He initiated a forward trajectory in response to the presumed pre-crash braking and continued forward in response to the impact force. Due to the "soft" collision with the basket of the recycler truck, the Montero's frontal air bag system deployed late in the crash event. At deployment, the child passenger was against, or in close proximity to the mid mount front right air bag module cover flap. A scuff mark and tissue transfer were evident to the right aspect of the cover flap. The expanding air bag membrane contacted the anterior neck and face of the child. Large tissue transfers were noted to the top and left aspects of the bag membrane. A large tissue transfer with an underlying blue fabric transfer was located at the mid bottom aspect of the air bag membrane. Tissue fragments were scattered on the inside surface of the windshield near the centerline with fragments noted to the overhead center console.

Exterior - 1990 Lodal ECO Recycler Truck

The damage to the rear of the recycler truck was limited to the wire mesh/angle iron basket that was mounted the rear of the vehicle. The impact crushed the lower outboard frame of the basket and deformed the back, bottom, and left side of the mesh walls. The damaged length along the lower edge of the frame was 200.7 cm (79.0") which extended from corner-to-corner of the basket. Maximum crush was measured at 35.2 cm (13.875") located 80.3 cm (31.6") inboard of the left corner. The crush profile measured at the lower edge of the frame work was as follows: C1 = 8.9 cm (3.5"), C2 = 31.75 cm (12.5"), C3 = 35.2 cm (13.875"), C4 = 30.4 cm (12.0"), C5 = 18.7 cm (7.375"), C6 = 0 cm. **Figure 9** is a view of the damage to the recycler truck.

Figure 9. Damage to the rear basket of the recycler truck.

Seat Belt Systems

1997 Mitsubishi Montero

The front seat belt systems consisted of continuous loop 3-point lap and shoulder belt systems with sliding latch plates, and lower B-pillar mounted retractors. The driver's retractor was an emergency locking retractor (ELR) with a belt sensitive locking feature. The front right retractor was dual mode ELR and automatic (ALR) locking (switchable). Both front seat belt systems utilized an energy management loop that was incorporated into the sleeve of the lap belt webbing at the outboard aspect of the seat cushion. Both of the management loops remained intact as the systems were not worn during the crash. Both B-pillar mounted D-rings were adjusted to the full-up positions. The rear outboard seated positions were equipped with continuous loop 3-point lap and shoulder belts with sliding latch plates. The retractors were dual mode, ELR/ALR and the D-rings were fixed. The center rear position was equipped with a 2-point lap belt that was affixed with a cinch bar locking latch plate.

The driver's seat belt system exhibited routine usage wear marks on the latch plate with subtle wear noted to the edges of the webbing. There was no loading evidence on the belt system and interior contact evidence supported the unbelted status of the driver.

The front right belt system yielded subtle historical usage wear marks on the latch plate with no wear noted to the webbing. Based on the lack of loading evidence, and the contact evidence on the front right air bag membrane, the 3 year old child passenger in this position was not restrained.

The rear seat belt systems yielded subtle routine usage indicators on both the latch plates and the webbing from infrequent usage and engagement with the child safety seats. A 12 year old male was seated in the right rear position of the vehicle. There was no loading evidence on the belt system to support usage during the crash. However, there was no loading evidence on the back surface of the front right seat back support. The police report listed the child passenger as restrained. He was not injured in this crash.

Frontal Air Bag System
1997 Mitsubishi Montero

The Montero was equipped with a frontal air bag system for the driver and right passenger positions. The system consisted of two front crash sensors that were mounted to the upper radiator support panel, the steering wheel mounted driver module, the right instrument panel mid mount passenger air bag module, and a center console mounted air bag control module. **Figure 10** is an overall view of the deployed frontal air bag system.

Figure 10. Deployed frontal air bags.

The driver air bag module was mounted within the four-spoke steering wheel rim and concealed by a single top hinged cover flap. The cover flap was 17.3 cm (6 13/16") in width at the top hinge point and was 7.6 cm (3.0") in width at the bottom leading edge. The sides of the flap tapered from a point beginning 5.1 cm (2.0") below the hinge to the horizontal tear seam (leading edge). This tapered edge was 7.5 cm (3.0") in length and was symmetrical to both sides. There was no damage or contact evidence to the driver's cover flap.

The front left air bag membrane measured 63.5 cm (25.0") in diameter in it's deflated state. The air bag was vented by two 3.8 cm (1.5") diameter ports that were located at the 10 and 2 o'clock positions, centered 4.8 cm (1.875") below the peripheral seam. Internally, the driver air bag was tethered by two 6.4 cm (2.5") wide tethers at the 3 and 9 o'clock positions. The tethers were sewn to the center face of the bag with a 16.2 cm (6.375") diameter tether reinforcement. The driver air bag was stamped with the following nomenclature:

662080-50340
ME6115121

The driver was contacted by the deploying air bag membrane. A tissue transfer was noted to the face of the bag at the lower left quadrant. The transfer was located 7.0-10.2 cm (2.75-4.0") left of center and 13.3-15.9 cm (5.25-6.25") below the horizontal centerline. There were no make-up transfers associated with this contact.

The front right passenger air bag was mounted in a mid mount configuration within the right instrument panel. The air bag was concealed by a single cover flap that measured 15.6 cm (6.125") vertically and 32.4 cm (12.75") horizontally. The flap was hinged with a 22.9 cm (9.0") wide mesh tether that was affixed to the top aspect of the flap and instrument panel. The acronym SRS and AIR BAG were molded into the center flap at the lower leading edge.

The child passenger was out-of-position forward at the time of deployment. A vertically oriented scuff mark, tissue transfers, and dried body fluid was noted to the face of the flap **(Figure 11)**, right of it's vertical centerline. The overall location of the scuff mark was located 20.0-25.4 cm (7.875-10.0") right of the left edge of the flap and 0-10.2 cm (0-4.0") above the leading edge. The tissue transfer within the

scuff was located 21.0-22/9 cm (8.25-9.0") right of the left edge and 3.5-6.0 cm (1.375-2.375") above the leading edge of the flap.

Figure 11. Scuff with tissue transfer to the module cover flap.

Figure 12. Tissue transfers on the top panel of the front right air bag.

Figure 13. Tissue transfer with blue fabric at the bottom of the bag membrane.

The face of the front right passenger air bag was rectangular in shape with a horizontal measurement of 47.0 cm (18.5) and a vertical length of 57.1 cm (22.5"). The top panel of the bag measured 25.4 cm (10.0") in width at the inflator manifold and flared to 48.3 cm (19.0") at the face of the bag over a depth of approximately 41.9 cm (16.5") in its deflated, but expanded state. The membrane was not tethered.

The front right air bag membrane deployed from the mid mount module into the out-of-positioned child passenger. Numerous tissue transfers evidenced the child's involvement with the air bag. Two large diagonally oriented tissue transfers were noted to the top panel of the bag membrane **(Figure 12)**. The upper transfer began 8.9 cm (3.5") left of the bag's centerline and extended 13.3 cm (5.25") to the left side panel. The second transfer began 4.4 cm (1.75") right of the referenced centerline and extended 22.2 cm (8.75") left of center. The transfer extended 21.6-35.6 cm (8.5-14.0") rearward of the air bag inflator manifold. This transfer continued on the face and left side of the bag at the perimeter seam. The laterally oriented tissue transfer contained vinyl transfers from bag expansion against the inside surface of the module cover flap. This transfer extended approximately 57.2 cm (22.5") in length.

A third transfer of tissue and fabric was noted to the bottom aspect of the bag **(Figure 13)**. A 19.1-12.7 cm (7.5x5.0") circular tissue transfer was located on the vertical centerline of the bag. A 2.5x10.7 cm (1.0 x 4.25") band-like (horizontally oriented) blue fabric transfer was located directly under the tissue transfer. There was no structural damage to the air bag membrane from the child passenger contact.

Child Safety Seats

Two rear facing infant child safety seats (CSS) were installed in the second seat of the Mitsubishi Montero **(Figure 14)**. These seats were not occupied at the time of the crash. The infant seat in the left rear position was an Evenflo Discovery, Model No. 2121223P1 with a Date of Manufacturer of 20 Dec 00. The CSS was installed in a rear facing position and properly engaged into the detachable base. The base was secured to the Montero by the 3-point lap and shoulder belt system that was properly routed through

the belt path. The retractor was not engaged into the automatic locking mode therefore the CSS was not properly secured by the belt system. The loose routing of the belt system allowed the CSS to rotated freely about the horizontal plane on the seat cushion. The folding handle was positioned in the forward locking position. Although not properly secured to the vehicle, the CSS was resting on the seat cushion at an angle of 45 degrees. The harness straps were twisted and positioned in the lowest of the two sets of slots.

Figure 14. Rear seat mounted child safety seats.

A matching Evenflo Discovery rear facing infant CSS was positioned in the center rear of the second seat and improperly restrained by the 2-point lap belt that was equipped with a locking latch plate. This CSS was identified by Model No. 2121223 P1 and was manufactured on 13 Jan 01. The CSS was properly engaged into the base and the lap belt was properly routed through the belt path of the base unit. The lap belt was not cinched tight. In its post-crash adjusted position, the CSS could be extended forward with a maximum clearance of 10.2 cm (4.0") between the rear aspect of the shell and the vehicle's seat back support. In this position, the CSS could be rotated 90 degrees horizontally in either direction on the seat cushion. The internal harness straps were twisted and positioned in the lowest slots. The folding handle was locked in the proper forward position when the CSS is in transport. This CSS was not occupied at the time of the crash.

Occupant Data - 1997 Mitsubishi Montero

Driver Demographics

Age/Sex:	31 year old female
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Mid track
Manual Belt Usage:	None
Eyeware:	Unknown
Mode of Transport From Scene:	Rode in ambulance with front right child passenger
Type of Medical Treatment:	Not injured

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Not injured	N/A	N/A

Driver Kinematics

The 31 year old female driver of the Mitsubishi Montero was seated in a presumed normal driving posture with her seat track adjusted to a mid track position, 9.1 cm (3.6") rear of full forward and 14.0 cm (5.5") forward of full rear. The seat back was reclined to a measured angle of 20 degrees and the adjustable head restraint was adjusted 3.8 cm (1.5") above the top of the seat back. In this seat adjusted position, the horizontal distance between the center of the air bag module cover flap and the seat back support was 48.5 cm (19.1"). She was not wearing the manual 3-point lap and shoulder belt system. There was no occupant related loading or air bag membrane contact evidence on the belt system.

Figure 15. Trajectory of the driver into the deploying air bag and steering assembly.

The impact with the angle iron frame and mesh basket that was mounted on the rear of the recycling truck produced an elongated crash pulse and deployment of the frontal air bag system late in the crash sequence **(Figure 15)**. At impact, the driver initiated a forward trajectory as the air bag deployed. The driver's face contacted the lower left quadrant of the expanding air bag membrane. A tissue transfer (without make-up) was noted the bag located 7.0-10.2 cm (2.75-4.0") left of center and 14.6-15.9 cm (5.75-6.25") below the horizontal centerline. The driver's continued forward trajectory resulted in her torso loading the air bag and compressing the bag membrane against the steering wheel rim. Her loading force was transmitted into the energy absorbing steering column which compressed the column as evidenced by shear bracket separation. The left shear bracket was separated 2.5 cm (1.0") and remained partially engaged against the block. The right shear bracket was completely separated with a measure forward movement of 3.2 cm (1.25"). The driver was not injured as a result of the crash.

Front Right Child Passenger Demographics

Age/Sex:	3 year old male
Height:	101.6 cm (40.0")
Weight:	15.0 kg (33.0 lb)
Seat Track Position:	Mid track
Mode of Transport From Scene:	Ambulance to a local hospital
Type of Medical Treatment:	Expired on arrival

Front Right Child Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanisms
Complete fracture between C1 and C2 with laceration of the spinal cord	Critical (640450.5,7)	Air bag cover flap and expanding air bag membrane
Bilateral pulmonary contusions	Severe (441410.4.3)	Expanding front right air bag membrane
Laceration of the trachea	Serious (442604.3.4)	Air bag cover flap and expanding air bag membrane
Small amount of subarachnoid blood in the cerebellum	Serious (140684.3.9)	Rebound contact /displacement into an unknown component
Fracture of the hyoid bone	Moderate (350200.2.5)	Front right air bag cover flap
Fracture of the maxilla	Moderate (250800.2.9)	Front right air bag cover flap
Diaphragmatic contusions	Moderate (440602.2.8)	Expanding front right air bag membrane
Contusion of the thymus with extravasated blood	Not codeable under AIS	Expanding front right air bag membrane
Laceration of the pericardial sac	Moderate (441602.2.4)	Expanding front right air bag membrane
Marked cardiac contusions	Minor (441002.1.4)	Expanding front right air bag membrane
Focal galeal and subgaleal blood in the right occipital region of the scalp	Minor (190402.1.6)	Rebound contact /displacement into an unknown component
Extensive abrasion of the helix of the right ear and cheek	Minor (290202.1.1)	Expanding front right air bag membrane
Extensive contusion of the helix of the right ear and cheek	Minor (290402.1.1)	Expanding front right air bag membrane
Extensive abrasion of the lobe of the left ear and cheek	Minor (290202.1.2)	Expanding front right air bag membrane
Extensive contusion of the lobe of the left ear and cheek	Minor (290402.1.2)	Expanding front right air bag membrane

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanisms
Extensive abrasion of the mouth, chin, and submentum	Minor (290202.1.8)	Air bag cover flap and expanding air bag membrane
Extensive contusion of the mouth, chin, and submentum	Minor (290402.1.8)	Air bag cover flap and expanding air bag membrane
Extensive abrasion of the neck extends around both sides to the back of the neck	Minor (390202.1.0)	Expanding front right air bag membrane
Extensive contusion of the neck extends around both sides to the back of the neck. There is abundant, diffuse extravasated blood in the subcutaneous fat and muscles.	Minor (390402.1.0)	Expanding front right air bag membrane
Avulsion of the left upper central and lateral incisors	Minor (251406.1.8)	Air bag cover flap and expanding air bag membrane
Lacerations of the buccal mucosa	Minor (243099.1.8)	Resulted from the avulsed teeth
Contusions of the neck extend to the right shoulder and arm. There is abundant, diffuse extravasated blood in the subcutaneous fat and muscles.	Minor (790402.1.1)	Expanding front right air bag membrane
There is abundant, diffuse extravasated blood in the subcutaneous fat and muscles of the chest	Minor (490402.1.0)	Expanding front right air bag membrane

** Source of Injury Data - Autopsy Report*

Front Right Child Passenger Kinematics

The child passenger was seated in a presumed upright and forward facing posture on the front right seat cushion of the Montero. The seat was adjusted to a mid track position, 11.4 cm (4.5") rearward of the full forward position and 8.3 cm (3.25") forward of the full rear position. At the time of the SCI inspection, the seat back was adjusted to a vertical position and the head restraint was set to it's lowest position, on top of the seat back. With the front right seat adjusted to this position, the horizontal distance between the seat back support and the leading edge of the mid mount air bag cover flap was 69.9 cm (27.5"). Although unconfirmed by interview data or physical evidence at the crash scene, the driver probably

braked immediately prior to impact. The pre-crash braking, in combination with a "soft" collision against the recycling basket on the rear of the truck, displaced the 3 year old child passenger forward. The air bag system probably deployed late in the crash sequence. At deployment of the front right air bag, the child passenger, face was against or within a close proximity to the mid mount cover flap.

The air bag cover flap expanded against the anterior neck and underside of the child's chin. A distinct abrasion pattern was noted to the submentum with an underlying fracture of the mandible and hyoid bone were directly attributed to the contact sequence with the cover flap. This contact sequence rotated the head rearward as the air bag membrane expanded from the module. The bag membrane contacted the anterior neck and as it continued to expand, wrapped onto the lateral surfaces of the child's neck, face and ears which resulted in a continuous abrasion and contusion pattern. These contusions extended onto the right shoulder and upper arm. The combination of the air bag cover flap and bag membrane expansion against the child passenger hyper-extended the neck which resulted in a complete fracture between C1 and C2 with a laceration of the spinal cord, and a laceration of the trachea. The facial and neck contact resulted in extensive tissue transfers to the air bag membrane. The child also sustained avulsions of the left upper central and lateral incisors from cover flap/membrane contact and lacerations of the buccal mucosa from the avulsed teeth.
The child passenger was displaced vertically by the expanding air bag. The bag continued to expand against his torso which resulted in bilateral pulmonary contusions, a laceration of the pericardial sac, cardiac contusions, a contusion of the thymus, and diaphragmatic contusions. In addition, the child sustained diffuse extravasated blood in the subcutaneous fat and muscles of the chest.

The child passenger was displaced vertically and probably rearward by the expanding air bag. Tissue fragments were noted to the windshield and the center overhead console of the Mitsubishi Montero. There was no direct evidence of contact to these components. He did sustained a rebound injury to the right occipital region of the scalp with a small amount of subarachnoid blood noted in the cerebellum.

The child was removed from the vehicle by the driver and placed on the ground adjacent to the right side of the Montero. Emergency personnel arrived on scene and prepared the child for ambulance transport to a local hospital where he expired within 30 minutes of the crash.

Right Rear Passenger

Age/Sex:	12 year old male
Height:	Unknown
Weight:	Unknown
Manual Restraint Usage:	3-point lap and shoulder belt
Usage Source:	Vehicle inspection, police report
Type of Medical Treatment:	Not injured

Right Rear Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanisms
*Not injured	N/A	N/A

** Source - Police Report*

Right Rear Passenger Kinematics

The right rear 12 year old male passenger was seated in a presumed upright posture, facing forward. He was police reported as restrained by the manual 3-point lap and shoulder belt system. There was no evidence on the belt system to support belt usage. At impact, the child passenger would have initiated a forward trajectory. Due to the lack of contact evidence to the rear seat, the right rear passenger probably loaded the manual belt webbing which restricted his forward movement and prevented him from potential injury.

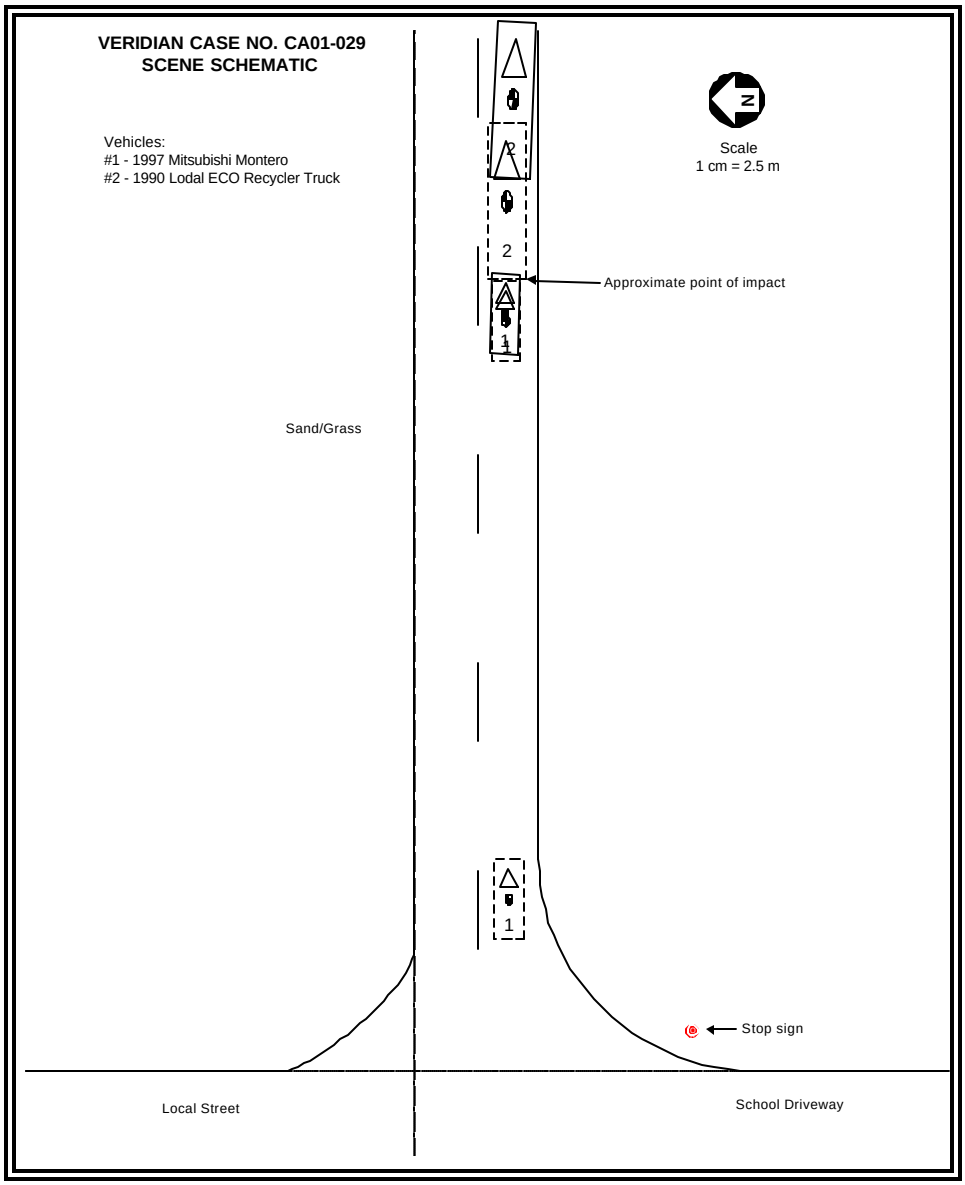

Figure 16. Crash Schematic.