

**TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER**

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**REMOTE AIR BAG RELATED CHILD FATALITY INVESTIGATION
SCI TECHNICAL SUMMARY REPORT**

VERIDIAN CASE NO. CA99-038

VEHICLE - 1998 MITSUBISHI ECLIPSE RS

LOCATION - STATE OF FLORIDA

CRASH DATE - FEBRUARY 1998

Contract No. DTNH22-94-D-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 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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<p>16. <i>Abstract</i> This remote investigation focused on a two-vehicle crash that involved a 1998 Mitsubishi Eclipse (subject vehicle) and a 1997 Dodge Ram 4x2 pickup truck. According to the Vehicle Identification Number (VIN), the Eclipse was not equipped with redesigned air bags as it was manufactured in November 1997. According to the Redesigned Air Bag Vehicle Identification, December 1998 listing, redesigned air bags were introduced in December 1997 for the Eclipse model. The Eclipse was occupied by a 25-year-old female driver, a 4-year-old female front right passenger, and a 6-year-old male rear passenger. The driver of the Eclipse stated to the police that all occupants of the Eclipse were restrained. It was determined that the front right child passenger was improperly restrained with the shoulder belt positioned behind her back. The Eclipse was equipped with frontal air bags that deployed as a result of an intersection collision with the Dodge pickup truck, which turned across the path of the Eclipse. All occupants of the Eclipse initiated forward trajectories as a response to the frontal impact with the Dodge pickup truck. The driver of the Eclipse contacted the deployed driver's air bag and sustained a contusion to her left breast and had a complaint of back pain. The front right child passenger was displaced forward by pre-crash braking and was struck by the front right passenger's air bag cover flap. She was redirected rearward by the deploying front right passenger's air bag and sustained a C1-C2 subluxation with a spinal cord injury, anterior neck abrasion, unspecified chest injury, and unspecified lower extremity injury. The rear passenger sustained a fractured jaw, fractured nose, and a contusion to the left eye. The driver and rear passenger were transported by ambulance to a local hospital. The driver was treated and released and the rear seat child passenger was admitted for treatment. The front right passenger was transported to a pediatric trauma center by helicopter and expired one hour following the crash. Due to the remote nature of this investigation and the lack of detailed injury data, the specific injury mechanisms were uncertain. Probable scenarios for these injuries are described in the kinematic section of this report. The restrained driver and passenger of the Dodge pickup truck were not injured.</p>			
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BACKGROUND

This remote investigation focused on a two-vehicle crash that involved a 1998 Mitsubishi Eclipse (subject vehicle) and a 1997 Dodge Ram 4x2 pickup truck. According to the Vehicle Identification Number (VIN), the Eclipse was not equipped with redesigned air bags as it was manufactured in November 1997. According to the Redesigned Air Bag Vehicle Identification, December 1998 listing, redesigned air bags were introduced in December 1997 for the Eclipse model. The Eclipse was occupied by a 25-year-old female driver, a 4-year-old female front right passenger, and a 6-year-old male rear passenger. The driver of the Eclipse stated to the police that all occupants of the Eclipse were restrained. It was determined from contact evidence within the vehicle that the front right child passenger was improperly restrained with the shoulder belt positioned behind her back. The Eclipse was equipped with frontal air bags that deployed as a result of an intersection collision with the Dodge pickup truck, which turned across the path of the Eclipse. All occupants of the Eclipse initiated forward trajectories as a response to the frontal impact with the Dodge pickup truck. The driver of the Eclipse contacted the deployed driver's air bag and sustained a contusion to her left breast and had a complaint of back pain. The front right child passenger was displaced forward by pre-crash braking and was struck by the front right passenger's air bag cover flap. She was redirected rearward by the deploying front right passenger's air bag and sustained a C1-C2 subluxation with a spinal cord injury, anterior neck abrasion, unspecified chest injury, and unspecified lower extremity injury. The rear passenger sustained a fractured jaw, fractured nose, and a contusion to the left eye. The driver and rear passenger were transported by ambulance to a local hospital. The driver was treated and released and the rear seat child passenger was admitted for treatment. The front right passenger was transported to a pediatric trauma center by helicopter and expired one hour following the crash. Due to the remote nature of this investigation and the lack of detailed injury data, the specific injury mechanisms were uncertain. Probable scenarios for these injuries are described in the kinematic section of this report. The restrained driver and passenger of the Dodge pickup truck were not injured.

This crash was originally identified through a search of the Fatality Analysis Reporting System (FARS) for fatalities that occurred in vehicles equipped with redesigned air bags. The crash occurred in February 1998 and was assigned to the Veridian Special Crash Investigation Team of September 2, 1999 as a remote investigation effort. Police photographs, insurance photographs, investigative death follow-up report, and a transcribed insurance interview with the driver were obtained, which provided the basis for this narrative report.

SUMMARY

Crash Site

This two-vehicle crash occurred during the daytime hours of February 1998. At the time of the crash, it was daylight with no adverse conditions as the asphalt roads were dry. The crash occurred at a residential 3-leg (T) intersection of a two-lane undivided north/south roadway and a two-lane unmarked east/west roadway leading into a residential development. Both roadways had level grades. The north/south roadside environment consisted of grassy shoulders and trees on either side. The east/west roadway environment consisted of concrete curbs, sidewalks, and residential driveways. Traffic control at the scene consisted of a stop sign for westbound traffic. The posted speed limit for the north/south roadway was 48 km/h (30 mph).

Pre-Crash

The 25-year-old female driver of the 1998 Mitsubishi Eclipse was operating the vehicle northbound on approach to the 3-leg intersection at a police-reported speed of 48 km/h (30 mph). The 27-year-old male driver of the Dodge Ram pickup truck was operating the vehicle southbound at a police-reported speed of 24 km/h (15 mph) on approach to the 3-leg (T) intersection (**Figure 1**). He initiated a left turn at the intersection and failed to recognize the close proximity of the approaching 1998 Mitsubishi Eclipse traveling in the opposite direction in the northbound lane. The driver of the Eclipse, realizing the impending harmful event, steered right and braked with sufficient force to lock the front wheels of the vehicle. The investigating officer documented 15 m (48') of skid marks from the right front tire and 8 m (27') of skid marks from the left front tire of the Eclipse (**Figure 2**). The driver's steering input redirected the Mitsubishi across the southeast quadrant of the intersection and onto the intersecting roadway where the impact occurred.



Figure 1. Direction of travel for the Dodge pickup truck



Figure 2. Point of impact and pre-impact skid marks from the Mitsubishi Eclipse

Crash

As the Mitsubishi Eclipse entered the southeast quadrant of the intersection, the front left area impacted the right center side area of the Dodge pickup truck. The front bumper of the Eclipse initially impacted, then under rode the side of the Dodge pickup truck forward of the right rear wheel, causing the area above the bumper on the Eclipse to engage the side plane of the pickup truck. As the vehicles engaged, the left front corner of the Eclipse caused deep pocketing in the right rear quarter panel aft of the B-pillar on the Dodge pickup. The left front fender of the Eclipse contacted the right rear wheel of the Dodge pickup truck causing

the two vehicles to rotate clockwise (CW) approximately 45 degrees before disengaging. The resultant directions of force for the Mitsubishi and Dodge pickup truck were in the 11 o'clock and 2 o'clock sectors, respectively. Impact resulted in minor damage to the Dodge pickup truck and moderate damage to the Eclipse. The impact induced deceleration was sufficient to deploy the frontal air bag system in the Eclipse. The deployment probably did not occur until the grille area of the Eclipse contacted the sill of the pickup truck, therefore resulting in a late deployment of the frontal air bag system. The damage algorithm of the WinSMASH program computed total velocity changes of 18.2 km/h (11.4 mph) for the Eclipse based on the estimated crush profile. The specific longitudinal and lateral components were -17.9 km/h (-11.2 mph) and 3.2 km/h (2 mph) respectively. The damage algorithm of the WinSMASH program computed total velocity changes of 12.4 km/h (7.8 mph) for the Dodge pickup truck based on the estimated crush profile. The specific longitudinal and lateral components were -2.2 km/h (-1.4 mph) and -12.2 km/h (-7.7 mph) respectively. The Eclipse came to rest in the intersection immediately after the disengagement with the Dodge pickup truck. The pickup truck continued to travel in a southeast direction and came to rest onto the grassy area adjacent to the southeast corner of the intersection. The Eclipse was then driven to the right road edge approximately 8 m (25') from the point of impact along the curb edge (**Figure 3**).



Figure 3. Final rest positions of both vehicles

Post-Crash

Based on a transcribed insurance interview with the driver of the Eclipse, the driver exited the Eclipse under her own power, unbuckled the seat belt from the front right child passenger and removed the child passenger from the vehicle. She stated that she laid the front right child passenger on the ground and removed the rear seat child passenger from the vehicle. The driver and rear passenger of the Eclipse were transported by ambulance to a local hospital. The driver was treated and released, and the rear passenger was admitted for treatment. The front right passenger was transported by helicopter to a pediatric trauma center with reportedly serious injuries and pronounced dead one hour after the crash. The driver and passenger of the Dodge pickup truck were not injured.

SUBJECT VEHICLE - 1998 Mitsubishi Eclipse

The 1998 Mitsubishi Eclipse RS was identified by the Vehicle Identification Number (VIN): 4A3AK34Y9WE (production sequence omitted). The vehicle was a 2-door hatchback equipped with front wheel drive, automatic transmission, and a 2.0 liter, 4-cylinder engine. The vehicle's odometer reading was 4,054 km (2,534 miles) at the time of the crash. The police report listed a rental car company as the owner of the vehicle. The seating was configured with reclining front bucket seats with folding backs, and a two-person rear bench seat with a folding back.

VEHICLE DAMAGE

Exterior Damage - 1998 Mitsubishi Eclipse

The 1998 Mitsubishi Eclipse sustained moderate frontal damage as a result of the impact with the Dodge Ram pickup truck (**Figure 4**). The direct contact damage began at the front left bumper corner and extended laterally approximately 130 cm (51") across the bumper fascia. Direct contact damage was also noted at the level above the bumper from the under ride with the Dodge pickup truck, which caused the front edge of the hood to crush rearward. The left headlight was displaced rearward, and slight buckling was noted on the left aspect of the bumper fascia and left front fender (**Figure 5**). A scuff mark from the right rear wheel of the Dodge was also identified on the left front fender above the wheel, which resulted from the pocketing and rotation prior to disengagement. The Collision Deformation Classification (CDC) for this impact to the Mitsubishi Eclipse was 11-FDEW-1. Six crush measurements were estimated along the frontal plane above the bumper as were as follows: C1 = 10 cm (4"), C2 = 8 cm (3"), C3 = 7 cm (3"), C4 = 7 cm (3"), C5 = 7 cm (3"), C6 = 5 cm (2").



Figure 4. View of frontal and left side damage for Mitsubishi Eclipse



Figure 5. Frontal damage to Mitsubishi Eclipse

Interior Damage - 1998 Mitsubishi Eclipse

Interior damage to the 1998 Mitsubishi Eclipse was attributed to occupant contact. There was no damage associated with exterior deformation or intrusion of interior components. A tissue transfer was identified on the upper left aspect of the front right passenger air bag module cover flap. The windshield directly above the cover flap was cracked in a spider-web fashion (**Figure 6**). The glove compartment door was open. Blood smears were visible on the rear aspect of the driver seat and head restraint (**Figure 7**), the rear left seat cushion, rear left seat back, rear left side panel, rear left seat belt webbing and latch plate, rear center seat cushion (**Figure 8**), and rear aspect of the front right seat head restraint.

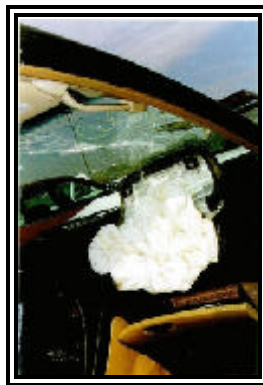


Figure 6. Front right passenger's air bag and spider web on windshield



Figure 7. Rear aspect of front left seat back



Figure 8. Rear left seat

Exterior Damage - 1997 Dodge Ram Pickup Truck

The 1997 Dodge Ram pickup truck sustained moderate damage as a result of the impact with the Mitsubishi Eclipse (Figure 9). The direct damage was concentrated below the side body line, and extended longitudinally from the front of the right door to the right rear wheel. Pocketing of the sheet metal was noted forward of the right rear wheel from the engagement and rotation of the vehicles. The CDC for the impact to the Dodge Ram pickup truck was 02-RZLW-3.



Figure 9. Damage to 1997 Dodge Ram pickup truck

AIR BAG SYSTEM- 1998 Mitsubishi Eclipse

The 1998 Mitsubishi Eclipse was equipped with air bags for the driver and front right passenger positions that deployed as a result of the impact with the Dodge pickup truck. According to the Vehicle Identification Number (VIN), the Eclipse was not equipped with redesigned air bags as it was manufactured in November 1997. The Redesigned Air Bag Vehicle Identification, December 1998 listing, stated redesigned air bags began production in December 1997 for the Eclipse model. Based on the impact configuration and damage patterns, the frontal air bag system probably deployed late in the crash sequence. The driver’s air bag was housed in the center of the steering wheel with a horizontally oriented flap tear seam (H-configuration). Blood smears were noted on the top aspect of the air bag, but no contact evidence was noted on the exterior surface of the air bag cover flaps. The flaps were symmetrical in shape.

The front right passenger’s air bag deployed from the right mid-instrument panel area with a single cover flap design hinged at the top aspect (Figure 10). The cover flap was rectangular in shape. A large tissue transfer was noted on the upper left portion of the air bag module cover flap, indicating the front right child passenger was possibly positioned above the cover flap when it deployed (Figure 11). Black (probably vinyl) transfers were noted on the left, top, and bottom aspects of the air bag surface indicating an impeded deployment (Figure 12). Contact evidence, possibly a clothing transfer, was noted on the left aspect of the air bag.



Figure 10. Photo from 1998 Mitsubishi Eclipse brochure showing the front right passenger air bag cover flap

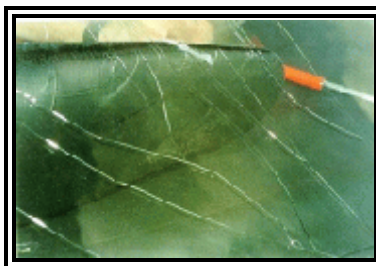


Figure 11. View through the windshield showing the tissue transfer on the cover flap



Figure 12. Front right passenger’s air bag showing black vinyl transfers

OCCUPANT DEMOGRAPHICS - 1998 Mitsubishi Eclipse

Driver

Age/Sex: 25-year-old female
Height: 163 cm (64")
Weight: Unknown
Seat Track Position: Mid-to-rear
Manual Restraint Use: 3-point lap and shoulder belt
Usage Source: Police report
Eyewear: Unknown
Type of Medical Treatment: Transported by ambulance to local hospital and released

Driver Injuries

Injury	Injury Severity (AIS 90)	Possible Injury Mechanisms
Contusion of the left breast	Minor (490402.1,2)	Driver's air bag or manual belt webbing

*Injury source: Transcribed insurance interview with driver

Driver Kinematics

Due to the remote nature of this investigation and the lack of detailed injury data, the specific injury mechanisms were uncertain. The 25-year-old female driver of the 1998 Mitsubishi Eclipse was presumed to be seated in an upright posture, with the seat track adjusted between mid-track and full rear positions. The adjustable head restraint was fully lowered and the D-ring was adjusted to a mid position. The police report stated that she was restrained by the available 3-point lap and shoulder belt system, however, restraint usage could not be supported.

At impact, she initiated a forward trajectory and loaded the manual restraint. She subsequently contacted the deployed driver's air bag which offered additional protection from the frontal crash forces. According to the transcribed insurance interview, she sustained a contusion to her left breast and had a complaint of back pain. She was transported by ambulance to a local hospital and was treated and released.

Front Right Passenger

Age/Sex: 4-year-old female
Height: Unknown
Weight: Unknown
Seat Track Position: Unknown (mid-to-full forward)
Manual Restraint Use: 3-point lap and shoulder belt worn improperly with the shoulder belt positioned behind her back
Usage Source: Contact evidence/injury data
Eyewear: Unknown
Type of Medical Treatment: Transported by helicopter to pediatric trauma center and expired one hour following the crash

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90)	Injury Mechanisms
Subluxation of C1-C2 with spinal cord injury	Maximum (640236.6,6)	Front right passenger's air bag cover flap and air bag membrane expansion
Anterior neck abrasion	Minor (390202.1,5)	Front right passenger's air bag cover flap and air bag membrane expansion
Unspecified chest injuries	N/A (not coded under AIS 90)	Front right passenger's air bag cover flap and air bag membrane expansion
Unspecified lower extremity injuries	N/A (not coded under AIS 90)	Glove box door/instrument panel

*Injury source: Medical Examiner's investigative report, no autopsy performed

Front Right Passenger Kinematics

The child passenger's kinematics and injury mechanisms were based on the police photographs, the medical examiner's investigative report, and a transcript of the driver's interview with the insurance company. The injury data was incomplete because there was no hospitalization or autopsy performed. The investigative death follow-up report stated that the 4-year-old female front right passenger of the Mitsubishi Eclipse was reportedly restrained by the 3-point lap and shoulder belt system and it appeared that she slid under the seatbelt which caught her in the neck. Based on tissue transfers to the cover flap and injuries identified above, the front right passenger's air bag cover flap and air bag expansion were presumed to be the primary injury mechanisms and cause of death. Although the driver stated the child was restrained, it was determined by this contact sequence that she was improperly restrained with the shoulder belt positioned behind her back.

Photographs taken at the scene indicate the front right seat was adjusted to a mid to full rear track position, with the seat back reclined. It was not known if the seat back was in the reclined position prior to impact. The adjustable head restraint was raised approximately 3 cm (1") and the D-ring was adjusted to the full-up position.

The 4-year-old female front right passenger was improperly restrained by the manual restraint system. The available 3-point lap and shoulder belt system would have been a poor fit for her small stature, and if worn properly, the shoulder belt would have most likely situated against the upper portion of her neck or across her face. Therefore, it was determined that the shoulder belt was positioned behind her back which would have allowed her to jackknife forward over the lap belt into the path of the deploying mid mount front right air bag. Additionally, she may have been positioned forward on the seat cushion to allow her lower legs to clear the edge of the seat.

The front right passenger initiated a forward trajectory due to pre-impact braking. As she moved forward and loaded the lap belt webbing of the manual system, the lap belt restricted the forward motion of her pelvic region allowing her torso and head to translate forward over the lap belt. This forward motion placed the child in the path of the mid mount front right passenger's air bag. As the Eclipse engaged the Dodge pickup truck, she continued forward and slightly vertical due to the vehicle underride, which positioned her head above the front right passenger's air bag module cover flap. As the air bag deployed, she was struck by the air bag cover flap on the underside of her chin, evidenced by a large tissue transfer noted on the top left aspect of the module cover flap. Black vinyl transfers on the air bag surface from the air bag module cover flap support the probability of an impeded deployment. The air bag subsequently expanded against her neck, and in combination with the cover flap contact, caused an anterior neck abrasion and probable hyper-extension of the neck. She sustained a C1-C2 subluxation and spinal cord injury.

The driver stated that the child's head came to rest toward the center console of the Eclipse, which is consistent with the rotational forces during the crash sequence. She was removed from the vehicle by the driver and transported by helicopter to a pediatric trauma center where she expired one hour following the crash. There was no autopsy performed on the body at the request of the parents.

Rear Passenger

Age/Sex:	6-year-old male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	N/A
Manual Restraint Use:	3-point lap and shoulder belt worn improperly or unrestrained
Usage Source:	Contact evidence/injury data
Eyewear:	Unknown
Type of Medical Treatment:	Transported by ambulance to local hospital and admitted

Rear Passenger Injuries

Injury	Injury Severity (AIS 90)	Possible Injury Mechanisms
Unspecified fractures of the jaw area	Minor (250400.1,9)	Front seat back support
Nose fracture	Minor (251000.1,4)	Front seat back support
Left orbital contusion	Minor (290402.1,2)	Front seat back support

*Injury source: Transcribed insurance interview with driver

Rear Passenger Kinematics

Due to the remote nature of this investigation and the lack of detailed injury data, the specific injury mechanisms were uncertain. Injury data was obtained from the transcribed insurance interview with the driver of the Mitsubishi Eclipse.

The 6-year-old male rear passenger of the Mitsubishi Eclipse was reported by the police to have been seated in the rear left position, however, in the transcribed insurance interview, the driver stated that he was seated in the rear right position. The police report stated he was utilizing the occupant restraint, however seat belt usage could not be supported.

The 6-year-old male rear passenger was probably out-of-position due to pre-impact braking. At impact, he initiated a forward trajectory in response to the frontal crash forces. Based on injuries sustained, he probably struck his face on the rear aspect of the front seat backs. Numerous blood stains were noted on the rear aspect of the front left seat back, rear left seat, and rear left seat belt webbing. He sustained a fractured nose, a left orbital contusion, and unspecified fractures of the jaw. He was transported by ambulance to a local hospital and admitted.