On-scene Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS97021
1996 Mercury Sable
Oregon
October/1997

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

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

Technical Report Documentation Page

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16. Abstract

This case was initiated in response to a report of a child-involved air bag fatality and an atypical air bag deployment in a 1996 Mercury Sable. Vehicle 1, a 1996 Mercury Sable GS four-door driven by an unrestrained 26-year-old female, was traveling eastbound approaching an uncontrolled, residential, three-leg, intersection. The right front seat was occupied by an unrestrained 7-year-old male. The lack of restraint use was based on the driver's statement to police, the position of the child prior to impact, and skin contact evidence found on the air bag. Vehicle 2, a 1993 Chevrolet C150 pickup driven by a 19-year-old male, was traveling southbound approaching the same intersection. The right front of Vehicle 2 was occupied by a 20-year-old male. Vehicle 2 was traveling at a fairly high rate of speed–approximately 80 km/h (50 MPH). The vehicle was set up for off-road travel and there was a height mismatch between the two vehicles. As Vehicle 1 reached the intersection the driver slowed and may have stopped prior to pulling into the intersection with the intention of turning left--to the north. The front of Vehicle 1 struck the right side of Vehicle 2. Vehicle 2 sustained swiping type damage from the right front tire and along the sill, as well as damage to the right rear tire. Vehicle 1 sustained moderate damage (10FDEW1) with a longitudinal delta V of -10.2 km/h (-6.4 MPH). The right front air bag deployed at this point, but the driver's side air bag did not. The bumper facia was knocked off, the left discriminating sensor was broken free of its mountings, the right discriminating sensor was pushed into the radiator, and the right front door was jammed shut (it could be opened, but not without further damaging the vehicle). The impact caused Vehicle 2 to begin a clockwise rotation. Vehicle 2 crossed over the left side of the roadway and struck a parked 1963 Ford pickup truck with it's left side. This impact caused Vehicle 2 to rotate in a counterclockwise direction before coming to rest on the roadway. Vehicle 2 then attempted to flee the scene. The driver reversed his original direction of travel and began traveling north. The right rear tire on Vehicle 2 had been broken off and the vehicle was forced to stop after traveling several blocks. The right front occupant of Vehicle 1 was seated forward on the seat with his legs over the edge of the seat. He was wearing a school backpack. The mother had just picked up the child from school and they were apparently discussing the day's events. It appears likely that the driver of Vehicle 1 tapped her brakes just prior to impact. This caused the child to move forward, bringing his head closer to the air bag module cover. His right arm was probably extended outward to catch himself which put him in a somewhat left facing position. At impact, the air bag on the passenger side deployed. The module cover likely struck the right arm and forced it into the windshield. As the air bag expanded it contacted the underside of the chin and anterior neck area of the child causing the abrasions, and hyperextending the neck, which resulted in a complete C-1 separation. The child also sustained an abrasion to the right ear from the deploying air bag and a laceration to the right elbow which was likely related to interaction between the air bag module cover and the windshield. According to the mother, the child came to rest near her. The child was transported from the scene by ground ambulance; a local city ambulance began the transport and then rendezvoused with fire department paramedics. The child arrived at the hospital 64 minutes after the crash and was placed on life support. The child died the following day. According to statements attributed to the medical examiner, the child remained on life support overnight but was effectively killed at the scene.

17. Key Words	18. Distribution Statement
Air bag, deployment, injury, accident, child, fatal	

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Dynamic Science, Inc.
Accident Investigation
Case Number: DS97021

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BACKGROUND:

Description:	This case was initiated in response to a report of a child-involved air bag fatality and an atypical air bag deployment in a 1996 Mercury Sable.
Investigation Type:	On-scene
Crash Location:	Oregon
Crash Date:	October 1997
Notification Date:	October 9, 1997
Field Work Completed:	October 14, 1997

SUMMARY:

This case was initiated in response to a report of a child-involved air bag fatality and an atypical air bag deployment in a 1996 Mercury Sable. The collision occurred in October 1997 at 1454 hours. The NHTSA was notified on October 8, 1997 by the NHTSA regional office. DSI was notified on October 9, 1997. This was an on-scene investigation. Field work was completed on October 14, 1997. Two representatives from Ford Motor Company were present during the vehicle inspections; one of the representatives downloaded information from the control module and performed some on-site diagnostics. The Office of Defects Investigation has been notified of the investigation.

Vehicle 1, a 1996 Mercury Sable GS four-door driven by an unrestrained 26-year-old female, was traveling eastbound approaching an uncontrolled, residential, three-leg, intersection. The right front seat was occupied by an unrestrained 7-year-old male. The lack of restraint use was based on the driver's statement to police, the position of the child prior to impact, and skin contact evidence found on the air bag. Vehicle 2, a 1993 Chevrolet C150 pickup driven by a 19-year-old male, was traveling southbound approaching the same intersection. The right front of Vehicle 2 was occupied by a 20-year-old male. Vehicle 2 was traveling at a fairly high rate of speed–approximately 80 km/h (50 MPH)[1]. The

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[1] Calculated using combined speed formula

$Sc = \sqrt{S1^2 + S2^2 + S3^2 + S4^2}$

where

$S1$ = delta V for impact with V1 used as impact speed

$S2$ = skid speed, 90 ft. with f of 0.6

$S3$ = delta V for impact with parked vehicle used as impact speed

$S4$ = skid speed, 40 ft. with f of 0.6

$Sc = \sqrt{8.3^2 + 40.25^2 + 8.4^2 + 26.83^2} = 49.79 \text{ mph} = 80.1 \text{ km / h}$

vehicle was set up for off-road travel and there was a height mismatch between the two vehicles. As Vehicle 1 reached the intersection the driver slowed and may have stopped prior to pulling into the intersection with the intention of turning left--to the north. The front of Vehicle 1 struck the right side of Vehicle 2. Vehicle 2 sustained swiping type damage from the right front tire and along the sill, as well as damage to the right rear tire. Vehicle 1 sustained moderate damage (10FDEW1) with a longitudinal delta V of -10.2 km/h (-6.4 MPH). The right front air bag deployed at this point, but the driver's side air bag did not. The bumper facia was knocked off, the left discriminating sensor was broken free of its mountings, the right discriminating sensor was pushed into the radiator, and the right front door was jammed shut (it could be opened, but not without further damaging the vehicle). The impact caused Vehicle 2 to begin a clockwise rotation. Vehicle 2 crossed over the left side of the roadway and struck a parked 1963 Ford pickup truck with it's left side. This impact caused Vehicle 2 to rotate in a counterclockwise direction before coming to rest on the roadway. Vehicle 2 then attempted to flee the scene. The driver reversed his original direction of travel and began traveling north. The right rear tire on Vehicle 2 had been broken off and the vehicle was forced to stop after traveling several blocks. Both vehicles were towed from the scene due to damage and impounded by the police.

The right front occupant of Vehicle 1 was seated forward on the seat with his legs over the edge of the seat. He was wearing a school backpack. The mother had just picked up the child from school and they were apparently discussing the day's events. It appears likely that the driver of Vehicle 1 tapped her brakes just prior to impact. This caused the child to move forward, bringing his head closer to the air bag module cover. His right arm was probably extended outward to catch himself which put him in a somewhat left facing position. It appears likely that the child was wearing some type of blue denim jacket or shirt but the actual clothing could not be located.[2] There is blue fabric fragment evidence which was found embedded in the top of the module cover and in the windshield. There are blue fabric transfers along the front of the air bag, mostly on the right side. At impact, the air bag on the passenger side deployed. The module cover likely struck the right arm and forced it into the windshield. As the air bag expanded it contacted the underside of the chin and anterior neck area of the child causing the abrasions, and hyperextending the neck, which resulted in a complete C-1 separation. There is substantial skin transfer evidence of this contact. The child also sustained an abrasion to the right ear from the deploying air bag and a laceration to the right elbow which was likely related to interaction between the air bag module cover and the windshield. According to the mother, the child came to rest near her

The child was transported from the scene by ground ambulance; a local city ambulance began the transport and then rendezvoused with fire department paramedics. The child arrived at the hospital 64 minutes after the crash and was placed on life support. According to hospital administration personnel, the involved hospital is a trauma center. The following table describes events and times related to the crash and the transport of the child to the hospital.

[2]This is an American-Indian child. As part of the burial ritual his belongings were burned, including we are told his clothing.

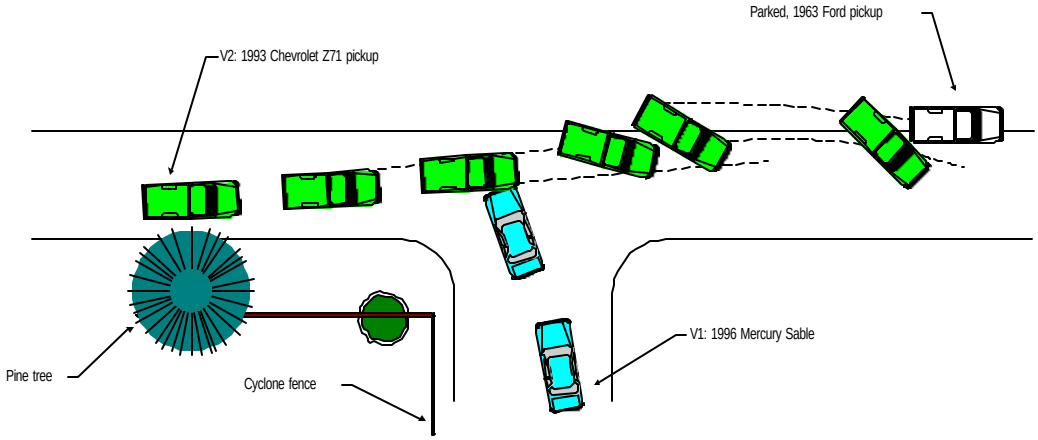
Event	Time
Accident:	1454
EMS notified:	1459
Police notified:	1500
EMS arrived:	1506
Police arrived:	1520
EMS met ambulance:	1523
Ambulance arrive at hospital:	1550

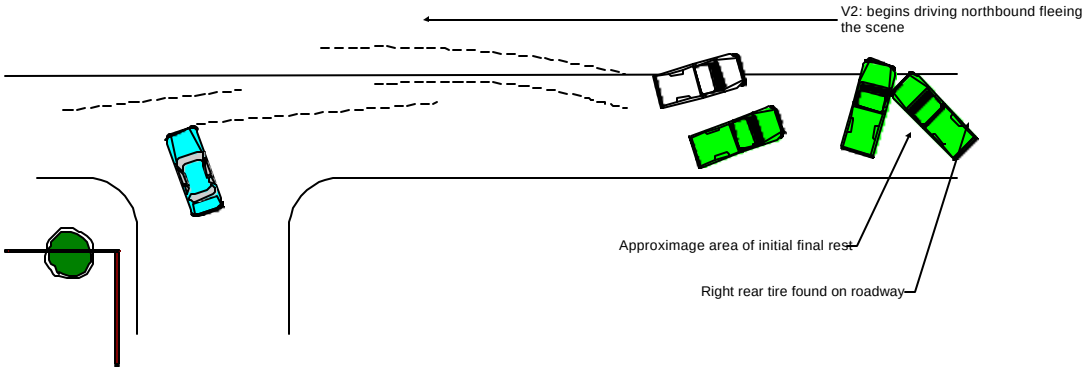
The child died the following day. According to statements attributed to the medical examiner, the child remained on life support overnight but was effectively killed at the scene. The death certificate indicated "seconds" as the interval between the onset of the injury and death.

The driver of Vehicle 1 sustained a neck strain and has complained of pain to one of her hands. The two occupants of Vehicle 2 sustained some injuries but their source and relationship to the actual crash have not been determined.

The events described in this paragraph, while being part of this case, do not bear directly on the issues in this case so their discussion will be brief. The driver of Vehicle 2 attempted to leave the scene in Vehicle 2 but it was too badly damaged. Both the driver of Vehicle 2 and the right front occupant were at one point confronted by the husband of the driver of Vehicle 1. The husband assaulted one or both of the men. Both men fled the scene on foot but were later apprehended. There was alcohol involvement for both men and both indicated that they were not the driver.

Scene Diagram





DETAILED INFORMATION

Vehicles

Vehicle 1

Description:	1996 Mercury Sable GS four-door	
VIN:	1MELM50UXTGXXXXXX	
Odometer:	64,417 km (38,164 miles)	
Engine:	3.0L EFI V6	
Reported Defects:	None	
Cargo:	None	
Damage Description:	The bumper facia was knocked off, the left discriminating sensor was broken free of its mountings, the right discriminating sensor was pushed into the radiator, and the right front door was jammed shut (it could be opened, but not without further damaging the vehicle).	
CDC:	10FDEW1	
Delta V:	Total	17.8 km/h (11.1 mph)
	Longitudinal	-10.2 km/h (-6.4 mph)
	Latitudinal	14.6 km/h (9.1 mph)
	Energy	38,141 joules (28,157 ft-lbs.)

Vehicle 1 was equipped with a driver's side air bag and a top-mount passenger side air bag. There are three sensors on the vehicle, two discriminating sensors on the radiator mounting bracket and one in the instrument panel. All are of the ball-in-tube design. The top-mount, passenger air bag module cover is vaguely oval in shape and is secured to the vehicle by two fabric tethers. The air bag was rectangular and measured 59 cm (23 in.) laterally by 63 cm (25 in.) vertically . It had a maximum excursion of 77 cm (30 in.) as measured from the top of the module cover. The right front seat was of the electrical adjustment variety; it was positioned 21 cm (8 in.) rearward of the face of the instrument panel.

Figure 3. Exterior, Vehicle 1

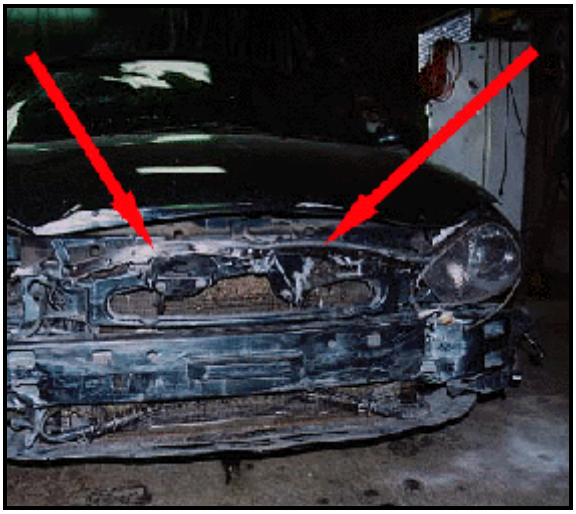


Figure 4. Vehicle 1, damaged sensors

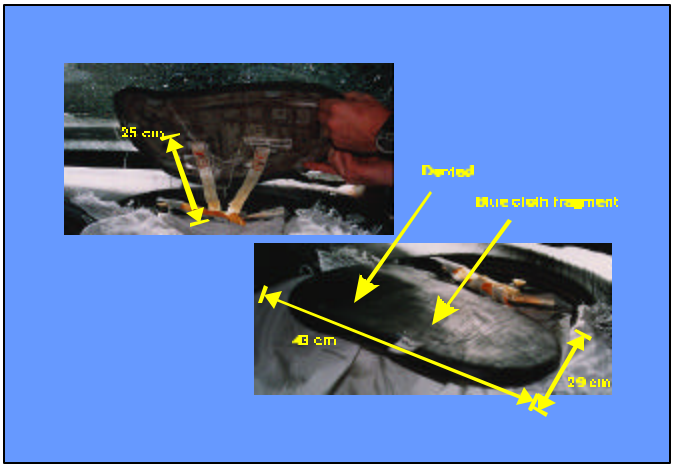


Figure 5. Module cover

Vehicle 2

Description:	1993 Chevrolet C150 pickup	
VIN:	2GCEK19K6P1XXXXXX	
Odometer:	91,557 km (56,893 miles)	
Engine:	5.7l V8	
Reported Defects:	Steering	
Cargo:	Unknown	
Damage Description:	Impact #1: Glancing, sideswipe type damage along lower sill on right side. Right tire knocked off. Impact #2: Moderate crush to the rear part of the left side of the cab.	
CDC:	Impact 1: 12FZLW2 Impact 2: 11LZAW2	
Delta V:	Total	13.4 km/h (8.3 mph)
	Longitudinal	-13.2 km/h (-8.2 mph)
	Latitudinal	-2.3 km/h (-1.4 mph)
	Energy	31,963 joules (23,592 ft-lbs)

Figure 6. Exterior, Vehicle 2, Impact #1

Figure 7. Exterior, Vehicle 2, Impact #2

Occupants

Vehicle 1	Occupant 1	Occupant 2
Age/Sex:	26/Female	7/Male
Seated Position:	Left front	Right front
Seat Type:	Bucket	Bucket
Height:	180 cm (71 in.)	Unknown
Weight:	70 kg (155 lbs.)	Unknown
Occupation:	Unknown	NA
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	.10 years	NA
Body Posture:	Normal, upright	Seated forward on the seat with his legs over the edge of the seat. He was wearing a school backpack
Hand Position:	Unknown	Unknown
Foot Position:	Right presumed to be on brake	Unknown
Restraint Usage:	None used	None used

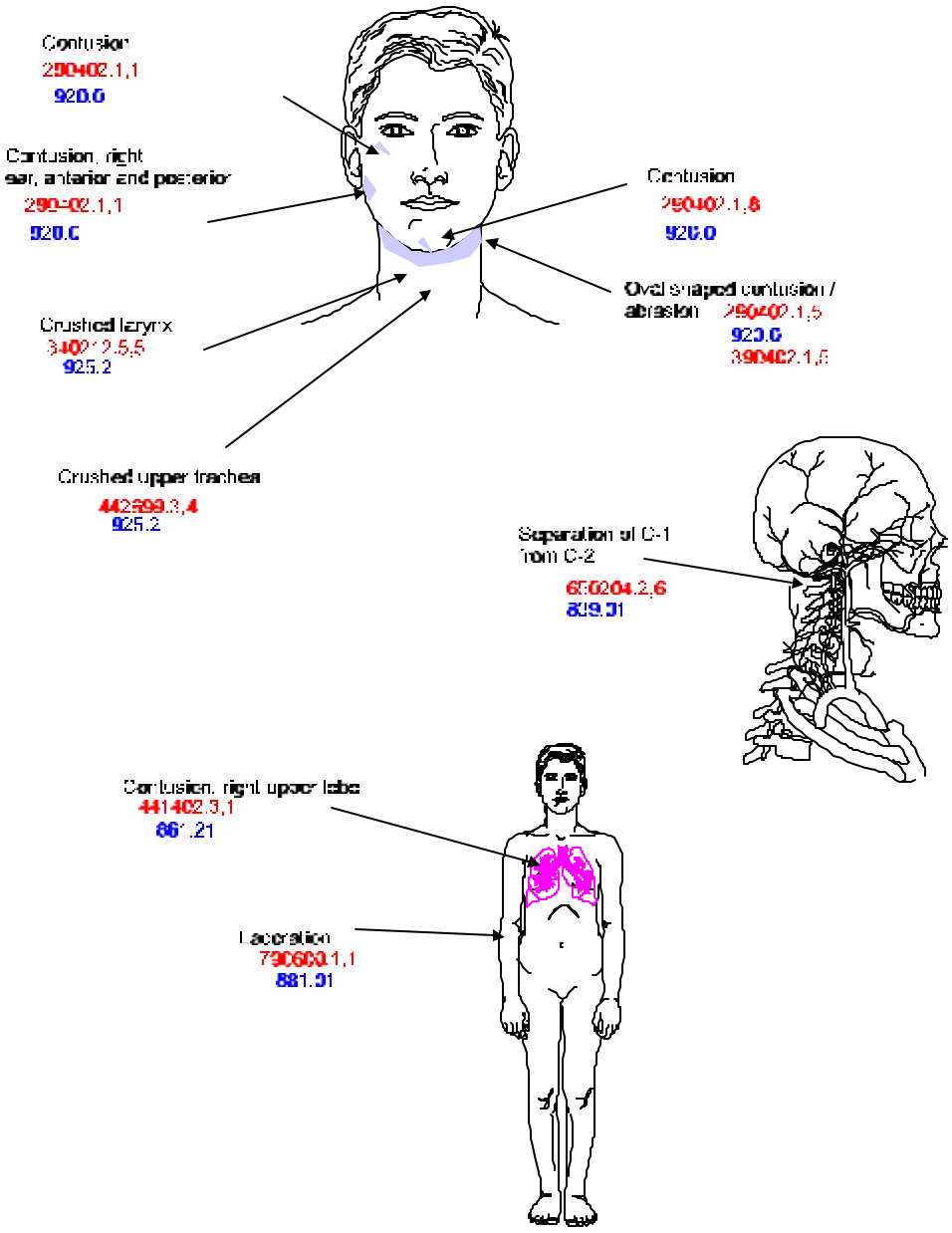
Occupants

Vehicle 2	Occupant 1	Occupant 2
Age/Sex:	19 / Male	20 / Male
Seated Position:	Left front	Right front
Seat Type:	Bucket with folding back	Bucket with folding back
Height:	183 cm (72 in.)	Unknown
Weight:	73 kg (160 lbs.)	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	Unknown	Unknown
Alcohol/Drug Involvement:	Yes	Yes
Driving Experience:	Unknown	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Right presumed to be on brake	Unknown
Restraint Usage:	None used	None used

Injuries and Injury Mechanisms

Vehicle 1

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Neck strain	640278.1,6	847.0	Unknown
RF occupant:	Crushed larynx	340212.5,5	925.2	Air bag
	Crushed upper trachea	442699.3,4	925.2	Air bag
	Separation of C-1 from C-2	650204.2,6	839.01	Air bag
	Contusion, right cheek	290402.1,1	920.0	Air bag
	Contusion, right ear, posterior and anterior	290402.1,1	920.0	Air bag
	Contusion, chin	290402.1,8	920.0	Air bag
	Oval shaped abrasion/contusion to chin	290402.1,5 390402.1,5	920.0	Air bag
	Contusion, upper lobe of right lung	441402.3,1	861.21	Air bag
	Laceration, right forearm	790600.1,1	881.01	Windshield


Contusion
290402.1,1
920.0
Contusion, right
ear, anterior and posterior
290402.1,1
920.0
Contusion
290402.1,8
920.0
Oval shaped contusion /
abrasion 290402.1,5
920.0
Crushed larynx
925.2
Crushed upper trachea
925.2
Separation of C-1
from C-2
959.01
Contusion, right upper lobe
441402.3,1
861.21
Laceration
790600.1,1
881.01

Occupant Kinematics

The right front occupant of Vehicle 1 was seated forward on the seat with his legs over the edge of the seat. He was wearing a school backpack. His mother had just picked up the child from school and they were apparently discussing the day's events. As Vehicle 1 approached the intersection, it appears likely that the driver of Vehicle 1 tapped her brakes just prior to impact. This caused the child to move forward, bringing his head closer to the air bag module cover. His right arm was probably extended outward to catch himself which put him in a somewhat left facing position. It appears likely that the child was wearing some type of blue denim jacket or shirt but the actual clothing could not be located. There is blue fabric fragment evidence which was found embedded in the top of the module cover and in the windshield. There are blue fabric transfers along the front of the air bag, mostly on the right side, extending 20 cm 7.8 in.) along the face of the air bag and 37 cm (14.5 in.) along the top. At impact, the air bag on the passenger side deployed. The module cover likely struck the right arm and forced it into the windshield. This held the child in place. As the air bag expanded it contacted the underside of the chin and anterior neck area of the child causing the abrasions, and hyperextending the neck, which resulted in a complete C-1 separation. There is substantial skin transfer evidence of this contact, mostly on the left side of the face of the air bag beginning near the bottom and continuing on for 27 cm (10.6 in.). The child also sustained an abrasion to the right ear which appears to be a wraparound injury from the air bag and a laceration to the right elbow which was likely related to interaction between the air bag module cover and the windshield. According to the mother, the child came to rest near her.

Figure 11. Interior, module cover in down position

Figure 10. Interior, module cover in up position

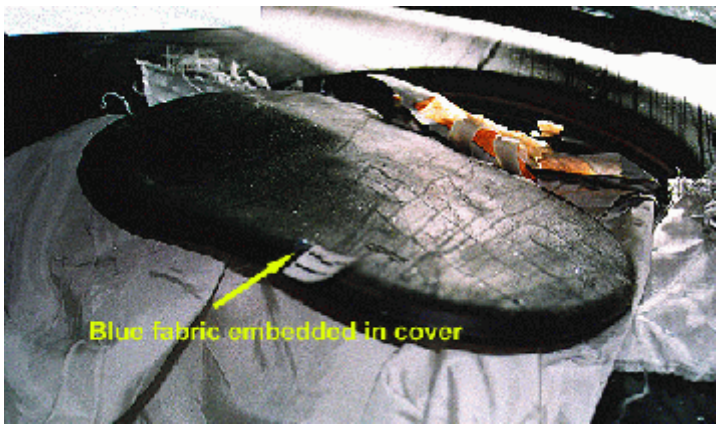


Figure 9. Module cover, embedded blue fabric

Figure 12. Skin and fabric transfers to passenger air bag

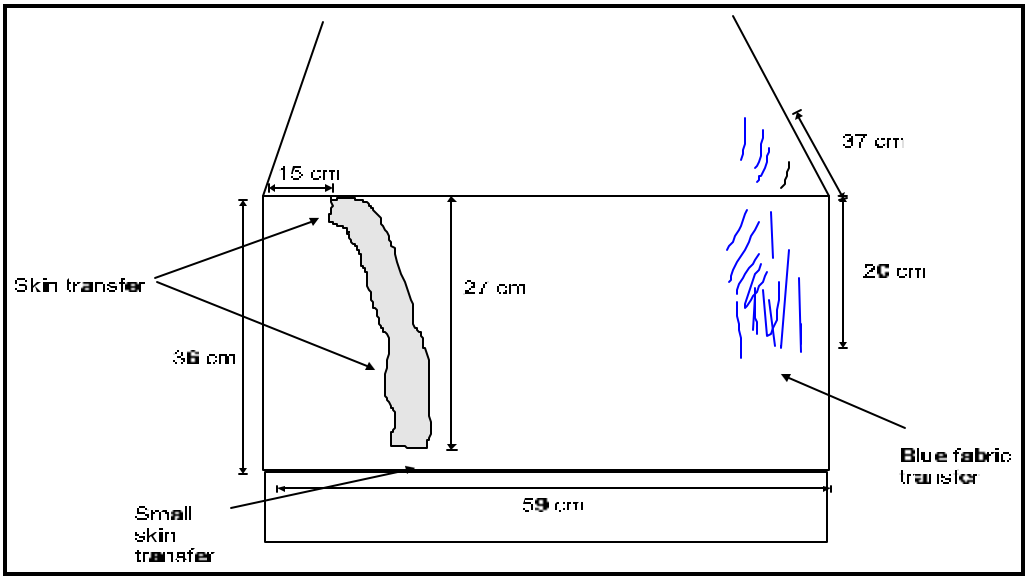


Figure 13. Passenger side air bag

Photo Index

Photo no.	Vehicle No.	Direction of Picture	Subject Matter
DS9702101 - DS9702102	1	East	Approach to area of impact.
DS922103	1	East	Area of impact.
DS9702104 - DS9702106	1	West	Looking back along path of travel.
DS9702107 - DS9702108	2	South	Approach to area of impact.
DS9702109	2	South	Area of impact.
DS9702110	2	North	Looking back along path of travel.
DS9702111 - DS9702112	2	South	Approach to area of second impact.
DS9702113 - DS9702114	2	South	Shows impact area as well as track marks from fleeing vehicle.
DS9702115	2	South	Impact with parked vehicle.
DS9702116 - DS9702131	1	CW	Exterior of vehicle.
DS9702138 - DS9702156	1	NA	Interior of vehicle.
DS9702157 - DS9702173	2	CCW	Exterior of vehicle.
DS9702174 - DS9702188	2	NA	Interior of vehicle.
DS9702189 - DS9702191	NA	NA	Parked vehicle.
DS9702192 - DS97293	NA	NA	Backpack belonging to Occupant #2, Vehicle #1.

Police Photo Index

Photo no.	Vehicle No.	Direction of Picture	Subject Matter
97021p01	1	West	Approach to area of impact.
97021p02	1	East	Looking back along path to area of impact.
97021p03			