Remote Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS99022
1997 Toyota 4Runner
Nevada
July 1999

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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

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

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient Catalog No.
DS99022		

4. Title and Subtitle	5. Report Date
In-Depth Accident Investigation	June 1, 2000
	6. Performing Organization Report No.

7. Author(s)	8. Performing Organization Report No.
Dynamic Science, Inc.	

9. Performing Organization name and Address	10. Work Unit No. (TRAIS)
Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401	11. Contract or Grant no. DTNH22-94-D-27058

12. Sponsoring Agency Name and Address	13. Type of report and period Covered [Report Month, Year]
U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590	14. Sponsoring Agency Code

15. Supplemental Notes

16. Abstract

This two vehicle crash occurred at 1541 hours in July, 1999 in the state of Nevada. The case vehicle, a 1997 Toyota 4-Runner LTD Sport Utility Vehicle driven by a properly restrained 66-year-old male, was traveling west on a two-lane residential type roadway approaching a three-leg intersection. The roadway is bordered on both sides by a golf course. The front right seat was occupied by a properly restrained 64-year-old female (99 cm/62 in., 51 kg/112 lbs.). The other vehicle, a 1999 Mercury Grand Marquis four-door sedan driven by a 69-year-old male, was traveling south approaching the intersection. The front right seat was occupied by a 20-year-old male. The northern leg of the intersection is controlled by a stop sign. The speed limit in all directions is 40 km/h (25 mph). The driver of the case vehicle had stopped his vehicle at some distance from the intersection in order to let a golf cart cross the roadway. After letting the golf cart go by, the driver proceeded forward and then into the intersection at a driver estimated speed of 32-35 km/h (20-22 mph). The driver of the other vehicle failed to stop at the stop sign and entered the intersection–attempting to make a left hand turn. The driver of the case vehicle saw the other vehicle and began braking heavily. The front of the case vehicle (12FDLW1) struck the left side of the other vehicle (09LYEW2) just outside of the eastern leg of the intersection. The case vehicle sustained a longitudinal delta v of -21.2 km/h (-13.3 mph) and a lateral delta v of -1.9 km/h (–1.2 mph). Both air bags deployed at this point. The other vehicle sustained a longitudinal delta v of -4.0 km/h (-2.4 mph) and a lateral delta v of 21.8 km/h (13.4 mph). The front right passenger of the case vehicle recalls being struck by something and then blacked out for a time before awakening briefly in the ambulance. She sustained a serious head/brain injury, abrasions to her face and neck, an abrasion to top of her right forearm, contusions to the neck area, and large contusion to the back of her head. She has indicated that the head injury, the abrasions, and the contusions to her neck were due to contact with the deploying air bag. There is contact evidence on the air bag verifying the facial contact. The contusion to the back of her head was a rebound type injury to the back of her seat. She was transported from the scene to the hospital. She was treated and then released. She returned to the hospital nearly 30 days later. After arriving at the hospital, she had surgery to relieve brain swelling[1]. She was released 10 days later. Since that time, she has made several trips in order to get CATSCANs to check on the progress of the swelling. There is a chance that additional surgery will be needed. At this time, she reports that she had full verbal function but has not regained the ability to move properly. The driver of the case vehicle sustained a seriously sprained right ankle from the braking activity, chest contusions from the torso belt, and an abrasion to his right forearm from the deploying air bag.

The status of the driver of the other vehicle did not sustain any injuries. Both vehicles were towed from the scene due to damage. The case vehicle has since been repaired.

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

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price

[1]Subdural hematoma, according to the driver

Dynamic Science, Inc.
Accident Investigation
Case Number: DS99022

TABLE OF CONTENTS

BACKGROUND:

Description:	This case is being initiated in response to a report of a passenger air bag-related adult serious injury. The NHTSA was notified by phone on August 25, 1999. The initiator is the husband of the injured party. DSI was notified on August 26, 1999. This case was conducted as a remote investigation.
Investigation Type:	Remote
Crash Location:	Nevada
Crash Date:	July 1999
Notification Date:	August 26, 1999
Field Work Completed:	NA

SUMMARY:

This two vehicle crash occurred at 1541 hours in July, 1999 in the state of Nevada.

The case vehicle, a 1997 Toyota 4-Runner LTD Sport Utility Vehicle driven by a properly restrained 66-year-old male, was traveling west on a two-lane residential type roadway approaching a three-leg intersection. The roadway is bordered on both sides by a golf course. The front right seat was occupied by a properly restrained 64-year-old female (99 cm/62 in., 51 kg/112 lbs.).

Figure 1. Exterior, case vehicle

The other vehicle, a 1999 Mercury Grand Marquis four-door sedan driven by a 69-year-old male, was traveling south approaching the intersection. The front right seat was occupied by a 20-year-old male. The northern leg of the intersection is controlled by a stop sign. The speed limit in all directions is 40 km/h (25 mph).

Figure 2. Exterior, other vehicle

The driver of the case vehicle had stopped his vehicle at some unknown distance from the intersection in order to let a golf cart cross the roadway. After letting the golf cart go by, the driver proceeded forward and then into the intersection at a driver estimated speed of 32-35 km/h (20-22 mph). The

driver of the other vehicle failed to stop at the stop sign and entered the intersection–attempting to make a left hand turn. The driver of the case vehicle saw the other vehicle and began braking heavily. The front of the case vehicle (12FDLW1) struck the left side of the other vehicle (09LYEW2) just outside of the eastern leg of the intersection. The case vehicle sustained a longitudinal delta v of -21.2 km/h (-13.3 mph)[2] and a lateral delta v of -1.9 km/h (–1.2 mph). Both air bags deployed at this point. The other vehicle sustained a longitudinal delta v of -4.0 km/h (-2.4 mph) and a lateral delta v of 21.8 km/h (13.4 mph).

The front right passenger of the case vehicle recalls being struck by something and then blacked out for a time before awakening briefly in the ambulance. She sustained a serious head/brain injury, abrasions to her face and neck, an abrasion to top of her right forearm, contusions to the neck area, and large contusion to the back of her head. She has indicated that the head injury, the abrasions, and the contusions to her neck were due to contact with the deploying air bag. There is contact evidence on the air bag verifying the facial contact. The contusion to the back of her head was a rebound type injury to the back of her seat. She was transported from the scene to the hospital. She was treated and then released. She returned to the hospital the nearly 30 days later. After arriving at the hospital, she had surgery to relieve brain swelling[3]. She was released 10 days later. Since that time, she has made several trips in order to get CATSCANs to check on the progress of the swelling. There is a chance that additional surgery will be needed. At the time of the interview, she reported that she had full verbal function but has not regained the ability to move properly.

The driver of the case vehicle sustained a seriously sprained right ankle from the braking activity, chest contusions from the torso belt, and an abrasion to his right forearm from the deploying air bag.

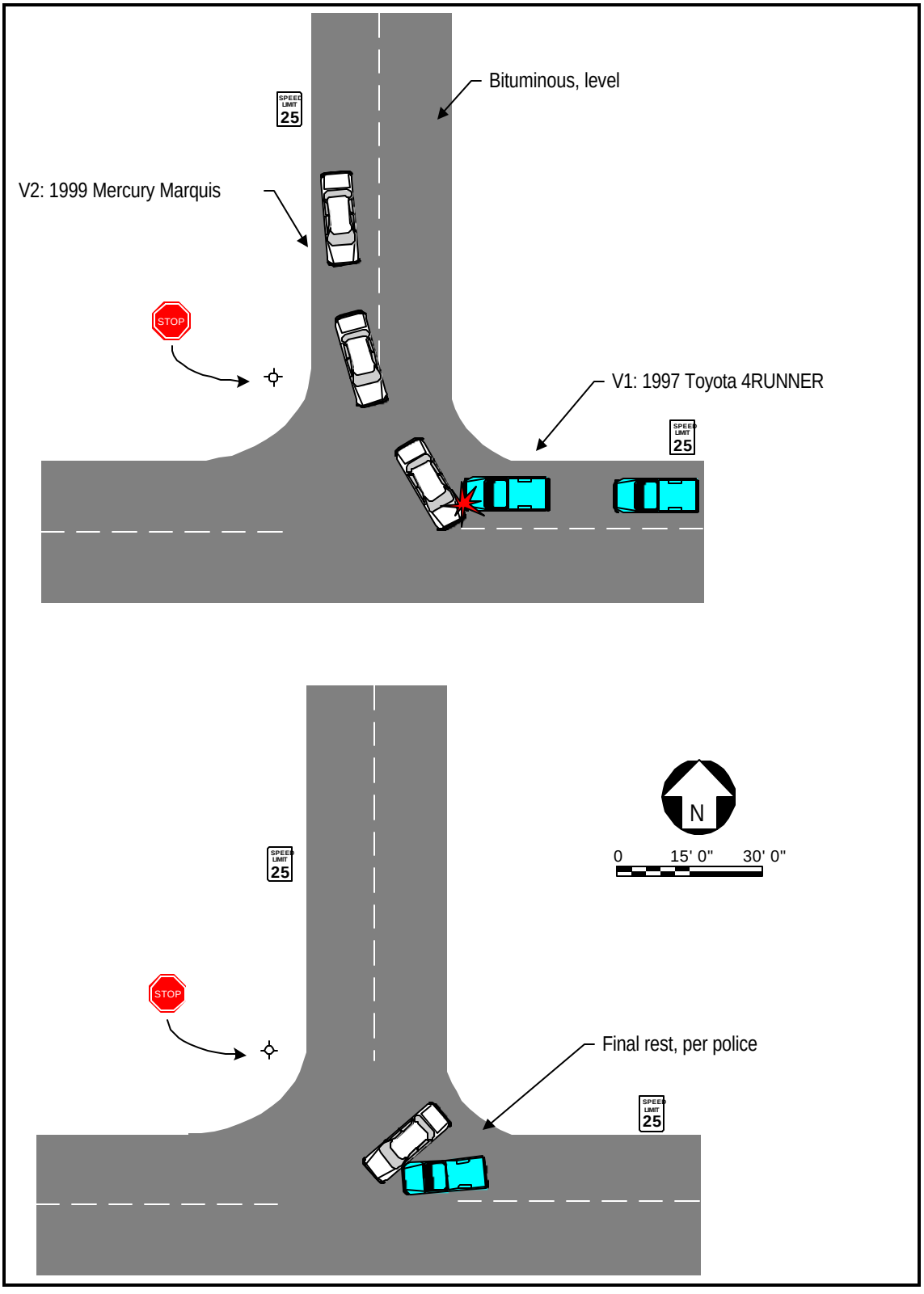
The status of the driver of the other vehicle did not sustain any injuries.

Both vehicles were towed from the scene due to damage. The case vehicle has since been repaired.

[2]Calculated using WinSmash–CDC only run

[3]Subdural hematoma, according to the driver

Scene Diagram



DETAILED INFORMATION

Vehicles

Case vehicle

Description:	1997 Toyota 4-Runner LTD Sports Utility Vehicle	
VIN:	JT3HN87R9V0XXXXXX	
Odometer:	29,824 miles	
Engine:	3.4L V6	
Reported Defects:	None	
Cargo:	2 canvas chairs, 5 pairs of golf shoes, tool box, miscellaneous clothing and books	
Damage Description:	Minor front damage. Right side windshield broken by air bag.	
CDC:	12FDLW1	
Delta V:	Total	21.3 km/h (13.3 mph)
	Longitudinal	-21.2 km/h (-13.2 mph)
	Latitudinal	-1.9 km/h (-1.2 mph)
	Energy	43,344 joules (31.987 ft-lbs.)

Figure 4. Exterior, case vehicle

Figure 5. Exterior view of exemplar vehicle

The front left air bag was housed in the steering wheel hub and was concealed by symmetrical H-configuration cover flaps. The circular air bag was equipped with one tether and two vent ports. No contact evidence was found on the bag and the bag and cover flaps were not damaged. There was, however, evidence of bleeding found on the back side of the upper portion of the air bag.

The front right midmount air bag is rectangular in shape and is equipped with two vent ports and no tethers. It measured 55 cm 21.6 in.) high by 54 cm (21.2 in.) wide with a deployed excursion of 69 cm (27.2 in.). Contact evidence consisting of make-up and skin tissue was found on the top left of the front of the bag as a result of contact with the front right passengers's face.

DSI is in possession of both air bags.

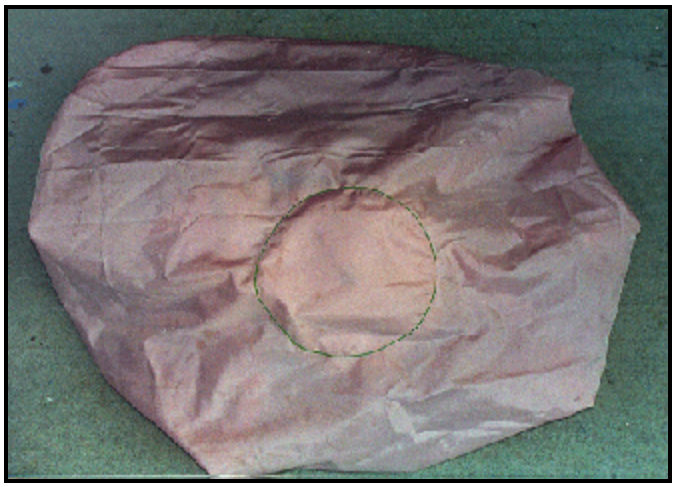


Figure 6. Driver's front air bag

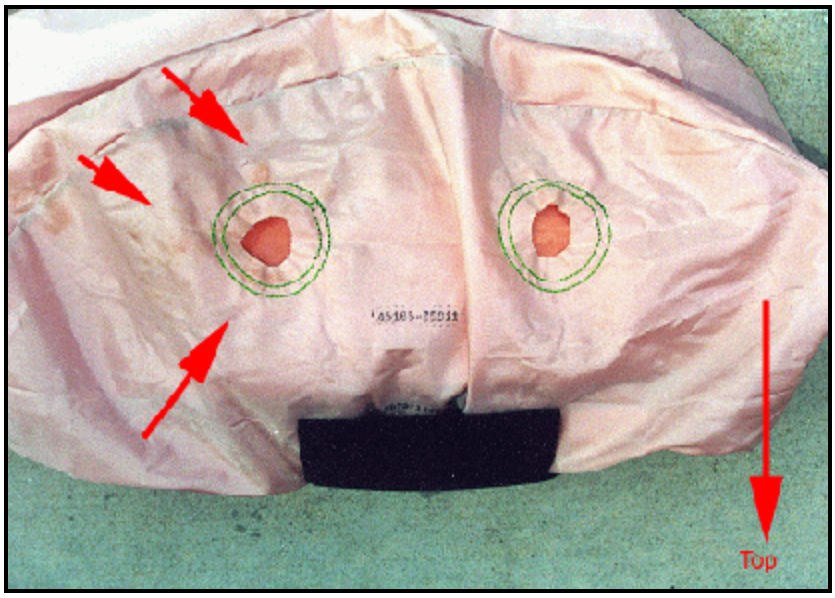


Figure 7. Back side of driver air bag–arrows indicate blood/saliva markings

Figure 8. Front view of passenger air bag

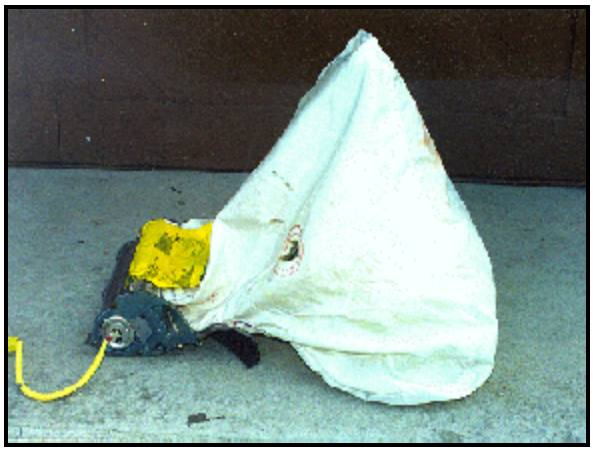


Figure 9. Passenger air bag, left side

Figure 10. Passenger air bag, right side

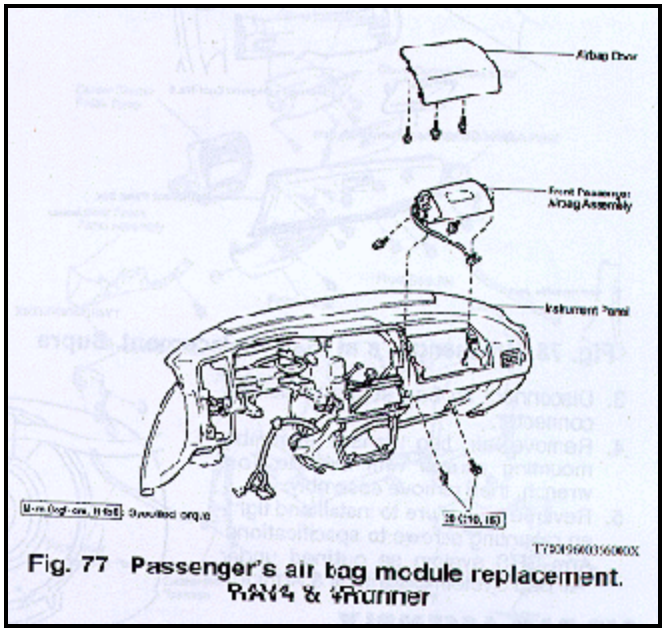


Figure 11. Schematic of front right air bag installation

Other vehicle

Description:	1999 Mercury Grand Marquis LS four-door sedan	
VIN:	2MEFM75W1XXXXXXXX	
Odometer:	4,648 miles	
Engine:	4.6 L V8	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Minor lateral crush to left front fender area	
CDC:	09LYEW2	
Delta V:	Total	21.8 km/h (13.6 mph)
	Longitudinal	-3.8 km/h (-2.4 mph)
	Latitudinal	21.5 km/h (13.4 mph)
	Energy	25,575 joules (18,874 ft-lbs.)

Figure 12. Exterior, other vehicle

Occupants

Case vehicle	Occupant 1	Occupant 2
Age/Sex:	66/Male	64/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket	Bucket
Height:	Unknown	99 cm/62 in.
Weight:	Unknown	51 kg/112 lbs.
Occupation:	Retired	Retired
Pre-existing Medical Condition:	Unknown	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	> 40 years	NA
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Both hands on steering wheel, 2 and 10 o'clock positions	Unknown
Foot Position:	Right foot pressing hard on brake, left on floor board	Both feet on floor board
Restraint Usage:	Lap and shoulder belt used properly	Lap and shoulder belt used properly
Air bag:	Deployed during impact	Deployed during impact

Occupants

Other vehicle		
Age/Sex:	69/Male	20/Male
Seated Position:	Front left	Front right
Seat Type:	Unknown	Unknown
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown, presumed to be retired	Unknown
Pre-existing Medical Condition:	Unknown	Unknown
Alcohol/Drug Involvement:	None	None
Driving Experience:	> 40 years	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:		Unknown
Restraint Usage:	Belt used, unknown if used properly	Belt used, unknown if used properly
Air bag:	Equipped with 2nd Generation air bags which did not deploy	Equipped with 2nd Generation air bags which did not deploy

Injuries and Injury Mechanisms

Case vehicle

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Sprained right ankle	850206.1,1	845.0	Brake pedal
	Contusion to center of chest	409402.1,4	922.1	Torso belt
	Abrasion, right forearm	790202.1,1	913.0	Air bag
RF Occupant:	Subdural hematoma	140650.4,9	852.2	Air bag / seat back / head rest / rebound
	Abrasion, chin	290202.1,8	910.0	Air bag
	Abrasion, right cheek	290202.1,1	910.0	Air bag
	Abrasion, nose	290202.1,4	910.0	Air bag
	Cervical strain	640278.1,6	847.0	Air bag
	Abrasion, right arm - at bend of elbow on top side	790202.1,1	913.0	Air bag
	Contusion, right arm - at bend of elbow on top side	790402.1,1	923,11	Air bag
	Right shoulder strain	751020.1,1	840.9	Unknown
	Right hip injury	Unknown		Unknown
	Contusion, back of head	190402.1,6	920.0	Seat back / head rest

Vehicle 2

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Not injured			
RF Occupant:	Not injured			

Occupant Kinematics

The driver of Vehicle 1 was seated in a normal upright posture in the front left position of the vehicle and was wearing the manual lap/shoulder restraint. The front right passenger was seated in a normal upright posture and was wearing the manual lap/shoulder restraint. The seat track locations are not known. As Vehicle 2 entered the intersection, the driver of Vehicle 1 began braking heavily. The front of Vehicle 1 struck the left side of Vehicle 2. Vehicle 1 sustained a longitudinal delta v of -21.2 km/h (-13.3 mph). Both the driver's and passenger frontal air bags deployed at this point.

The braking motion and subsequent impact caused both occupants to pitch forward. The forward motion caused the driver to load the torso harness–causing the chest contusion. The expanding steering wheel hub mounted air bag engaged the driver's right forearm–causing the abrasion. The driver also sustained a sprained right ankle due to the heavy braking.

The front right occupant also pitched forward into close proximity of the now-deploying air bag. This occupant engaged the air bag near the left upper quadrant with her face–depositing a patch of skin and makeup transfer approximately 34 cm high by 12 cm wide (13.4 x 4.7 in.)–which caused the abrasions to her cheek, nose, chin, and neck. As the air bag deployed more fully, her head was thrust upward and rearward–causing the neck strain and contusion to the back of her head.

The subdural hematoma was likely incurred as a result of both the initial contact with the air bag and the subsequent contact with the seat back/head rest. The front right occupant reported that she lost consciousness immediately after impact, but the ER report that she denies any loss of consciousness. Upon admission, she had a Glasgow Coma Scale of 15. She was treated and released.

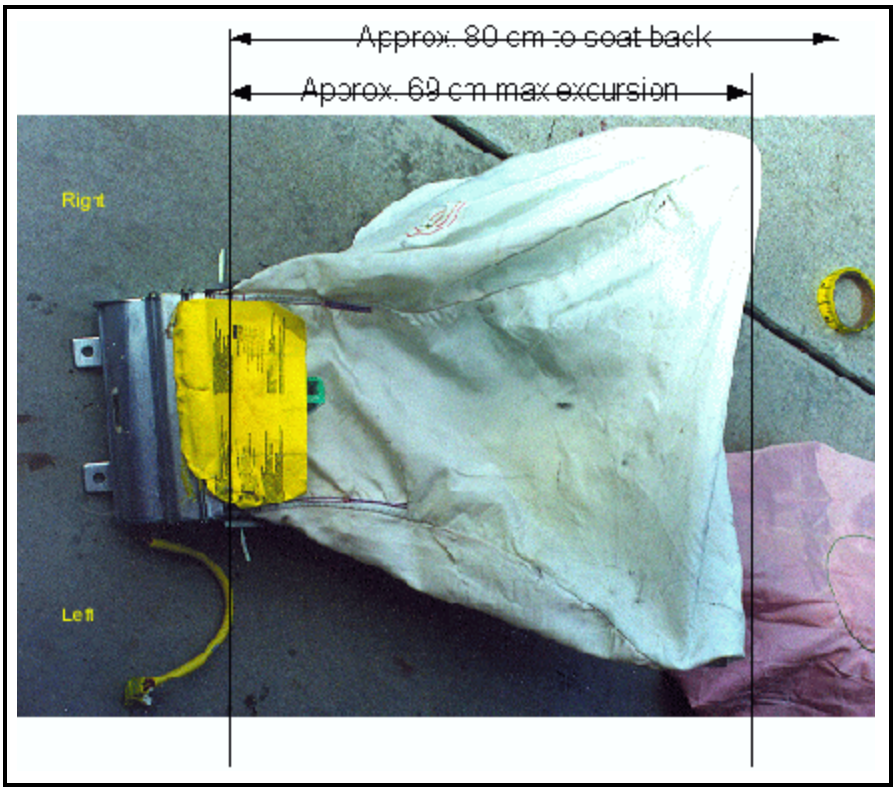


Figure 13. Top view of front right passenger air bag showing relationship between excursion and the seat back.

Figure 14. Passenger front air bag