

On-scene Investigation / Vehicle to Vehicle  
Dynamic Science, Inc. / Case Number: DS02017  
2002 Toyota Camry  
California  
June, 2002

---

*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. DS02017		2. Government Accession No.		3. Recipient Catalog No.	
4. Title and Subtitle In-Depth Accident Investigation				5. Report Date	
				6. Performing Organization Report No.	
7. Author(s) Dynamic Science, Inc.				8. Performing Organization Report No.	
9. Performing Organization name and Address Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401				10. Work Unit No. (TRAVIS)	
				11. Contract or Grant no. DTNH22-94-D-27058	
12. Sponsoring Agency Name and Address U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590				13. Type of report and period Covered [Report Month, Year]	
				14. Sponsoring Agency Code	
15. Supplemental Notes					
16. Abstract <p>This crash occurred in southern California in June, 2002 at 0952 hours. The crash occurred within the confines of a four-leg intersection. The intersection is controlled by tri-colored traffic signals. The roadways are level and straight. The speed limit is 64 km/h (40 mph) for westbound traffic and 40 km/h (25 mph) for southbound traffic.</p> <p>The case vehicle was a 2002 Toyota Camry LE that was being driven by a 57-year-old female (155 cm/61 in, 50 kg/110 lbs). The first other vehicle was a 1997 GMC C3500 truck driven by a 51-year-old male. The second other vehicle was a 1999 Mercedes-Benz SL500R 2-door convertible coupe driven by a 59-year-old male. This vehicle was stopped facing east.</p> <p>The case vehicle was traveling westbound and entered the intersection on a red light. The GMC truck was traveling southbound and entered the intersection at the same time. The front of the GMC truck struck the right side of the case vehicle (02RZAW2). The right side curtain deployed at this point. The case vehicle rotated clockwise and struck the front of the stopped Mercedes with its left side (09LZEW2).</p> <p>The driver of the case vehicle engaged the side curtain with the left side of her face. She sustained contusions to her left hip, left shoulder, and left breast. She was transported by ground ambulance to a local emergency room where she was treated and released. There were no injuries reported by the other drivers.</p> <p>The case vehicle was towed from the scene due to damage and was later declared a total loss by the insurance company. The GMC truck was driven from the scene. The Mercedes was towed from the scene.</p>					
17. Key Words Air bag, deployment, injury, curtain, AOPS, side curtain, passenger.			18. Distribution Statement		
19. Security Classif. (of this report)		20. Security Classif. (of this page)		21. No of pages	22. Price

**Dynamic Science, Inc.**  
**Accident Investigation**  
**Case Number: DS02017**

**TABLE OF CONTENTS**

Background .....	1
Description .....	1
Investigation Type .....	1
Crash Location .....	1
Crash Date .....	1
Notification Date .....	1
Field Work Completed .....	1
Summary .....	1
Scene Diagram .....	3
Detailed Information .....	4
Vehicles .....	4
AOPS Discussion .....	6
Occupants .....	10
Injuries and Injury Mechanisms .....	13
Occupant Kinematics .....	14

**BACKGROUND:**

Description: This side curtain case was identified by DSI through insurance contacts. The case was reported to NHTSA on August 15, 2002. DSI was assigned the case on August 20, 2002. Field work was completed on August 26, 2002.

Investigation Type: On-scene  
 Crash Location: California  
 Crash Date: June, 2002  
 Notification Date: August 20, 2002  
 Field Work Completed: August 26, 2002

**SUMMARY:**

This crash occurred in southern California in June, 2002 at 0952 hours. The crash occurred within the confines of a four-leg intersection. The intersection is controlled by tri-colored traffic signals. The roadways are level and straight. The speed limit is 64 km/h (40 mph) for westbound traffic and 40 km/h (25 mph) for southbound traffic.

The case vehicle was a 2002 Toyota Camry LE that was being driven by a 57-year-old female (155 cm/61 in, 50 kg/110 lbs). The first other vehicle was a 1997 GMC C3500 truck with an unknown attached body driven by a 51-year-old male. The GMC truck was a city maintenance vehicle. The second other vehicle was a 1999 Mercedes-Benz SL500R 2-door convertible coupe driven by a 59-year-old male. This vehicle was stopped facing east.

The case vehicle was traveling westbound and entered the intersection on a red light. The GMC truck was traveling southbound and entered the



**Figure 1.** Approach to area of impact (west)



**Figure 2.** Left side, case vehicle – 2<sup>nd</sup> impact

intersection at the same time. The front of the GMC truck struck the right side of the case vehicle (02RZAW2).

There was insufficient information on the GMC truck to produce delta V results using the WINSMASH collision model. For informational purposes, delta Vs were calculated using the barrier algorithm. The total velocity change for this impact was 18 km/h (11.2 mph). The longitudinal and lateral delta V components were -6.2 km/h (-3.8 mph) and -16.9 km/h (-10.5 mph), respectively. The right side curtain deployed at this point. The seat mounted side air bag did not deploy.

The case vehicle rotated clockwise and struck the front of the stopped Mercedes with its left side (09LZEW2). The total velocity change for the second impact calculated by the Missing Vehicle algorithm of the WINSMASH collision model was 18.0 km/h (11.2 mph). The longitudinal and lateral delta V components were -3.1 km/h (-1.9 mph) and 17.7 km/h (11.0 mph), respectively. The left side curtain deployed at this point. The seat mounted side air bag did not deploy.

The driver of the case vehicle engaged the side curtain with the left side of her face. She sustained contusions to her left hip, left shoulder, and left breast. She was transported by ground ambulance to a local emergency room where she was treated and released.

There were no injuries reported by the other drivers.

The case vehicle was towed from the scene due to damage and was later declared a total loss by the insurance company. The GMC truck was driven from the scene. The Mercedes was towed from the scene.



**Figure 3.** Right rear, case vehicle – impact 1



**Figure 4.** Driver's seat position

# Scene Diagram

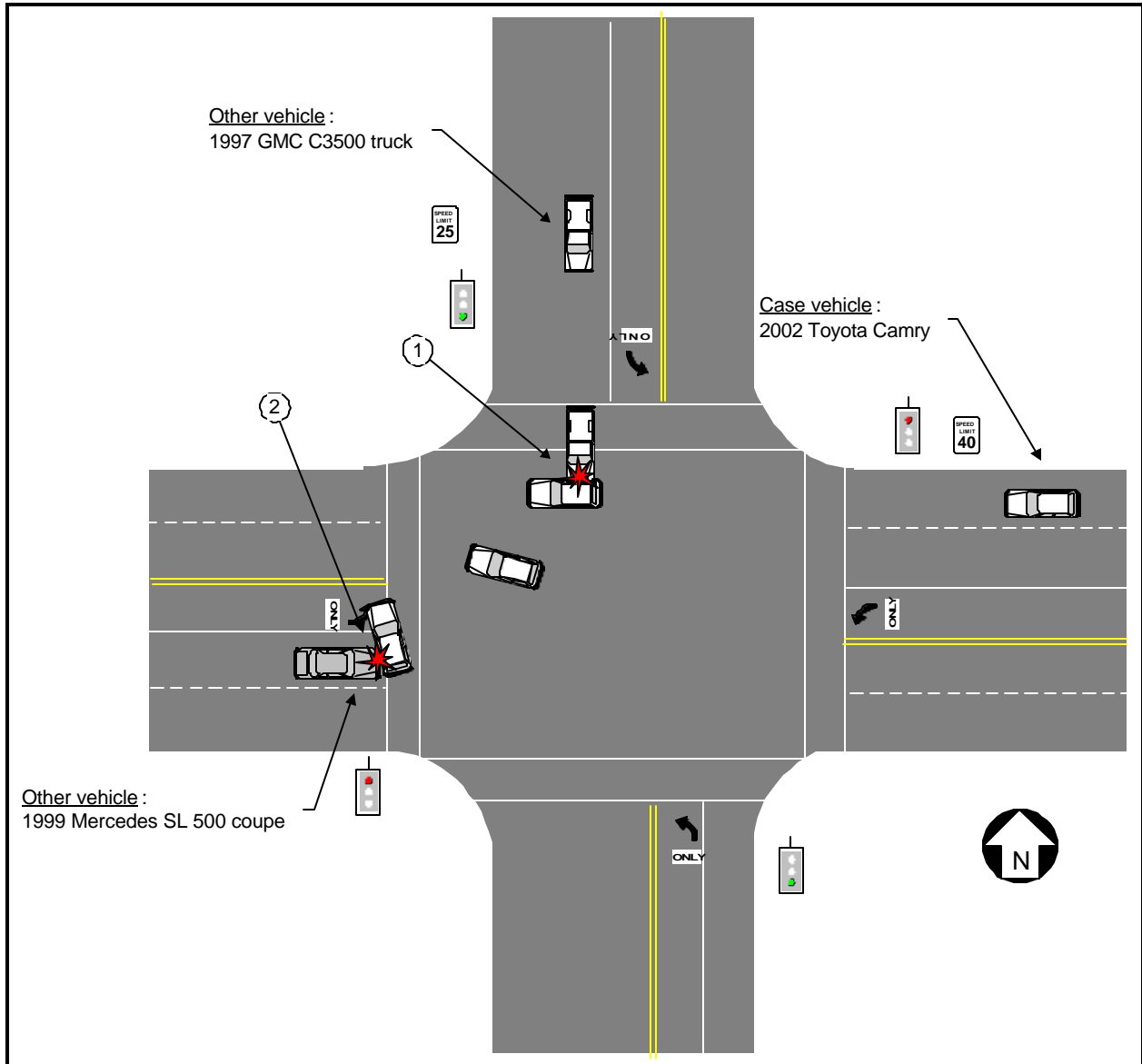


Figure 5. Scene diagram

**DETAILED INFORMATION****Vehicles**Case vehicle

Description:	2002 Toyota Camry LE four door sedan	
VIN:	4T1BF30K42U5xxxxxx	
Odometer:	15,884 km (9,870 miles) per salvage yard	
Engine:	3.0L V6	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Moderate sheet metal crush to both rear doors and rear quarter panels. Vehicle towed due to damage. Left and right side door intrusion. Declared a total loss by insurance company.	
CDC:	Impact 1: 02RZAW2 Impact 2: 09LZEW2	
Delta V (Impact 2):	Total	18.0 km/h (11.2 mph)
	Longitudinal	-3.1 km/h (-1.9 mph)
	Latitudinal	17.7 km/h (11.0 mph)
	Energy	39,949 joules (29,465 ft-lbs)



The right side of the case vehicle sustained 160 cm (62.9 in) of direct contact that extended from just rear of the rear tire to the B pillar. The maximum crush of 14 cm (5.5 in) was found at the C3 location. The principle direction of force was within the 2 o'clock sector and was an estimated 70 degrees. The rear door was jammed shut and the sideglass had disintegrated as a result of crash damage.



**Figure 6.** Right side, initial impact

The left side of the case vehicle sustained 163 cm (64 in) of direct contact that extended from the rear of the vehicle to the B pillar. The maximum crush of 25.5 cm (10 in) was found at the C4 location. The principle direction of force was in the 9 o'clock sector and was an estimated 280 degrees. The rear door was jammed shut. The rear door window frame was bowed outward at the top.



**Figure 7.** Left side, second impact

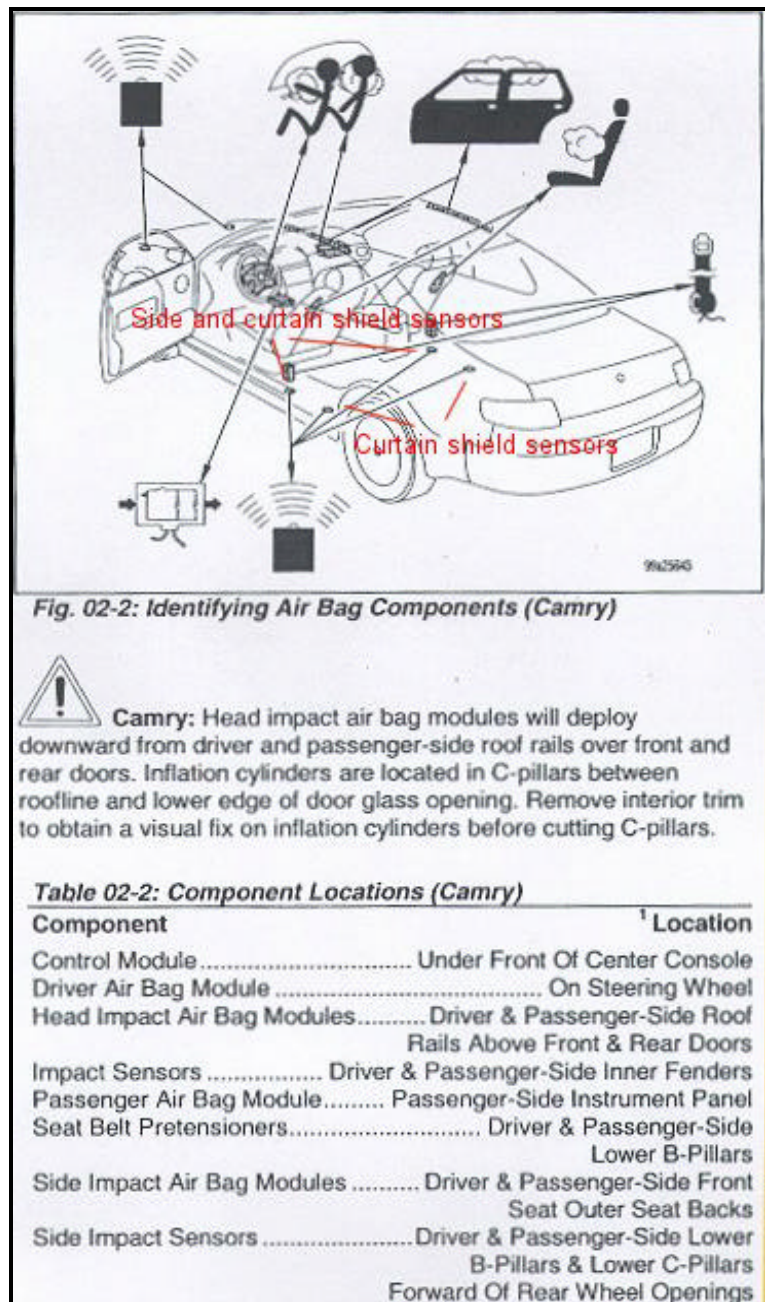
AOPS discussion

The case vehicle was equipped with a driver's air bag, a front right passenger air bag, a driver's seat mounted side air bag, a front right passenger seat mounted side air bag, left and right side air curtains for all four outboard seat positions, and seat belt pretensioners for the left and right front seats. The front air bags are located in the steering wheel and the top of the instrument panel. The side air bags are located in the outboard sides of the front seat backs. There are no visible seams. The curtain shields are located in the driver and passenger side roof rails over the front and rear doors.

According to Toyota literature, the front air bags are designed to deploy if the impact is above the designed manufacturer specific threshold level. It is possible that in some collisions at the lower zone of air bag sensor detection and activation the air bags and seat belt pretensioners will not operate together.

The SRS side air bag and side curtain system is controlled by the air bag sensor assembly. The sensor assembly consists of a safing sensor and air bag sensor. There are combination side and curtain shield air bag sensors located at the base of the left and right B pillars. There are curtain shield air bag sensors located forward of the C pillar.

The SRS side air bag and curtain shield air bag on the passenger side are activated even with no passenger in the front seat or rear seat.



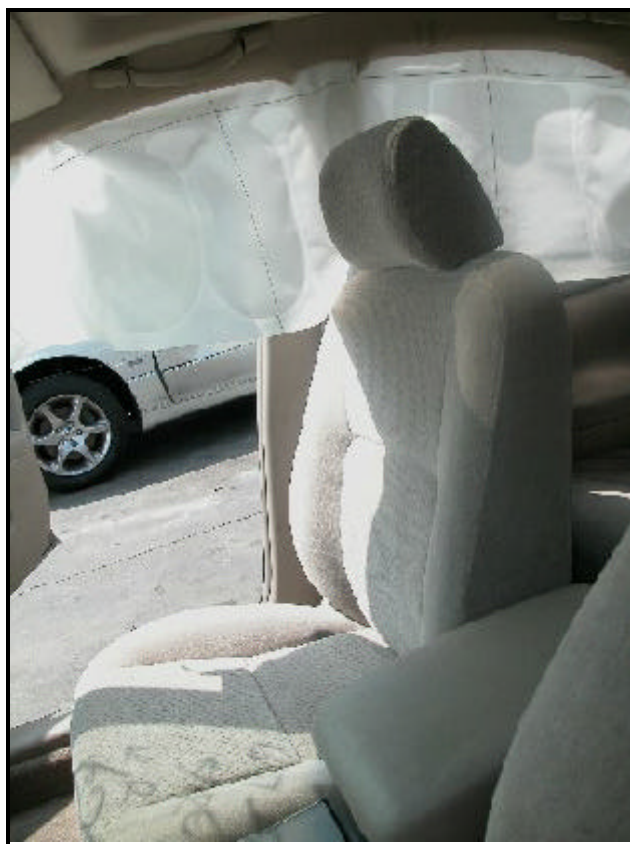
**Figure 8.** Camry air bag components

The curtain shield air bags may activate when the side air bags are not activated. In this case it appears that the delta V was of sufficient magnitude and at the right location to cause only the side air curtains to deploy.

The side curtains were 153 cm (60.2 in) long, 22 cm (8.7 in) tall at the front, and 33 cm (12.9 in) at the back. They are comprised of 11 individual pocket type air pillows contained within the curtain. There was one 33 cm (12.9 in) tether at each A pillar. The tethers separated at 21 cm (8.3 in). This appears to be a designed in separation. The left side curtain was marked by two make-up transfers at the driver location. The two transfers were in the same general location—one measured 12 x 7 cm (4.7 x 2.8 in) and the other measured 6 x 8 cm (2.4 x 3.1 in).



**Figure 9.** Left side curtain



**Figure 10.** Right side curtain

Other vehicle

Description:	1997 GMC C3500 Sierra 4 x 2 pickup style truck with an unknown type body attached	
VIN:	1GDGC34J3VJxxxxxx	
Odometer:	Unknown	
Engine:	7.4 L (454 CID) V8	
Reported Defects:	None, per police	
Cargo:	Unknown	
Damage Description:	Minor frontal damage. Driven from the scene.	
CDC:	Unknown	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

Other vehicle

Description:	1999 Mercedes-Benz SL500R 2-door convertible coupe	
VIN:	WDBFA68F0XFxxxxxx	
Odometer:	Unknown	
Engine:	5.0 L, 8 cylinder	
Reported Defects:	None, per police	
Cargo:	Unknown	
Damage Description:	Moderate frontal damage. Vehicle towed from the scene.	
CDC:	Unknown	
Delta V:	Total	15.0 km/h (9.3 mph)
	Longitudinal	-14.8 km/h (-9.2 mph)
	Latitudinal	2.6 km/h (1.6 mph)
	Energy	20,510 joules (15,127 ft-lbs)



**Figure 11.** Exemplar view of Mercedes coupe

**Occupants**

<u>Case vehicle</u>	Occupant 1
Age/Sex:	57/Female
Seated Position:	Front left
Seat Type:	Fabric covered bucket seat, seat adjusted to between the middle and rear most track position
Height:	155cm (61 in)
Weight:	50 kg (110 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	>20 years
Body Posture:	Normal, upright
Hand Position:	Both hand on steering wheel, 10 and 2 o'clock position
Foot Position:	Right foot on accelerator, left on floor
Restraint Usage:	Continuous loop 3-point lap and shoulder belt with sliding latch, used in crash
Air bag:	Steering wheel mounted air bag, not deployed
	Seat back mounted side air bag, not deployed
	Roof rail mounted side air curtain, deployed

Other vehicle (GMC)

Age/Sex:	51/Male
Seated Position:	Front left
Seat Type:	Unknown
Height:	173 cm (68 in)
Weight:	86 kg (190 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used, per police report

Other vehicle (Mercedes)

Age/Sex:	59/Male
Seated Position:	Front left
Seat Type:	Bucket
Height:	175 cm (69 in)
Weight:	74 kg (163 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used, per police report



**Injuries and Injury Mechanisms**Case vehicle

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Contusion, left hip	890402.1,2	924.01	Door side panel
	Contusion, left shoulder	790402.1,2	923.00	Door side panel
	Contusion, left breast	490402.1,2	922.0	Door side panel

GMC

Driver: No reported injuries

Mercedes

Driver: No reported injuries

## Occupant Kinematics

The 57-year-old driver of the case vehicle was seated in a normal, upright fashion. The fabric covered bucket seat was adjusted to between the middle and the rear most track position. The driver was wearing the continuous loop 3-point lap and shoulder belt. The shoulder belt upper anchorage was adjusted to the full up position. The driver's hands were at the 10 and 2 o'clock positions. Her right foot was on the accelerator, her left on the floor. She was wearing a long sleeve shirt. She was not wearing glasses or contact lenses.

During the initial impact, the driver responded to the 70 degree direction of force by moving forward and to the right. She loaded and was held in place by the seat belt. As the vehicle began its clockwise rotation, the rotational forces forced the driver back to the left. Upon the second impact, the side air curtain deployed. The driver responded to the 280 degree direction of force by moving sharply to the left. The left side of her face and her left shoulder contacted the deployed curtain. The facial contact deposited a make-up transfer to the curtain. The driver did not sustain any facial injuries of any kind. At this same time, the left side of the driver's shoulder, breast and hip engaged the door side panel—resulting in contusions at each of these locations.



Figure 12. Driver's seat-contact to side air curtain



Figure 13. Close up of contact to side curtain