

On-site Child Safety Seat Investigation / Vehicle to Vehicle  
Dynamic Science, Inc. / Case Number: DS02010  
1996 Toyota Camry four-door  
California  
June, 2002

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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.*

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**Technical Report Documentation Page**

1. Report No. <b>DS02010</b>		2. Government Accession No.		3. Recipient Catalog No.	
4. Title and Subtitle <b>On Site Child Safety Seat Investigation</b>			5. Report Date <b>September 2, 2003</b>		
			6. Performing Organization Report No.		
7. Author(s) <b>Dynamic Science, Inc.</b>			8. Performing Organization Report No.		
9. Performing Organization name and Address <b>Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401</b>			10. Work Unit No. (TRAVIS)		
			11. Contract or Grant no. <b>DTNH22-94-D-27058</b>		
12. Sponsoring Agency Name and Address <b>U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590</b>			13. Type of report and period Covered [Report Month, Year]		
			14. Sponsoring Agency Code		
15. Supplemental Notes					
16. Abstract <p>This crash occurred in June, 2002 at 1115 hours in an unincorporated area of southern California. The crash occurred within the confines of a four-leg intersection. The northbound leg of the intersection is comprised of one northbound lane, one southbound lane, and one left turn lane. The speed limit is 80 km/h (50 mph). The westbound leg of the intersection is comprised of one westbound travel lane, one eastbound lane, and one left turn lane. The speed limit is 72 km/h (45 mph) during normal hours and 40 km/h (25 mph) during school hours. The 72 km/h (45 mph) speed limit was in effect at the time of the crash. All roads leading into and out of the intersection are of asphalt construction and are level. The intersection is controlled by tri-color traffic signals.</p> <p>The case vehicle is a 1996 Toyota Camry LE four-door sedan driven by a restrained 49-year-old female. The front right seat was occupied by a 4-year-old female who was seated in an unknown type booster seat. The other vehicle is a 1995 Ford F-150 pickup driven by a 17-year-old male.</p> <p>The case vehicle was traveling north in the right hand through lane. The driver of the case vehicle was unfamiliar with the area. She was looking for a street that would take her back onto the highway. She did not notice that the light had turned red. She entered the intersection, saw the red signal, and began braking. The other vehicle was initially stopped at the intersection, facing west. As the light turned green, the other vehicle entered the intersection and crossed in front of the case vehicle. The front of the case vehicle struck the left side of the other vehicle. Both frontal air bags in the case vehicle deployed at this point.</p> <p>There were no reported injuries to either driver. The front right occupant of the case vehicle sustained facial abrasions, corneal abrasions, and a closed head injury. This occupant was transported by helicopter to an area trauma center and hospitalized.</p>					
17. Key Words <b>Air bag, deployment, injury, booster seat, passenger injury.</b>			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: DS02010**

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**BACKGROUND:**

Description: This child safety seat case was generated as a result of a newspaper article provided by DSI. DSI notified NHTSA on June 17, 2002 and was assigned the case on June 18, 2002. Field work was completed on June 19, 2002.

Investigation Type: On-scene  
 Crash Location: California  
 Crash Date: June, 2002  
 Notification Date: June 18, 2002  
 Field Work Completed: June 19, 2002

**SUMMARY:**

This crash occurred in June, 2002 at 1115 hours in an unincorporated area of southern California. The crash occurred within the confines of a four-leg intersection. The northbound leg of the intersection is comprised of one northbound lane, one southbound lane, and one left turn lane. The speed limit is 80 km/h (50 mph). The westbound leg of the intersection is comprised of one westbound travel lane, one eastbound lane, and one left turn lane. The speed limit is 72 km/h (45 mph) during normal hours and 40 km/h (25 mph) during school hours. The 72 km/h (45 mph) speed limit was in effect at the time of the crash. All roads leading into and out of the intersection are of asphalt construction and are level. All roadways were dry and free of defects. The intersection is controlled by tri-color traffic signals.



**Figure 1.** Approach to area of impact–case vehicle



**Figure 2.** Approach to area of impact-other vehicle

The case vehicle is a 1996 Toyota Camry LE four-door sedan driven by a restrained 49-year-old female (165 cm/65 in, 59 kg/130 lbs). The fabric covered bucket seat was adjusted to between the middle and rear most track positions. The front right seat was occupied by a 4-year-old female who was seated in an unknown type booster seat. The fabric covered bucket seat was adjusted to between the middle and rear most track positions.

The other vehicle is a 1995 Ford F-150 pickup driven by a 17-year-old male.

The case vehicle was traveling north in the right hand through lane. The driver of the case vehicle was unfamiliar with the area. She was looking for a street that would take her back onto the highway. She did not notice that the light had turned red. She entered the intersection, saw the red signal, and began braking. The other vehicle was initially stopped at the intersection, facing west. As the light turned green, the other vehicle entered the intersection and crossed in front of the case vehicle. The front of the case vehicle (01FDMW1) struck the left side of the other vehicle.

The total velocity change calculated by the Missing Vehicle algorithm of the WINSMASH collision model was 39 km/h (24 mph). The longitudinal and lateral delta v components were -37 km/h (23 mph) and -13 km/h (-8 mph)<sup>1</sup>, respectively. Both frontal air bags in the case vehicle deployed at this point.

The total velocity change for the other vehicle was 23 km/h (14 mph). The longitudinal and lateral delta v components were -8 km/h (5 mph) and 22 km/h (13 mph), respectively.

The case vehicle rotated counterclockwise and came to rest in the intersection. The other vehicle was



**Figure 3.** Area of impact/final rest—west



**Figure 4.** Front right, case vehicle

<sup>1</sup>Calculated using WinSmash version 2.32, above bumper crush averaged with bumper crush

pushed in a clockwise direction and also came to rest in the intersection. Both vehicles were moved to the roadside prior to police arrival.

The case vehicle was towed from the scene due to damage and, according to tow personnel, was going to be declared a total loss by the insurance company. The other vehicle was driven from the scene.

There were no reported injuries to either driver.

The front right occupant sustained a head injury but did not lose consciousness. She was alert and awake at the scene; however, her eyes were closed and reportedly a pupil was fixed. The paramedics attempted to intubate the child but were unsuccessful. The paramedics indicated that the child was not acting appropriately so a trauma activation was called. She was transported by helicopter to an area trauma center. She arrived with a Glasgow Coma Scale (GCS) of 14 (without spontaneous eye opening). She sustained what was described as a "first degree facial burn" from contact with the air bag. There was a small amount of hyphema (10%) in the right eye, as well as several corneal abrasions. There was some upper and lower eye lid swelling to the right eye but it was otherwise atraumatic. She was admitted with a closed head injury/concussion. CT scans were negative.

# Scene Diagram

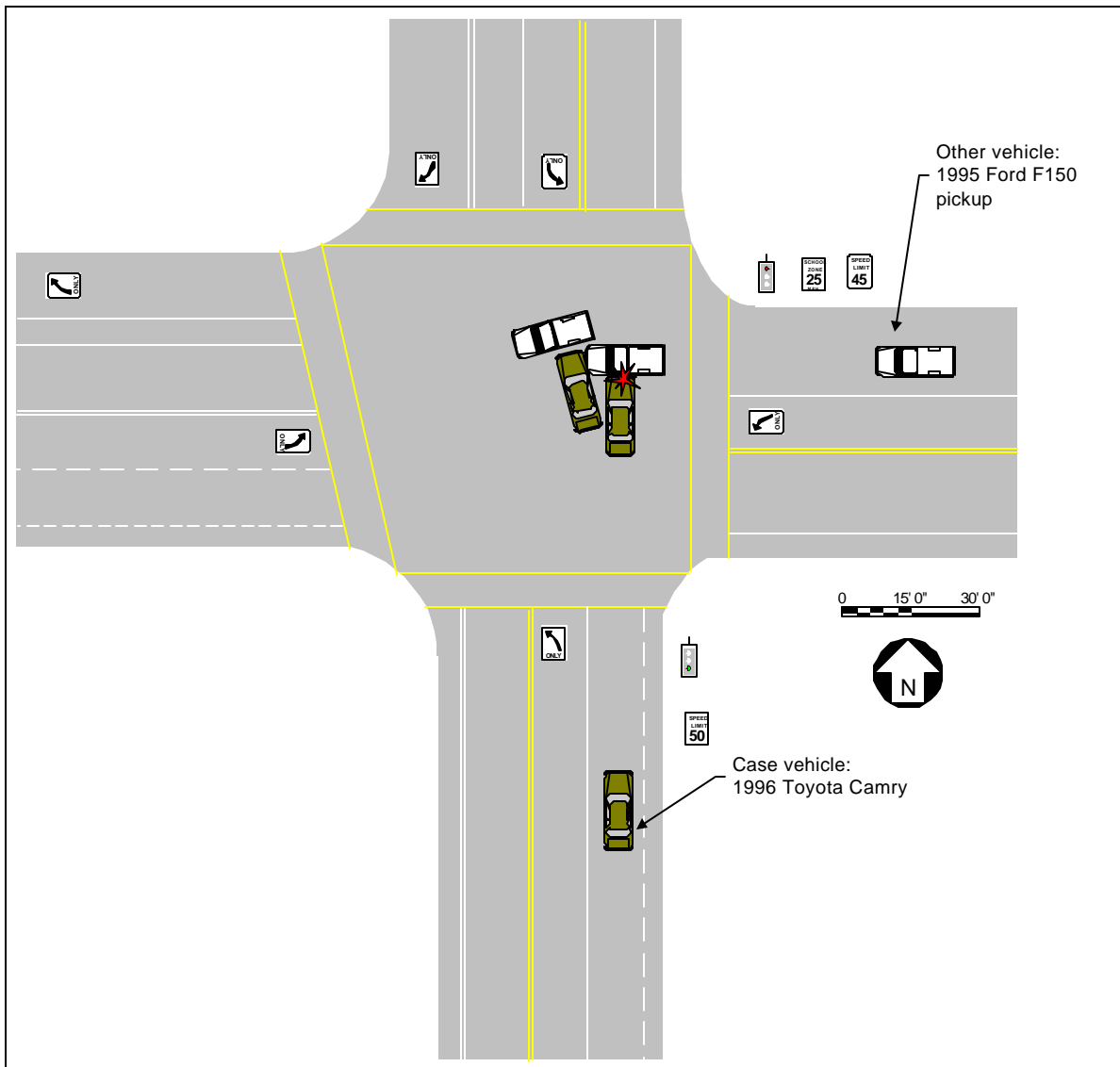


Figure 5. Scene diagram



<b>COLLISION MEASUREMENT TABLE</b>						
<b>Crash Data</b>	<b>Case vehicle</b>		<b>Other vehicle</b>			
<b>Heading Angle</b>	000		270			
<b>Surface Type</b>	Asphalt - Roadway Concrete - Sidewalk		Asphalt - Roadway Concrete - Sidewalk			
<b>Surface Condition</b>	Dry		Dry			
<b>Grade (pre-impact)</b>	0E		0E			
<b>Grade (impact)</b>	0E		0E			
<b>Speed Limit</b>	80 km/h (50 mph)		72 km/h (45 mph)			
<b>Reference Point:</b> North curb edge			<b>Reference Line:</b> East curb line			
<b>Data Point</b>	<b>Distance and Direction from RP</b>			<b>Distance and Direction from RL</b>		
	ft	m	d	ft	m	d
ERF - other vehicle	1.3	0.4	South	36.5	11.1	West
ERR - other vehicle	7.9	2.4	South	29.9	9.1	West
ERF - case vehicle	10.8	3.3	South	29.7	9.1	West
ELF - case vehicle	14.3	4.4	South	23.6	7.2	West
ERR - case vehicle	18.1	5.5	South	29.3	8.9	West

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

Description:	1996 Toyota Camry four-door	
VIN:	4T1BF12K9TUxxxxxx	
Odometer:	Unknown	
Engine:	6 cyl / 183 CID	
Reported Defects:	None	
Cargo:	Booster seat	
Damage Description:	Moderate override damage to grille, hood, and fenders. Vehicle towed from the scene.	
CDC:	01FDMW1	
Delta V:	Total	39 km/h (24mph)
	Longitudinal	-37 km/h (23 mph)
	Latitudinal	-13 km/h (-8 mph)
	Energy	29,176 joules (21,519 ft lbs)



**Figure 6.** Left front, case vehicle

The case vehicle sustained 144 cm (57 in) of direct contact damage that extended across the entire frontal end width of the vehicle. The residual crush was measured at both the bumper and above bumper levels (radiator support). The averaged maximum crush was 17 cm (7 in) at C5. The principle direction of force was within the 1 o'clock sector and was an estimated 20 degrees. The impact energy was managed by the forward structures of the vehicle. The damaged components included the bumper fascia and reinforcement bar, upper radiator supports, grille, and hood.



**Figure 7.** Front of case vehicle

There was no measured change in the wheelbase dimensions. There was impact related glazing damage to the right side of the windshield. There was a star shaped occupant contact to the driver's side of the windshield. All four doors remained closed and operational.

### Safety system discussion

This vehicle was equipped with dual front air bags. Both front air bags deployed during the crash. The circular driver's side front air bag was mounted in the steering wheel hub and measured 64 cm (25 in) in diameter. The air bag was equipped with two vents ports and two tethers. The vent ports were at the 11 and 1 o'clock positions. There were 10 horizontal folds on the face the air bag. The "H" type module cover opened at the designed tear points and there was no damage to the cover.

The rectangular front right air bag was mounted in the top of the instrument panel and measured 47 cm (19 in) wide by 60 cm (24 in) high. The air bag was equipped with two vents. The vent ports were at the 3 and 9 o'clock positions. The air bag had a maximum post-crash excursion of 90 cm (35 in). The maximum excursion matched the distance to the seat back. The single module cover flap opened at the designed tear points and there was no damage to the cover. There was a stain found on the left side of the face of the air bag that measured 14 cm (6 in) wide by 9 cm (4 in) high.

Other vehicle

Description:	1995 Ford F150 pickup	
VIN:	1FTD15NXSNBxxxxxx	
Odometer:	Unknown	
Engine:	8 cyl / 302 CID	
Reported Defects:	None	
Cargo:	Unknown	
Damage Description:	Moderate left side damage, per police. Vehicle driven from scene.	
CDC:	Unknown	
Delta V:	Total	23 km/h (14 km/h )
	Longitudinal	-8 km/h (-5 mph)
	Latitudinal	22 km/h (13.0 mph)
	Energy	116,741 joules (86,104 ft lbs)

**Occupants**

<u>Case vehicle</u>	Occupant 1	Occupant 2
Age/Sex:	49/Female	4/Female
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat, adjusted to between the middle and rear most track positions	Fabric covered bucket seat, adjusted to between the middle and rear most track positions
Height:	165 cm (65 in)	Unknown <sup>2</sup>
Weight:	59 kg (130 lbs)	Unknown
Occupation:	Unknown	NA
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Presumed to be > 10 years	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Right foot on brake, left on floor	Unknown
Restraint Usage:	Continuous loop 3-point lap and shoulder belt available, used	Continuous loop 3-point lap and shoulder belt available, used with child booster seat
Air bag:	Driver's air bag available, deployed	Front right passenger's air bag, deployed

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<sup>2</sup>Unable to contact driver or this occupants relatives. No response to phone or mail contacts.

Other vehicle

Age/Sex:	17/Male
Seated Position:	Front left
Seat Type:	Unknown
Height:	173 cm (68 in)
Weight:	54 kg (120 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Right foot likely on accelerator
Restraint Usage:	Lap and shoulder belt used, per police

**Injuries and Injury Mechanisms**

Case vehicle

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Not injured			
RF Occupant:	Concussion, closed head injury. No loss of consciousness. GCS=14	160602.2,0	850.0	Air bag
	Facial abrasions	290202.1,9	910.0	Air bag
	Corneal abrasions, right eye	240602.1,1	918.0	Air bag

Other vehicle

Driver: Not injured

## Occupant Kinematics

The 49-year-old female driver (165 cm/65 in, 59 kg/130 lbs) of the case vehicle was seated in normal, upright fashion. She was wearing the available lap and shoulder belt. The shoulder belt upper anchorage was adjusted to the full down position. The fabric covered bucket seat was adjusted to between the middle and rear most track positions. Prior to impact, the driver began braking with her right foot. This action caused her to pitch forward to some degree and likely preloaded the lap and shoulder belt. Upon impact, the driver's air bag deployed. The driver responded to the 1 o'clock direction of force by exhibiting a forward and slight right trajectory and loading the lap and shoulder belt. Her face and torso likely engaged the deployed air bag, but there were no indications of contact. Her left hand came off the steering wheel and struck and cracked the windshield (Figure 9). These contacts did not result in any reported injury. There was no steering wheel rim or column deformation.

The front right seat was occupied by a 4-year-old female who was seated in an unknown type booster seat. The fabric covered bucket seat was adjusted to between the middle and rear most track positions. A 3-point lap and shoulder belt was available and was being used in conjunction with an unknown type booster seat. The belt was equipped with a dual mode locking retractor, but it is not known if it was being used in the ALR or ELR mode. There were indications of seat belt loading. Prior to impact, the driver began braking with her right foot. This action caused this occupant to pitch forward to some degree and likely pre-loaded the lap and shoulder belt. Upon impact, the front right passenger air bag deployed. This occupant responded to the 1 o'clock direction of force by exhibiting a forward and slight right trajectory and loading the lap and shoulder belt. Her face engaged the deploying air bag—causing the facial and corneal abrasions and the concussive injury. There stains found on the left face of the passenger air bag (Figure 11), but no indications of occupant contact.

Given the fact that the air bag had a maximum post-crash excursion of 90 cm (35 in), and this excursion matched the distance to the seat back, it would have been impossible for the bag to fully inflate before this occupant engaged the air bag.



Figure 8. Driver's seated position



Figure 9. Windshield contact





**Figure 10.** Front right seating position



**Figure 11.** Front right passenger air bag