

Rollover/Child Safety Seat Investigation / Vehicle to Object
Dynamic Science, Inc. / Case Number: DS07032
1989 Toyota Pickup
California
May 2007

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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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16. Abstract This on-site investigation focused on a forward facing child safety seat that was installed in the front right seat position of a 1989 Toyota pickup that was involved in a rollover crash. This two-vehicle crash occurred at 1847 hours in May 2007. The crash occurred on a four-lane divided interstate highway. The speed limit at this location was 105 km/h (65 mph). The case vehicle was a 1989 Toyota pickup that was being driven by a restrained 64-year-old male. The front right seat was occupied by a 4-year-old male who was seated in the child safety seat. The Toyota was contacted on the left side by a 2003 Toyota Camry near an interstate off-ramp. The driver of the Toyota lost control of the vehicle. The Toyota went off the roadway through the off-ramp gore area and overturned. The vehicle came to rest on its left side, facing north. The 64-year-old driver of the case vehicle sustained a fractured neck. According to the interviewee, he was unconscious at the scene and had not regained consciousness. He remained hospitalized as of the date of the interview (two months post-crash). The 4-year-old front right seat occupant sustained a left wrist fracture and a contusion to the right side of his face. He was transported a local hospital where he was treated and released.				
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Background

This on-site investigation focused on a forward facing child safety seat that was installed in the front right seating position of a 1989 Toyota pickup that was involved in a rollover crash (Figure 1). This two-vehicle crash occurred at 1847 hours in May 2007. The crash occurred on a four-lane divided interstate highway. The speed limit at this location is 105 km/h (65 mph). The case vehicle was a 1989 Toyota pickup that was being driven by a restrained 64-year-old male. The front right seat was occupied by a 4-year-old male who was seated in the child safety seat. The Toyota was contacted on the left side by a 2003 Toyota Camry near an interstate off-ramp. The driver of the pickup lost control of the vehicle. The pickup went off the roadway through the off-ramp gore area and overturned. The vehicle came to rest on its left side, facing north.



Figure 1. Case vehicle, 1989 Toyota pickup

This on-site child seat investigation was initiated in response to an online news article reporting a child seat success story. DSI was instructed to locate the case vehicle and the child seat. The case vehicle was being held at a salvage facility. The child seat was in the possession of the driver's wife. DSI was assigned the case on July 23, 2007. The vehicle and child seat inspections took place on July 25, 2007.

Summary

Crash Site

This two-vehicle crash occurred at 1847 hours in May 2007. The crash occurred on a north/south interstate highway in the northbound lanes (Figure 2). The northbound roadway was configured with four travel lanes separated by white painted lines and raised reflector dots. An off-ramp was located to the right of the travel lanes. At the gore point area between the travel lanes and the off-ramp, there was a wooden exit sign, followed by an area of shrubs that separate the two roadways. The north roadway was straight with a slight up grade and was of asphalt construction. The roadway was dry and the weather was clear and sunny. The speed limit for the interstate at this location was 105 km/h (65 mph). The cautionary speed limit for the off-ramp was 48 km/h (30 mph).



Figure 2. Area of initial vehicle to vehicle contact

Pre-Crash

The 1989 Toyota pickup was traveling northbound in the right hand lane of the four-lane roadway and was being driven by a restrained 64-year-old male. The front right seat was occupied by a 4-year-old male who was seated in a forward facing child safety seat. The child seat had been installed in the vehicle by the driver. The other vehicle was a 2003 Toyota Camry that was being driven by a 29-year-old female. The Toyota Camry was traveling in the second lane from the right at an unknown speed.



Figure 3. Area of overturn and impact with sign

Crash

The driver of the Camry changed lanes to the right, possibly attempting to access the off-ramp. The driver of the Toyota pickup steered to the right to avoid the impact, but the front right side of the Camry contacted the left side of the Toyota pickup bed. The driver of the Toyota lost control of his vehicle. The vehicle went into a clockwise rotation as it entered the gore area and overturned after traveling approximately 48 m (160 ft). While in the rollover, the vehicle struck a wooden exit sign after traveling approximately 21 m (70 ft). The vehicle continued rolling as it traveled northbound in the gore area. The vehicle rolled five quarter turns. The vehicle came to rest on its left side facing north on the east roadway edge dirt shoulder approximately 48 m (160 ft) north of the impact with the sign (Figure 4).

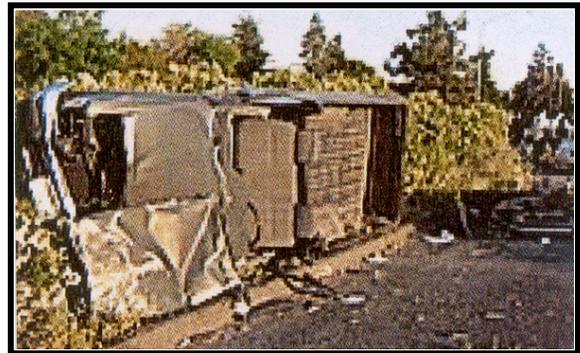


Figure 4. Case vehicle at final rest

Post-Crash

The 64-year-old driver of the case vehicle sustained a fractured neck. According to the interviewee, he was unconscious at the scene and had not regained consciousness. He remained hospitalized as of the date of the interview (two months post-crash). The 4-year-old front right seat occupant sustained a left wrist fracture and a contusion to the right side of his face. He was transported to a local hospital where he was treated and released.

The Toyota pickup was towed from the scene due to damage. It was later declared to be a total loss by the insurance company.

VEHICLE DATA - 1989 Toyota pickup

The 1989 Toyota long bed deluxe 4x4 pickup was identified by the Vehicle Identification Number (VIN): JT4VN02D7K6xxxxxx. There was 193,597 km (120,299 miles) on the odometer at the time of the vehicle inspection. The Toyota pickup was equipped 3.0 liter, six cylinder engine, four-wheel drive, and a manual transmission. The vehicle had a fiberglass bed cap. The pickup was configured with Big O Big Foot AT/T 31x10.5R15LT tires. The tire manufacturer's maximum tire pressure was 345 kPa (50 psi). The vehicle manufacturer's recommended tire size was P225/75R16 with a cold tire pressure of 179 kPa (26 psi) for the front and 241 kPa (35 psi) for the rear. The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	248 (36 psi)	8 mm (10/32 in)	No	None
LR	Flat	8 mm (10/32 in)	No	Rim cracked, tire debedded
RR	Flat	8 mm (10/32 in)	No	Tire debedded
RF	Flat	8 mm (10/32 in)	No	Tire debedded

The seating in the Toyota pickup was configured with a fabric covered bench seat with integral head restraints for the two outboard seating positions (Figures 5-6).



Figure 5. Driver's seated position



Figure 6. Front right passenger's seated position

Vehicle Damage

Exterior Damage -1989 Toyota pickup

The 1989 Toyota pickup sustained moderate top damage as a result of the rollover impact. There was direct damage to the cab roof that measured 107 cm (42.1 in) wide by 70 cm (27.5 in) long. The bed cap was knocked off during the rollover. There was direct damage to the top of the cap that measured 214 cm (84.3 in) in length by 114 cm (44.9 in) in width. There was direct damage to the left front of the hood. The cab roof had been cut off by rescue personnel. The right front, right rear, and left rear tires were flattened and their rims were cracked. The Collision Deformation Classification (CDC) for the rollover was 00TDDO3.



Figure 7. Right side of case vehicle



Figure 8. Crush at left A pillar area



Figure 9. Direct contact damage and crush to cab roof



Figure 10. Contact damage to top of box cap

The pickup sustained minor left side damage as a result of the impact with the Toyota Camry. The direct damage began 64 cm (25.2 in) rear of the rear axle and extended 182 cm (71.7 in) forward along the left side plane. The maximum crush was located between C1 and C2 and measured 5 cm (1.9 in). Six crush measurements were taken at the belt line level and measured: C1 = 0 cm (0 in), C2 = 3 (1.2 in), C3 = 0 cm (0 in), C4 = 1 cm (0.4 in), C5 = 2 cm (0.8 in), C6 = 0 cm (0 in).



Figure 11. Left side contact damage from Event 1

Interior Damage -1989 Toyota pickup

The 1989 Toyota pickup sustained moderate interior damage as a result of passenger compartment intrusion. There was vertical intrusion of the A-pillars, the left B-pillar, roof, windshield header, and the left and right side rails. There was also lateral intrusion of the left A-pillar. The roof had been cut off the vehicle. The maximum intrusion appeared to be at the left roof/left windshield header area and measured approximately 15 cm (5.9 in) vertically.

Manual Restraints -1989 Toyota pickup

The 1989 Toyota pickup was configured with manual 3-point lap and shoulder belts at the two front outboard seating positions and a lap belt in the middle seat position. Both front outboard safety belts were configured with sliding latch plates and Emergency Locking Retractors (ELR).

Child Safety Seat (Evenflo Victory 5)

The Evenflo Victory 5 CSS was positioned forward facing in the front right seat of the Toyota pickup. The model number was 3771346 P1 and the date of manufacture was July 8, 2003. The convertible CSS was configured with a 5-point harness and a two-piece, locking harness retainer clip (Figure 12). The harness was in the top set of harness slots at the time of the crash. The retainer clip was used at the below armpit level, according to the interviewee. A label on the CSS outlined the recommended use of the CSS as follows:

- Forward facing - children weighing between 9-18 kg (20-40 lbs) and whose height is 101 cm (40 in) or less.
- Rear facing- children weighing between 2.3-13.6 kg (5-30 lbs).

The child's weight was 21 kg (46 lbs) and his height was 107 cm (42 in) which was outside the manufacturer's recommended weight and height guidelines. After the crash, the CSS was retrieved by the wife of the driver from the police. Prior to giving CSS back to her, they cut the harness to ensure that the CSS would not be re-used (Figure 13). The CSS had been installed in the vehicle by the driver. The vehicle was equipped with ELR retractors. A locking clip was not used.

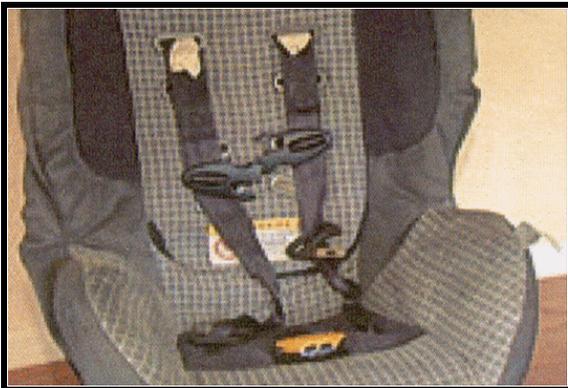


Figure 12. Evenflo Victory 5 CSS



Figure 13. Evenflo Victory 5 CSS

OCCUPANT DEMOGRAPHICS - 1989 Toyota pickup

	Driver	Occupant 2
Age/Sex:	64/Male	4/Male
Seated Position:	Front left	Front right
Seat Type:	Bench	Bench
Height:	165 cm (65 in)	107 cm (42 in)
Weight:	64 kg (140 lbs)	21 kg (46 lbs)
Occupation:	Retired	N/A
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	N/A
Driving Experience:	>20 years	N/A
Body Posture:	Normal, upright	Normal, upright in CSS
Hand Position:	Both hands on steering wheel. Driver actively steering.	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used.	Lap and shoulder belt available, used with CSS
Air bag:	None	None

OCCUPANT INJURIES -1989 Toyota pickup

Driver: Injuries obtained from the interviewee (wife of driver) and the police report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Head injury, unconscious at scene. Has not regained consciousness. Police report driver as being unconscious on a gurney at the trauma center.	160899.3,0	Front header	Probable
Neck fracture	650216.2,6	Front header	Probable
Head contusion	190402.1,9	Front header	Possible
Head laceration	190600.1,9	Front header	Possible

Front row right occupant (2): Injuries obtained from the interviewee and the police report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Left wrist fracture	751800.2,2	Unknown	Unknown
Contusion, right side of face	290402.1,1	Unknown	Unknown
Abrasions, both arms	790202.1,1 790202.1,2	Unknown	Unknown

OCCUPANT KINEMATICS - 1989 Toyota pickup**Driver Kinematics**

The 64-year-old male driver of the Toyota pickup was seated in an upright manner. He was wearing the manual 3-point lap and shoulder belt. The fabric covered bench seat was adjusted to the middle track position. The seat back was at a 24 degree angle from vertical. The seat cushion was at a 17 degree angle from horizontal. The driver of the pickup steered to the right to avoid the impact with the Camry. The impact with the Camry was relatively minor. As the driver steered to the right, he lost control of the vehicle. The vehicle went into a clockwise rotation as it entered the gore area and overturned. It appears that there were five quarter turns before the vehicle came to rest on the driver's side. The driver appears to have contacted the front header and the left side door. He sustained a fractured neck, a head laceration, and a head contusion. According to the interviewee, he was unconscious at the scene and had not regained consciousness. The investigating police officer reported the driver as being unconscious during his visit to the hospital. The driver was still unconscious and hospitalized at the time of the

interview (two months post-crash).

First Row Right Occupant Kinematics

The 4-year-old male front right passenger of the Toyota pickup was seated in an upright manner in a forward facing child safety seat. He was wearing the internal CSS 5-point harness, and the vehicle lap and shoulder belt was used to secure the CSS to the vehicle. A locking clip should have been used with this safety belt, but was not. The fabric covered bench seat was adjusted to the middle track position. The seat back was at a 24 degree angle from vertical. The seat cushion was at a 17 degree angle from horizontal. The driver of the pickup steered to the right to avoid the impact with the Camry. The impact with the Camry was relatively minor. As the driver steered to the right, he lost control of the vehicle. The vehicle went into a clockwise rotation as it entered the gore area and overturned. It appears that there were five quarter turns before the vehicle came to rest on the driver's side. During the rollover sequence, the front right occupant remained belted within the CSS and the CSS remained secured within the vehicle. He was removed from the vehicle by private citizens. The child sustained a left wrist fracture, a contusion to the right side of his face, and bilateral arm abrasions. He was transported a local hospital where he was treated and released.

Attachment 1. Scene Diagram

