Combination Child Safety Seat Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: 2003-74-110B
1994 Chevrolet Camaro
Nebraska
May, 2003

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.
2003-74-110B		

4. Title and Subtitle	5. Report Date
Combination Child Safety Seat Investigation	December 16, 2003
	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. DTNH22-01-C-27002

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 child seat involved crash occurred in Nebraska within the confines of a four-leg intersection in May, 2003 at 1750 hours. The speed limit is 89 km/h (55 mph) for travel north and south. The case vehicle was a 1994 Chevrolet Camaro Z28 convertible driven by an unrestrained 20-year-old male. The convertible top of the vehicle was down at the time of the crash. A 17-month-old male occupied the right rear seat position. The child was seated in a Cosco Alpha Omega convertible child safety seat. The other vehicle was a 2003 Honda CR-V EX four-door sport utility vehicle being driven by a 44-year-old female. This vehicle was equipped with advanced dual stage frontal air bags. The case vehicle was traveling north, approaching the intersection, and began a left hand turn to go west. The other vehicle was traveling southbound. As the Chevrolet Camaro turned it was struck in the right side by the front of the Honda CR-V. The driver of the Camaro was ejected. He was hospitalized for one day. The rear right child occupant of the Camaro was fatally injured.

17. Key Words	18. Distribution Statement
Air bag, deployment, child seat, crash, child fatality, passenger	

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

Form DOT F 1700.7 (8_72) Reproduction of this form and completed page is authorized

Dynamic Science, Inc.
Crash Investigation
Case Number: 2003-74-110B

TABLE OF CONTENTS

BACKGROUND:

Description:	This is a NASS/SCI combination case. This child safety seat fatality case was identified from a variety of news articles. DSI was notified on May 28, 2003. DSI field work was completed on June 16, 2003. The case was later sampled by the local NASS team. The original case number was DS03019.
Investigation Type:	Combination child seat
Crash Location:	Nebraska
Crash Date:	May, 2003
Notification Date:	May 28, 2003
Field Work Completed:	June 16, 2003 (DSI), July 8, 2003 (NASS team)

SUMMARY

Crash Site

This two-vehicle crash occurred in Nebraska within the confines of a four-leg intersection in May, 2003 at 1750 hours. The divided northbound approach to the intersection is comprised of a right hand turn lane, two northbound through lanes, and a left hand turn lane. The divided southbound approach is comprised of a right hand turn lane, two southbound through lanes, and a left hand turn lane. The weather was clear and the concrete roadways were dry and free of defects. The roadways were straight and level in both directions. The intersection was controlled by tri-color traffic signals. The speed limit is 89 km/h (55 mph) for travel north and south.

Figure 1. Approach of case vehicle (north)

Pre-Crash

The case vehicle was a 1994 Chevrolet Camaro Z28 convertible driven by an unrestrained 20-year-old male. The convertible top of the vehicle was down at the time of the crash. A 17-month-old male occupied the right rear seat position. The child was seated in a Cosco Alpha Omega convertible child safety seat (CSS). The other vehicle was a 2003 Honda CR-V EX four-door sport utility vehicle being driven by a 44-year-old female. This vehicle was equipped advanced dual stage frontal air bags. The case vehicle was traveling north, approaching the intersection, and began a left hand turn to go west. The other vehicle was traveling southbound.

Crash

As the Chevrolet Camaro turned it was struck in the right side (01RZAW4) by the front of the Honda CR-V (11FDEW2). The total velocity change for the Camaro calculated by WinSmash was 42.0 km/h (26.1 mph). The longitudinal and lateral components were -32.0 km/h (-19.9 mph) and -27.0 km/h (-16.8 mph), respectively. Both front air bags deployed at this time. The total velocity change for the CR-V was 43.0 km/h (26.7 mph). The longitudinal and lateral components were -40.0 km/h (-24.9 mph) and 15.0 km/h (9.3 mph), respectively. Both front air bags deployed at this time.

Figure 2. Approach of other vehicle (south)

Post-Crash

The unrestrained driver of the Camaro was ejected from the vehicle. Both vehicles rotated in a clockwise direction and came to rest in the southwest corner of the intersection.

The driver of the Camaro sustained a concussive head injury, minor lacerations to the right scalp and upper right arm, a left flank abrasion, and bilateral lower extremity abrasions. He was transported by ground ambulance to a local hospital. He was admitted with a Glasgow Coma Scale (GCS) score of 15 and spent one day in the hospital.

The rear right occupant of the Camaro was fatally injured. He was transported by air ambulance to an area trauma center where he was pronounced dead due to head injuries.

The driver of the Honda sustained abrasion/burns to the right hand, bilateral thigh contusions and abrasions, an abdominal contusion, and a concussive head injury. She was transported by ground ambulance to a local hospital where he arrived with a GCS score of 15. She was treated and released that same day.

Both vehicles were towed from the scene and declared total losses.

SCENE DIAGRAM

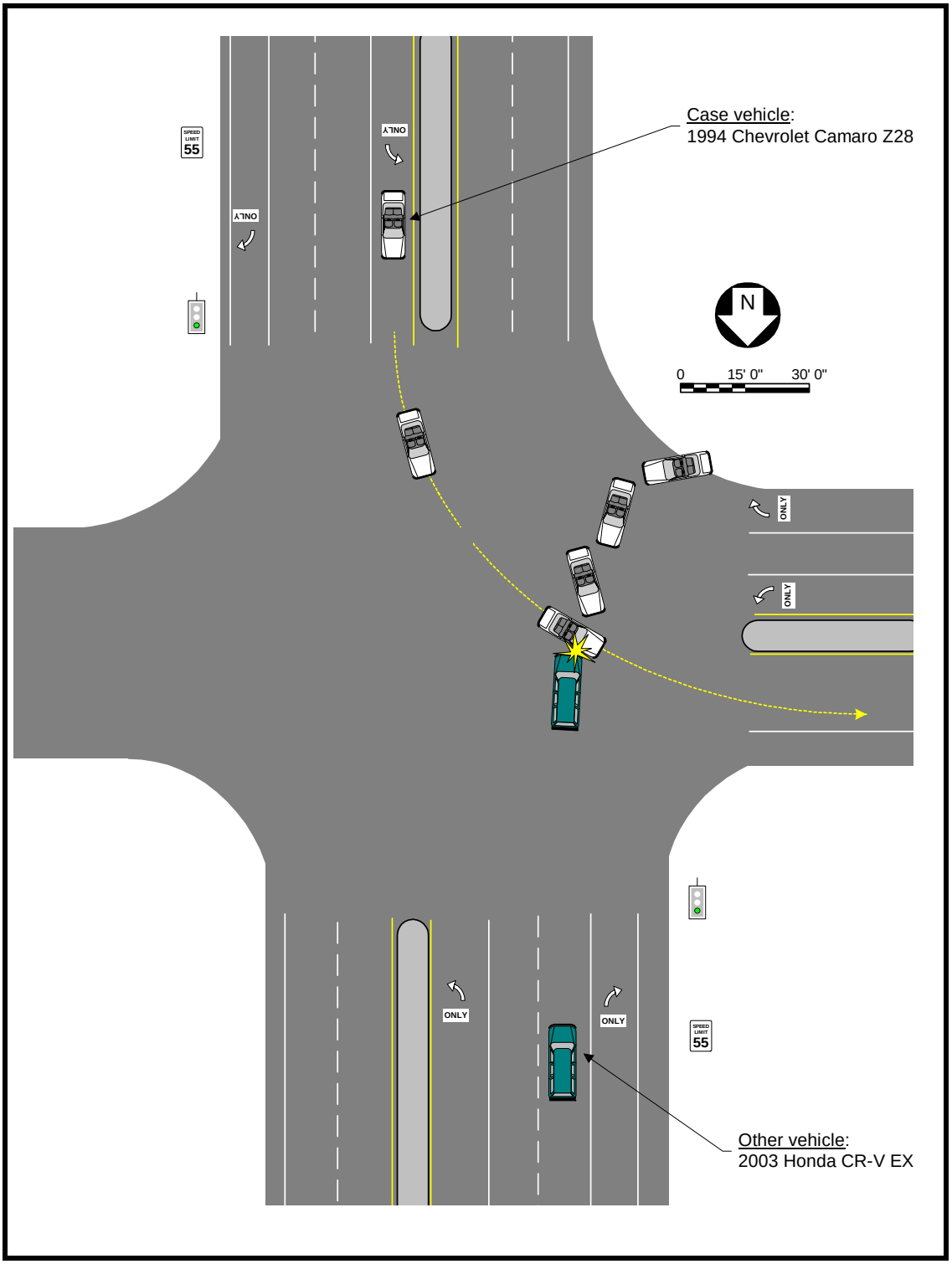

Figure 3. Scene diagram

VEHICLE DATA - 1994 Chevrolet Camaro Z28 convertible

VIN:	2G1FP32P9R2xxxxxx
Odometer:	97,707 km (60,714 miles)
Engine:	5.7L, 8 cylinder
Reported Defects:	None
Cargo:	None

The 1994 Chevrolet Camaro was equipped with Dunlop Sport 5000 P245/50ZR16 tires. The specific tire data is as follows:

Tire	Tread	Pressure	Cold tire pressure
LF	5 mm (0.19 in)	262 kPa (38 psi)	207 kPa (30 psi)
LR	6 mm (0.24 in)	234 kPa (34 psi)	207 kPa (30 psi)
RF	6 mm (0.24 in)	241 kPa (35 psi)	207 kPa (30 psi)
RR	5 mm (0.19 in)	flat	207 kPa (30 psi)

The front seating positions in the 1994 Chevrolet Camaro were configured with bucket seats with integral head restraints. The driver's seat back was slightly reclined. The rear seating positions were configured with bench seats.

VEHICLE DAMAGE

Exterior Damage - 1994 Chevrolet Camaro

Damage Description:	Major side damage. Right front door jammed shut. Right sill overridden.	
CDC:	01RZAW4	
Delta V:	Total	42.0 km/h (26.1 mph)
	Longitudinal	-32.0 km/h (-19.9 mph)
	Latitudinal	-27.0 km/h (-16.8 mph)
	Energy	170,262 joules (125,580 ft-lbs)

The 1994 Chevrolet Camaro sustained major side damage as a result of the impact with the Honda. The direct damage began 60.0 cm (23.6 in) rear of the front axle and extended 226.0 cm (88.9 in) down the side. The right rear tire was broken away from the axle. The field L began 70.0 cm (27.5 in) aft of the front axle and extended 245.0 cm (96.4 in) down the side. The Honda overrode the sill of the Camaro. The crush profile was taken at the mid door plane. The crush profile is as follows: C1=4.0 cm (1.6 in), C2=37.0 cm (14.5 in), C3=51.0 cm (20.0 in), C4=52.0 cm (20.4 in), C5=42.0 cm (16.5 in), C6=20.0 cm (7.9 in).

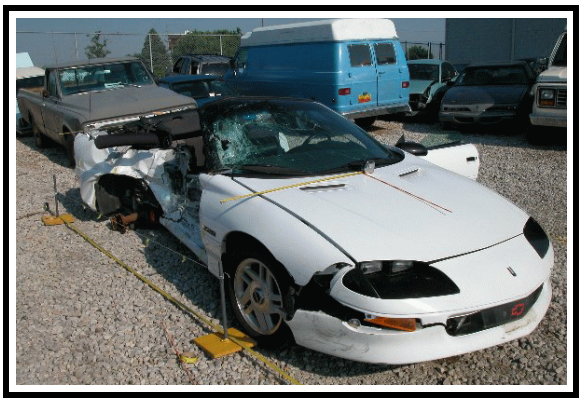

Figure 4. Front right, case vehicle

Figure 5. Right side, case vehicle

Interior Damage - 1994 Chevrolet Camaro

Interior damage to the 1994 Chevrolet Camaro was extensive and attributed to occupant contact and passenger compartment intrusion. The right side of the windshield was fractured and holed from impact forces. The right door was jammed shut. There was extensive intrusion to the right side. The maximum intrusion to the right front door was 27.0 cm (10.6 in). The right front seat was pushed into the left seating area. The maximum intrusion to the right rear seating area was 30.0 cm (11.8 in).

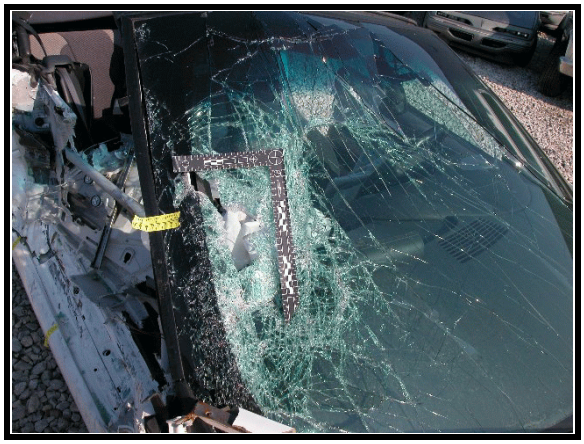

Figure 6. Right side windshield damage

MANUAL RESTRAINT SYSTEMS - 1994 Chevrolet Camaro

The 1994 Chevrolet Camaro was configured with 3-point lap and shoulder belts with sliding latch plates for all four seating positions. The driver's seat belt was configured with an emergency locking retractor. The retractor type for the front right seat position is not known. Both rear seat belts were configured with switchable retractors. The driver's seat belt was not in use at the time of the crash. The rear right seat belt was being used in conjunction with a child safety seat at the time of the crash.

Figure 7. Overview of vehicle interior showing right side intrusion

Figure 8. Right rear seat belt

FRONTAL AIR BAG SYSTEM - 1994 Chevrolet Camaro

The case vehicle was equipped with a driver's air bag and a front right passenger's air bag. The driver's air bag was mounted in the steering column. It measured 50.0 cm (19.6 in) in diameter in its deflated state. It was equipped with two vent ports and did not have any tethers. There were nine horizontal folds on the air bag face. The module cover was an "I" design. The left and right flaps each measured 10.0 cm (3.9 in) wide by 12.0 cm (4.7 in) high. There were no indications of contact or damage to the module cover. There was a small cut found on the bottom right quadrant of the air bag. The front passenger's air bag was mounted in the top of the instrument panel. It measured 50.0 cm (19.6 in) wide by 60.0 cm (23.6 in) high. It was equipped with two vent ports (at the 9 and 3 o'clock positions) and two tethers. There was a single rectangular module cover that was 35.0 cm (13.7 in) wide by 24.0 cm (9.4 in) high. The cover was secured by a single 15.0 cm (5.9 in) long tether. There were no indications of contact or damage to the module cover. There were cuts found on the top left quadrant of the air bag. This had been caused by the bag's interaction with the windshield.

Figure 9. Driver's air bag

Figure 10. Small hole, driver's air bag

Figure 11. Front right passenger's air bag

CHILD SAFETY SEAT - 1994 Chevrolet Camaro

The child was seated in a Cosco Alpha Omega convertible child safety seat (Model No.: 02-531 IBB). It was manufactured on 04/22/2002. The seat was equipped with a 5-point harness. It is designed for the following configurations:

- rear-facing for infants up to 15.8 kg (35 lbs);
- forward-facing for toddlers 9.9-18.1 kg (22-40 lbs);
- belt-positioning booster 13.6-36.2 kg (30-80 lbs).

The seat was equipped with the following features:

- 4 harness positions;
- adjustable head rest;
- 3-position recline;
- belt-positioning guides on both sides.

The child seat was being used in the forward facing mode in the rear right seat position. According to the police: (1) the child seat had been properly installed in the vehicle using the available 3-point lap and shoulder belt and (2) the child was properly harnessed to the seat. Using the seat in the forward facing mode was appropriate given the weight of the child (10 kg/22 lbs)–though the usage was at very lowest end of the range.

The impact and subsequent intrusion fractured and displaced the right side of the shell. The fracture ran vertically down the right side of the shell and compressed the bottom of the base.

Figure 12. Front, Cosco CSS

Figure 14. Shell fractures to seat back and side panel

Figure 15. Side view of CSS showing seat back fracture

Figure 16. Bottom of child seat–shows compression to left side of base.

VEHICLE DATA - 2003 Honda CR-V

Description:	2003 Honda CR-V sport utility vehicle	
VIN:	JHLRD78853Cxxxxxx	
Odometer:	Unknown	
Engine:	2.4L, 4 cylinder	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Moderate frontal crush. Damage to bumper, grille, hood.	
CDC:	11FDEW2	
Delta V:	Total	43.0 km/h (26.7 mph)
	Longitudinal	-40.0 km/h (-24.9 mph)
	Latitudinal	15 km/h (9.3 mph)
	Energy	144,563 joules (106,624.2 ft-lbs)

Figure 17. Front, other vehicle

OCCUPANT DEMOGRAPHICS - 1994 Chevrolet Camaro

	Driver	Occupant 2
Age/Sex:	20/Male	17 months/Male
Seated Position:	Front left	Rear right
Seat Type:	Fabric covered bucket seat. Seat adjusted to forward most track position. Seat back slightly reclined.	Bench seat. Seated in Cosco Alpha Omega convertible child safety seat.
Height:	157 cm (62 in)	81 cm (32 in)
Weight:	57 kg (126 lbs)	10 kg (23 lbs)
Occupation:	Unknown	NA
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown	NA
Body Posture:	Normal	Upright, seated in child safety seat
Hand Position:	Left on steering wheel, right on shifter	On lap
Foot Position:	Right foot on accelerator, left on floorboard	NA
Restraint Usage:	Lap and shoulder belt available, not used.	Lap and shoulder belt available, used with child safety seat.
Air bag:	Steering wheel mounted driver's air bag available, deployed.	None

OCCUPANT DEMOGRAPHICS - 2003 Honda CR-V

Age/Sex:	44/Female
Seated Position:	Front left
Seat Type:	Bucket seat. Seat adjusted to between forward most and middle track positions.
Height:	157 cm (62 cm)
Weight:	59 kg (130 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	BAC test performed, results not known
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Right foot on brake, left on floor
Restraint Usage:	Lap and shoulder belt available, used.
Air bag:	Steering wheel mounted driver's air bag available, deployed. Seat back mounted side air bag available, deployed.

OCCUPANT INJURIES -1994 Chevrolet Camaro

	INJURY	OIC CODE	SOURCE
Driver:	Concussive injury, no prior unconsciousness with neurological deficit	160404.2,0	Ground
	Minor scalp laceration, right side, behind ear	190602.1,1	Ground
	Upper arm laceration, right	790602.1,1	Ground
	Left flank abrasion	690202.1,2	Ground
	Lower extremity abrasion, bilateral	890202.1,3	Steering wheel rim
Right rear occupant:	Traumatic brain injury	115299.7,0	Right side panel, reinforced by right side of child restraint

OCCUPANT INJURIES - 2003 Honda CR-V

	INJURY	OIC CODE	SOURCE
Driver:	Burn, right hand, 4th and 5th fingers	792006.1,1	Air bag exhaust gases
	Contusion, left abdomen	590402.1,2	Lap belt
	Abrasions/contusions, anterior thigh	890202.1,3 890402.1,3	Air bag

OCCUPANT KINEMATICS - 1994 Chevrolet Camaro

The 20-year-old male driver of the 1994 Chevrolet Camaro was seated in a forward facing fashion in the fabric covered bucket seat. The seat was slightly reclined and had been adjusted to the forward seat track positions. The driver was not wearing the available lap and shoulder belt. The driver was in the process of making a left hand turn. His right foot was likely on the accelerator and the left on the floor. At impact, the driver responded to the 40 degree direction of force by pitching forward and to the right. Since the driver was not restrained and their were no internal structures to inhibit his motion, the driver was fully ejected from the right side of the vehicle[1]. He essentially passed over the right door, through the area originally occupied by the right side glass, and onto the street. He sustained a number of injuries that were attributed to contact with the ground, including: a concussive head injury, minor lacerations to the right scalp and upper right arm, and a left flank abrasion. He also sustained bilateral lower extremity abrasions–these were likely caused by the steering wheel rim during the ejection. He was transported by ground ambulance to a local hospital.

Figure 18. Right rear intruding surface

The 17-month-old male right rear occupant of the Camaro was seated in a Cosco Alpha Omega convertible child safety seat (Model No.: 02-531). The child seat was being used in the forward facing mode and was, according to the police, properly anchored to the vehicle using the available lap and shoulder belt. The police also indicate that the 5-point harness was properly being used to secure the child into the child seat. At impact, both the rear right occupant and the child seat pitched sharply to the right and engaged the intruding right side panel. The impact and subsequent intrusion fractured and displaced the right side of the shell. The fracture ran vertically down the right side of the shell and compressed the bottom of the base. The child's head engaged the right side of the child seat shell, which was reinforced by the right rear side panel–causing the fatal traumatic head injury. He was transported by air ambulance to an area trauma center where he was pronounced dead due to head injuries.

Figure 19. Right side of child safety seat (exterior)

[1]SCI change. PSU indicated a left side ejection.

Figure 20. Right side of child seat (interior)