Child Safety Seat Combination Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: 2002-76-097A
2001 Chevrolet Cavalier / 1992 Pontiac Bonneville
Arizona
November, 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.	2. Government Accession No.	3. Recipient Catalog No.
2002-76-097A		

4. Title and Subtitle	5. Report Date
Child Safety Seat Combination Investigation	November 7, 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. DTNH22-94-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 head-on crash occurred in Arizona in November, 2002 at 1200 hours. The crash occurred on a curved east/west four-lane undivided state roadway. The posted speed limit is 89 km/h (55 mph). Case vehicle 1 was a 2001 Chevrolet Cavalier two-door coupe driven by an unrestrained 22-year-old female. The front right seat was occupied by an unrestrained 18-year-old male. The rear left seat was occupied by a 2-year-old female in a child safety seat. The rear right seat was occupied by an 11-month old male seated in an infant seat. Case vehicle 2 was a 1992 Pontiac Bonneville SE four-door sedan driven by a restrained 48-year-old male. The front right seat was occupied by a restrained 41-year-old male. The rear left seat was occupied by an 11-year-old female. The rear middle seat was occupied by a male child seated in an unknown model rear facing child safety seat. The rear right seat was occupied by a 29-year-old female. The Chevrolet was traveling westbound along the right hand curved roadway. The Pontiac was traveling eastbound. The Chevrolet crossed the center line into the path of the Pontiac. The driver of the Pontiac braked and steered to the right but was unable to avoid the crash. The front of the Chevrolet struck the front of the Pontiac in a head-on configuration. Both vehicles were towed from the scene due to damage. The driver of the Chevrolet was able to exit the vehicle on her own. She was transported by ambulance to a local hospital where she was treated and released. The front right occupant was fatally injured. The rear left occupant was transported from the scene by ambulance to a local hospital where she was treated and released. The right rear occupant was transported from the scene by ambulance to a local trauma center and was admitted with a skull fracture and bleeding in the brain. The driver of the Pontiac was transported to a local trauma center where he was treated and released for minor injuries. The front right occupant sustained blunt abdominal trauma and a liver hematoma. He was admitted at a local hospital. The rear left occupant sustained minor injuries. She was treated and released. The rear middle occupant sustained minor injuries. He was transported to a local hospital where he was treated and released. The rear right occupant sustained minor contusions and abrasions. He was treated and released.

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

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: 2002-76-097A

TABLE OF CONTENTS

BACKGROUND:

Description: This child safety seat combination case was generated by the local National Automotive Sampling System (NASS) team. DSI was assigned the case on November 30, 2002. This two vehicle crash is being investigated as a combination case. There were child safety seats in both vehicles. The NASS team inspected the case vehicles on November 29, 2002.

Investigation Type:	Remote
Crash Location:	Arizona
Crash Date:	November, 2002
Notification Date:	November 30, 2002
Field Work Completed:	NA

SUMMARY:

This head-on crash occurred in Arizona in November, 2002 at 1200 hours. The crash occurred on a curved east/west four-lane undivided state roadway. The westbound lanes are bordered by a paved asphalt shoulder to the north. The eastbound lanes are bordered by a paved emergency lane and guardrail to the south. The west and east bound lanes are separated by double solid yellow lines. Traffic traveling westbound is negotiating a right hand curve and a steep down grade (-6%). The eastbound traffic would be negotiating a left hand curve and an upgrade. The asphalt roadway was dry. There were no visual defects. The weather was clear and calm. The posted speed limit is 89 km/h (55 mph).

Figure 1. Approach to area of impact, case vehicle. Westbound.

Case vehicle 1 was a 2001 Chevrolet Cavalier two-door coupe (red) driven by a restrained 22-year-old female (168 cm/66 in, 54 kg/119 lbs). The front right seat was occupied by an unrestrained 18-year-old male (180 cm/71 in, 82 kg/180 lbs). The rear left seat was occupied by a 2-year-old female (84 cm/33 in, 14 kg/31 lbs) in a Cosco Touriva convertible child safety seat. The rear right seat was occupied by an 11-month old male (66 cm/26 in, 11 kg/25 lbs) seated in a Graco Snugride infant car seat (Model 8457 MV) that was being used in a rear facing fashion. The child was 1.8 kg (5 lbs) heavier than the manufacturer's weight recommended for this infant seat.

The Chevrolet was equipped with redesigned driver's and front right passenger air bags.

Figure 2. Final rest

Case vehicle 2 was a 1992 Pontiac Bonneville SE (white) four-door sedan driven by a restrained 48-year-old male. The front right seat was occupied by a restrained 41-year-old male. The rear left seat was occupied by an 11-year-old female. The rear middle seat was occupied by a 1-month-old male child seated in an unknown model rear facing infant safety seat. The rear right seat was occupied by a 29-year-old female.

Figure 3. Front, Chevrolet Cavalier

The Chevrolet was traveling westbound along the right hand curved roadway at a police reported travel speed of 97 km/h (60 mph). The Pontiac was traveling eastbound at a police reported speed of 97 km/h (60 mph) . The Chevrolet crossed the center line into the path of case the Pontiac. The driver of the Pontiac braked and steered to the right but was unable to avoid the crash. The front of the Chevrolet (01FDEW5) struck the front of the Pontiac (12FDEW5) in a head-on configuration. After impact, the Chevrolet rotated counterclockwise; the Pontiac rotated clockwise. The Chevrolet came to rest on top of the southern guardrail facing north. The Pontiac came to rest facing south in the second eastbound travel lane. The Pontiac sustained a minor engine compartment fire.

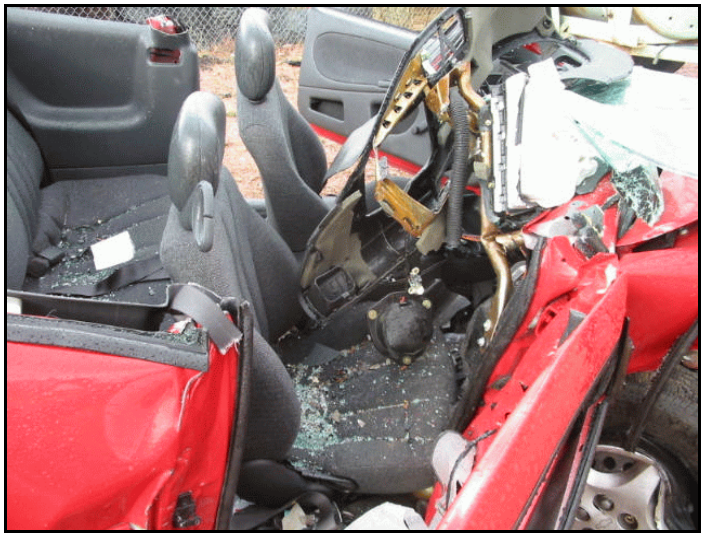

Figure 4. Interior view, Chevrolet

The Chevrolet sustained a total delta v of 84 km/h (52 mph), a longitudinal delta v of -79 km/h (-49 mph), a laterall delta v of -29 km/h (-18 mph), and a barrier equivalent speed of 79 km/h (49 mph). Both frontal air bags deployed.

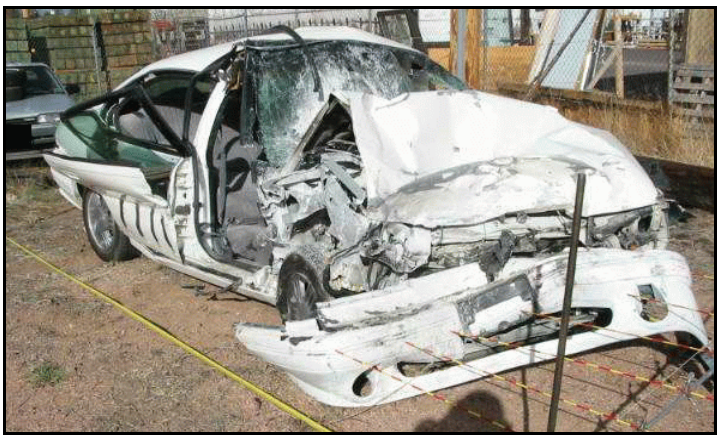

Figure 5. Right front, Pontiac

The Pontiac sustained a total delta v of 66 km/h (41 mph), a longitudinal delta v of -65 km/h (-40 mph), a lateral delta v of 12 km/h (7 mph), and a barrier equivalent speed of 71 km/h (44 mph). The driver air bag deployed. Both vehicles were towed from the scene due to damage.

Figure 6. Interior view, Pontiac

The driver of the Chevrolet was able to exit the vehicle on her own. She sustained a concussion, abrasions to her face, bilateral hip contusions, and lower leg lacerations/avulsions. She was transported by ambulance to a local hospital where she was treated and released.

The front right occupant was fatally injured.

The rear left occupant was seated in a Cosco Touriva convertible safety seat (CSS) with a 5-point restraint–model #02-524-AAR; the seat was being used in a forward facing position. She sustained an abrasion to her left eyelid, abrasion/contusions near the left side of her neck, and contusions to her shoulder and chest. She was transported from the scene by ambulance to a local hospital where she was treated and released.

The right rear occupant was seated in a Graco Snugride (Model 8457 MV) infant safety seat (ISS) that was being used in a rear facing fashion. It has been reported that the child seat came loose during the crash and the child was partially ejected. He sustained several brain and skull injuries. He was transported from the scene to a local trauma center. He was admitted and hospitalized for 17 days.

The driver of the Pontiac was transported to a local trauma center where he was treated and released for minor injuries. The front right occupant sustained blunt abdominal trauma and a liver hematoma. He was admitted at a local hospital. The rear left occupant sustained minor injuries. She was treated and released. The rear middle occupant sustained minor injuries. He was transported to a local hospital where he was treated and released. The rear right occupant

sustained minor contusions and abrasions. He was treated and released.

An overview of emergency response times is shown below:

Crash	1200
Police called	1206
Ambulance called	1206
Police arrived	1234
Ambulance arrived	1235
Ambulance departed	1355

Scene Diagram

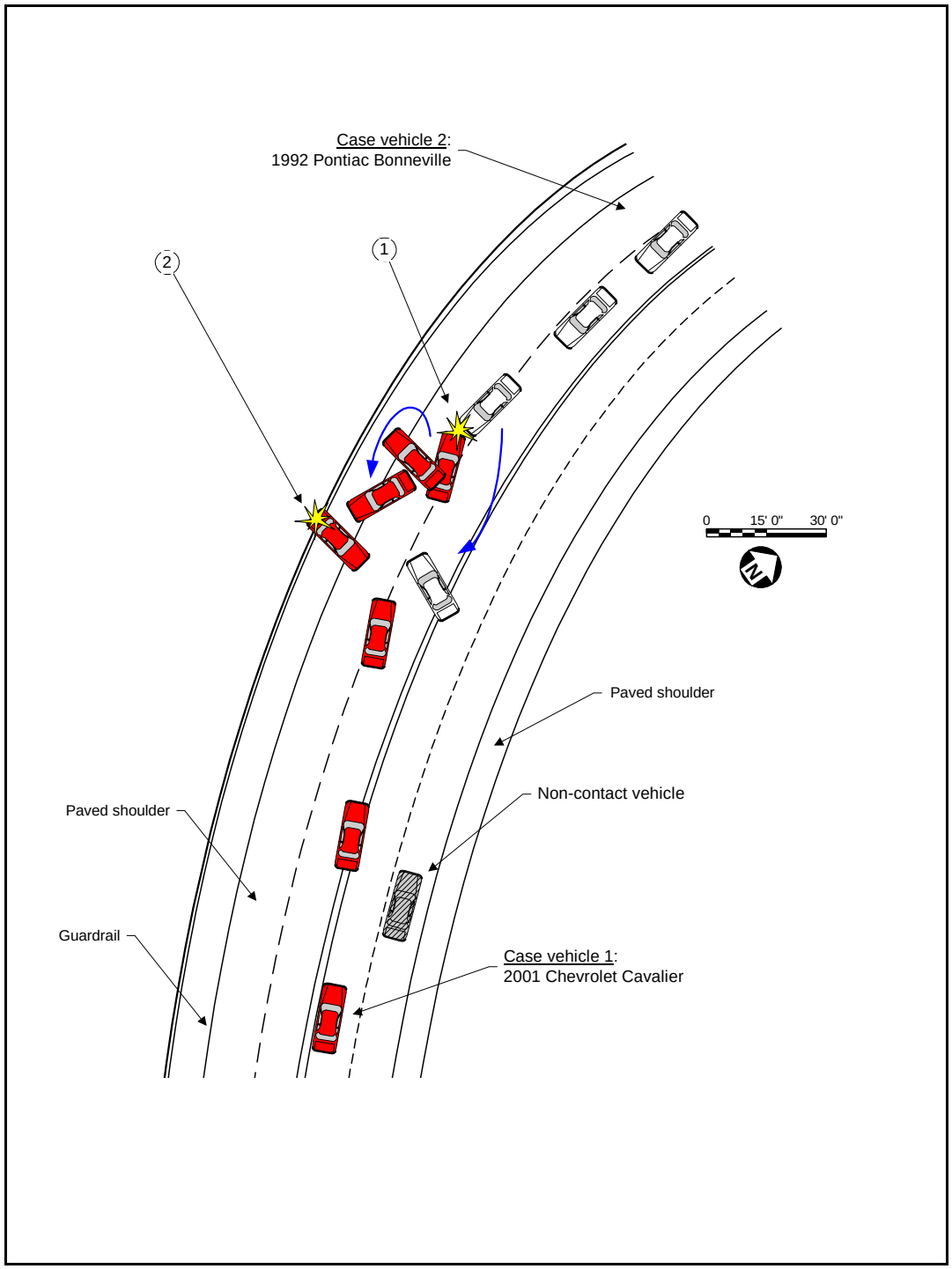

Figure 7. Scene diagram

COLLISION MEASUREMENT TABLE

Reference Point: white edge line	**Reference Line:** cement drainage on north side of road

Data Point	**Distance and Direction from RP**			**Distance and Direction from RL**		
	ft	m	d	ft	m	d
BLF - Pontiac	21	6.4	N	69.5	21.2	E
BRF - Pontiac	13.7	4.2	N	98.0	29.9	E
ILF - Pontiac	17.6	5.4	N	115.3	35.1	E
IRF - Pontiac	12.5	3.8	N	115.3	35.1	E
ELR - Chevrolet	7.4	2.3	S	134.7	41.1	E
ELF - Pontiac	15.0	4.6	N	136.4	41.6	E
ERF - Pontiac	9.6	2.9	N	136.4	41.6	E
ELF - Chevrolet	1.7	0.5	S	136.4	41.6	E
ERF - Pontiac	17.4	5.3	N	139.0	42.4	E
ERF - Chevrolet	2.2	0.7	S	140.6	42.9	E
Gouge	9.0	2.7	N	141.5	43.1	E
ERR - Pontiac	22.4	6.8	N	144.7	44.1	E
Gouge	9.0	2.7	N	145.0	44.2	E

DETAILED INFORMATION

Vehicles

Case vehicle 1

Description:	2001 Chevrolet Cavalier two-door (red)	
VIN:	1G1JC124017xxxxxx	
Odometer:	Unknown	
Engine:	2.2 L / 4 cylinder	
Reported Defects:	None	
Cargo:	91 kg (41 lbs)	
Damage Description:	Major longitudinal crush to front right bumper and fender. Right front tire restricted. Wheelbase shortened.	
CDC:	Impact 1: 01FDEW5 Impact 2: 00UBDW3 (guardrail impact)	
Delta V (Impact 1):	Total	84 km/h (52 mph)
	Longitudinal	-79 km/h (-49 mph)
	Lateral	-29 km/h (-18 mph)
	Energy	414,652 joules (305,831 ft lbs)

Figure 8. Right side, Chevrolet Cavalier

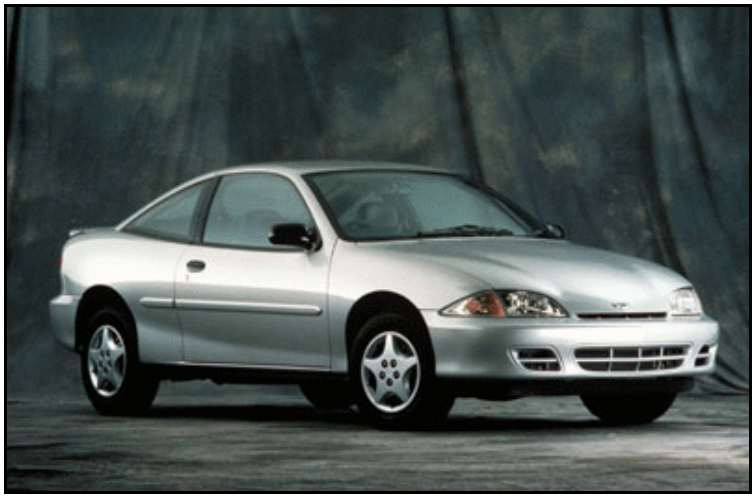

Figure 9. Exemplar view, 2001 Chevrolet Cavalier

The Chevrolet sustained 82 cm (32 in) of direct contact to the front end beginning at the right front bumper corner. The residual crush measured along the bumper was as follows: C1=33 cm (13 in), C2=71 cm (28 in), C3=88 cm (35 in), C4=101 cm (40 in), C5=117 cm (46 in), C6=124 cm (49 in). The maximum crush was located at the right bumper corner. The principle direction of force was within the 1 o'clock sector and was an estimated 20 degrees. The damaged components include the bumper fascia and reinforcement bar, hood, grille, and right side. There was impact force related damage to the windshield and the front right side glass was disintegrated. There was intrusion of the A pillar, instrument panel, and toe pan on the right side. The maximum intrusion was 65 cm (26 in) to the A pillar. There was intrusion of the rear seat back and instrument panel on the left side. The maximum intrusion was 15 cm (6 in) from the seat back.

The driver of the Chevrolet reported a brake failure.

Safety systems discussion

The Chevrolet Cavalier was equipped with redesigned driver and front right passenger air bags that deployed as a result of the crash. The driver air bag module was located in the center hub of the steering wheel ands had an "I" configuration cover. The cover measured 20.0 cm (7.9 in) wide by 10 cm (3.9 in) high. The diameter of the deployed air bag was 60.0 cm (23.6 in). The air bag did not have any tethers. There were two vent ports at the 11 and 1 o'clock, respectively. There was no evidence of contact nor damage to the air bag and the air bag module cover. The vehicle was equipped with a tilt steering wheel column. There was no steering rim deformation nor any steering column compression.

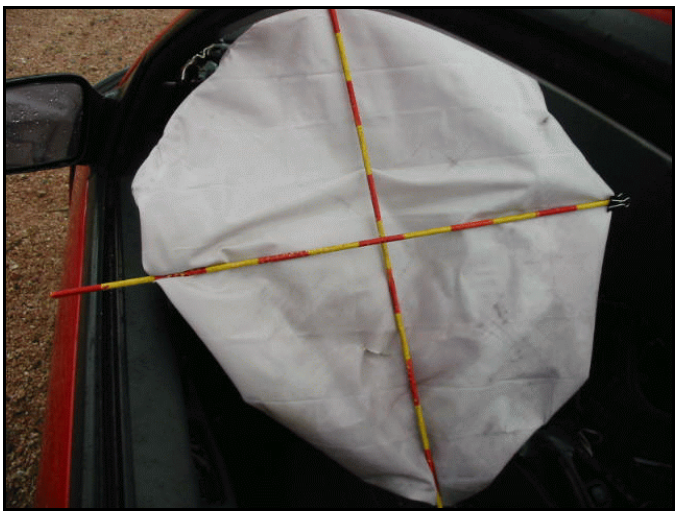

Figure 10. Driver's air bag

The front right passenger air bag was a top mount design located in the right aspect of the instrument panel. The single air bag module cover measured 33.0 cm (12.9 in) wide by 20.0 cm (7.9 in) high. The deployed air bag measured 72.0 cm (28.3 in) wide by 60.0 cm (23.6 in) high. There were no vent ports or and two tethers. There was no evidence of contact or damage to the air bag and the air bag module cover.

Figure 11. Front right passenger's air bag

The interviewee indicated that this vehicle had been bought at an auction before being sold to the driver. There are notes indicating that this vehicle had been in a prior crash and the air bags had been replaced.

Child safety seat discussion (Chevrolet)

The rear left seat was occupied by a 2-year-old female (84 cm/33 in, 14 kg/31 lbs) in a Cosco Touriva (Model No.: 02-524-AAR) CSS with a 5-point restraint. The seat was manufactured on June 7, 2002. It was being using the forward facing position. According to the manufacturer, the seat can properly accommodate a child up to 18 kg (40 lbs). The seat was anchored to the vehicle using the available lap and shoulder belt. The harness retainer clip was in use and had been placed at the armpit level. The harness was fitted through the top slots of the seat back. A retrofitted tether was available and was used during the crash. The vehicle's left tether anchorage was loaded and damaged during the crash. A locking clip was available, but was used incorrectly; the clip was installed on the lap and shoulder belt on the outboard side of the seat–opposite the seat belt latch plate.

Figure 12. Cosco Touriva CSS, left rear, Chevrolet

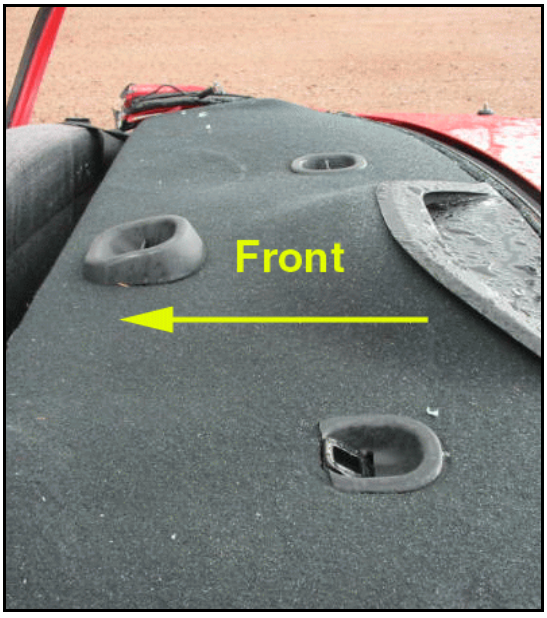

Figure 13. Left and right tether anchorages. Left anchorage damaged by loading.

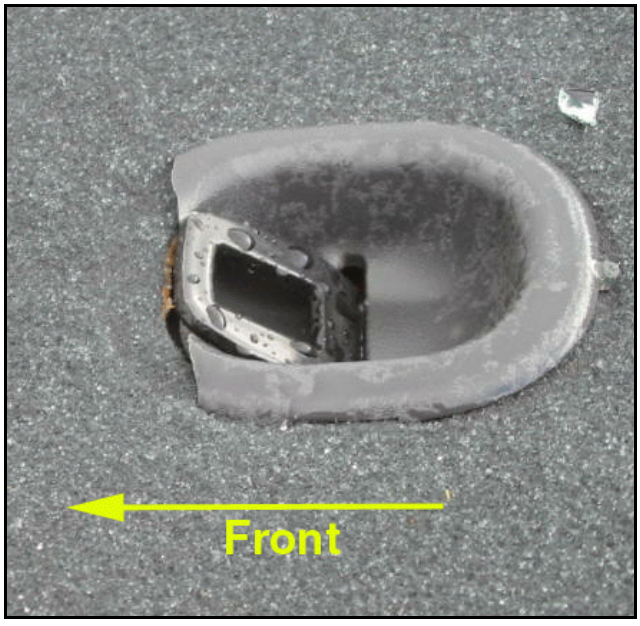

Figure 14. Close up of left tether anchorage

The rear right seat was occupied by an 11-month old male (66 cm/26 in, 11 kg/25 lbs) seated in a Graco Snugride (Model 8457 MV) ISS that was being used in a rear facing fashion. The seat was anchored to the vehicle using the available lap and shoulder belt. A locking clip was used with the lap and shoulder belt, but was used incorrectly (located on the webbing on the outboard side of the child seat opposite of the latch plate). The CSS was equipped with a 3-point harness. The harness straps were in the top slots, which would be appropriate for a child at the upper weight/height limit. The NASS investigator indicated that the seat harness had..."failed due to age and the harness free end not double back through the locking D ring on the back of the seat." This does not appear to be the case. Figure 16 shows the harness properly inserted into the harness tightener. The harness clip, however, was placed in a position that would have been well below the child's armpit level. The carrying handle was in the reclined position. It was not designed with a top tether or LATCH. The seat was manufactured on August 10, 2000. According to the manufacturer, the maximum weight capacity for this seat was 9 kg (20 lbs). The child was 1.8 kg (5 lbs) heavier than the recommended weight. The left carrier handle broke off during the crash due to contact with the front right seat back.

The interviewee indicated that this CSS had been used with a previous child and had been purchased new in 2000.

Figure 15. Graco Snugride ISS, right rear, Chevrolet

Figure 16. Harness and harness tightener

Case vehicle 2

Description:	1992 Pontiac Bonneville SE four-door sedan	
VIN:	1G2HX53L1N1xxxxxx	
Odometer:	Unknown	
Engine:	3.8 L / V6	
Reported Defects:	None	
Cargo:	2 kg (5 lbs) - child seat	
Damage Description:	Major longitudinal crush to front right bumper and fender. Right front tire restricted. Wheelbase shortened.	
CDC:	12FDEW6	
Delta V:	Total	66 km/h (41 mph)
	Longitudinal	-65 km/h (-40 mph)
	Lateral	12 km/h (7 mph)
	Energy	372,790 joules (274,956 ft lbs)

Figure 17. Right side, Pontiac Bonneville

The Pontiac sustained 130 cm (51 in) of direct contact that extended across the entire frontal end width of the vehicle. The residual crush measured along the bumper was as follows: C1=24 cm (9 in), C2=59 cm (23 in), C3=89 cm (35 in), C4=99 cm (39 in), C5=91 cm (36 in), C6=116 cm (47 in). The maximum crush was located at C6. The principle direction of force was within the 12 o'clock sector and was an estimated 350 degrees. The damaged components include the bumper fascia and reinforcement bar, hood, and grille. There was impact force related damage to the windshield and the left front side glass was disintegrated. The right front and right rear doors were jammed shut. There was intrusion of the A pillar, toe pan, windshield header, and B pillar on the right side. The maximum intrusion was to the right instrument panel.

Figure 18. Exemplar view of 1992 Pontiac Bonneville

Child safety seat discussion (Pontiac)

The 1-month-old male (51 cm/20 in, 4 kg/9 lbs) middle rear seat occupant was seated in a rear facing child safety seat. The seat was anchored to the vehicle using the manual lap belt. The make/model of the seat is not known.

Occupants

Case vehicle 1 (Chevrolet)	Occupant 1	Occupant 2
Age/Sex:	22/Female	18/Male
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat with folding back. Seat at forward most track position. Seat in upright position.	Fabric covered bucket seat with folding back. Seat at rear most track position. Seat track damaged. Seat back slightly reclined.
Height:	168 cm (66 in)	180 cm (71 in)
Weight:	54 kg (119 lbs)	82 kg (180 lbs)
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown	NA
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Unknown	Unknown
Foot Position:	Right foot presumed to be on the brake.	Unknown
Restraint Usage:	Lap and shoulder belt available, used.	Lap and shoulder belt available, not used.
Air bag:	Steering wheel mounted air bag available, deployed	Mid instrument panel mounted air bag available, deployed.

Case vehicle 1 (Chevrolet)	Occupant 3	Occupant 4
Age/Sex:	2/Female	11 month/male
Seated Position:	Rear left	Rear right
Seat Type:	Fabric covered bench seat with folding back.	Fabric covered bench seat with folding back.
Height:	84 cm (33 in)	66 cm (26 in)
Weight:	14 kg (31 lbs)	11 kg (25 lbs)
Occupation:	NA	NA
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	NA	NA
Driving Experience:	NA	NA
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used with CSS, unknown if used properly.	Lap and shoulder belt used with ISS, unknown if used properly.
Air bag:	None available	None available

Case vehicle 2 (Pontiac)	Occupant 1	Occupant 2
Age/Sex:	48/Male	41/Male
Seated Position:	Front left	Front right
Seat Type:	Split bench with separate back cushions, seat adjusted to between middle and rear most track position	Bucket, seat adjusted to middle track position.
Height:	185 cm (73 in)	178 cm (70 in)
Weight:	104 kg (230 lbs)	91 kg (200 lbs)
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown, presumed to be greater than 10 years	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, not used	Lap and shoulder belt available, used

Case vehicle 2 (Pontiac)	Occupant 3	Occupant 4	Occupant 5
Age/Sex:	11/Female	1 month / Male	29/Female
Seated Position:	Rear left	Rear middle	Rear right
Seat Type:	Bench with separate back cushions	Bench with separate back cushions	Bench with separate back cushions
Height:	102 cm (40 in)	51 cm (20 in)	152 cm (60 in)
Weight:	20 kg (45 lbs)	4 kg (9 lbs)	66 kg (145 lbs)
Occupation:	NA	NA	Unknown
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	NA	NA	NA
Driving Experience:	NA	NA	NA
Body Posture:	Normal, supine, facing forward	Normal, supine, facing rearward	Normal, upright
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap belt used with child safety seat, unknown if used properly	Lap and shoulder belt available, used

Injuries and Injury Mechanisms

Case vehicle

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Concussion, unconsciousness known to be < 1 hour	160414.2,0	850.1	Center instrument panel
	Abrasion/contusion, right forehead	290202.1,7 290402.1,7	910.0 920.0	Center instrument panel
	Abrasion, right chin/lower lip	290202.1,8	910.0	Center instrument panel
	Contusion, left shoulder	790402.1,2	923.0	Seat belt shoulder webbing
	Abrasion, left abdomen	590202.1,2	911.0	Seat belt lap webbing
	Hip contusions, bilateral	890402.1,3	924.01	Seat belt lap webbing
	Avulsion, left lower leg	890802.1,2	894.0	Knee bolster
	Laceration, right lower leg	890602.1,2	894.0	Knee bolster
Front right occupant:	Fatally injured . As of the date of this report, detailed medical information was not available for this occupant.			
Rear left occupant:	Abrasion, left eyelid	297202.1,2	918.0	Child seat
	Abrasion/contusion, upper shoulder near edge of neck	790202.1,2 790402.1.2	912.0 923.0	Child seat harness[1]
	Contusion, left shoulder	790402.1,2	923.0	Child seat harness

[1]SCI change. Child restrained by the child seat harness.

	Contusion, center chest	490402.1,4	922.1	Child seat harness
Rear right occupant:	Cerebral hematoma, epidural, bilateral	140634.5,3	853.0	Back of front right seat
	Left vault, frontal, temporal, parietal, occipital complex skull fracture with torn dura	150406.4,2	800.25[2]	Back of front right seat
	Subdural hematoma	140652.4,2	800.25	Back of front right seat
	Contusion, left cerebrum	140604.3,2	800.15	Back of front right seat
	Subarchnoid hemorrhage	140684.3,1 140684.3,1	800.25	Back of front right seat
	Concussive injury, unconscious >24 hours, unresponsive to verbal or painful stimuli	160820.4,0	800.25	Back of front right seat
	Contusion/subgaleal hematoma, left scalp	190402.1,2	920.0	Back of front right seat
	Abrasion, left lower leg	890202.1,2	916.0	Child safety seat

[2]Fracture of vault of skull, close with subarchnoid, subdural, and epidural hemorrhage. Fifth digit=5, unconsciousness > 24 hours

Case vehicle 2

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Toe fracture	853602.1,1	826.0	Foot controls
Front right occupant	Concussive head injury with unconsciousness < 1 hour	160602.2, 0	850.1	Unknown[3]
	Cerebrum hematoma/hemorrhage	140652.4,1	852.0	Unknown
	Finger fracture, right	752404.1,1	816.00	Right instrument panel and below
	Finger dislocation, right	750404.1,1	834.00	Right instrument panel and below
	Left hand abrasion	790202.1,2	914.0	Right instrument panel and below
	Left thigh abrasion	890202.1,2	916.0	Right instrument panel and below
	Left foot abrasion	890202.1,2	917.0	Floor
	Bilateral lower leg contusions	890402.1,3	916.0	Right instrument panel and below
Rear left occupant:	Lumbar spinal fracture, lamina	650624.3,8	805.4	Seat belt, flexion injury
	Lumbar spinal fracture, minor compression	650632.2,8	805.4	Seat belt, flexion injury
	Lumbar spinal fracture, spinous process	650618.2,8	805.4	Seat belt, flexion injury
	Lumbar spinal fracture, spinous process	650618.2,8	805.4	Seat belt, flexion injury
	Eyelid laceration, left	297602.1,2	870.0	Left side interior surface
	Right ankle abrasion	890202.1,1	916.0	Seat back support

[3]Right instrument panel and below, per EDCS. SCI change.

	Contusion, left cheek	290402.1,2	920.0	Left side interior surface
Rear middle occupant:	Chest contusion, left	490402.1,2	922.1	CSS harness
Rear right occupant:	Chest abrasion, left	490202.1,2	911.0	Seat belt webbing
	Chest contusion, left	490402.1,2	922.1	Seat belt webbing
	Abdomen abrasion, lower	590202.1,8	911.0	Seat belt webbing
	Left shoulder abrasion	790202.1,2	912.0	Child safety seat
	Right upper arm contusion	790402.1,1	923.03	Seat belt webbing
	Bilateral hip contusions	890402.1,3	924.01	Seat belt webbing
	Right shoulder contusion	790402.1,1	923.0	Right side interior surface

Occupant Kinematics

Chevrolet Cavalier

The 22-year-old female driver (168 cm/66 in, 54 kg/119 lbs) was seated in a normal, upright fashion. She was wearing the available lap and shoulder belt. The fabric covered bucket with folding back was adjusted to the forward most track position. At impact, the driver pitched forward and to the right and loaded the lap and shoulder system–causing the shoulder, abdomen, and bilateral hip contusions/abrasions. The driver's face engaged the deployed air bag–causing the forehead contusion/abrasion and a concussion. The driver was able to exit the vehicle on her own. She was transported by ambulance to a local hospital where she was treated and released.

Figure 19. Driver's air bag

The 18-year-old male (180 cm/71 in, 82 kg/180 lbs) front right seat occupant was seated in a slightly slouched fashion. He was not wearing the available lap and shoulder belt. The fabric covered bucket seat with folding back was adjusted to the rear most track position. This occupant was fatally injured . As of the date of this report, detailed medical information was not available for this occupant. It is presumed that this occupant pitched forward and to the right and engaged the lower instrument panel and the passenger air bag. The nature of his injuries is not known.

The 2-year-old female (84 cm/33 in, 14 kg/31 lbs) rear left seat occupant was seated in a forward facing Cosco Touriva CSS. The convertible seat was anchored to the fabric covered bench seat with the lap and shoulder belt. A locking clip was available, but was used incorrectly; the clip was installed on the lap and shoulder belt on the outboard side of the seat–opposite the seat belt latch plate. The child seat was tethered to the tether anchorage on the rear deck. At impact, this occupant responded to the 1 o'clock direction of force by moving forward and to the right. She pitched forward and loaded the convertible seat harness–causing the abrasion/contusion to her upper shoulder near the neck, the contusion to the left shoulder, and the contusion to the center of the chest. She also sustained an abrasion to the left eyelid. The NASS team attributed this injury to the convertible seat itself, but its actual origin is not known.

Figure 20. Front, CSS

Figure 21. Left side, CSS

Figure 22. CSS seat location

The 11-month old male (66 cm/26 in, 11 kg/24 lbs) rear right seat occupant was seated in a Graco Snugride seat (Model 8457 MV) ISS that was being used in a rear facing position. The infant seat was anchored to the fabric covered bench seat using the available lap and shoulder belt. A locking clip was used with the lap and shoulder belt, but was used incorrectly (located on the webbing on the outboard side of the child seat opposite of the latch plate). The front right seat had been adjusted to the rear most track position and the seat back slightly reclined–placing the seat back as close to the child seat as physically possible. The infant seat was, by design, reclined in approximately a 45 degree angle towards the front of the vehicle. The seat was equipped with a 3-point harness. The harness straps were in the top slots, which would be appropriate for a child at the upper weight/height limit. The investigator indicated that the seat harness had..."failed due to age and the harness free end not double back through the locking D ring on the back of the seat." This does not appear to be the case. The harness clip, however, was placed in a position that would have been well below the child's armpit level. At impact, the child seat pitched forward and the child seat back rotated downward–engaging the rear of the right front seat. The rear seat back intruded forward 15 cm (6 in) further reducing the available distance between the front and rear seat backs. The child's head pitched toward the front and to the right of the vehicle and engaged the left side of the infant seat back (when facing rearward)–causing the skull fracture and brain injuries. The initial impact was functionally between the infant seat back and the back of the right front seat.

Figure 23. Back of front right seat–shows infant seat contact

Figure 24. Side view of ISS installed location

Figure 25. Graco ISS

Attachment 1. Graco Recall [NHTSA Recall No. 02E014]

Models: Graco SnugRide
Number Involved: 918,930
Dates of Manufacture: August 1999 - February 2002

Noncompliance: This recall involves infant car seats, Model Numbers 7493G9, 7493RS, 7497HL, 7497SY, 7499LK, 7499N2, 841101, 841102, 841103, 841203, 8412T02, 8457D5, 8457DVB, 8457F3, 8457GP, 8457IND, 8457MA, **8457MV**, 8457RG, 8457TMJ, 8457TMP, 8457YL, 8458A5, 8458AE, 8458B7, 8458D8, 8458FKB, 8458HE, 8458HH, 8458KY, 8458N5, 8459VL, 8460LV, 8462HAV, 8462JAM, 8471UVB, 8472BLW, 8472BRN, 8472CYP, 8472GMP, 8472MAD, 8472YL, 8474HAB, 8474MEL, 8476VIN, 8477HAV, 8477JAM, 8477NGS, 8478SAR. Affected model numbers may also begin with the letter "A." These seats may be missing components on the base or the carrier shell. The components are 1 or 2 metal hooks and their retainer pins on the base, or the mating "U" shaped bars on the carrier shell that are used to attach the carrier to the base. If the hooks, pins, or "U" bars are missing, the carrier may not be securely attached to the base. In the event of a sudden stop or crash, the carrier could detach from the base, possibly resulting in serious injury or death to the seat occupant.

Remedy: Graco will provide a replacement seat or base free of charge. The manufacturer has reported that owner notification began March 19, 2002. Owners who do not receive the free replacement seat or base within a reasonable time should contact Graco Century at 1-800-345-4109. [NHTSA Recall No. 02E014]