

Remote Investigation / Vehicle to Vehicle  
Dynamic Science, Inc. / Case Number: DS02023  
1993 Cadillac DeVille four door sedan  
California  
September, 2001

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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  <p>This crash occurred in September, 2001 at 2000 hours. The crash occurred within the confines of a four leg intersection. The weather was clear and the asphalt roadway was dry at the time of the crash. It was dark; streetlights were present and operating at the time of the crash. The speed limit was 89 km/h (55 mph) for all intersecting roadways.</p> <p>The case vehicle, a 1993 Cadillac DeVille four door sedan driven by a restrained 29-year-old male, was traveling west. The front right seat was occupied by a restrained 20-year-old female. The second left seat was occupied by a restrained 5-year-old female. The second right seat was occupied by a 10-month-old female (79 cm/31 in, 8 kg/17 lbs) who was seated in a forward facing booster seat. The other vehicle, a 1985 Ford F150 pickup driven by an unrestrained 36-year-old male, was traveling southbound. The front middle seat was occupied by an unrestrained 28-year-old female.</p> <p>As the vehicles approached the intersection, the driver of the case vehicle had the green light. The driver of the other vehicle had the red light. The driver of the other vehicle failed to stop at the red light and struck the right side of the case vehicle with its front end. The case vehicle spun out in a clockwise direction and came to rest in the eastbound lanes. The other vehicle rolled over (6 quarter rolls) and left the roadway. The driver of the other vehicle was ejected through the left side window. This vehicle came to rest on its roof/right side facing north. The driver came to rest just north of this vehicle. The front occupants of the case vehicle sustained minor injuries. The rear left occupant sustained a fractured femur. The rear right occupant was fatally injured.</p> <p>Both vehicles were towed from the scene due to damage. The case vehicle was declared a total loss by the insurance company. It was later sold and dismantled.</p>					
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**Dynamic Science, Inc.**  
**Accident Investigation**  
**Case Number: DS02023**

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**BACKGROUND:**

Description: This child safety seat case was identified through FARS. DSI was assigned the case on October 31, 2002. This case was conducted as a remote investigation. The following information was obtained from the police report, autopsy reports, and on-scene photos.

Investigation Type: Remote  
 Crash Location: California  
 Crash Date: September, 2001  
 Notification Date: October 31, 2002  
 Field Work Completed: NA

**SUMMARY:**

This crash occurred in September, 2001 at 2000 hours. The crash occurred within the confines of a four leg intersection. The southbound leg of the intersection is comprised of a southbound travel lane, a left hand turn lane, and a northbound through lane. The roadway is controlled by an overhead tri-color signal that was red at the time of the crash. The eastbound leg of the intersection is comprised of a westbound through lane, two left hand turn lanes, and one eastbound through lane. The roadway is controlled by an overhead tri-color signal that was green at the time of the crash. The weather was clear and the asphalt roadway was dry at the time of the crash. It was dark; streetlights were present and operating at the time of the crash. The speed limit was 89 km/h (55 mph) for all intersecting roadways.



**Figure 1.** Final rest, case vehicle (northwest)

The case vehicle, a 1993 Cadillac DeVille four door sedan driven by a restrained 29-year-old male (168 cm/66 in, 82 kg/180 lbs), was traveling west. The front right seat was occupied by a restrained 20-year-old female. The second left seat was occupied by a restrained 5-year-old female. The second right seat was occupied by a 10-month-old female (79 cm/31 in, 8 kg/17 lbs) who was seated in a forward facing booster seat. According to police, this occupant was “properly secured in a child restraint seat.” The manufacturer of the seat (Cosco) recommends that it be used with children weighing between 10-18 kg (22-40 lbs). NHTSA recommends that a child who weighs less than 10 kg (22 lbs) be placed in a rear facing child seat.

The other vehicle, a 1985 Ford F150 pickup driven by an unrestrained 36-year-old male, was traveling southbound. The front middle seat was occupied by an unrestrained 28-year-old female. The driver of the other vehicle later tested positive for alcohol.

As the vehicles approached the intersection, the driver of the case vehicle had the green light. The driver of the other vehicle had the red light. The driver of the other vehicle failed to stop at the red light and struck the right side of the case vehicle (01RZAW3) with its front end (70FDEW2). The total velocity change for the case vehicle as calculated by the damage algorithm of the WinSmash collision model was 35 km/h (22 mph). The longitudinal and lateral delta V components were -27 km/h (-17 mph) and -23 km/h (-14 mph), respectively. The driver air bag deployed at this time. The total velocity for the other vehicle was 38 km/h (24 mph). The longitudinal and lateral delta V components were -24 km/h (-15 mph) and 29 km/h (18 mph), respectively.

The case vehicle spun out in a clockwise direction and came to rest in the eastbound lanes. The other vehicle rolled over (6 quarter rolls) and left the roadway. The driver of the other vehicle was ejected through the left side window. This vehicle came to rest on its roof/right side facing north. The driver came to rest just north of this vehicle.

The driver of the case vehicle sustained lacerations to his head and face (AIS=1). He was transported from the scene by ground ambulance.

The front right occupant sustained a laceration to her lip and other unspecified lacerations (AIS=1). She was transported from the scene by ground ambulance. The rear left occupant sustained a right femur fracture (AIS=3). She was transported from the scene by ground ambulance.



**Figure 2.** Final rest, other vehicle (south)



**Figure 3.** Right side damage, case vehicle

The rear right occupant sustained serious injuries, including: a fragmented spleen (AIS=3), a liver laceration (AIS=2), a left mandible fracture, a deep abrasion to the upper forehead, contusions to the right cheek, a lip abrasion, abrasion to right side of face, contusions to the inner aspect of the right knee, contusion to front of right thigh, contusion to the front of upper right shin, and abrasions/dicing injuries to right side of face. She was transported from the scene by helicopter. After arrival,

emergency room staff attempted to resuscitate her for approximately 35 minutes. She was pronounced dead at 2128 hours, approximately 1-1/2 hours post-crash, due to multiple blunt force injuries. Her injuries were due to the substantial intrusion through the right rear door and possibly the exterior of the striking vehicle. At impact, the child seat was pushed rearward and to the left. It appears that the child seat rotated 90 degrees rearward so that the seat bottom was actually facing the rear of the vehicle.



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

The driver of the other vehicle sustained a massive head trauma. He was transported from the scene by helicopter to a local trauma center. He was hospitalized and underwent surgery to repair the skull fracture. This effort was unsuccessful and brain death was declared at 1212 hours two days following the crash.

The front middle occupant of the other vehicle sustained lacerations to her head, face, and right knee (AIS=1). She was transported from the scene by air ambulance.

Both vehicles were towed from the scene due to damage. The case vehicle was declared a total loss by the insurance company. It was later sold and dismantled.

### Scene Diagram

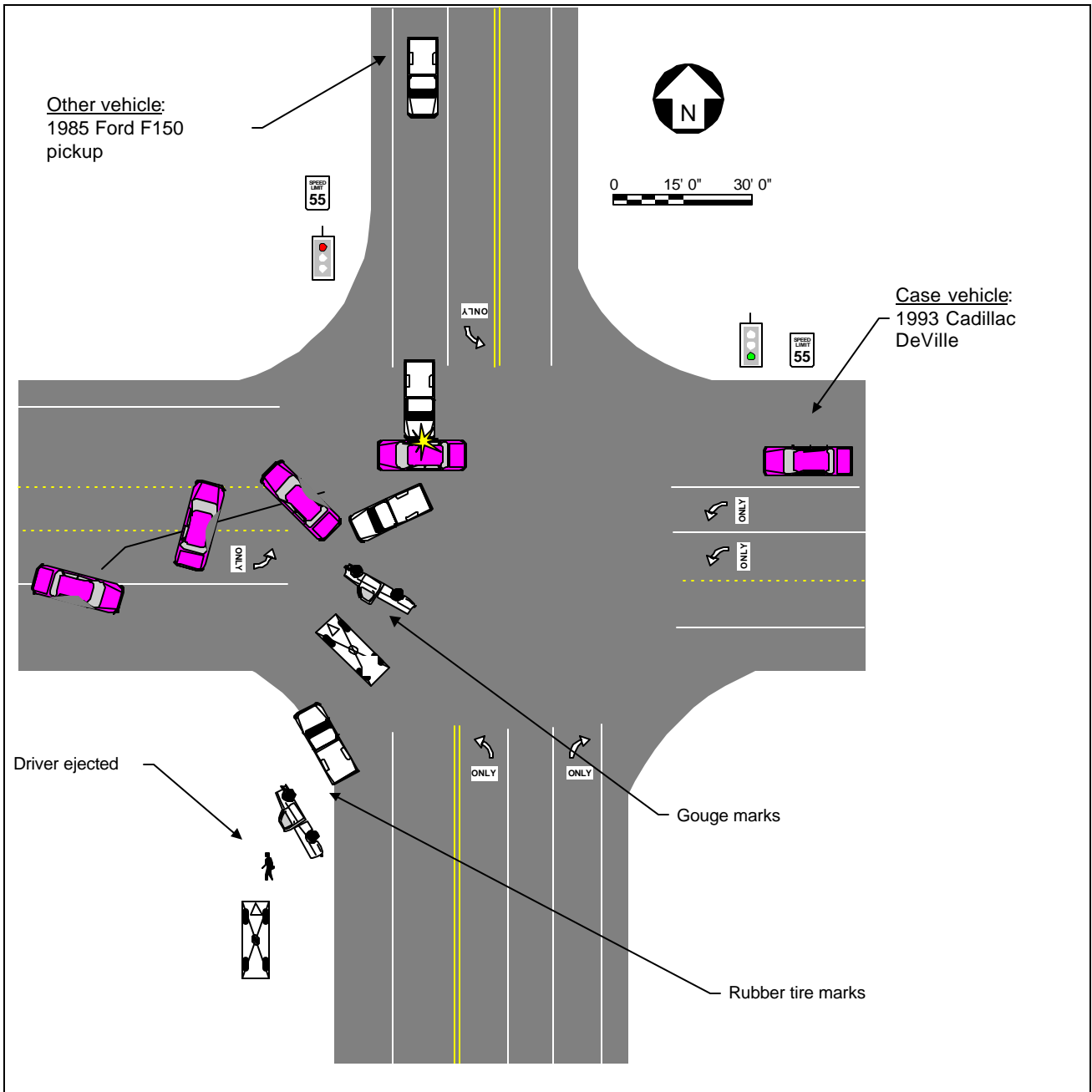


Figure 5. Scene diagram



COLLISION MEASUREMENT TABLE							
Crash Data	Case vehicle	Other vehicle					
Heading Angle	270	180					
Surface Type	Asphalt	Asphalt					
Surface Condition	Dry	Dry					
Grade (pre-impact)	0E	0E					
Grade (impact)	0E	0E					
Speed Limit	89 km/h (55 mph)	89 km/h (55 mph)					
<b>Reference Point:</b> West roadway edge			<b>Reference Line:</b> Intercept point 31.4 m (103 ft) south of south roadway edge				
Police Item Number	Data Point	Distance and Direction from RP			Distance and Direction from RL		
		ft	m	d	ft	m	d
1	Collision scrub (begin)	18	5.5	E	154	46.9	N
1	Collision scrub (middle)	10	3	E	151	46	N
1	Collision scrub (end)	1	0.3	E	150	45.7	N
2	Gouge (begin)	14	4.3	E	162	49.4	N
2	Gouge (middle)	8	2.4	E	162	49.4	N
2	Gouge (end)	3.5	1.1	E	161	49.1	N
3	Gouge (begin)	10	3	W	142	43.3	N
3	Gouge (continue)	19	5.8	W	138	42.1	N
3	Gouge (continue)	28	8.5	W	135	41.1	N
3	Gouge (continue)	36	11	W	134	40.8	N
3	Gouge (continue)	49	14.9	W	134	40.8	N
3	Gouge (continue)	53	16.2	W	130	39.6	N
3	Gouge (end)	58	17.7	W	125	38.1	N

4	White paint scrape from other vehicle (begin)	62	18.9	W	123	37.5	N
4	White paint scrape from other vehicle (end)	69	21	W	124	37.8	N
5	White paint scrape from other vehicle (begin)	2	0.6	E	117	35.7	N
5	White paint scrape from other vehicle (end)	2	0.6	W	109	33.2	N
6	Scrape mark (begin)	8	2.4	E	115	35.1	N
6	Scrape mark (continue)	0	0		0	0	
6	Scrape mark (end)	4	1.2	W	11	3.4	N
7	Scrape mark-white-other vehicle (begin)	9	2.7	E	114	34.7	N
7	Scrape mark-white-other vehicle (end)	5	1.5	E	110	33.5	N
8	Gouge-other vehicle (begin)	4.5	1.4	E	101	30.8	N
8	Gouge-other vehicle (end)	9	2.7	E	91	27.7	N
9	White paint scrape (begin)	4	1.2	W	96	29.3	N
9	White paint scrape (end)	9	2.7	W	86	26.2	N
10	Scrape mark-other vehicle (begin)	8	2.4	W	86	26.2	N
10	Scrape mark-other vehicle (end)	8	2.4	W	81	24.7	N
11	Scrape mark-other vehicle (begin)	6.5	2	W	81.5	24.8	N

11	Scrape mark–other vehicle (end)	7.5	2.3	W	80.5	24.5	N
12	Tire mark–other vehicle (begin)	10	3	W	78	23.8	N
12	Tire mark–other vehicle (end)	13	4	W	75	22.9	N
13	Tire mark–other vehicle (begin)	18.5	5.6	W	75.5	23	N
13	Tire mark–other vehicle (end)	18	5.5	W	75	22.9	N
14	Dirt tire impression–other vehicle (begin)	17	5.2	W	71	21.6	N
14	Dirt tire impression–other vehicle (end)	20	6.1	W	62	18.9	N
15	Driver of other vehicle-- final rest (head)	20	6.1	W	59	18	N
15	Driver of other vehicle–final rest (groin)	19	5.8	W	59	18	N
	Other vehicle FRP (LF)	22	6.7	W	49	14.9	N
	Other vehicle FRP (LR)	22	6.7	W	37	11.3	N
	Case vehicle FRP (LF)	58	17.7	W	122	37.2	N
	Case vehicle FRP (LR)	68	20.7	W	124	37.8	N

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

Description:	1993 Cadillac DeVille four-door sedan	
VIN:	Unknown	
Odometer:	Unknown	
Engine:	4.9 L (300 CID)/ 8 cylinder	
Reported Defects:	None noted	
Cargo:	Child seat, unknown additional items	
Damage Description:	Major damage through right side. Intrusion through both right doors. Vehicle towed due to damage.	
CDC (based on photos):	01RZAW3	
Delta V:	Total	35 km/h (22 mph)
	Longitudinal	-27 km/h (-17 mph)
	Latitudinal	-23 km/h (-14 mph)
	Energy	35,560 joules (26,228 ft-lbs)



**Figure 6.** Right side damage, case vehicle

### Child Safety Seat Discussion

The 10-month-old female rear right occupant was seated in what appears to be an older model Cosco Highback Booster seat. The manufacturer's recommendations for use of this seat are: between 10- 18 kg (22 and 40 lbs) use 5-point harness and for 14-32 kg (30-70 lbs) remove harness and use as a belt-positioning booster. This seat is designed to have a 5-point harness, however, the hip straps were not present. This is likely due to mis-threading of the harness. According to police, this occupant was "properly secured in a child restraint seat." Based on the location of the vehicle shoulder belt in the photos, it would appear that the belt was being used with the child seat. The photos represent the position of the seat after emergency personnel had extricated and transported the child.



**Figure 7.** Child safety seat as it was found in vehicle



**Figure 8,** Child safety seat, image rotated and webbing enhanced

Other vehicle

Description: 1985 Ford F150 pickup

VIN: 1FTDF15Y0FPBxxxxxx

Odometer: 154,266 km (95,856 miles)

Engine: 4.9 L (300 CID) / 6 cylinder  
3-speed automatic transmission

Reported Defects: The investigating police agency conducted a mechanical inspection on the throttle, tires and wheels, steering, suspension, service brake system, and engine/transmission. There were no defects or pre-collision conditions that would have affected the functionality of this vehicle.

Cargo: Unknown

Damage Description: Major front end damage. Bumper, hood, grille, and fenders damage.

CDC (based on photos): Impact 1: 70FDEW2  
Impact 2: 00LDAO3 (rollover)

Delta V (Impact 1):

Total	38 km/h (24 mph)
Longitudinal	-24 km/h (-15 mph)
Latitudinal	29 km/h (18 mph)
Energy	260,445 joules (192,094 ft-lbs)



**Figure 9.** Front of other vehicle (1985 Ford F150 pickup)



**Figure 10.** Left side, other vehicle

**Occupants**

<u>Case vehicle</u>	Occupant 1	Occupant 2
Age/Sex:	29/Male	20/Female
Seated Position:	Front left	Front right
Seat Type:	Leather covered bucket seat, unknown track position	Leather covered bucket seat, unknown track position
Height:	168 cm (66 in)	Unknown
Weight:	82 kg (180 lbs)	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Presumed > 10 years	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Right presumed to be on accelerator, left on floor board	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used
Air bag:	Driver's air bag available, deployed	None



<u>Case vehicle</u>	Occupant 3	Occupant 4
Age/Sex:	5/Female	10 months, 7 days/Female
Seated Position:	Rear left	Rear right
Seat Type:	Unknown	Unknown
Height:	Unknown	79 cm (31 in)
Weight:	Unknown	8 kg (17 lbs)
Occupation:	NA	NA
Pre-existing Medical Condition:	None noted	None
Alcohol/Drug Involvement:	NA	NA
Driving Experience:	NA	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used.	Lap and shoulder belt available, used with booster seat.
Air bag:	None available	None available

<u>Other vehicle</u>	Occupant 1	Occupant 2
Age/Sex:	36/Male	28/Female
Seated Position:	Front left	Front middle
Seat Type:	Unknown	Unknown
Height:	168 cm (66 in), per ME	Unknown
Weight:	100 kg (220 lbs), per ME	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	Hepatitis C	None noted
Alcohol/Drug Involvement:	BAC of 0.191 per urine screen. Negative for drugs.	NA
Driving Experience:	Unknown	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Right presumed to be on accelerator, left on floor board	Unknown
Restraint Usage:	Lap and shoulder belt available, not used. Per police report.	Lap belt available, not used.

**Injuries and Injury Mechanisms**

## Case vehicle

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Lacerations to head	190600.1,9	873.49	Unknown
	Lacerations to face	290600.1,9	873.40	Unknown
Front right occupant:	Laceration, left side of lip	290600.1,8	873.43	Unknown
	Multiple lacerations	990600.1,9	Unknown	Unknown
Rear left occupant:	Femur fracture, right	851800.3,1	820.0	Booster seat
Rear right occupant:	Fragmented spleen	544240.3,2	865.09	Right door panel
	Liver laceration	541820.2,1	864.05	Right door panel
	Lacerations, right side of face	290600.1,7	873.41	Unknown
	Abrasions, right side of face	290202.1,1	910.0	Unknown
	Large abrasion, center of upper forehead	290202.1,7	910.0	Door frame
	Superficial lacerations, forehead	290600.1,7	910.0	Door frame / side glass
	Lacerations, upper left forehead	290600.1,7	873.42	Door frame / side glass
	Contusions, right cheek	290402.1,1	920.0	Door frame
	Abrasion, lower lip	290202.1,8	910.0	Door frame
	Abrasion, right side of chin	290202.1,8	910.0	Door frame
Left mandible fracture	250602.1,2	802.20	Unknown	

Contusions, inner aspect of right knee	890402.1,1	924.11	Unknown
Contusion, anterior aspect of left lower leg	890402.1,2	924.10	Unknown
Contusion, anterior aspect of left knee	890402.1,2	924.11	Unknown
Abrasion, left hand	790202.1,2	914.0	Unknown

## Other vehicle

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Left tibia fracture	853404.2,2	823.02	Unknown
	Left fibula fracture	851605.2,2	823.02	Unknown
	Depressed skull fracture	150404.3,9	800.00	Ground
	Abrasion, head	190202.1,9	910.0	Unknown
	Abrasions to both shoulders	790202.1,1 790202.1,2	912.0 912.0	Ground
	Abrasions, left arm	790202.1,2	913.0	Ground
	Abrasion, left leg	890202.1,2	916.0	Ground
	Left chest trauma	415099.7,2	Unk	Unknown
	Hand trauma	715099.7,2	Unk	Unknown
Front right occupant:	Lacerations to head	190600.1,9	873.49	Unknown
	Lacerations to face	290600.1,9	873.40	Unknown
	Laceration, right knee	890600.1,1	891.0	Unknown

## Occupant Kinematics

The 29-year-old male driver of the case vehicle was seated in a forward facing position. He was wearing the available lap and shoulder belt. It is believed that his right foot was on the accelerator and his left was on the floor. At impact, he was projected forward and to the right. He loaded the lap and shoulder belt and engaged the deployed air bag. He sustained lacerations to his face and head from an unknown source.



**Figure 11.** Driver's air bag

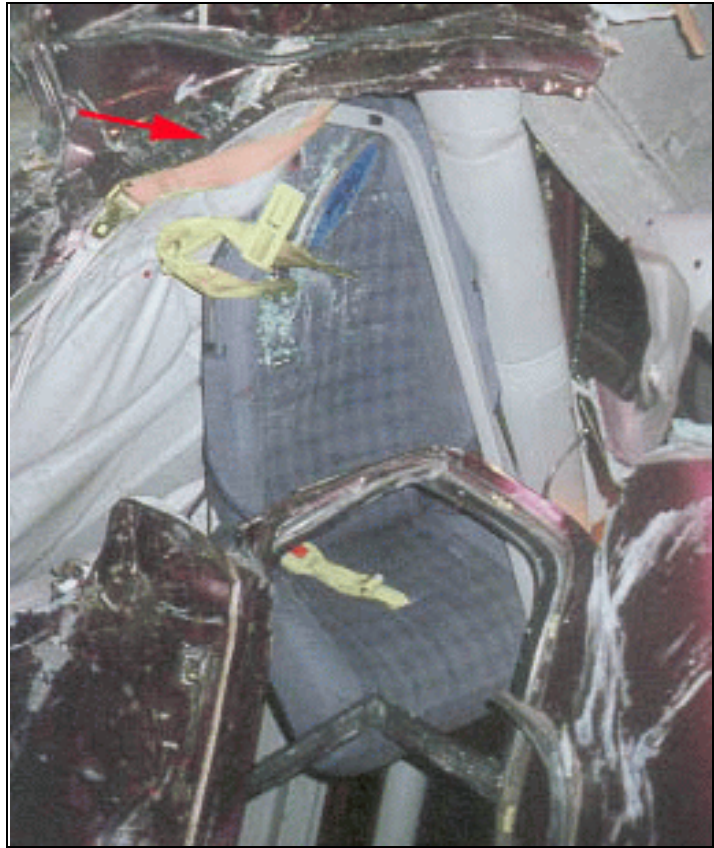
The 20-year-old female front right occupant of the case vehicle was seated in a forward facing position. She was wearing the available lap and shoulder belt. At impact, she was projected forward and to the right. She likely engaged to the door panel to some degree. She sustained a laceration to her lip as well as lacerations to unspecified parts of her body.



**Figure 12.** Rear right seat

The 5-year-old female rear left occupant was seated in a forward facing position. She was wearing the available lap and shoulder belt. At impact, she was projected forward and to the right. She likely engaged the seat belt to some degree. The intrusion to the right side of the vehicle appears to have pushed the right side child seat to the left where it engaged this occupant's right upper leg, fracturing the femur.

The 10-month-old female rear right occupant was seated in a forward facing/booster seat with what appears to be a modified harness system. The seat was designed with a 5-point harness, however there was no visual sign of the hip straps being available and/or used. It is believed that the seat was anchored to the vehicle and the child was strapped into the seat. The hip straps were not being used and do not appear to be available at the time of the crash. At impact, the child's initial motion would have been forward and to the right. As the right rear door intruded into the passenger compartment, this occupant engaged the door panel and side glass frame. The facial injuries were most likely related to the frame, while the abdominal injuries were related to the door panel.



**Figure 13**, Child safety seat, image rotated and webbing enhanced