On-scene Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS98027
1998 Chevrolet Cavalier v. 1998 Chevrolet Cavalier
Oregon
November 1998

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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 collision occurred in the state of Washington in November at 1408 hours. The weather was clear and the asphalt roadway was dry and free of defects.

Vehicle 1, a 1998 Chevrolet Cavalier 4-door (red) driven by a restrained 21-year-old male, was traveling northbound in the second lane of a curved, four-lane, undivided roadway. Vehicle 2, a 1998 Chevrolet Cavalier 2-door driven by a restrained 24-year-old female, was traveling southbound at approximately 61 km/h (38 mph) on the same roadway in the second lane. The right front of Vehicle 2 was occupied by a restrained 51-year-old female. The speed limit for both vehicles is 56 km/h (35 mph). The driver of Vehicle 1 reported that he was distracted by a spider which dropped onto his face. This took his attention away from the roadway and his vehicle veered into the path of oncoming traffic. There were no indications of pre-impact braking–both vehicles were ABS-equipped. The left front of Vehicle 1 struck the left front of Vehicle 2 in an off-set type configuration. There was substantial damage to both vehicles and both driver and passenger air bags in both vehicles deployed at this time. Vehicle 1 was assigned a CDC of 12FYEW4 and had a maximum crush of 90 cm (35.4 in.). Vehicle 1 sustained a longitudinal delta v of -59.1 km/h (-33.4 mph) and a lateral delta v of +5.2 km/h (+2.9 mph). Vehicle 2 was assigned a CDC of 12FYEW4 and had a maximum crush of 84 cm (33 in.). Vehicle 2 sustained a longitudinal delta v of -58.1 km/h (-32.7 mph) and a lateral delta v of +5.1 km/h (+2.9 mph).

Vehicle 1 was pushed into a counterclockwise rotation and came to rest facing generally west. Vehicle 2 was diverted into a counterclockwise rotation and came to rest facing southeast.

The driver of Vehicle 1 was pinned in his vehicle by the lower instrument panel. There was 40 cm (14.9 in.) of instrument panel intrusion and 31 cm (12.2 in.) of toe pan intrusion. The driver required extrication by the fire department. He sustained a fractured right femur, a left ankle fracture, and a dislocated right big toe. All of the injuries appear to have occurred due to the toe pan intrusion. He was transported by ambulance to a local hospital where he was reported to be in stable condition. The driver of Vehicle 2 was pinned in her vehicle. She required extrication by the fire department. The driver sustained a fractured left arm, unknown injuries to her right knee and left ankle, and a concussion. She was transported by ambulance to a local hospital. The front right occupant of Vehicle 2 sustained an ulna/radius fracture to the left arm, a forehead contusion, chest and hip contusions, and possible additional injuries to her knee. The chest and hip contusions are related to seat belt usage.

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Dynamic Science, Inc.
Accident Investigation
Case Number: DS98027

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BACKGROUND:

Description:	This case was initiated in response to a report of a high-speed, moderate injury collision between two 1998 Chevrolet Cavaliers equipped with "Next Generation Dual Air Bags". This case was conducted as an on-scene investigation. DSI was made aware of the case via a call from the investigating police agency. The NHTSA was notified on November 23, 1998.
Investigation Type:	On scene
Crash Location:	Oregon
Crash Date:	November 1998
Notification Date:	November 23, 1998
Field Work Completed:	November 1998

SUMMARY:

Figure 1. Final rest, facing north.

This collision occurred in the state of Oregon in November at 1408 hours. The weather was clear and the asphalt roadway was dry and free of defects.

Vehicle 1, a 1998 Chevrolet Cavalier 4-door (red) driven by a restrained 21-year-old male, was traveling northbound in the second lane of a curved, four-lane, undivided roadway. Vehicle 2, a 1998 Chevrolet Cavalier 2-door driven by a restrained 24-year-old female, was traveling southbound at approximately 61 km/h (38 mph)[1] on the same roadway in the second lane. The right front of Vehicle 2 was occupied by a restrained 51-year-old female. The speed limit for both vehicles is 56 km/h (35 mph).

The driver of Vehicle 1 reported that he was distracted by a spider which dropped onto his face. This took his attention away from the roadway and his vehicle veered into the path of oncoming traffic. There were no indications of pre-impact braking–both vehicles were ABS-equipped. The left front of Vehicle 1 struck the left front of Vehicle 2 in an off-set type configuration. There was substantial

[1]Speedometer stuck at 38 mph.

damage to both vehicles and both driver and passenger air bags in both vehicles deployed at this time. Vehicle 1 was assigned a Collision Deformation Classification (CDC) of 12FYEW4 and had a maximum crush of 90 cm (35 in.). Vehicle 1 sustained a longitudinal delta v of -59.1 km/h (-33 mph)[2] and a lateral delta v of +5.2 km/h (+2.9 mph). Vehicle 2 was assigned a CDC of 12FYEW4 and had a maximum crush of 84 cm (33 in.). Vehicle 2 sustained a longitudinal delta v of -58 km/h (-32 mph) and a lateral delta v of +5 km/h (+3 mph).

Figure 2. Rescue efforts, facing south

Vehicle 1 was pushed into a counterclockwise rotation and came to rest facing generally west. Vehicle 2 was diverted into a counterclockwise rotation and came to rest facing southeast.

The driver of Vehicle 1 was entrapped by the lower instrument panel. There was 40 cm (15 in.) of instrument panel intrusion and 31 cm (12 in.) of toe pan intrusion. The driver required extrication by the fire department. He sustained a fractured right femur, a left ankle fracture, and a dislocated right big toe. All of the injuries appear to have occurred due to the toe pan intrusion. He was transported by ambulance to a local hospital where he was reported to be in stable condition.

The driver of Vehicle 2 was pinned in her vehicle. She required extrication by the fire department. There was 49 cm (19 in.) of instrument panel intrusion. The driver sustained a fractured left arm, unknown injuries to her right knee and left ankle, and a concussion. She was transported by ambulance to a local hospital. The front right occupant of Vehicle 2 sustained an ulna/radius fracture to the left arm, a forehead contusion, chest and hip contusions, and possible additional injuries to her knee. The chest and hip contusions are related to seat belt usage.

[2]Calculated using WinSmash with offset option

Scene Diagram

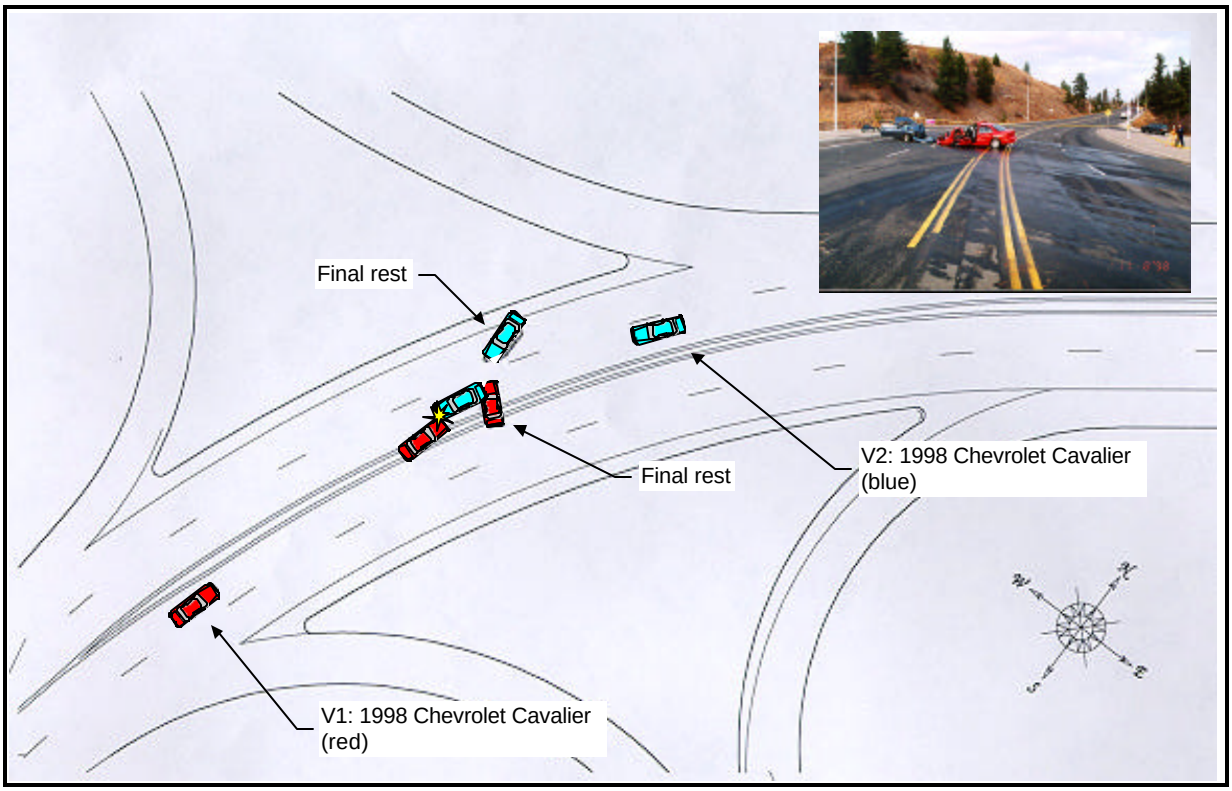

Figure 3. Scene diagram (adapted from police diagram–not to scale)

DETAILED INFORMATION

Vehicles

Vehicle 1

Description:	1998 Chevrolet Cavalier 4-door	
VIN:	1G1JC5246W7XXXXXX	
Odometer:	Unknown	
Engine:	2.2 L 4	
Brakes:	Four wheel ABS	
Reported Defects:	None noted	
Cargo:	None noted	
Damage Description:	Extensive frontal crush. Direct damage begins at the left front corner and extends to the midpoint. The left front tire was pushed rearward. There was intrusion of the instrument panel and toe pan. All four doors were jammed post-impact.	
CDC:	12FYEW4	
Delta V:	Total	59.3 km/h (33.5 mph)
	Longitudinal	-59.1 km/h (-33.4 mph)
	Latitudinal	5.2 km/h (2.9 mph)
	Energy	222,445 joules (164,162 ft-lbs)

Figure 4. Exterior, Vehicle 1

This vehicle was equipped with dual front air bags. The circular driver's side front air bag was mounted in the steering wheel hub and measured 52 cm at its widest point. The air bag was equipped with two vents ports and it was not tethered. The "I" type module cover opened at the designed tear points and there was no damage to the cover.

Figure 5. Exterior, Vehicle 1

The rectangular front right air bag was mounted in the top of the instrument panel and measured 53 cm wide by 65 cm high. There were no vents or internal tether straps. The single module cover flap opened at the designed tear points and there was no damage to the cover.

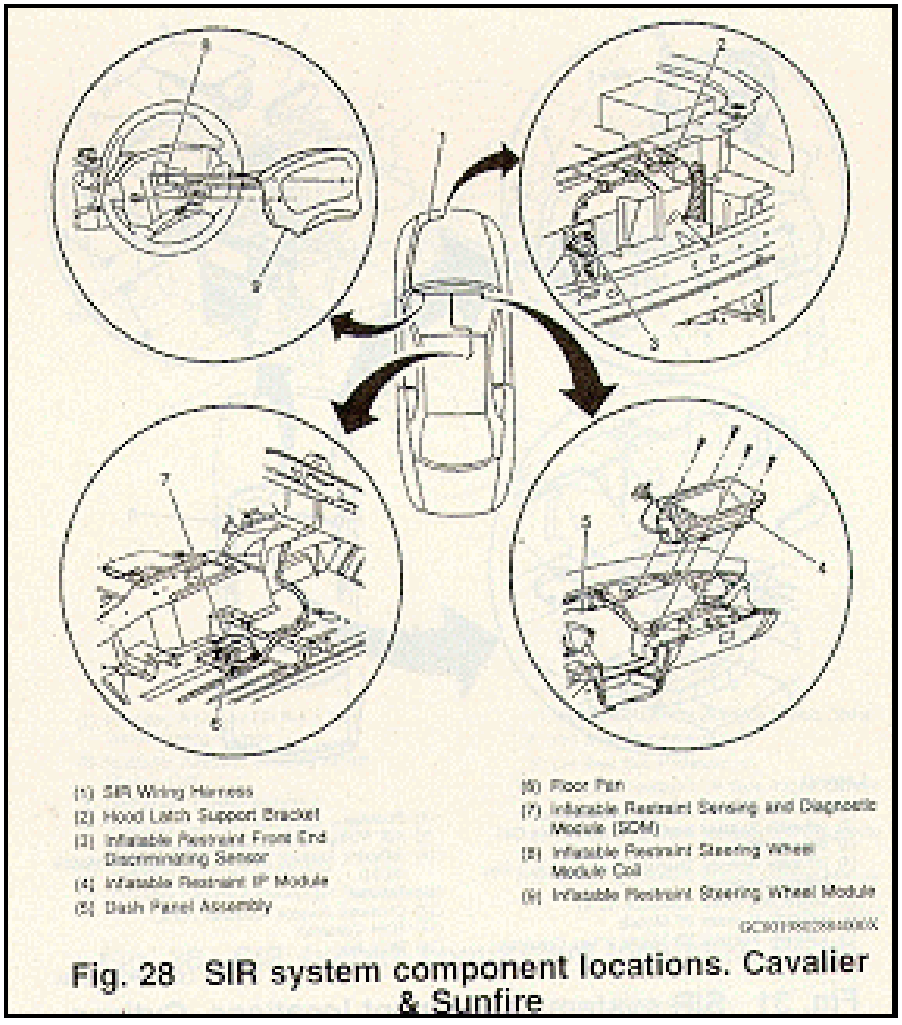

Figure 6. SIR System Component Locations, 1998 Chevrolet Cavalier

Vehicle 2

Description:	1998 Chevrolet Cavalier 2-door	
VIN:	1G1JC1241WXXXXXX	
Odometer:	50,449 km/h (31,348 miles)	
Engine:	2.2 L 4	
Brakes:	Four wheel ABS	
Reported Defects:	None noted	
Cargo:	None noted	
Damage Description:	Extensive frontal crush. Direct damage begins at the left front corner and extends to the midpoint. There was intrusion of the instrument panel and toe pan.	
CDC:	12FYEW4	
Delta V:	Total	58.1 km/h (32.8 mph)
	Longitudinal	-57.9 km/h (-32.7 mph)
	Lateral	5.1 km/h (2.9 mph)
	Energy	122,285 joules (90,247 ft-lbs)

Figure 7. Exterior, Vehicle 2

This vehicle was equipped with dual front air bags. The circular driver's side front air bag was mounted in the steering wheel hub and measured 53 cm at its widest point. The air bag was equipped with two vents ports and it was not tethered. There was no damage to the air bag. Make-up evidence was found near the center of the air bag. The "I" type module cover opened at the designed tear points and there was no damage to the cover.

Figure 8. Exterior, Vehicle 2

The rectangular front right air bag was mounted in the top of the instrument panel and measured 53 cm wide by 65 cm high. There were no vents or internal tether straps. There was no damage to the air bag. Make-up evidence was found on the right side of the face of the air bag. The single module cover flap opened at the designed tear points and there was no damage to the cover.

Occupants

Vehicle 1	Occupant 1
Age/Sex:	21/Male
Seated Position:	Front left
Seat Type:	Bucket
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Normal, upright
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belts used
Air bag:	Deployed during impact

Occupants

Vehicle 2		
Age/Sex:	24/Female	51/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket with folding back	Bucket with folding back
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
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:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belts used	Lap and shoulder belts used
Air bag:	Air bag deployed during impact	Air bag deployed during impact

Injuries and Injury Mechanisms

	INJURY	OIC CODE	ICD-9	SOURCE
Vehicle 1				
Driver:	Fracture, right femur	851800.3,1	820.0	Knee bolster
	Fracture, left ankle	852000.2,1	824.4	Toe pan
	Dislocated right big toe	851006.1,1	838.9	Toe pan
Vehicle 2				
Driver:	Fracture, left arm	751800.2,2	813.8	A-pillar
	Injured right knee	850899.1,1	959.7	Knee bolster
	Injured left ankle	850299.1,2	916.8	Toe pan
	Concussion	161000.2,0	850.0	Air bag
Front right occupant:	Fracture, ulna/radius, left arm	752800.2,2 753200.2,2	813.08[3]	Right instrument panel
	Forehead contusion	290402.1,7	920.0	Air bag
	Chest contusion	490402.1,9	922	Shoulder belt harness
	Hip contusion, bilateral	590402.1,1 590402.1,2	924.01 924.01	Lap belt harness
	Possible knee injury	Not codeable	--	
	Possible clavicle right fracture	Not codeable	--	

[3]Includes radius and ulna

Occupant Kinematics

The driver of Vehicle 1 was seated in a normal, upright position. The bucket seat was adjusted the full upright position and the seat track was positioned between full and middle back. The driver was wearing the available lap and shoulder belt. The driver reported that he was distracted by a spider which dropped onto his face. This took his attention away from the roadway and his vehicle veered into the path of oncoming traffic. There were no indications of pre-impact braking–both vehicles were ABS-equipped–but appears likely that there was some braking by both parties. At impact, this occupant reacted to the 350E direction of force by moving forward and slight to the left. The seat belt restricted the forward motion as he engaged the deployed air bag with his face and chest–loading through the air bag and slightly deforming the upper rim of the steering wheel. His right foot engaged the toe pan as it was being deformed inward, causing the toe dislocation, then loading the knee on the instrument panel and fracturing the right femur. The left foot also engaged the toe pan, causing the left ankle fracture.

Figure 9. Interior, Vehicle 1

The driver of Vehicle 2 was seated in a normal, upright position. The bucket seat with folding back was adjusted to the middle track position. The vehicle was equipped with a fixed steering column. The driver was wearing the available lap and shoulder belt. As stated earlier, there was no indication of braking, but some braking seems likely. At impact, the driver reacted to the 350E direction of force by moving forward and slight to the left. The seat belt restricted the forward motion as she engaged the deployed air bag with her face–deposited a make up transfer on the face of the air bag and caused the concussive injury. The driver slid forward and contacted both sides of the knee bolster with both knees. The encroaching lower instrument panel pinned the driver in the vehicle. As the air bag deployed, it likely pushed the driver's left arm into the A-pillar area, which caused the arm fracture. The left ankle was injured as the toe pan intruded into the vehicle.

Figure 10. Interior, Vehicle 2

The front right occupant of Vehicle 2 was seated in a normal, upright position. The bucket seat with folding back was adjusted to a mid-track position. This occupant was wearing the available lap and shoulder belt. At impact, the driver reacted to the 355E direction of force by moving forward and slightly to the left. The seat belt restricted the forward motion, and caused the bilateral hip contusions and the chest contusion. As she engaged the left side of the face of the deployed air bag with her face she sustained a minor

forehead contusion. This occupant sustained an ulna/radius fracture to her left arm. The source of this injury is not known. A probable source would seem to be the instrument panel, however.

Figure 11. Interior, Vehicle 2. Shows make-up transfer from driver.