Remote Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS9817
1998 Oldsmobile Achieva
1998 Chevrolet Cavalier
Florida
January 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

Vehicle 1, a 1998 Oldsmobile Achieva four-door driven by a 30-year-old male, was traveling westbound on the state highway at a speed estimated by police at 161 km/h (100 mph); a minimum speed of (111.8 km/h) 69.49 mph was calculated using speed loss from rotation combined with the velocity change. Vehicle 2 (case vehicle), a 1998 Chevrolet Cavalier Z-24 four-door driven by a 21-year-old male, was traveling eastbound on the same roadway. The driver of Vehicle 2 indicated that just prior to the crash he reached down to set the speed control; he indicated that he was traveling 56-64 km/h (35-40 mph). Vehicle 1 was a rental vehicle; Vehicle 2 was being leased. According to the police report both drivers were wearing their lap and shoulder belts.

Vehicle 1 departed the roadway on the right side. The right side tires entered a grassy area. The driver overcorrected to the left, overcorrected to the right, and went into a clockwise rotation. The vehicle crossed the adjacent travel, the turn lane, and then entered the first eastbound travel lane. At this point, Vehicle 1 had skidded approximately 79 M (260 ft) and had rotated approximately 105E. The front of Vehicle 2 struck the left rear of Vehicle 1. The air bags in Vehicle 2 deployed at this point. The air bags in Vehicle 1 did not deploy. Vehicle 1 sustained a longitudinal delta V of +35.0 km/h (+21.8 mph). Vehicle 2 sustained a longitudinal delta V of -36.7 km/h (-22.8 mph). Vehicle 1 pushed Vehicle 2 backwards into a clockwise rotation until Vehicle 2 was facing south. Vehicle 1 rotated, tripped, and overturned. It came to rest on its right side facing generally north. The driver of Vehicle 1 was trapped in his vehicle after the crash and was fatally injured. He sustained a subdural hematoma, a C-4 fracture, bilateral hemothoraces with posterior fractures of T9 bilaterally and T10 and 11 on the left, extensive retroperitoneal hematoma with pelvic fractures, a lacerated bladder, a fractured right femur, and multiple contusions and abrasions. The driver of Vehicle 2 sustained moderate injuries. He was transported to a local hospital where he was treated and released.

17. Key Words	18. Distribution Statement
Air bag, deployment, injury, accident, 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: DS9817

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BACKGROUND:

Description:	This case was initiated in response to a report of a depowered air bag deployment. There was a single fatality in this case. This case is being conducted as a remote investigation. NHTSA was notified by FARS.
Investigation Type:	Remote
Crash Location:	Florida
Crash Date:	January 1998
Notification Date:	April 29, 1998
Field Work Completed:	NA

SUMMARY:

This collision occurred in Pinellas County, Florida in January 1998 at 0640 hours. The crash took place on a bituminous, undivided, five-lane state highway. It was dark at the time of the crash, but the streetlights were lit. The weather was clear and the roadway was dry. For eastbound traffic, the roadway is essentially straight and level. The posted speed limit is 88 km/h (55 mph). For westbound traffic, there is a gradual right-hand curve. The posted speed limit is 97 km/h (60 mph).

Figure 1. Final rest (east).

Vehicle 1, a 1998 Oldsmobile Achieva four-door driven by a 30-year-old male (180 cm/71 in, 81 kg/179 lbs), was traveling westbound on the state highway at a speed estimated by police at 161 km/h (100 mph); a minimum speed of (111.8 km/h) 69.49 mph was calculated using speed loss from rotation combined with the velocity change. Vehicle 2, a 1998 Chevrolet Cavalier Z-24 four-door driven by a 21-year-old male, was traveling eastbound on the same roadway. The driver of Vehicle 2 indicated that just prior to the crash he reached down to set the speed control; he indicated that he was traveling 56-64 km/h (35-40 mph). Vehicle 1 was a rental vehicle; Vehicle 2 was being leased. According to the police report both drivers were wearing their lap and shoulder belts.

Vehicle 1 departed the roadway on the right side. The right side tires entered a grassy area. The driver overcorrected to the left, overcorrected to the right, and went into a clockwise rotation. The vehicle crossed the adjacent travel lane, the turn lane, and then entered the first eastbound travel lane. At this point, Vehicle 1 had skidded approximately 79 M (260 ft) and had rotated approximately 105E. The front of Vehicle 2 struck the left rear of Vehicle 1. The air bags in Vehicle 2 deployed at this point. The air bags in Vehicle 1 did not deploy. Vehicle 1 sustained a longitudinal delta V of +35.0 km/h (+21.8 mph)[1]. Vehicle 2 sustained a longitudinal delta V of -36.7 km/h (-22.8 mph).

Vehicle 1 pushed Vehicle 2 backwards into a clockwise rotation until Vehicle 2 was facing south. Vehicle 1 rotated, tripped, and overturned. It came to rest on its right side facing generally north.

The driver of Vehicle 1 was trapped in his vehicle after the crash and was fatally injured. He sustained a subdural hematoma, a C-4 fracture, bilateral hemothoraces with posterior fractures of T9 bilaterally and T10 and 11 on the left, extensive retroperitoneal hematoma with pelvic fractures, a lacerated bladder, a fractured right femur, and multiple contusions and abrasions.

The driver of Vehicle 2 lost consciousness for an unknown time period after the crash. He reported that he may have sustained a skull fracture of some type. He also indicated that he sustained abdominal contusions from the lap portion of the seat belt, some neck pain, a hyper-extended right knee, a forehead laceration from contact with the windshield, and the loss of sight in his left eye. He also reported that he was “internally bruised”. He was transported to a local hospital where he was treated and released after six hours. He returned the following day after passing out and vomiting. He underwent a CT-scan, an MRI, and a variety of X-rays. The results of these examinations are not known.

[1] Calculated using WinSmash with CDC information only

Scene Diagram

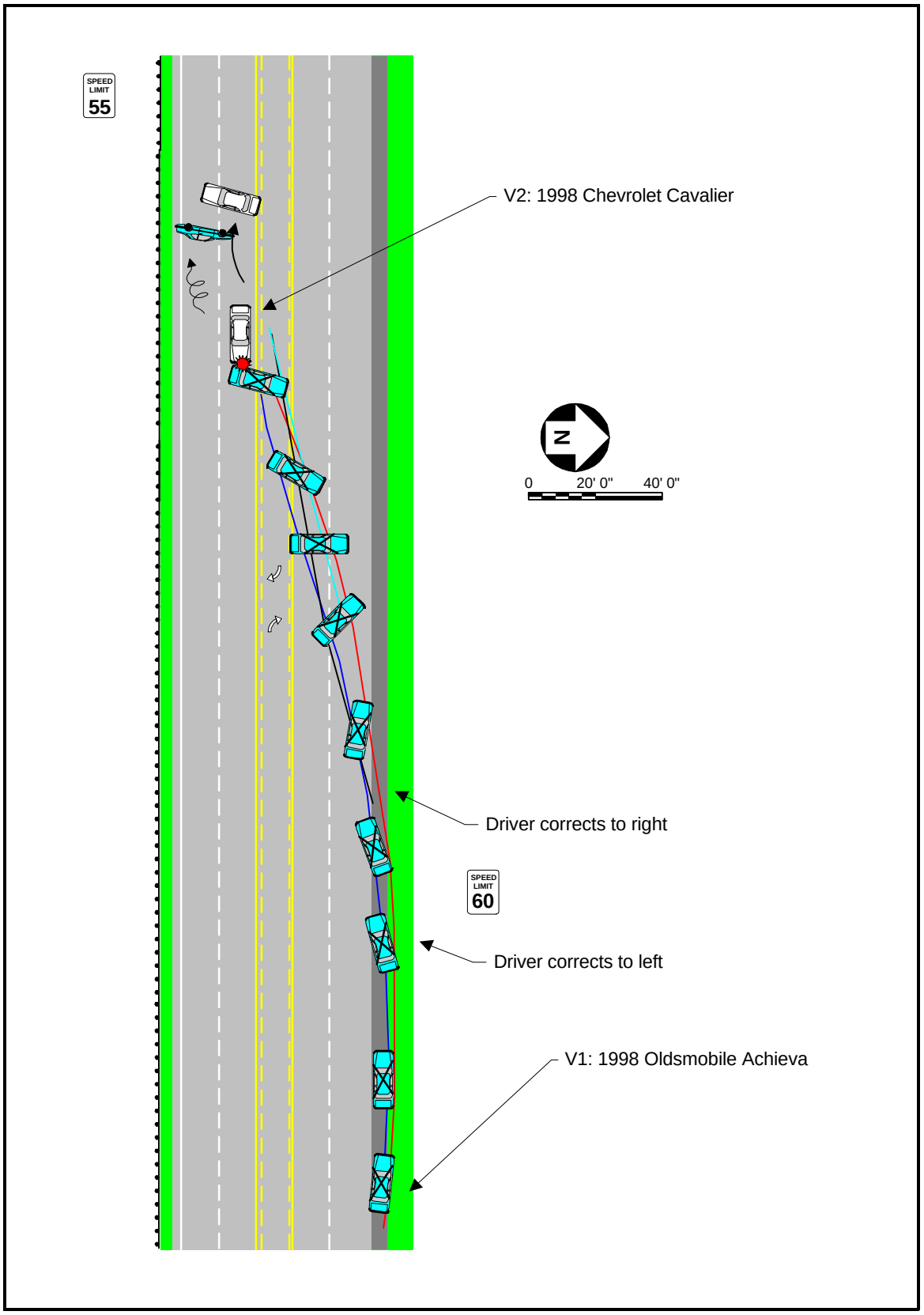

Figure 2. Scene diagram

Collision Measurements (Police)

Description	RL	RP
RF FRONT TIRES	3 M (10 ft)	1 M (3.4 ft) NRP
RR	6.7 M (22 ft)	1 M (3.4 ft) NRP
RF	6.7 M (22. ft)	1.5 M (5.0 ft) NRP
RR	9 M (30 ft)	4.4 M (1.34 ft) SRP
RF	9 M (30 ft)	5.5 M (1.7 ft) SRP
RR	12 M (40 ft)	4.9 M (1.49 ft) SRP
RF	12 M (40 ft)	6.0 M (1.8 ft) SRP
RR	15 M (50 ft)	4.11 M (1.40 ft) SRP
RF	15 M (50 ft)	6.6 M (2 ft) SRP
RR	18 M (60 ft)	4.11 M (1.5 ft) SRP
RF	18 M (60 ft)	6.9 M (2.1 ft) SRP
RR	21 M (70 ft)	4.9 M (1.49 ft) SRP
RF	21 M (70 ft)	7.1 M (2.2 ft) SRP
RR	24 M (80 ft)	4.5 M (1.37 ft) SRP
RF	24 M (80 ft)	7.0 M (2.1 ft) SRP
RR	27.4 M (90 ft)	3.9 M (1.2 ft) SRP
RF	27.4 M (90 ft)	6.9 M (2.1 ft) SRP
RR	30.4 M (100 ft)	3.3 M (1 ft) SRP
RF	30.4 M (100 ft)	6.5 M (1.98 ft) SRP
RR	33.5 M (110 ft)	2.5 M (.76 ft) SRP
RF	33.5 M (110 ft)	5.10 M (1.55 ft) SRP
RR	36.5 M (120 ft)	1.4 M (.43 ft) NRP
RF	36.5 M (120 ft)	5.3 M (1.6 ft) NRP
RR	39.6 M (130 ft)	.3 M (.09 ft) NRP
RF	39.6 M (130 ft)	.2 M (.08 ft) NRP
RR	42.6 M (140 ft)	1.7 M (.5 ft) SRP
RF	42.6 M (140 ft)	3.0 M (.9 ft) NRP
RR	45.7 M (150 ft)	3.6 M (1.09 ft) NRP
RF	45.7 M (150 ft)	1.6 M (.49 ft) SRP
RR	48.7 M (160 ft)	0

Description	RL	RP
RF	48.7 M (160 ft)	5.4 M (1.6 ft) SRP
RR	51.8 M (170 ft)	7.5 M (2.3 ft) SRP
RF	51.8 M (170 ft)	2.7 M (82 ft) SRP
RR	54.8 M (180 ft)	10.1 M (3.07 ft) SRP
RF	54.8 M (180 ft)	4.3 M (1.3 ft) SRP
RR	57.9 M (190 ft)	13.0 M (3.96 ft) SRP
RF	57.9 M (190 ft)	6.0 M (6.0 ft) SRP
RR	60.9 M (200 ft)	16.1 M (4.9 ft) SRP
RF	60.9 M (200 ft)	8.3 M (2.5 ft) SRP
RR	64 M (210 ft)	19.6 M (5.97 ft) SRP
RF	64 M (210 ft)	10.9 M (3.3 ft) SRP
CROSS OVER	65.2 M (214 ft)	6.40 M (21.2 ft) SRP
RR	67 M (220 ft)	22.9 M (6.97 ft) SRP
RF	67 M (220 ft)	13.9 M (4.2 ft) SRP
RR	70 M (230 ft)	26.2 M (7.98 ft) SRP
RF	70 M (230 ft)	17.3 M (5.3 ft) SRP
RR	73 M (240 ft)	29.4 M (8.96 ft) SRP
RF	73 M (240ft)	21.0 M (6.4 ft) SRP
RR	76.2 M (250 ft)	31.8 M (9.69 ft) SRP
RF	76.2 M (250 ft)	24.9 M (7.59 ft) SRP
RR	79.2 M (260 ft)	33.6 M (10.2 ft) SRP
RF	79.2 M (260 ft)	28.8 M (8.78 ft) SRP
CROSS OVER	79.5 M (261 ft)	29.2 M (8.9 ft) SRP
RR	81.4 M (267 ft)	31.2 M (9.5 ft)SRP
REAR TIRES		
LR	39.3 M (129 ft)	0
LR	42.6 M (140 ft)	3.8 M (1.15 ft) SRP
LR	45.9 M (150 ft)	6.1 M (1.85 ft) SRP
LR	48.7 M (160 ft)	8.9 M (2.7 ft) SRP
LR	51.8 M (170 ft)	11.8 M (3.6 ft) SRP
LR	54.8 M (180 ft)	14.0 M (4.26 ft) SRP

Description	RL	RP
LR	57.9 M (190ft)	16.2 M (4.9 ft) SRP
LR	60.9 M (200 ft)	18.6 M (5.67ft) SRP
LR	64 M (210 ft)	20.6 M (6.28 ft) SRP
LR	67 M (220 ft)	22.7 M (6.9 ft) SRP
LR	70 M (230 ft)	24.3 M (7.4 ft) SRP
LR	73 M (240 ft)	26.1 M (7.9 ft) SRP
LR	76.2 M (250ft)	27.8 M (8.4 ft) SRP
LR	79.2 M (260 ft)	29.1 M (8.9 ft) SRP
LR	87.2 M (270 ft)	30.2 M (9.2 ft) SRP
LF	60.9 M (200 ft)	10 M (3 ft) SRP
LF	64 M (210 ft)	11.6 M (3.5 ft) SRP
LF	67 M (220 ft)	13.9 M (4.24 ft) SRP
LF	70 M (230 ft)	16.2 M (4.9 ft) SRP
LF	73 M (240 ft)	19.0 M (5.79 ft) SRP
LF	76.2 (250 ft)	21.6 M (6.5 ft) SRP
LF	79.2 (260 ft)	25.2 M (7.6 ft) SRP
LF	82.2 M (270 ft)	28.0 M (8.5 ft) SRP
LF	85.5 M (280 ft)	31.0 M (9.45 ft) SRP
AREA OF IMPACT	82.2 M (270 ft)	38.0 M (11.6f t) SRP
V#1 RF	93.4 M (306.4 ft) WRL	46.6 M (14.2 ft) SRP
V#1 RR	94 M (308.4 ft) WRL	54.4 M (16.6 ft) SRP
V#2 RF	97.1 M (318.7 ft) WRL	41.3 M (12.6 ft) SRP
V#2 RR	96.4 M (316.6 ft) WRL	33.5 M (10.2 ft) SRP
V#2 LF	94.6 M (310.5 ft) WRL	34.10 M (10.4 ft) SRP
V#2 LR	95.25 M (312.5 ft) WRL	43.2 M (13.1 ft) SRP
V#1 FRONT BUMPER	92.7 M (304.2 ft) WRL	44.4 M (13.5 ft) SRP

DETAILED INFORMATION

Vehicles

Vehicle 1

Description:	1998 Oldsmobile Achieva[2]	
VIN:	1G3NL52M7WMXXXXXX	
Odometer:	Unknown	
Engine:	3.1L V6	
Reported Defects:	None indicated	
Cargo:	Unknown	
Damage Description:	Heavy damage to the left rear and left passenger area. Rollover damage to right side.	
CDC:	#1 07LZEW4 #2 Unknown	
Delta V:	Total	40.4 km/h (25.1 mph)
	Longitudinal	35.0 km/h (21.8 mph)
	Latitudinal	20.2 km/h (12.6 mph)
	Energy	99,876 joules (73,732 ft-lbs)

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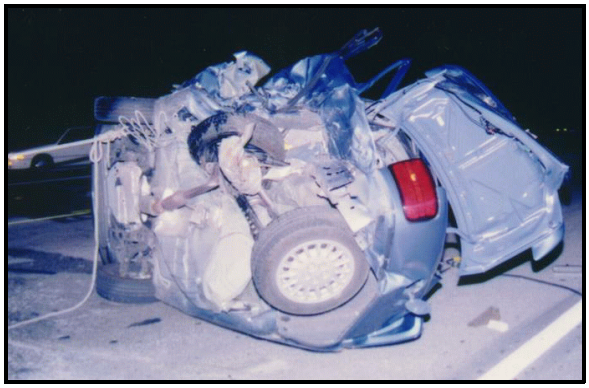

Figure 3. Vehicle 1, 1998 Oldsmobile Achieva.

Figure 4. Exemplar vehicle

[2] Despite the model year indicated by the VIN, Oldsmobile has indicated that the Achieva was discontinued as a regular production model after the 1997 model year

DETAILED INFORMATION

Vehicles

Vehicle 2

Description:	1998 Chevrolet Cavalier, four-door sedan	
VIN:	1G1JF52T8W7XXXXXX	
Odometer:	Unknown	
Engine:	2.4 L L4	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Moderate to heavy crush to the front bumper, grille, and hood.	
CDC:	11FDEW2	
Delta V:	Total	42.4 km/h (26.3 mph)
	Longitudinal	-36.7 km/h (-22.8 mph)
	Latitudinal	21.2 km/h (13.2 mph)
	Energy	122,088 joules (90,100 ft-lbs)

Figure 5. Vehicle 2, 1998 Chevrolet Cavalier.

Occupants

Vehicle 1	Occupant 1
Age/Sex:	30/Male
Seated Position:	Left front
Seat Type:	Bucket seat
Height:	180 cm (71 in.)
Weight:	81 kg (179 lbs.)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	Tested positive for cocaine
Driving Experience:	> 10 years
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder used, per police
Air bag:	Available, not deployed

Occupants

Vehicle 2	Occupant 1
Age/Sex:	21/Male
Seated Position:	Left front
Seat Type:	Bucket
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder used
Air bag	Available, deployed

Injuries and Injury Mechanisms

Vehicle 1

	INJURY	OIC CODE	ICD-9	SOURCE
Driver	Subdural hematoma	140652.4,2	852.20	Head restraint
	Subarachnoid hemorrhage	140684.3,2	852.00	Head restraint
	Cerebral edema	140454.3,2	854.00	Head restraint
	Bilateral hemothoraces with posterior fractures of T9 bilaterally and T10 and 11 on the left	450222.3,3	807.04[3] 860.2[4]	Seat back
	Contusion with fracture, posterior C4 vertebral body	650230.2,6	805.04	Head restraint
	Fracture, left and right sacriolilliac joints	852800.3,6	805.6	Unknown
	Fracture, neck of femur	851812.3,1	820.0	Center IP
	Dislocated fractures, anterior symphysis pubis	853000.3,5	808.2	Door panel
	Diaphragm contusion	440602.2,8	862.0	Unknown
	Mesentery contusions	542010.2,8	Unk.	Unknown
	Bladder laceration	540620.2,8	867.0	Unknown
	Subgaleal hematoma	190402.1,2	920.0	Unknown
	Abrasion, 10 x 3 in., posterior left hip	890202.1,2	916.0	Seat bottom
	Abrasion, 7 x 1/4 in., right lateral hip	890202.1,1	916.0	Center console
	Contusion, base of scalp	690402.1,7	920.0	Head rest
	Abrasion w/contusion, 3 in., left scapula	690402.1,7 690202.1,7	923.01 912.0	Seat back
	Abrasion, lower back	690202.1,8	911.0	Seat back
	Linear abrasion, left calf	890202.1,2	916.0	Unknown
	Linear abrasion, left calf	890202.1,2	916.0	Unknown

[3]Rib fractures

[4]Hemothoraces

INJURY	OIC CODE	ICD-9	SOURCE
Linear abrasion, 14 in. long, right calf	890202.1,1	916.0	Unknown
Abrasion left hip	890202.1,2	916.0	Webbing
Abrasion right hip	890202.1,1	916.0	Webbing
Abrasion, 11 x 2-3 in., right anterior thigh	890202.1,1	916.0	Steering wheel rim
Abrasion, 8 in., left anterior thigh	890202.1,2	916.0	Webbing
Abrasion, 6 x 2, right knee	890202.1,1	916.0	Left IP
Abrasion, 2 in., right ankle	890202.1,1	916.0	Unknown
Abrasion, left shin	890202.1,2	916.0	Unknown

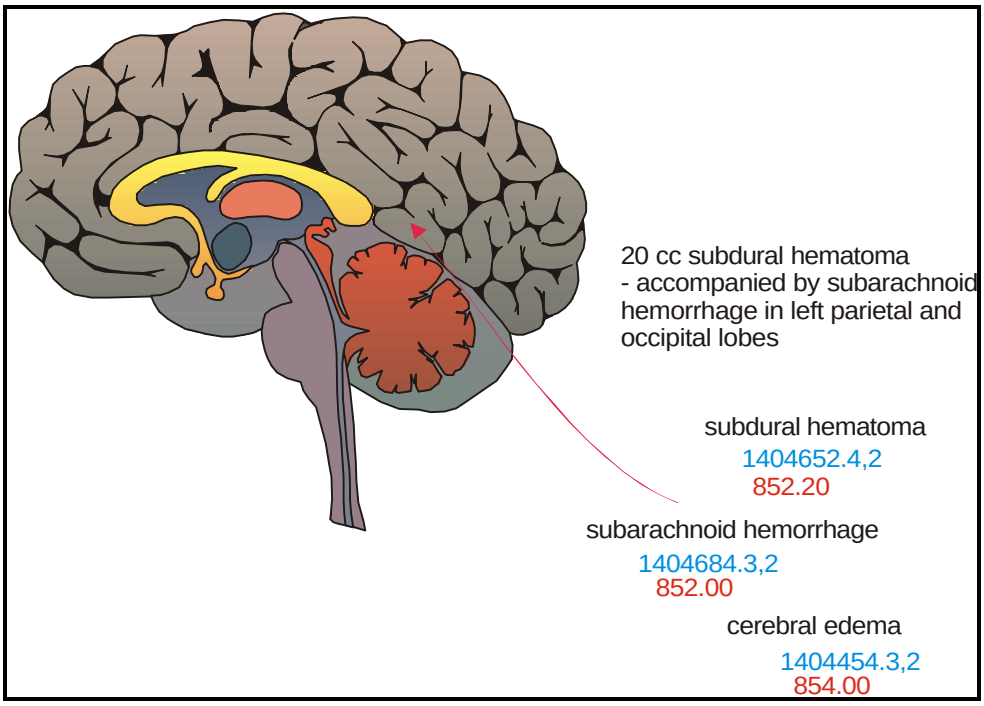

Figure 7. Brain injuries

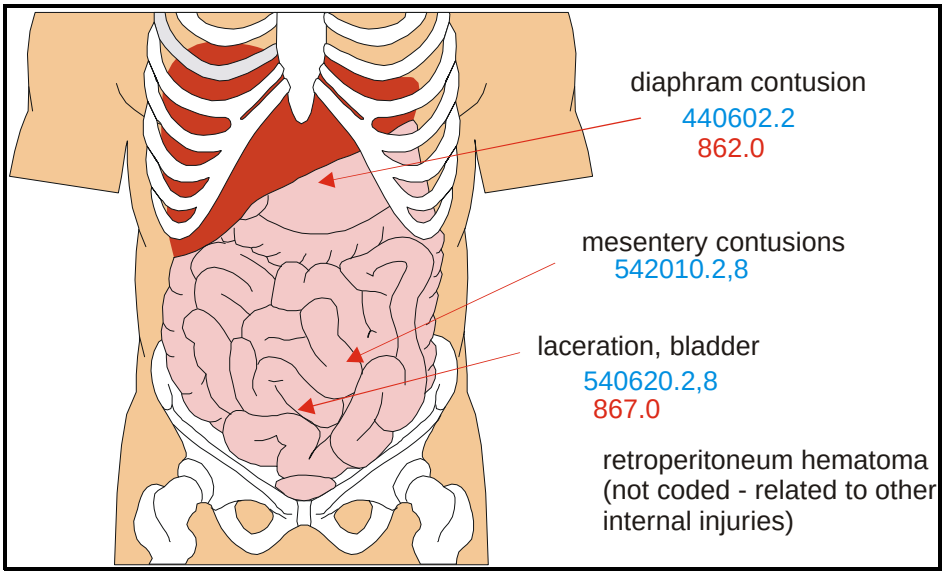

Figure 6. Internal injuries

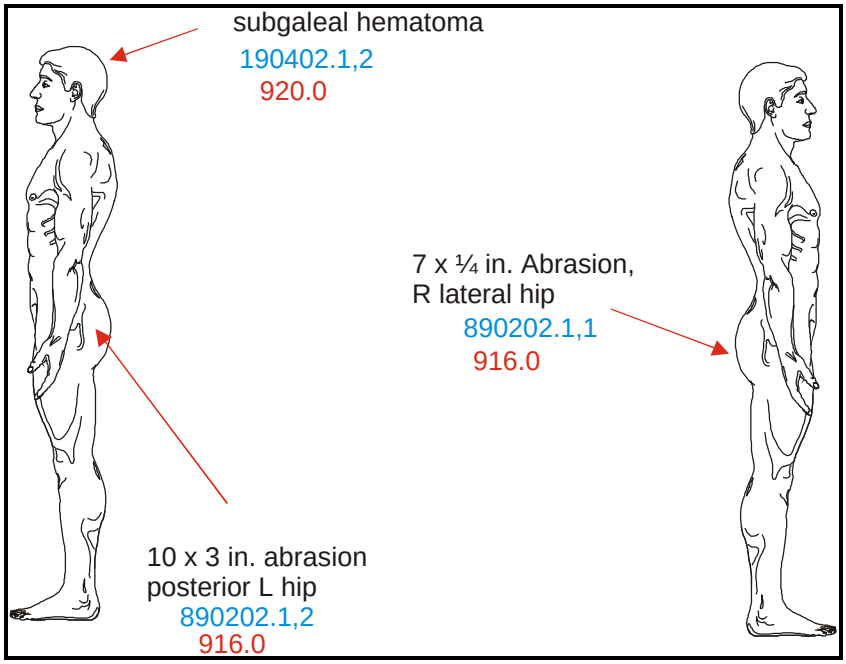

Figure 9. External injuries

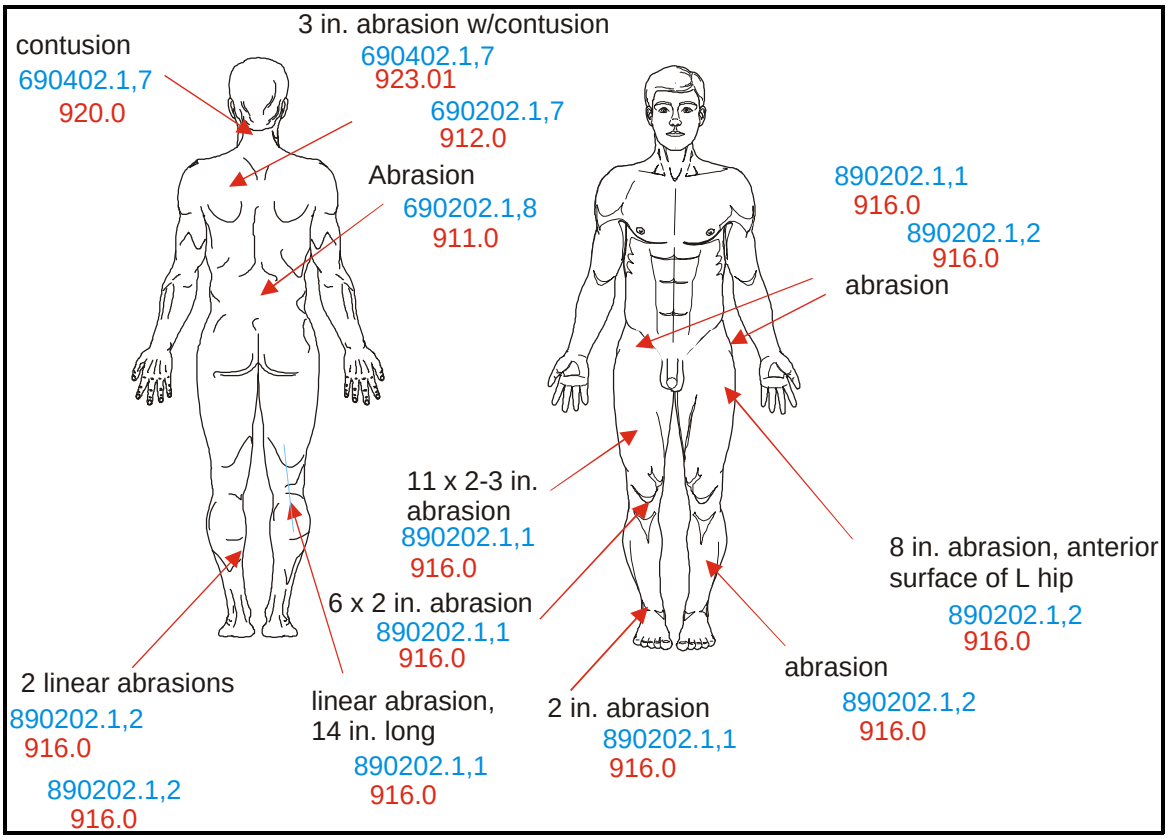

Figure 8. External injuries

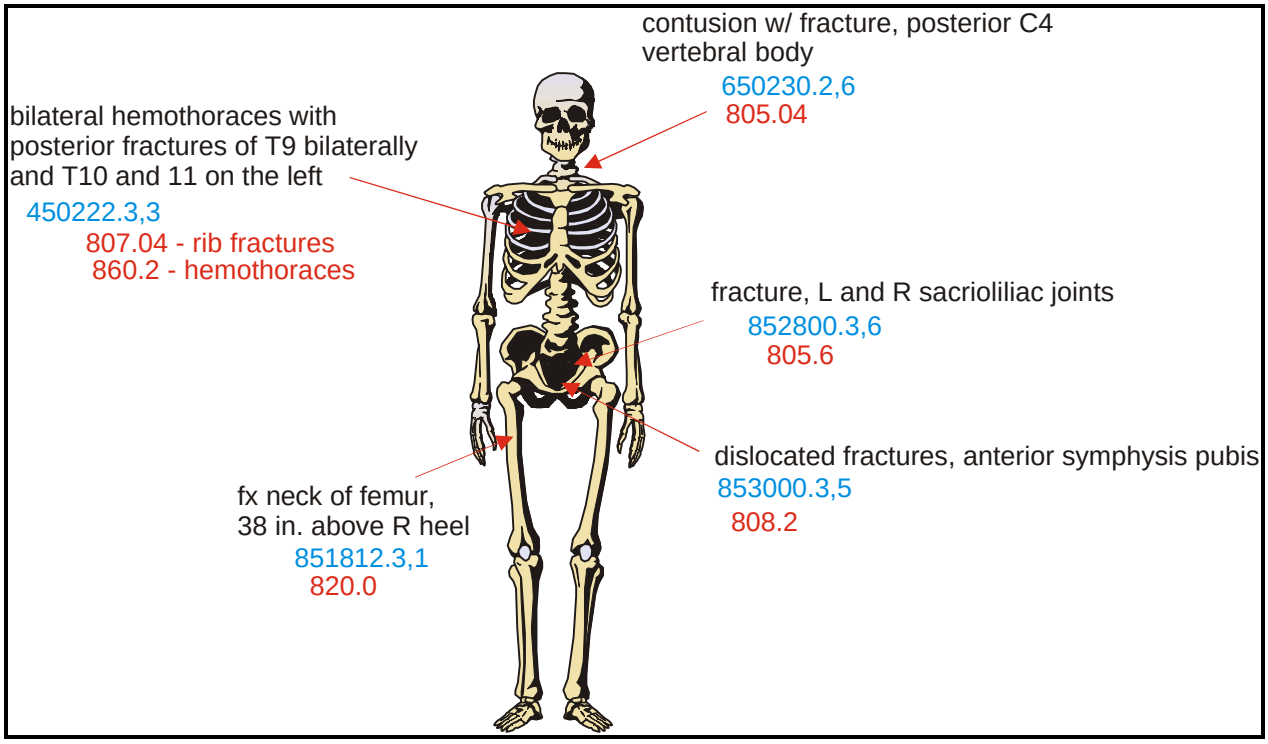

Figure 10. Skeletal injuries

Vehicle 2

	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Concussion	160202.2,0	850.1	Windshield
	Forehead laceration	290600.1,7	873.42	Windshield
	Abdominal contusions	590402.1,4	911.0	Seat belt
	Sprain, left hand/wrist	751420.1,2	842.0	SW
	Right knee hyper-extension	850206.1,2	844.9	Unknown

Occupant Kinematics

The driver of Vehicle 1 was initially in a forward facing position. During the first evasive maneuver, he would have shifted somewhat to the right. During the second evasive maneuver and the subsequent clockwise vehicle rotation, he would have shifted heavily to the left. At impact, he would have loaded the seat back, the head rest, and the side door panel. This caused his head to rotated rearward, likely causing the neck fracture and the brain injuries. The impact forces then pushed him forward and to the right where he likely contacted the left and center instrument panel, the steering wheel rim, and the center console; this same movement, plus the intrusion, would have caused the driver to load the lap portion of the seat belt.

The driver of Vehicle 2 (case vehicle) was seated in a forward facing position. He was wearing the available lap and shoulder belt. At impact, the driver pitched forward and to the left. The driver loaded the seat belts–causing the abdominal contusions. According to the driver, the steering wheel deformed and he was able to wrap around it despite the air bag deployment as the impact continued. His head apparently struck the windshield–causing the forehead laceration and concussion. During the impact sequence the driver's left hand was strained as it came off the steering wheel. The driver lost consciousness for an unknown time period after the crash. He also reported that he was "internally bruised". He was transported to a local hospital where he was treated and released after six hours. He returned the following day after passing out and vomiting. He underwent a CT-scan, an MRI, and a variety of X-rays.