Remote Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS99021
1995 Dodge Caravan
California
May, 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 two vehicle crash occurred in May, 1998 in southern California at 1540 hours. This crash occurred in a four-leg intersection in a downtown business area. The intersection is controlled by tri-color traffic signals. At the time of the crash the north and southbound lights were yellow. The speed limit is 56 km/h (35 mph) for vehicles in both directions. At the time of the crash, the level, bituminous roadway was dry and free of defects.

Vehicle 1, a 1995 Dodge Caravan driven by a 42-year-old female, was traveling southbound in the curb lane approaching the intersection. A non-contact vehicle was traveling in the same direction and to the left of this vehicle. The driver wears glasses for farsightedness and was wearing them at the time of the crash. The front right seat was occupied by a restrained 27-year-old female. The front right occupant suffers from cerebral palsy with multiple musculoskeletal involvement. She is wheelchair bound. Her past medical history includes numerous hospital admissions. She also has significant bilateral degenerative hip disease. This occupant was seated in her wheelchair in an upright and normal fashion using the wheelchair's lap belt. The rear middle seat was occupied by a restrained 5-year-old male. The rear right seat was occupied by a restrained 29-year-old female. Vehicle 2, a 1977 Chevrolet C-30 utility pickup truck driven by a 59-year-old male (175 cm/69 in., 75 kg/165 lbs.), was traveling northbound approaching the same intersection. This vehicle had pulled into the left turn lane. As Vehicle 2 reached the intersection, the light had turned yellow. The non-contact vehicle (a dark Mercedes) stopped for the light and Vehicle 2 began the left hand turn. The driver of Vehicle 1 saw Vehicle 2 and began braking. The front of Vehicle 1 struck the right side of Vehicle 2. The front right air bag in Vehicle 1 deployed at this time. The steering wheel mounted driver's side front air bag did not deploy.

The front right occupant sustained a transverse fracture of the distal diaphysis of the right humerus, non-displaced fractures of the proximal phalanx of the 3rd digit and the base of the middle phalanx of the 2nd digit, moderate left knee effusion, abrasions and ecchymosis of the right hand, ecchymosis of the left thigh, a left femur fracture, and abrasions on the right side of the face.

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Dynamic Science, Inc.
Accident Investigation
Case Number: DS99021

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BACKGROUND:

Description:	This case is being initiated in response to a report of an adaptive control equipped vehicle involved in crash where the passenger air bag caused some type of injury. The NHTSA was notified on August 9, 1999. The initiator is a safety consultant under contract to the attorney of the case occupant. DSI was notified on August 26, 1999. This case was conducted as a remote investigation.
Investigation Type:	Remote
Crash Location:	California
Crash Date:	May, 1998
Notification Date:	August 9, 1999
Field Work Completed:	NA

SUMMARY:

This two vehicle crash occurred in May, 1998 in southern California at 1540 hours. This crash occurred in a four-leg intersection in a downtown business area. The intersection is controlled by tri-color traffic signals. At the time of the crash the north and southbound lights were yellow. The northern leg of the intersection is comprised of two northbound travel lanes, two southbound travel lanes, and a left hand turn bay. The southern leg of the intersection is comprised of two northbound travel lanes, two southbound travel lanes, and a left hand turn bay. The speed limit is 56 km/h (35 mph) for vehicles in both directions. At the time of the crash, the level, bituminous roadway was dry and free of defects.

Figure 1. Overview of intersection, facing north.

Figure 2. Exterior, Vehicle 1. Vehicle at final rest position.

Vehicle 1, a 1995 Dodge Caravan driven by a 42-year-old female (170 cm/67 in., 84 kg/185 lbs.), was traveling southbound in the curb lane approaching the intersection. A non-contact vehicle (dark Mercedes) was traveling in the same direction and to the left of this vehicle. The driver wears glasses for farsightedness and was wearing them at the time of the crash. The front right seat was occupied by a restrained 27-year-old female (132 cm/52 in., 44 kg/98 lbs.).

Figure 3. Exterior, Vehicle 2.

The front right occupant suffers from cerebral palsy with multiple musculoskeletal involvement. According to her medical records, she is essentially paralyzed without any voluntary movement below the chin. However, she does have some limited function of her right arm. She uses a wheelchair. Her past medical history includes numerous hospital admissions. She has had surgeries to fuse her cervical and thoracic spine. She also has significant bilateral degenerative hip disease. This occupant was seated in her wheelchair in an upright and normal fashion using the wheelchair's lap belt. The wheelchair was secured to the vehicle in a series of steps: (1) the wheelchair is pushed into a position so that its four wheels go into securing slots on the floor of the van, (2) the two straps attached to the toe pan area are then hooked to the front wheels of the wheelchair and pulled tight, (3) the two straps attached to the floor behind the wheel chair are then hooked into the rear wheels of the wheelchair and are tightened using a ratchet-type device, (4) a large strap that is attached to the wheelchair's back frame is wrapped across the front of the occupant, and then attached to the other side of the wheelchair–essentially holding the occupant's torso to the wheelchair, and (5) the standard equipment seatbelt that runs from the B-pillar is drawn across the front of the occupant, and then down to the floor–using an extended strap.

The rear middle seat was occupied by a restrained 5-year-old male. The rear right seat was occupied by a restrained 29-year-old female.

Vehicle 2, a 1977 Chevrolet C-30 utility pickup truck driven by a 59-year-old male (175 cm/69 in., 75 kg/165 lbs.), was traveling northbound approaching the same intersection. This vehicle had pulled into the left turn lane.

As Vehicle 2 reached the intersection, the light had turned yellow. The non-contact vehicle (a dark Mercedes) stopped for the light and Vehicle 2 began the left hand turn. The driver of Vehicle 1 saw Vehicle 2 and began braking–depositing 6.7 m (22 ft) of locked wheel skids. The front of Vehicle 1 (11FDEW1) struck the right side of Vehicle 2 (02RZEW2). Vehicle 1 sustained a total delta v of 19.2 km/h (12.0 mph), a longitudinal delta v of -18.1 km/h (-11.2 mph), and a lateral delta v of 6.6 km/h (4.1 mph). The front right air bag in Vehicle 1 deployed at this time. The steering wheel mounted driver's side front air bag did not deploy. The reason for this non-deployment is not known.

Figure 4. Interior, Vehicle 1.

The front right occupant sustained a transverse fracture of the distal diaphysis of the right humerus, non-displaced fractures of the proximal phalanx of the 3rd digit and the base of the middle phalanx of the 2nd digit, moderate left knee effusion, abrasions and ecchymosis of the right hand, ecchymosis of the left thigh, a left femur fracture, and abrasions on the right side of the face.

Figure 5. Front right seating position.

This occupant was hospitalized for 10 days. She was then transferred to a second hospital for additional treatment. She remained at this hospital for 29 days before being released. She was readmitted one month later through the ER with an infection related to the surgical repair of the humerus. She remained in the hospital for 17 days. She was readmitted three additional times for infections related to the humerus surgery.

The driver of Vehicle 1 sustained a fractured left clavicle and complained of pain to her chest and left knee. She was transported to a local clinic by her employer. The middle rear occupant complained of chest pain but the parent will seek their own medical treatment. The rear right occupant complained of chest pain and indicated that she would seek her own medical treatment.

The driver of Vehicle 2 complained of back pain and indicated that he would seek his own medical treatment. Vehicle 1 was towed from the scene. The status of Vehicle 2 is not known.

Scene Diagram

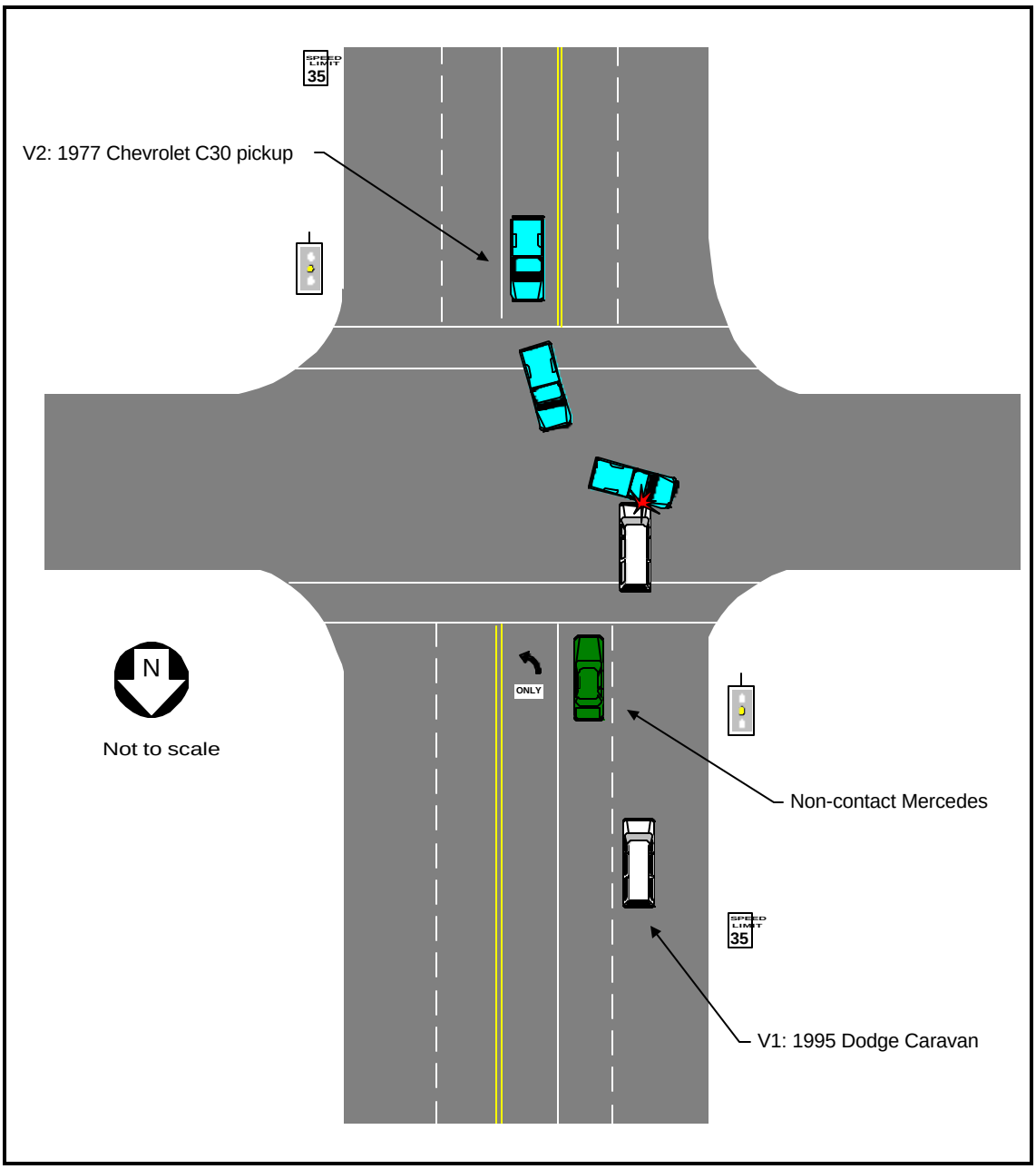

Figure 6. Scene diagram

DETAILED INFORMATION

Vehicles

Vehicle 1

Description:	1995 Dodge Caravan	
VIN:	Unknown	
Odometer:	Unknown	
Engine:	Unknown	
Reported Defects:	None noted	
Cargo:	Wheelchair, wheelchair lift	
Damage Description:	Moderate frontal crush with movement from left to right.	
CDC:	11FDEW1	
Delta V:	Total	19.2 km/h (12.0 mph)
	Longitudinal	-18.1 km/h (-11.2 mph)
	Latitudinal	6.6 km/h (4.1 mph)
	Energy	22,419 joules (16,542 ft-lbs)

Figure 7. Exterior, Vehicle 1.

Figure 8. Exterior, Vehicle 1.

Vehicle 2

Description:	1977 Chevrolet C-30 utility pickup truck	
VIN:	Unknown	
Odometer:	Unknown	
Engine:	Unknown	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Minor to moderate crush to right front door area. Vehicle driven from scene.	
CDC:	02RZEW2	
Delta V:	Total	7.9 km/h (4.9 mph)
	Longitudinal	-3.9 km/h (-2.4 mph)
	Latitudinal	-6.8 km/h (-4.2 mph)
	Energy	18,813 joules (13,894 ft-lbs.)

Figure 9. Exterior, Vehicle 2.

Occupants

Vehicle 1	Occupant 1	Occupant 2
Age/Sex:	42/Female	27/Female
Seated Position:	Front left	Front right
Seat Type:	Pedestal	No vehicle seat present.
Height:	170 cm (67 in.)	132 cm (52 in.)
Weight:	84 kg (185 lbs)	44 kg (98 lbs.)
Occupation:	Van driver	Volunteer teacher's assistant
Pre-existing Medical Condition:	None noted	The front right occupant suffers from cerebral palsy with multiple musculoskeletal involvement. She is wheelchair bound. She has some limited function of her right arm.. Her past medical history includes numerous hospital admissions. She has had surgeries to fuse her cervical and thoracic spine. She also has significant bilateral degenerative hip disease.
Alcohol/Drug Involvement:	None	NA
Driving Experience:	First day driving this kind of van	NA
Body Posture:	Normal, upright	Normal, upright for wheelchair seated person
Hand Position:	Unknown	Unknown
Foot Position:	Right foot on brake, left on floor	On wheelchair foot rests
Restraint Usage:	Lap and shoulder belt used	Seated in wheelchair, using wheelchair lap belt, wheel chair secured to vehicle, also using vehicle seat belt with extended strap

Air bag:	Non-deployed	Deployed as a result of the impact

Vehicle 1	Occupant 3	Occupant 4
Age/Sex:	5/Male	29/Female
Seated Position:	Rear middle	Rear right
Seat Type:	Bench	Bench
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	NA	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	NA	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Police indicate lap and shoulder belt used, but this position only has a lap belt	Lap and shoulder belt used

Vehicle 2	Occupant 1
Age/Sex:	59/Male
Seated Position:	Front left
Seat Type:	Unknown
Height:	175 cm (69 in.)
Weight:	75 kg (165 lbs.)
Occupation:	Electrical contractor
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown, presumed to be >20 years
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used

Injuries and Injury Mechanisms

Vehicle 1	INJURY	OIC CODE	ICD-9	SOURCE
Driver:	Fracture, left clavicle	752200.2,2	810.00	Seat belt
RF Occupant:	Transverse displace fracture, distal diaphysis of the right humerus	752604.3,1	812.50	Air bag / windshield
	Non-displaced fracture proximal phalanx of the 3rd digit and the base of the middle phalanx of the 2nd digit	752404.1,1 752404.1,1	817.1[1]	Air bag / windshield
	Abrasions, ecchymosis of right hand	790202.1,1 790402.1,1	923.20	Air bag / windshield
	Moderate left knee effusion	Not codeable	–	Right instrument panel
	Ecchymosis, left thigh	890402.1,2	924.00	Unknown
	Abrasions, right side of face	290202.1,1	910.0	Air bag
	Left supracondylar femur fracture	851822.3,2	821.23	Right instrument panel
MR Occupant	Complained of chest pain	Not codeable		
RR Occupant	Complained of chest pain	Not codeable		
Vehicle 2				
Driver	Complained of back pain	Not codeable		

[1]Multiple fractures to same hand coded with a single code.

Occupant Kinematics

Some of the major injuries to the front right occupant are related to the air bag deployment. It appears that the wheelchair was not completely secure on the right side (based on occupant statements). As the driver of Vehicle 1 began braking, the wheelchair came out of the floor slots on the right side. This occupant indicated that she saw the impending crash and a logical response would have been to put her right hand/arm out in front of her. As the braking continued, the wheelchair then pivoted to a small degree in a counterclockwise direction–making the occupant lead with her right side. At impact, she pitched forward and to the left–exacerbating the right side lead. As the air bag deployed, the bag itself and possibly the cover struck the underside of the right forearm, forcing it upward into the windshield--causing the fracture; the air bag continued its deployment and struck the right side of her face–causing the abrasions. It appears that this occupant struck the lower instrument panel with her left knee–causing the effusion. This strike also caused the femur fracture as the knee was loaded against the instrument panel.