

CASE: D016-99

**Crash Description:** 22 Year old, Black, Female, Driver, Inspector

**Impact Type:** Undercarriage

Case Vehicle: 1999 Nissan GXE  
Crash Type: Vehicle to Large Truck  
Restraint: Lap & Shoulder Belt  
Airbag Deployment (front): Driver Side: Deployed Passenger Side: Deployed

Principle Direction of Force: 11 o'clock

Total Delta V: 20.0 MPH

Estimated Speed: 20 MPH

Intrusion:  
LR seat back: 26" Forward  
L IP: 24"  
CR seat back: 23" Forward

Steering Wheel Deformation: in.

Sheer Capsule Movement (left): .00 in. (right): .00 in.

Seat Position: Mid Range

Maximum Crush: 39.00 in. at Position: C1

Wheelbase: Pre: 100.0(in. Post: 93.00 in. Difference: 7.00 in.

Other Measurements: Maximum crush to back plane = 45"@C4

**Occupant Measurements:**

Height:	68 in.	Torso:	21.0 in.
Weight:	160 lbs.	Knee Up:	22.0 in.
Handed:	Right	Knee Down:	19.0 in.
Eyewear:	None	Elbow Up:	15.0 in.
Shoes:	Size 11/ Unknown Style	Elbow Down	19.5 in.

**Conditions:**

Crash Date:	03/11/1999	Crash Time:	01:00
Weather:	Clear	Posted Speed:	55 MPH
Road Condition:	Dry	Coeff. of Friction:	0.70
Surface Condition:	Blacktop		

**Case Vehicle Model:**

1999 Nissan GXE

Vehicle meets 1997 Side Impact Standard: Yes

**Case Summary:**

Case Vehicle: 1999 Nissan Sentra  
POV 1: 1990 International Dump Truck  
POV 2: Tractor-Trailer Combo

The case vehicle was equipped with 3 point lap and shoulder restraints for both frontal-seating positions. In addition the case vehicle was equipped with driver and passenger air bags both of which deployed in the crash. The driver of the case vehicle was a restrained 22 year-old female, 68" tall and 160 pounds.

The crash site was a divided limited access highway. All three vehicles were southbound in the outside lane. POV 2 was in the lead followed by the case vehicle, which was followed by POV 1. Both POV 2 and the case vehicle were traveling at a low rate of speed. It is estimated that POV 1 was traveling at a normal highway speed.

The driver of POV 1 noticed the slower moving case vehicle and took the evasive action of steering left, but it was too late to avoid a collision. The front of POV 1 impacted the rear of the case vehicle. The impact force pushed the case vehicle forward to the south while initiating a clockwise rotation. The front of the case vehicle impacted the right upright support of POV 2's under-ride bar. This impact accentuated the case vehicle's clockwise rotation. The case vehicle's left side impacted the rear of POV 2's under-ride bar. The case vehicle continued to rotate clockwise and snagged its left side structure on the left side of POV 2's trailer.

POV 2 came to rest facing south in the outside lane. The case vehicle came to rest facing north in the center lane adjacent to the back of POV 2's trailer. POV 1 departed the roadway to the left and impacted the dividing wall coming to rest at that point.

Direct damage to the case vehicle from the impact with POV 1 spanned the entire back plane. This 5 o'clock direction of force impact (CDC: 05 BDAW 9) crushed the back structure of the case vehicle to a maximum depth of 45" located at C-4. The SMASH program was not used to calculate a deltaV for this impact because POV 1 over-rode the case vehicle and POV 1 is outside the scope of the SMASH program. The crash investigator estimates the case vehicle's deltaV for this impact to be 35 mph.

Direct damage to the case vehicle from the frontal impact with POV 2 was centered 23" left of the centerline and spanned 5" in width. This 11 o'clock direction of force impact (CDC: 11 FLEE 7) crushed the frontal structure of the case vehicle to a maximum depth of 39" at C-1. The SMASH program was not used to calculate a deltaV for this impact because the case vehicle under-rode POV 2, and POV 2 is outside the scope of the SMASH program. The crash investigator estimates the case vehicle's deltaV for this impact to be 20 mph.

The case vehicle was damaged extensively in its first two impacts. The damage sustained in the case vehicle's third impact (left side to back of POV 2's trailer) could not be isolated in detail. A CDC of 09 LYAW 3 was assigned, and the severity can be classified as moderate.

### Kinematics Summary:

#### Occupant Kinematics

With the initial impact, the driver moved rearward with respect to the accelerating vehicle and in a path consistent with the 5 o'clock direction of force impact. As the driver moved rearward, the left front seatback deformed and moved rearward. As the driver began to move rearward with respect to the PDOF, she contacted the left "B" pillar with her head, and sustained a small laceration to the posterior occipital area. At this time, the entire left rear seat was moving forward with respect to the intruding rear of the case vehicle. The rear, intruding surface contacted and loaded the left front seat back, pushing it forward. The left front seatback bent forward at the hinge point. The driver was using the available 3-point lap and shoulder restraint. As the left front seat back was bending forward, due to the intruding rear surface, the driver was held in the seat by the restraint. Because she was anchored to the seat, as it was bending forward, the driver was bending forward at the waist. She loaded the shoulder restraint across her chest and abdomen. The restraint, which was still anchored to the upper "B" pillar tightened across the torso of the driver, acting as a tourniquet. As the driver rotated forward at the waist, the restraint webbing loaded the upper left shoulder and she sustained an abrasion from the edge of the restraint webbing. She also sustained a contusion to the left breast and the left chest above the sternal area. The liver was compressed into the posterior portion of the rib cage and as a result the driver sustained a posterior grade II liver laceration. As the lap belt loaded the abdomen, the driver sustained a bruise to the right abdomen.

The case vehicle was pushed forward into an impact with the rear of a semi trailer. The case vehicle struck the rear underride guard with the front end in an 11 o'clock direction of force impact. The driver's steering wheel mounted air bag deployed at this time. The deploying air bag contacted the driver in the upper chest. She sustained a fracture to the right ribs numbers 2 and 3. She also sustained a contusion to the right eyelid and a minor laceration to the tongue from interaction with the deploying air bag. In addition to the mentioned injuries, the driver also sustained an abrasion to the infraclavicular area as well as a right forearm abrasion.

The left instrument panel had intruded rearward a total distance of 24" (61-cm). The driver contacted and loaded the intruding left instrument panel with her left leg. The axial loading to the left femur resulted in a fracture to the posterior wall of the acetabulum. In addition to the posterior wall being fractured, the superior wall was also fractured. This mechanism is related to the rearward axial loading from the left instrument panel and the downward loading, which resulted from the forward rotation of the upper torso as it was pushed forward by the intruding seatback. This loading resulted in an upward force being applied along the shaft of the femur as it was being loaded axially by the instrument panel. As the driver moved rearward with the first impact, her right upper arm became wedged behind the right seat back. As the driver responded forward from the intruding rear seat, the resulted loading on the trapped right arm resulted in a comminuted fracture to the right humerus.

The driver also sustained several minor-dicing lacerations from contact with pieces of flying broken glass. She sustained dicing lacerations to the forehead, and above the right ear. She also had dicing lacerations to the dorsal aspect of the right hand and the posterior right arm. Finally she also had a dicing laceration on the upper portion of the abdomen.

#### Arrival Data:

ED Arrival Date: 03/1999 Time: 02:24  
 Trauma Criteria: 11 High Suspicion Of Injury

	<u>E.D.</u>	<u>Scene:</u>
Systolic blood pressure:	129	110
Pulse:	105	Unk.
Respiration:	18	22
Glasgow Coma Score:	15	15
BAC:	Not Done	
Drug Screen:	Not Done	

#### Past Medical History:

PSH: None  
 PMH: None

#### Psycho-Social:

3/1999: Pt. is a 22 Year old BF who is employed as a inspector in a pharmaceutical company. Pt. has two children (boy's ) ages 1 and 5. Pt. is very cooperative and interested in our study. LS

#### Other Hospital Data:

Time to first OR: 10 days, 21:36 hrs.  
 Hosp. Length of Stay 17.00 days  
 ICU Length of Stay: 0  
 Ventilator Days: 0  
 Disposition: SRF / Rehabilitation  
 Hospital Charges:

#### Injury Severity:

ISS Score: 22  
 Maximum AIS: 852604.3  
 caused by injury: Fracture, closed, comminuted to the Anterior Left Roof of acetabulum

Occupant Injuries and Contacts:

<u>Contact Point</u>	<u>Injury</u>	<u>Mechanism of Inj.</u>	<u>AIS Severity</u>
Air bag-driver side	• Fracture, multiple, closed to the Anterior Right Rib cage	Direct Contact	2
	• Bruise to the Anterior Right eye	Direct Contact	1
	• Abrasion to the Anterior Right Skin of infraclavicular region	Direct Contact	1
	• Abrasion to the Anterior Right Right forearm	Shearing	1
	• Minor laceration to the Anterior Lateral margin of tongue	Indirect Contact	1
Belt restraint webbing/buckle	• Moderate laceration to the Anterior Right Posterior segment of right lobe of liver	Compression	3
	• Abrasion to the Posterior Left Scapular region of back	Direct Contact	1
	• Bruise to the Anterior Right Skin of abdomen	Direct Contact	1
	• Bruise to the Anterior Left Skin of upper trunk	Direct Contact	1
	• Contusion to the Anterior Left Skin of breast	Direct Contact	1
Flying glass	• Minor laceration to the Anterior Forehead	Direct Contact	1
	• Minor laceration to the Posterior Right Skin of posterior surface of forearm	Direct Contact	1
	• Minor laceration to the Anterior Left Upper abdomen	Direct Contact	1
	• Minor laceration to the Anterior Right Skin of dorsal area of hand	Direct Contact	1
	• Minor laceration to the Anterior Lateral aspect of face	Direct Contact	1
Left B-pillar	• Minor laceration to the Posterior Occipital region	Direct Contact	1
Left instrument panel and below	• Fracture, closed, comminuted to the Anterior Left Roof of acetabulum	Axial Loading	3
Left side interior surface, excluding hardware or armrests	• Fracture, closed to the Anterior Left Inferior ramus of pubis	Direct Contact	2
Seat, back support	• Fracture, closed, comminuted to the Anterior Right Shaft of humerus	Bending	3
	• Contusion to the Posterior Right Skin of posterior surface of forearm	Direct Contact	1

# D016-99



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Scale 1/200  
Case Vehicle: 1999 Nissan Sentra  
POV 1: (grey) 1999 International Dump Truck  
POV 2: (white) Tractor/trailer combo

