

On-Site Child Safety Seat Investigation / Vehicle Rollover
Dynamic Science, Inc. / Case Number: DS02013
1999 Chevrolet Blazer
Colorado
July, 2002

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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 crash-worthiness performance of the involved vehicle(s) or their safety systems.

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Crash Investigation
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BACKGROUND:

This on-site investigation focused on a child safety seat that was installed in the 2nd row center seat of a 1999 Chevrolet Blazer. The Chevrolet Blazer was occupied by an unrestrained 29-year-old male driver. There were three additional occupants in the case vehicle. The front right seat was occupied by an unrestrained 25-year-old male. The 2nd row middle seat position was occupied by a 17-month-old female child that was in a forward facing child seat. The child seat was anchored to the vehicle using the manual lap belt. The 2nd row right seat position was occupied by a 25-year-old female who was not restrained. The Chevrolet Blazer was traveling northbound on a two lane interstate freeway/highway. The driver attempted a lane change to the left and lost control of the vehicle. The Blazer rolled numerous times down an embankment. All three adult occupants were ejected and fatally injured. The child occupant remained in the child seat throughout the crash sequence and sustained moderate injuries.



Figure 1. Newspaper at scene photograph.

This case was identified by the NHTSA through a newspaper article describing the crash. DSI was assigned the case on July 9, 2002. An on-site investigation was conducted. The investigating police officer was present during the inspection of the case vehicle. All scene work was completed on July 12, 2002.

SUMMARY

Crash Site

The crash occurred in Colorado in July, 2002 at 2040 hours. In the area of the crash the roadway is a two lane northbound interstate freeway/highway. The asphalt roadway surface was dry and has a slight downhill grade. The roadway is bordered on the right/east edge by an asphalt shoulder and a metal guardrail. On the other side of the guardrail is a 63 % downhill grade embankment. At the bottom of the embankment is a concrete drainage ditch. There was on-going construction on the east edge of the interstate. There were no traffic controls present and the speed limit was 105 km/h (65 mph).



Figure 2. Area of crash—right side.

Pre-Crash

This was a single vehicle, rollover type collision. The case vehicle is a 1999 Chevrolet Blazer 4WD that was driven by an unrestrained 29-year-old male. There were three additional occupants in the case vehicle. The front right seat was occupied by an unrestrained 25-year-old male. The 2nd row middle seat position was occupied by a 17-month-old female child that was in a forward facing child seat. The 2nd row right seat position was occupied by a 25-year-old female who according to the police report, was not restrained. However, inspection of the seat belt in this occupant's position showed evidence of loading.

The case vehicle was traveling northbound on a two lane interstate. Witnesses indicated that traffic conditions were moderate to heavy and that the driver of the case vehicle seemed impatient with the volume of traffic and cut off another vehicle. The case vehicle was attempting a lane change when the driver lost control of the vehicle.

Crash

The case vehicle swerved from the right lane into the left lane. The driver then overcorrected to the right. The vehicle rotated clockwise, rolled over eight quarter turns as it headed towards the right shoulder area. The vehicle struck the metal guardrail with its left front (see Figure 3); there was minor damage to the top part of the guardrail. Witnesses indicated that during the rollover on the right shoulder area the driver was ejected out of the driver's window. The driver was found laying on the right shoulder area approximately 1.8 meters (6 ft) west of the guardrail. The vehicle continued in a clockwise yaw and rolled over three quarter turns, vaulted upward and the vehicle's rear left door struck the top backside of the guardrail. After striking the guardrail, the case vehicle then traveled down a 63% grade embankment rolling ten quarter turns. Both the front right and 2nd row right occupants were fully ejected. The vehicle traveled 24.4 meters (80 ft) down the embankment and came to final rest on top of a concrete drainage ditch facing south on all four wheels.

Post-Crash

The case vehicle sustained major rollover type damage about the entire vehicle. Three of the four doors were jammed shut. All the glazing, with the exception of the driver's window (it was rolled down) disintegrated. There was significant intrusion to the vehicle's passenger



Figure 3. Left side of case vehicle impact top-back side of guardrail and rollover embankment.



Figure 4. Area of rollover 2.

compartment; mainly the roof intruding into the driver's area. The vehicle is equipped with driver and front right passenger air bags which did not deploy. The vehicle was towed from the scene due to damage and was being held by the police.

Relatives of the driver reported to police that the vehicle had been recently purchased and that it had been involved in a minor rear end collision; this damage was identified during the on-scene inspection. Carfax was used to search the vehicle's history. Carfax reported no salvage/junk title, no rebuilt/reconstructed title and no damage disclosure. Carfax reported that the case vehicle had been sold at an auto auction in February 2002 and was then sold on March 2002 to the present owner. The vehicle was registered but not owned by the driver.

As indicated above, all three adult occupants in the case vehicle were ejected during the collision. All expired at the scene. The 29-year-old driver of the case vehicle sustained numerous head and torso injuries. The autopsy report indicated that the cause of death was "due to a broken neck involving C3 and spinal cord injury secondary to blunt force trauma." The 25-year-old male front right seat occupant sustained numerous head and facial injuries. The autopsy report indicated that the cause of death was "due to massive head injuries." The 25-year-old female 2nd row right occupant sustained multiple injuries to the head, abdomen and extremities. The autopsy report indicated that the cause of death was "due to massive head injuries secondary to blunt force trauma." The 17-month-old 2nd row middle female occupant remained in the vehicle. She was extricated from the vehicle by medical personnel and transported by air ambulance to an area trauma center. She arrived with a Glasgow Coma Score (GCS) of 15. She sustained a closed head injury with a concussion and multiple minor abrasions. She was kept overnight for observation and then released.



Figure 5. Damage to case vehicle.

VEHICLE DATA - 1999 Chevrolet Blazer

The 1999 Chevrolet Blazer four-door sport utility vehicle was identified by the Vehicle Identification Number (VIN): 1GNDT13W8X2XXXXXX . The vehicle's digital odometer could not be read because there was no power to the instrument panel. The vehicle was equipped with a 4-cylinder, 1.8 liter engine, 4-speed automatic transmission, four wheel drive, air conditioning, power steering, and a tilt steering wheel.

The 1999 Chevrolet Blazer was equipped with Uniroyal Laredo P235/70R15 tires. The specific tire data is as follows:

Tire	Measured Tread Depth	Measured Pressure	Recommended Cold Pressure	Restricted	Damage
LF	7 mm (9/32 in)	Flat	221 kPa (32 psi)	Yes	Bent rims, sidewall torn
LR	3 mm (4/32 in)	Flat	241 kPa (35 psi)	No	Cracked rim, tire debaded
RR	3 mm (4/32 in)	Flat	241 kPa (35 psi)	No	Cracked rim, sidewall torn
RF	3 mm (4/32 in)	76 kPa (11 psi)	221 kPa (32 psi)	Yes	Scratched rim, asphalt embedded

The front seating positions in the Chevrolet Blazer were configured with front bucket seats with integral head restraints that were not damaged. The driver's seat was locked in place but appeared to be between the rear most and middle track position when compared to the front right seat. The front right seat was located at the rear most track position. The 2nd row was configured with a split bench seat with folding backs and adjustable head restraints for the outboard positions.

VEHICLE DAMAGE - 1999 Chevrolet Blazer

Exterior Damage

The Chevrolet Blazer sustained major damage all over the vehicle due to the rollover and contacts to the guardrail. Three of the four doors were jammed shut. All the glazing, with the exception of the driver's window (it was rolled down) disintegrated. There was significant intrusion to the vehicle's passenger compartment; mainly the roof intruding into the driver's area. Both front tires were restricted. The left front, left rear and right rear tires were deflated. The rims on the two rear tires were cracked. The Collision Deformation Classification (CDC) for the rollover was 00TDD02. The CDC for the first guardrail impact was 00LPEW3. The CDC for the second guardrail impact was 00LPEW3.



Figure 6. Left side, Chevrolet Blazer

Interior Damage

The 1999 Chevrolet Blazer sustained moderate interior damage as a result of passenger compartment intrusion. The roof, side rails and pillars sustained vertical intrusion. The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
FL	Roof	40.0 cm (15.7 in)	Vertical
RL	C pillar	39.0 cm (15.3 in)	Vertical
FL	Roof side rail	31.0 cm (12.2 in)	Vertical
FL	B pillar	35.0 cm (13.8 in)	Vertical
FM	Floor	27.0 cm (10.6 in)	Vertical
FL	Windshield header	20.0 cm (7.9 in)	Vertical
FL	A pillar	24.0 cm (9.4 in)	Vertical
FL	Floor pan	10.0 cm (3.9 in)	Lateral
RL	Roof	8.0 cm (3.1 in)	Vertical
RL	Center overhead console	14.0 cm (5.5 in)	Lateral
FR	A pillar	4.0 cm (1.6 in)	Vertical

MANUAL RESTRAINT SYSTEMS

The 1999 Chevrolet Blazer was configured with manual 3-point lap and shoulder belts for each outboard seating position and a manual lap belt for the 2nd row middle seat position. The driver's seat belt was equipped with an Emergency Locking Retractor (ELR) and a sliding latch plate. The front right, 2nd row left and 2nd row right seat belts were equipped with sliding latch plates and switchable ELR/Automatic Locking Retractors (ALR). There was no retractor for the 2nd row middle seat position belt.

All four lap and shoulder belts exhibited signs of historical usage, but were not used at the time of the crash.

The lap belt in the 2nd row middle seat position was used to secure the child safety seat. The lap belt measured 135.0 cm (53.1 in). There were loading marks to the belt. The first measured 21.0 cm (8.3 in) along the webbing and began 23.0 cm (9.0 in) from the tip of the tang. The second measured 16.0 cm (6.3 in) along the webbing and began 50.0 cm (19.7 in) from the tip of the tang.

FRONTAL AIR BAG SYSTEM

The 1999 Chevrolet Blazer was equipped with frontal air bags that did not deploy. There was no damage to the air bag modules and there were no known failures.

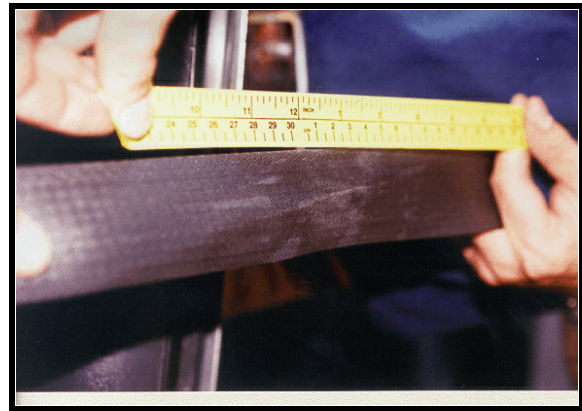


Figure 7. 2nd row middle seat belt webbing

CHILD SAFETY SEAT - Century Breverra Ascend SE

The 2nd row middle seat position was occupied by a 17-month old female child (12 kg [26.7 lbs], unknown height) who was harnessed in a forward facing child seat. The child seat was anchored to the vehicle's seat using the lap belt. The child seat was identified as a Century Breverra Ascend SE. It is a forward facing or belt positioning booster child seat. It was manufactured on October 3, 2001. Labels on the child seat indicate that when used with the 5-point harness system it is for use by children who weigh between 13.6-18 kg (30-40 lbs.) and are between 89-109.2 cm (35-43 in.) tall. The child must be able to sit upright unassisted and the child's shoulders should not be above the top harness slots. If used without the harness, it is for use by children who weigh between 13.6-36.3 kg (30-80 lbs.) and who are 89-127 cm (35-50 in.) tall. The child must be able to sit upright unassisted and the top of child's ears should not be above top of headrest.

The child safety seat was inspected, but it had been removed from the vehicle prior to inspection. The 5-point harness appeared to operate properly and the latch locked into the buckle. The harness system was slotted through the bottom slot. The harness webbing showed usage and was abraded/scored (see Figure 11). The harness clip was very low. A tether was not present.



Figure 8. Frontal view child seat.

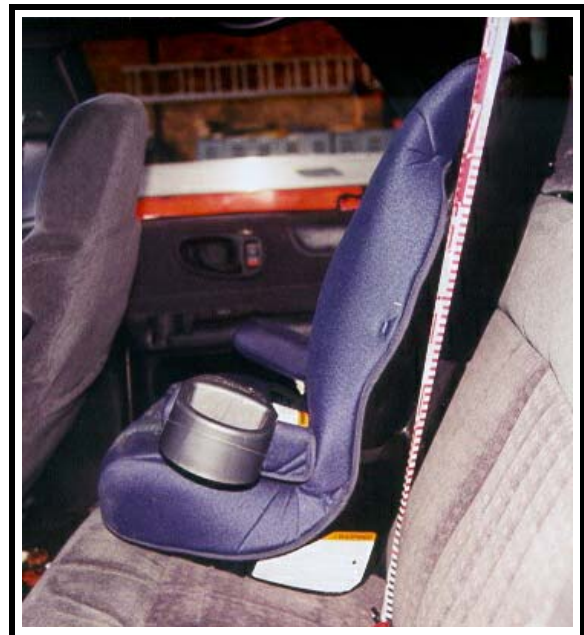


Figure 9. Child seat in case vehicle post impact.

The police reported that the child seat was in a forward facing position and that the vehicle's lap belt was used and routed through the vehicle belt paths located on the sides and through the back of the child seat. The investigating officer indicated that emergency rescue personnel unbuckled the vehicle's lap belt from the child seat. The police officer was familiar with the child seat and indicated that the low position of the vehicle belt path on the sides of the child seat caused it to tip easily. Emergency rescue personnel reported finding the child seat tipped over to the right facing down on the 2nd seat. This investigator anchored the child seat using the vehicle's lap belt and was unable to position the child seat tipped over to the right facing down. The lap belt had to be released to position the child seat in this fashion.

The 17-month-old child remained in the vehicle harnessed to the child seat. She was transported to a medical center where she was treated and held overnight for observation. She sustained a closed head injury with a concussion, a contusion to the right parietal scalp, and an abrasion to the left side of the nose.



Figure 10. Reported position of child seat at final rest.



Figure 11. Loading marks to child safety seat harness

OCCUPANT DEMOGRAPHICS - 1999 Chevrolet Blazer

	Driver	Occupant 2
Age/Sex:	29/Male	25/Male
Seated Position:	Front left	Front right
Seat Type:	Bucket, seat adjusted to between rear most and middle track position	Bucket, seat adjusted to rear most track position
Height:	173 cm (68 in)	170 cm (67 in)
Weight:	111 kg (244 lbs)	64 kg (140 lbs)
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	Unknown	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown, actively steering	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, <u>not</u> used	Lap and shoulder belt available, <u>not</u> used
Air bag:	Air bag available, did <u>not</u> deploy	Air bag available, did <u>not</u> deploy

OCCUPANT DEMOGRAPHICS

	Occupant 3	Occupant 4
Age/Sex:	17 months/Female	25/Female
Seated Position:	Second row middle	Second row right
Seat Type:	Split bench with folding back	Split bench with folding back
Height:	Unknown	163 cm (64 in)
Weight:	12 kg (26.7 lbs)	81 kg (179 lbs)
Occupation:	NA	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	NA	NA
Driving Experience:	NA	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap belt used with child safety seat	Lap and shoulder belt available, <u>not</u> used

OCCUPANT INJURIES - 1999 Chevrolet Blazer

Driver: All injury data was obtained from the autopsy that was performed by the county coroner. Toxicology results were negative for blood alcohol and urine drug screens. A carbon monoxide screen showed a 20 percent saturation, by Spectrophotometry. The cause of death was reported as a fractured neck (C3) and spinal cord injuries due to blunt force trauma due to a motor vehicle accident. The following injuries were noted on the autopsy report:

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Displaced widely separated fracture of C3 with hemorrhage of subdural space and spinal canal. Extensive injury with transection of spinal cord.	640272.6,6	Vehicle exterior/ground	Possible
Bilateral subdural hemorrhage (100cc)	140654.5,3	Vehicle exterior/ground	Possible
Diffuse subarachnoid hemorrhage	140684.3,9	Vehicle exterior/ground	Possible
Lacerations of the brain stem - cerebellum and the pituitary reveals laceration of the brain stem	140678.4,9	Vehicle exterior/ground	Possible
Fractures of ribs in the right chest anteriorly involving 1, 2, 3 and 4 ribs w/small amount of hemorrhage	450230.3,1	Vehicle exterior/ground	Possible
Laceration of the innominate vein	420602.3,4	Unknown	Unknown
Lacerations of the corpus callosum and septum pellucidum	140688.4,9	Vehicle exterior/ground	Possible
Upper forehead, abrasion	290202.1,7	Unknown	Unknown
Back of head, abrasion and superficial laceration	190202.1,6 190602.1,6	Ground	Possible
Back of head, slightly above the horizontal plane of the ears, is a transverse, deeply penetrating laceration measuring 7.62 cm (3 in) in length by 3/16 in. in width	190602.1,6	Vehicle exterior	Possible

Back of head, below the horizontal plane of the ears, is a transverse deeply penetrating laceration measuring 15.24 cm (6 in) in length by 1.27 cm (½ in) in width	190604.2,6	Vehicle exterior	Possible
Ears, contusion and abrasion involving the lateral aspect of the left ear and an abrasion on the lateral aspect of the right ear	190402.1,2 190202.1,2 190202.1,1	Ground	Possible
Abrasion, left shoulder	790202.1,2	Door side panel	Probable
Extensive abrasions involving the mid and lower chest on both sides	490202.1,3	Door side panel	Possible
Circular indentation with abrasion involving the left lower chest and left upper abdomen	490202.1,2 590202.1,2	Vehicle exterior	Possible
Extensive abrasions in the upper aspect of both side of the abdomen	590202.1,0	Ground	Possible
Abrasions and contusions are widely distributed across the upper and mid back	690202.1,0 690402.1,0	Ground	Possible
Present on the left buttock are scattered punctuate abrasions	890202.1,2	Ground	Possible
Abrasions on the posterior aspect of both thighs	890202.1,3	Ground	Possible
Abrasions on the posterior aspects of both calves.	890202.1,3	Ground	Possible
Laceration of the heel of the right foot that measures 10.2 cm (4 in)	890602.1,1	Unknown	Unknown
Compound fracture of the right wrist	751800.2,1	Ground	Possible
Abrasion, the anterior surface of the left upper arm	790202.1,2	Ground	Possible

Large medial diagonal laceration involving the right upper arm measuring 12.7 cm (5 in) in length.	790604.2,1	Unknown	Unknown
Abrasions on the anterior surface of both knees	890202.1,3	Ground	Possible
Contusions on the back of the head and the right upper anterior surface of the head	190402.1,6 190402.1,1	Unknown	Unknown
Laceration, right lung with hemothorax	441414.3,1	Vehicle exterior	Possible

Right Front Occupant (Occupant 2): All injury data was obtained from the autopsy that was performed by the county coroner.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Medial, diagonal laceration extending from the right parietal area to left frontal area	190604.2,5	Vehicle exterior/ground	Possible
Massive fracture that bivalves the extending from the right parietal area medially to the left frontal area	150404.3,5	Vehicle exterior/ground	Possible
Evaluation and fragmentation - laceration of brain tissue	140688.4,9	Vehicle exterior/ground	Possible
Extensive abrasion on the anterior surface of the nose	290202.1,4	Unknown	Unknown
Abrasion involving the right side of the face	290202.1,1	Unknown	Unknown
Multiple fractures of the facial bones	250400.1,1 250400.1,2	Vehicle exterior/ground	Possible
Numerous abrasions are widely distributed on the lateral surface of both sides of the chest	490202.1,3	Ground	Possible
Numerous abrasions widely distributed on the lateral surfaces of both sides of the abdomen	590202.1,1 590202.1,2	Ground	Possible
Upper and mid aspect of the right side of the back is a large area of contusion that measures 20.32 cm (8 in) in greatest dimension	690402.1,1	Unknown	Unknown
Numerous abrasions are widely distributed on the lateral surface of the left mid-back and the lower aspect of the back and pelvic area	690202.1,2 890202.1,2	Ground	Possible
Numerous abrasions are on the posterior aspect of the left gluteal area	890202.1,2	Ground	Possible

Abrasion, lateral to the right of the midline in the lower back just above the apex of the gluteal area	690202.1,1	Ground	Possible
Abrasions on the posterior - lateral aspect of the left thigh	890202.1,2	Ground	Possible
Abrasions on the lateral aspect of the left hand and wrist	790202.1,2	Ground	Possible
There is a transverse laceration on the lateral aspect of the right forearm measures 10.16 cm (4 in) in length	790604.2,1	Unknown	Unknown
Fracture of the proximal aspect of the right ulna	753202.2,1	Vehicle exterior/ground	Possible
Compound fracture of the right femur	851800.3,1	Vehicle exterior/ground	Possible
Circular laceration associated with the marginal abrasion involving the anterior lateral aspect of the right mid thigh	890600.1,1	Unknown	Unknown
Compound fracture, right tibia and fibula	851605.2,1 853404.2,1	Vehicle exterior/ground	Possible
Abrasions, anterior-lateral aspect of the left leg	890202.1,2	Ground	Possible
Fracture of the base of the skull	150200.3,8	Vehicle exterior/ground	Possible

2nd row middle (Occupant 3): Injuries obtained from medical records.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusion right parietal scalp	190402.1,1	Other occupant	Probable
Abrasion, left side of nose	290202.1,4	Unknown	Unknown
Closed head injury w/concussion	161000.2,0	Other occupant	Probable

2nd row right (Occupant 4): All injury data was obtained from the autopsy that was performed by the county coroner.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Large transverse, posterior fracture that extends from ear to ear that is widely separated (brain protrudes somewhat on the right side) - Base of the skull reveals extension of the posterior fractures, anterior and laterally, and then extend across the base of the skull to, in tact, form a circular fracture surrounding the foramen magnum. The base of the skull fracture involves both temporal fossae. The sphenoid bone is hinged and widely separated	150206.4,8	Vehicle exterior/ ground	Possible
Lacerations of the brain stem involving the cerebellum	140212.6,8 140474.4,6	Vehicle exterior/ground	Possible
Laceration-Transection of the upper aspect of the cervical portion of the spinal cord	640260.5,6	Vehicle exterior/ground	Possible
Laceration-Transection of the distal aspect of the trachea and longitudinal lacerations involving the posterior aspects of both main stem bronchi	442610.5,4	Vehicle exterior/ground	Possible

Numerous lacerations involving both the right and left lobes of the liver	541826.4,1	Vehicle exterior/ground	Possible
Anterior fracture of the left side of the pelvis that also involves the associated acetabulum	852600.2,2	Vehicle exterior/ground	Possible
Fracture of the right wrist	751800.2,1	Vehicle exterior/ground	Possible
Fracture of the right ankle	852002.2,1	Vehicle exterior/ground	Possible
Right ear laceration to the lateral surface	190600.1,1	Unknown	Unknown
Abrasion, anterior-lateral aspect of the right mid and lower abdomen (vertically oriented)	590202.1,1	Ground	Possible
Abrasion on the lateral aspect of the left lower abdomen	590202.1,2	Child seat	Possible
Right upper back and posterior aspect of the right shoulder are multiple horizontally oriented abrasions, associated with a superficial laceration 10.16 x 7.62 cm (4 x 3 in) in size	690202.1,1 790202.1,1 690602.1,1	Ground	Possible
Left lower quadrant of the back (horizontally) curvilinear laceration measuring 6.35 cm (2 ½ in) in size	690602.1,2	Vehicle exterior/ground	Possible

Right gluteal area is a deeply penetrating L shape laceration that measured 15.24 cm (6 in) in length and penetrates a depth of 12.7 cm (5 in) - adjacent to the right of apex of the gluteal area is a vertically oriented, deeply penetrating laceration measuring 5.08 cm (2 in) in length with a 25.4 cm (10 in) depth of penetration	890604.2,1	Vehicle exterior/ground	Possible
Several large areas of contusions on the lateral aspect of the right hand	790402.1,1	Ground	Possible
Cluster of longitudinally oriented, linear abrasions on the lateral aspect of the right wrist	790202.1,1	Ground	Possible
Large, gaping deeply penetrating laceration involving the anterior lateral aspect of the left side of the pelvis and proximal thigh which measures 20.32 cm (8 in) x 12.7 cm (5 in) in size with a depth of penetration of 17.78 cm (7 in).	890604.2,2	Vehicle exterior/ground	Possible
Medial surface of both thighs are circumscribed area of abrasion	890202.1,3	Ground	Possible
Abrasion on the lateral aspect of the left lower leg	890202.1,2	Ground	Possible
Abrasion on the medial aspect of the right calf	890202.1,1	Ground	Possible
100cc of subdural hemorrhage overlies both cerebral hemispheres	140656.5,9	Vehicle exterior/ground	Possible
Multifocal subarachnoid hemorrhage	140684.3,9	Vehicle exterior/ground	Possible

Intraventricular hemorrhage	140678.4,9	Vehicle exterior/ground	Possible
Laceration of the corpus callosum	140688.4,9	Vehicle exterior/ground	Possible
Scalp contusions	190402.1,0	Unknown	Unknown

OCCUPANT KINEMATICS - 1999 Chevrolet Blazer

Driver

The 29-year-old male driver was seated in a generally upright posture. He was not wearing the available lap and shoulder belt. The seat was adjusted to between the rear most and middle track position. The seat back angle was 64 degrees. The driver had initially steered to the left, then sharply to the right. The driver was braking and actively steering. As the vehicle went into a clockwise rotation, the driver began pitching to the left against the door panel. As the vehicle continued rotating, it tripped and began a left side leading rollover. The vehicle rolled eight quarter turns as it headed towards the right shoulder area.



Figure 12. Driver's seated position

The vehicle then struck the metal guardrail with its left front. Witnesses indicated that during the rollover on the right shoulder area the driver was ejected out of the driver's window. The driver was crushed by the overturning vehicle. He was found laying on the right shoulder area approximately 1.8 meters (6 ft) west of the guardrail. He was fatally injured.

Front right occupant

The 25-year-old male front right seat occupant was probably seated in a generally upright posture. He was not wearing the available lap and shoulder belt. The seat was adjusted to the rear most track position. The seat back angle was 59 degrees. The driver had initially steered to the left, then sharply to the right. The driver was braking and actively steering. This occupant was likely pitching from side to side in response to the driver's steering movements. As the vehicle continued rotating, it tripped and began a left side leading rollover. The vehicle rolled eight quarter turns as it headed towards the right shoulder area. The vehicle then struck the metal guardrail with its left front



Figure 13. Front right occupant seated position

The vehicle continued in a clockwise yaw and rolled over three quarter turns, vaulted upward and the vehicle's rear left door struck the top backside of the guardrail. After striking the guardrail, the case vehicle then traveled down a 63% grade embankment rolling ten quarter turns. This occupant was ejected through the right front window. He came to rest on the roadside 11.9 m (38.9 ft) east of the guardrail. During the rollover sequence he was likely caught between the vehicle and the ground and crushed prior to being fully ejected.

2nd row middle occupant

The 17-month-old female 2nd row middle seat occupant was seated in an upright fashion and was harnessed in a forward facing child seat. The child seat was anchored to the vehicle's seat using the lap belt. The vehicle seat back angle was 68 degrees. The driver had initially steered to the left, then sharply to the right. The driver was braking and actively steering. This occupant was likely pitching from side to side in response to the driver's steering movements. As the vehicle continued rotating, it tripped and began a left side leading rollover. The vehicle rolled eight quarter turns as it headed towards the right shoulder area. The vehicle then struck the metal guardrail with its left front. The vehicle continued in a clockwise yaw and rolled over three quarter turns, vaulted upward and the vehicle's rear left door struck the top backside of the guardrail. After striking the guardrail, the case vehicle then traveled down the embankment rolling ten quarter turns. Emergency rescue personnel reported finding the child seat tipped over to the right facing down on the 2nd seat. The child remained in the vehicle harnessed to the child seat. She was transported to a medical center where she was treated and observed. She sustained a closed head injury with a concussion, a contusion to the right parietal scalp, and an abrasion to the left side of the nose. The injuries were likely due to contact to the other occupant during the rollover sequence.

2nd row right occupant

The 25-year-old female 2nd row right seat occupant was probably seated in a generally upright posture. She was not wearing the available lap and shoulder belt. The seat back angle was 68 degrees. The driver had initially steered to the left, then sharply to the right. The driver was braking and actively steering. This occupant was likely pitching from side to side in response to the driver's steering movements. As the vehicle continued rotating, it tripped and began a left side leading rollover. The vehicle rolled eight quarter turns as it headed towards the right shoulder area. The vehicle then struck the metal guardrail with its left front. The vehicle continued in a clockwise yaw and rolled over three quarter turns, vaulted upward and the vehicle's rear left door struck the top backside of the guardrail. After striking the guardrail, the case vehicle then traveled down the embankment rolling ten quarter turns. This occupant was ejected through the right rear window. She came to rest on the roadside 13.6 m (44.6 ft) east of the guardrail. During the rollover sequence she was likely caught between the vehicle and the ground and crushed prior to being fully ejected.



Figure 14. 2nd row right occupant seated position

Attachment 1. Scene Diagram

