

Child Safety Seat Fatality Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS04015
2004 Volkswagen Beetle
Oregon
July, 2004

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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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16. Abstract <p>This on-site investigation focused on the performance of a rear-facing child safety seat (CSS) that was installed in the right rear position of a 2004 Volkswagen Beetle. The Volkswagen Beetle was being driven by a restrained 54-year-old female. The front right seat was occupied by a restrained 25-year-old female. The rear right seat was occupied by an 8-month-old male child who was seated in the rear facing CSS. The Beetle was struck in the front by a 2004 Chrysler Pacifica that had lost control and crossed the median into the Beetle's travel path. The Beetle was pushed into a sharp, clockwise rotation and came to rest on the roadway facing generally north. The Pacifica continued its counterclockwise rotation as it left the roadway. The front of the Pacifica struck a guardrail on the west side of the roadway where it came to rest. The driver of the Volkswagen Beetle sustained ankle and femur fractures, multiple contusions, and a neck strain. The front right occupant sustained a severely comminuted right ankle fracture dislocation, an acetabular fracture, a right hip dislocation, right side rib fractures, a pulmonary contusion, and multiple contusions and abrasions. The infant in the Volkswagen was fatally injured. The infant was found upside down, in the infant seat, behind the driver's seat. He sustained blunt trauma to the back of the head, as well as a variety of contusions and abrasions.</p>			
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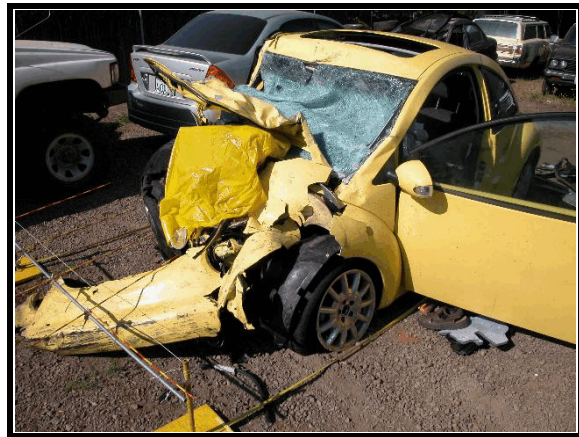
Dynamic Science, Inc.
Crash Investigation
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BACKGROUND:

This on-site investigation focused on the performance of a rear-facing child safety seat (CSS) that was installed in the right rear position of a 2004 Volkswagen Beetle. The Volkswagen Beetle was being driven by a restrained 54-year-old female. The front right seat was occupied by a restrained 25-year-old female. The rear right seat was occupied by an 8-month-old male child who was seated in the rear facing CSS. The Beetle was struck in the front by a 2004 Chrysler Pacifica that had lost control and crossed the median into the Beetle's travel path. The impact resulted in sufficient longitudinal deceleration of the Beetle to



command the deployment of the frontal air bag system. The Beetle was pushed into a sharp, clockwise rotation and came to rest on the roadway facing generally north. The Pacifica continued its counterclockwise rotation as it left the roadway. The front of the Pacifica struck a guardrail on the west side of the roadway where it came to rest. The driver of the Volkswagen Beetle sustained an open fracture/dislocation of the right ankle, a right femur fracture, multiple contusions, and a neck strain. The front right occupant sustained a severely comminuted right ankle fracture dislocation with vertical shear injury to talus, a comminuted acetabular fracture, a right hip dislocation, right side rib fractures, a pulmonary contusion, a large right knee laceration, and multiple contusions and abrasions. The infant in the Volkswagen was fatally injured. The infant was found upside down, in the infant seat, behind the driver's seat. He sustained blunt trauma to the back of the head, as well as a variety of contusions and abrasions.

This Child Safety Seat Fatality Investigation was identified by a Child Passenger Safety Seat Technician who had been contacted by the investigating police agency. NHTSA was notified on July 22, 2004. DSI was assigned the case on July 22, 2004. Field work was completed on July 29, 2004.

SUMMARY

Crash Site

This two vehicle crash occurred at 1050 hours in July, 2004 in a rural area of Oregon. The crash occurred on a four-lane divided interstate roadway. This is a north/south interstate. There are two travel lanes in both directions. The northbound lanes are bordered on the right by a yellow lane line and an asphalt shoulder and on the left by a rumble strip grooved shoulder. The southbound lanes are bordered on the right by a



Figure 2. Overview of northbound vehicle approach

yellow lane line and an asphalt shoulder and on the left by a rumble strip grooved shoulder. Parallel to the southbound lane is a metal guardrail. The north/southbound lanes are separated by a grass covered median that contains a row of hedges (approximately 1.8-2.4 m (6-8 ft) in height). The speed limit in both directions is 105 km/h (65 mph). The weather was clear and dry.

Pre-Crash

The case vehicle is a 2004 Volkswagen Beetle two-door sedan being driven by a restrained 54-year-old female. The Beetle was equipped with dual front air bags. The front right seat was occupied by a restrained 25-year-old female. The rear right seat was occupied by an 8-month-old male child (8.6 kg/19 lbs, 69.9 cm/27.5 in)¹. The child had been placed in an Evenflo Discovery rear facing 3-point infant seat (model 2091F2P1, manufacture date 12/13/99). The other vehicle was a 2004 Chrysler Pacifica sport utility vehicle driven by a 70-year-old male. The Pacifica was equipped with dual front air bags, a driver-side knee air bag, and dual head-protecting curtain side air bags that cover all three seating rows.



Figure 3. Final rest, Volkswagen Beetle (looking south)



Figure 4. Final rest, Chrysler Pacifica

¹Rounded in EDCS to 71 cm (28 in), 9 kg (19 lbs)

The driver of the Pacifica has Parkinson's disease. He was using Mirapex² at some point prior to the crash. He was also using Mobic³ to relieve the symptoms of osteoarthritis in adults. The driver also had a history of neurologic problems that involve weakness in the lower extremities and has recently required use of bilateral Canadian forearm crutches for activity.

The Volkswagen was traveling southbound. The Pacifica was traveling northbound. The driver of the Pacifica apparently lost consciousness due to the Mirapex medication. The Pacifica departed the roadway on the left side and entered the median at a diagonal. The Pacifica was tracking as it left the roadway. The vehicle traveled approximately 165 m (540 ft) in the median. At some point prior to re-entry into the southbound travel lanes the vehicle began a counterclockwise rotation. The Pacifica had rotated approximately 90 degrees.



Figure 5. Right side, Volkswagen Beetle

Crash

At this point, the front of the Beetle (11FDEW4) struck the right side of the Pacifica (02RPAW5). The total velocity change for the Volkswagen Beetle as calculated by the WinSmash program was 85.2 km/h (53.0 mph)⁴. The longitudinal and lateral delta V components were -80.1 km/h (-49.8 mph) and 29.1 km/h (18.1 mph), respectively. Both front air bags and the right side air bag in the Volkswagen deployed at this time. The total velocity change for the Pacifica was 50.0 km/h (31.1 mph). The longitudinal and lateral delta V components were -17.1 km/h (-10.6 mph) and -47.0 km/h (-29.2 mph), respectively.

The Beetle was pushed into a sharp, clockwise rotation and came to rest on the roadway facing generally north. The Pacifica continued its counterclockwise rotation as it left the roadway. The front of the Pacifica struck a guardrail on the west side of the roadway where it came to rest.

²Mirapex: This medicine is a dopamine agonist used to treat Parkinson's Disease. Side effects include nausea, constipation, insomnia, sleepiness, dizziness, or headache.

³Mobic: This medicine is a nonsteroidal anti-inflammatory drugs (NSAIDs). Mobic works by reducing hormones that cause inflammation and pain in the body.

⁴Stiffness values derived from NCAP test 3051

Post-Crash

The driver of the Volkswagen Beetle sustained an open fracture/dislocation of the right ankle, a right femur fracture, multiple contusions, and a neck strain. She was transported by ground ambulance to a local hospital. She was treated and then hospitalized for nine days.

The front right occupant sustained a severely comminuted right ankle fracture dislocation with vertical shear injury to talus, a comminuted acetabular fracture, a right hip dislocation, right side rib fractures, a pulmonary contusion, a large right knee laceration, and multiple contusions and abrasions.

The infant in the Volkswagen was fatally injured. The infant was found upside down, in the infant seat, behind the driver's seat. He sustained blunt trauma to the back of the head, as well as a variety of contusions and abrasions. Two witnesses to the crash removed the child from the rear of the vehicle and began CPR. As paramedics arrived, the child was in the infant seat on the pavement directly behind the Volkswagen.

The driver of the Pacifica sustained a right hip dislocation, a serious forehead laceration, and a variety of contusions and abrasions. He was transported from the scene by ground ambulance to a locale hospital where he arrived with a Glasgow Coma Scale score of 15. He was treated and then hospitalized for five days.

EMS response to the crash is shown below:

<u>Event</u>	<u>Time</u>
Crash	1050
EMS notified	1050
EMS arrival	1109

Both vehicles were towed from the scene due to damage.



Figure 7. Right side, Chrysler Pacifica



Figure 6. Contact damage from guardrail impact

VEHICLE DATA - 2004 Volkswagen Beetle GLS

The 2004 Volkswagen Beetle was identified by the Vehicle Identification Number (VIN): 3VWCR31C14Mxxxxxx. The vehicle's odometer could not be read since there was no power available. The Volkswagen was a two-door coupe that was equipped with a 2.0 liter, four cylinder engine, front wheel drive, anti lock brakes, power assisted front and rear disc brakes, a five mph bumper, and height adjustable and telescoping steering column.

The 2004 Volkswagen Beetle was equipped with Continental Contitouring Contact P205/55R16 tires. The specific tire data is as follows:

Tire	Tread	Measured pressure	Manufacturer recommended pressure
LF	6 mm (8/32")	Flat	303 kPa (44 psi)
LR	7 mm (9/32")	117 kPa (17 psi)	303 kPa (44 psi)
RF	6 mm (8/32")	Flat	303 kPa (44 psi)
RR	7 mm (9/32")	234 kPa (34 psi)	303 kPa (44 psi)

The front seating positions in the 2004 Volkswagen Beetle were configured with fabric covered bucket seats with adjustable head restraints. The rear seating positions were configured with a bench seat with a folding back.

VEHICLE DAMAGE

Exterior Damage - 2004 Volkswagen Beetle

Damage Description:	Major front end crush.	
CDC:	11FDEW4	
Delta V:	Total	85.0 km/h (52.8 mph)
	Longitudinal	-80 km/h (-49.7 mph)
	Latitudinal	29.0 km/h (18.0 mph)
	Energy	639,810 joules (471,899 ft-lbs)

This vehicle sustained 150.0 cm (59.0 in) of direct contact to the front bumper corner from the impact with the right side Chrysler Pacifica. The residual crush measured along the bumper was as follows: C1=26.0 cm (10.2 in), C2=46.0 cm (18.1 in), C3=65.0 cm (25.6 in), C4=73.0 cm (28.7 in). The maximum crush was measured at C1. The principle direction of force was within the 11 o'clock sector and was an estimated 340 degrees. There was end shift to the right. The damaged components included the bumper fascia and reinforcement bar, hood, grille, and radiator. Both wheelbases were shortened; the left by 15.0 cm (5.9), the right by 51.0 cm (20.0 in). The front right door was jammed shut. The windshield was damaged and cracked. The front right window was disintegrated from impact forces.

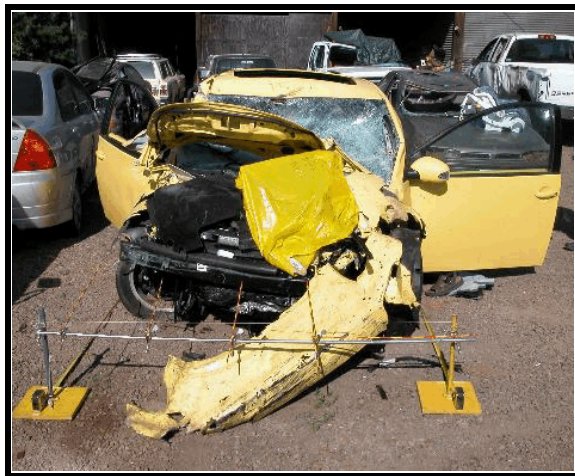


Figure 8. Front, Volkswagen Beetle

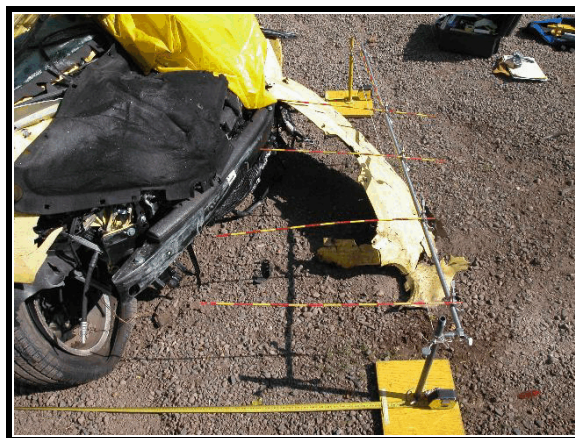


Figure 9. Right side view showing depth of crush

Interior Damage - 2004 Volkswagen Beetle

Interior damage to the Volkswagen Beetle was significant and was attributed to occupant contact and passenger compartment intrusion. The windshield sustained fracture damage from impact forces. The right side glass was disintegrated by impact forces. There was longitudinal intrusion to the driver's seated area from both the toe pan and instrument panel, with the maximum intrusion from the toe pan measuring 6.0 cm (2.3 in). There was longitudinal intrusion to the front left seat area from the instrument panel, the toe pan, the A pillar and the area forward of the A pillar. The maximum intrusion to the right front was to the A pillar and measured 20.0 cm (7.9 in). It appears that both front doors were initially jammed shut and had to be opened by rescue personnel. The steering wheel collapsed due to occupant loading and the rim was deformed 5.0 cm (1.9 in) forward.



Figure 10. Interior view from left side

MANUAL RESTRAINT SYSTEMS - 2004 Volkswagen Beetle

The Volkswagen Beetle was configured with manual 3-point lap and shoulder belts with sliding latch plates for all four seating locations. The driver's manual restraint was configured with an emergency locking retractor (ELR). The remaining restraints were configured with switchable retractors that were in the ELR mode at the time of the vehicle inspection. The right rear seat belt was being used with an infant safety seat at the time of the crash.

FRONTAL AIR BAG SYSTEM - 2004 Volkswagen Beetle

The Volkswagen Beetle was equipped with dual stage frontal air bags for the driver and front right passenger positions that deployed as a result of the frontal impact with the Pacifica. The driver's air bag was housed in the steering wheel hub with an inverted U configuration module cover. The driver's air bag was circular in shape and measured 56.0 cm (22.0 in) in diameter in its deflated state. The air bag was vented by a single, circular vent port at the 12 o'clock position. The air bag was tethered by a single internal strap. The right side of the air bag sustained minor cuts from contact with the windshield. There were no visible contacts or damage to the module cover.



Figure 11. Driver's air bag

The front right passenger's air bag was housed in the mid instrument panel with a single cover flap. The flap measured 34.0 cm (13.4 in) wide by 17.0 cm (6.7 in) high. The flap is attached at the base of the flap to the instrument panel by a single, horizontal flap that measured 24.0 cm (9.5 in) wide by 13.0 cm (5.1 in) in length. The front right passenger's air bag was vaguely rectangular in shape and measured 58.0 cm (22.8 in) high by 40.0 cm (15.7 in) wide. The bag had a single circular vent port on the right side. There were no tethers. There was no contacts or damage to the air bag or the module cover.



Figure 12. Driver's air bag module cover

The Beetle was also equipped with seat back mounted side air bags. The front right passenger side air bag deployed during the crash. The air bag has a bow-tie shape. The width was 64.0 cm (25.2 in). The height at both ends was 31.0 cm (12.2 in) and narrows to 24.0 cm (9.5 in) in the middle. There is a single horizontal seam. There were no tethers. There was no contacts or damage to the air bag or the module cover.



Figure 13. Front right passenger air bag



Figure 14. Back side of passenger air bag module cover—showing tether to base of cover



Figure 15. Right, seat back mounted side air bag

CHILD SAFETY SEAT - 2004 Volkswagen Beetle

The rear right was occupied by an 8-month-old male child (8.6 kg/19 lbs, 69.9 cm/27.5 in). The child had been placed in an Evenflo Discovery rear facing 3-point infant seat (Model 2091F2P1, manufacture date 12/13/99). The manufacturer recommends usage for infants weighing between 2.3- 9.0 kg (5 - 20 lbs). The infant seat base was placed on the fabric covered bench seat. The carrying handle was in the up position rather than down. The infant seat was designed with a detachable stay-in-vehicle base. The seat attaches to the base by fitting the aft end of the seat into a single locking tab, then dropping the seat into the dual locking tabs. The locking occurs automatically. The seat base was anchored to the vehicle using the lap and shoulder belt. LATCH anchors were available in the vehicle. The seat belt was equipped with a switchable retractor and a sliding latch plate. It is unknown whether or not the seat belt was switched from the Emergency Locking Retractor (ELR) mode to the Automatic Locking Retractor (ALR) mode. The length of the infant seat was 58.0 cm (22.8 in). When placed in the vehicle, the back of the infant seat is either in contact with the back of the front right passenger seat or very nearly so—depending on the seat back angle.

At impact, the child and infant seat responded to the 11 o'clock direction of force by moving forward and to the left. There are clear indications that the child was initially held in place by the infant seat harness. There were bilateral shoulder contusions/abrasions, most significantly on the right side of the child (see graphic images at the end of this report). The child's head engaged the interior of the infant seat. There are clear indications that the seat base and lap and shoulder belt sustained impact related loading (13.0 cm/5.1 in long, starting 36.0 cm/14.2 in from the button stop).



Figure 17. Side view, Evenflo Discovery infant seat

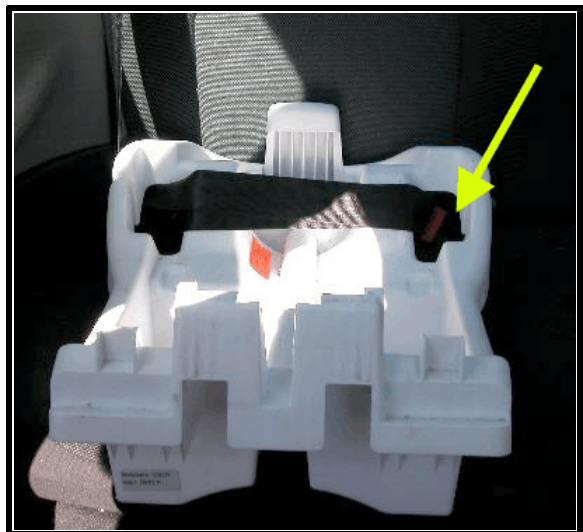


Figure 16. Infant seat base (arrow indicate area of loading to lap and shoulder belt)

After the initial impact, the infant seat came out of the base. The infant was found upside down, in the infant seat, behind the driver's seat. The seat base was found in place, still anchored to the vehicle. There were no indications that the seat base/seat locking mechanism failed.

For the infant seat to come out of the base it would have been necessary for the release handle on the leading side of the infant seat to be rotated upward. The amount of movement and the force required for movement is minimal.

During the impact the infant seat and front right passenger seat back both traveled forward. The infant seat twisted clockwise and traveled forward approximately 13.0 cm (5.2 in). There was loading and compression to the infant seat, causing the fracture on the right side. At some point during the impact, the release handle was either in contact with the seat back (or possibly a diaper/bottle bag that was in the rear seat). As the impact terminated and the vehicle began a sharp clockwise rotation, the seat back and infant seat began to reconstitute. This movement between the two surfaces caused the release handle to move/rotate upward. At this point, the seat was released from the base. The continuing clockwise rotation caused the seat to come out of its base and pitch to the left where it came to rest upside down.



Figure 18. Distance between infant seat and vehicle seat back



Figure 19. Loading to lap and shoulder belt at the right rear seat position



Figure 20. Fracture to infant seat back

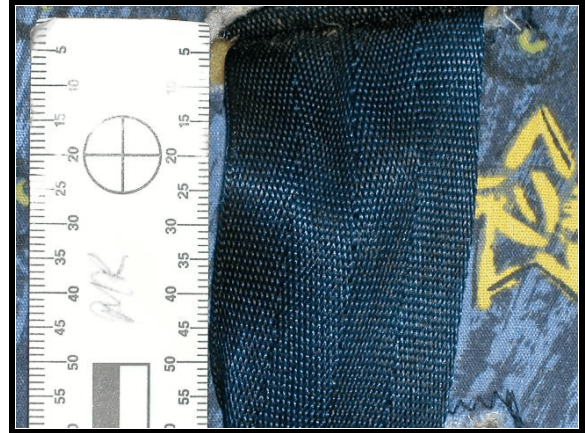


Figure 21. Skin transfer to right infant seat harness

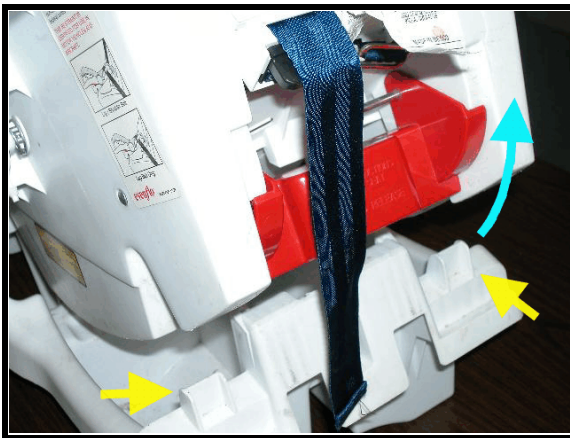


Figure 22. Seat release movement



Figure 23. Bottle/diaper bag

VEHICLE DATA - 2004 Chrysler Pacifica

The 2004 Chrysler Pacifica was identified by the Vehicle Identification Number (VIN): 2C8GF6842Rxxxxxx. The 2004 Chrysler Pacifica was a four door, six passenger sport utility vehicle. The vehicle was equipped with a 3.5 liter, six cylinder engine, four-wheel drive, 4-speed automatic transmission, power windows, power steering, tilt steering wheel, 8-way power driver seat, 4-way power passenger seat, 8-way power driver seat, 4-way power passenger seat, air conditioning, power door locks, remote keyless entry, Infinity AM/FM/CD player, analog clock, tachometer, illuminated visor mirrors, map lights, variable-intermittent wipers, rear defogger, rear wiper/washer, and automatic-off headlights.

VEHICLE DAMAGE

Exterior Damage - 2004 Chrysler Pacifica

Damage Description:	Major right side damage.	
CDC:	02RYAW5	
Delta V:	Total	50.0 km/h (31.1 mph)
	Longitudinal	-17.1 km/h (-10.6 mph)
	Latitudinal	-47.0 km/h (-29.2 mph)
	Energy	Unknown

This vehicle sustained 277.0 cm (109.0 in) of direct contact to the right side from the impact with the front of the Volkswagen. The damage began at the right rear axle and extending forward. The residual crush measured at the mid door level was as follows: C1=0 cm (0 in), C2=64.0 cm (25.2 in), C3=78.0 cm (30.7 in), C4=79.0 cm (31.1 in), C5=45.0 cm (17.7 in), C6=0 cm (0 in). The maximum crush was measured at C4. The principle direction of force was within the 2 o'clock sector and was an estimated 70 degrees. All the glazing on the right side was disintegrated from impact forces. Both right side doors were jammed shut. The right side wheelbase was shortened by 45.0 cm (17.7 in). The windshield was damaged and cracked.



Figure 24. Right side, Chrysler Pacifica

AIR BAG SYSTEMS - Chrysler Pacifica

The Chrysler Pacifica was equipped with dual stage frontal air bags for the driver and front right passenger positions that deployed as a result of the side impact with the Volkswagen.

The Pacifica was also equipped with a driver's side knee air bag and dual head-protecting curtain air bags that cover all three seating rows. The knee air bag and the right side curtain also deployed during the impact with the Volkswagen.

The driver's air bag was housed in the steering wheel hub with a U configuration module cover. The driver's air bag was circular in shape and measured 60.0 cm (23.6 in) in diameter in its deflated state. The air bag was vented by two circular vent ports at the 1 and 11 o'clock positions. There air bag was tethered by a single internal strap. There were no visible contacts or damage to the module cover. There was post-crash blood found on the face of the air bag.

The driver's knee bag was housed in the lower instrument panel with a rectangular module cover. The cover measured 28.0 cm (11.0 in) high by 44.0 cm (17.3 in) wide. The air bag was roughly rectangular in shape and measured 34.0 cm (13.4 in) high by 44.0 cm (17.3 in) wide. There were no visible contacts or damage to the module cover. There was no damage to the air bag.

The front right passenger's air bag was housed in the top of the instrument panel. The front right passenger's air bag was rectangular in shape and measured 44.0 cm (17.3 in) wide by 58.0 cm (22.8 in) high in its deflated state. There was a single circular vent port on the right side and no tethers.



Figure 25. Overview of driver air bag, knee air bag, and passenger frontal air bag



Figure 26. Close up view of knee air bag

The right side air curtain was housed in the roof rail cladding. It was essentially rectangular in shape. It measured 201.0 cm (79.1in) long by 48.0 cm (18.9 in) high. The curtain covered all three seating positions in the right side. The front bottom of the curtain was tethered to the A pillar, the rear bottom was tethered just rear of the D pillar.



Figure 27. View of air curtain covering front right and second seat right positions



Figure 28. View of air curtain covering third row seat

OCCUPANT DEMOGRAPHICS - 2004 Volkswagen Beetle

	Driver	Occupant 2
Age/Sex:	55/Female	25/Female
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat. Seat adjusted to rear most track position. Seat back slightly reclined.	Fabric covered bucket seat. Seat adjusted to rear most track position. Seat back slightly reclined.
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Not working
Pre-existing Medical Condition:	Significant for a bilateral total knee arthroplasties (knee joint replacement)	Congenital deformity of the right hand with long standing weakness. Amputations on right hand from previous injury.
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Presumed to be greater than 10 years	NA
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Unknown	Unknown
Foot Position:	Right foot on brake, left on floor	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used
Air bag:	Steering wheel mounted front air bag available, deployed. Seat back mounted side air bag, did not deploy.	Mid mount front air bag available, deployed. Seat back mounted side air bag, deployed.

	Occupant 3
Age/Sex:	8-month-old /
Seated Position:	Second seat right
Seat Type:	Fabric covered bench seat with a folding back.
Height:	69.8 cm (27.5 in), crown to heel
Weight:	8.8 kg (19 lbs, 2 oz), without clothes
Occupation:	NA
Pre-existing Medical Condition:	None
Alcohol/Drug Involvement:	NA
Body Posture:	Child seat position, semi reclined
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used with child safety seat

OCCUPANT DEMOGRAPHICS - 2004 Chrysler Pacifica

	Driver
Age/Sex:	70/Male
Seated Position:	Front left
Seat Type:	Leather covered bucket seat.
Height:	Unknown
Weight:	117 kg (257 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	Parkinson's, osteoarthritis, hypertension, gastroesophageal reflux disorder, right hip replacement, left knee replacement
Alcohol/Drug Involvement:	Prescription drug involvement. Loss of consciousness due to Miraplex usage.
Driving Experience:	Unknown, presumed to be greater than 20 years
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt available, used

OCCUPANT INJURIES - 2004 Volkswagen Beetle

	Injury	OIC Code	Injury Mechanism	Confidence Level
Driver:	Open fracture, right ankle	852002.2,1	Brake	Certain
	Dislocation, right ankle	850210.1,1	Brake	Certain
	Comminuted right fibula fracture	851605.2,1	Lower instrument panel	Certain
	Right supracondylar femur fracture, non displaced	851822.3,1	Lower instrument panel (indirect)	Certain
	Contusion, posterior aspect of right hip	690402.1,1	Seat	Probable
	Abrasion over anterior aspect of right knee, 1.0 x 2.0 cm (0.4 x 0.8 in)	890202.1,1	Lower instrument panel	Certain
	Laceration, left elbow, 4 cm long, lateral aspect	790602.1,2	Unknown	Unknown
	Mild abrasions over legs	890202.1,1 890202.1,2	Lower instrument panel	Probable
	Chest wall contusion, minor	490402.1,9	Shoulder belt	Certain
	Cervical strain, minor	640278.1,6	Impact forces	Probable
Front seat, right:	Severely comminuted ankle fracture dislocation with vertical shear injury to talus	853200.2,1 (talus fracture) 850210.2,1 (ankle dislocation)	Floor	Certain
	Comminuted acetabular fracture, right	852604.3,1	Glove box door (indirect)	Certain
	Full thickness tear through abductor muscle, right	840600.2,1	Glove box door (indirect)	Certain
	Dislocation of right hip	850610.2,1	Glove box door	Certain
	Multiple contusions and abrasions	990400.1,9 990200.1,9	Unknown	Unknown

	Fractured ribs, right pneumothorax with two rib fractures	450222.3,1	Shoulder belt	Certain
	Pulmonary contusion	441402.3,9	Shoulder belt	Certain
	Large open laceration, right knee	890600.1,1	Lower instrument panel	Probable
Second seat, right	Brain lacerations, due to overriding plates of skull	140688.4,9	Child seat back	Certain
	Skull fracture, 20.3 cm (8.0 in), from left frontal bone, to left coronal suture, to sagittal suture (which is dislocated), then posteriorly along sagittal suture to near the lambda where the fracture bifurcates along the two lambdoidal sutures into elliptical fractures measuring 6.3 cm (2.5 in) in long by 3.8 cm (1.5 in) wide which are comminuted, dislocated, depressed and elevated	150400.2, 5 (frontal bone) 150040.3,2 (parietal) 150404.3,6 (occipital)	Child seat back	Certain
	Fracture, right clavicle	752200.2,1	Child seat harness	Probable
	Fracture, left humerus	752600.2,2	Unknown	Unknown
	Contusion, intercostal muscle between ribs 5, 6, and 7 at the mid clavicular line	490402.1,4	Child seat harness	Probable
	Contusion, posterior midline of occipital scalp, 2.5 x 0.9 cm (1.0 in x 0.38 in)	190402.1,6	Child seat back	Certain
	Abraded contusion, T-shaped, bilateral posterior scalp, coronal arm measured 7.6 x 1.9 cm (3.0 x 0.75 in), sagittal arm measured 7.6 x 1.3 cm (3.0 x 0.5 in)	190402.1,1 190402.1,2	Child seat back	Certain

Triangular abrasion, right parietal scalp, measured 1.3 cm (0.5 in) to a side	190202.1,1	Unknown	Unknown
Elliptical abraded contusion, low left parietal scalp	190402.1,2	Unknown	Unknown
Circular abrasion, left parietal scalp, 0.9 cm (0.4 in) in diameter	190202.1,2	Unknown	Unknown
Abrasion, forehead, 0.6 cm (0.3 in) above right eyebrow, vertical elliptical in shape, measured 0.9 x 0.48 (0.4 x 0.19 in)	290202.1,7	Unknown	Unknown
Circular abrasion, right temple, 0.9 cm (0.38 in) diameter	290202.1,1	Unknown	Unknown
Abrasion, right cheek and chin, vertical elliptical measured 6.4 x 1.9 cm (2.5 x 0.75 in)	290202.1,1 290202.1,8	Unknown	Unknown
Abrasion, right shoulder at junction with neck, L shaped, 10.2 x 3.8 cm (4.0 x 1.5 in) vertically, 7.6 x 3.8 cm (3.0 x 1.5 in) horizontally	790202.1,1	Child seat harness	Certain
Contusion, right wrist	790402.1,1	Unknown	Unknown
Contusions, right middle and ring fingers	790402.1,1 790402.1,1	Unknown	Unknown
Contusion, left upper arm, C shaped, with horizontal abrasions within C	790402.1,2 790202.1,2	Unknown	Unknown
Contusion, left forearm	790402.1,2	Unknown	Unknown
Contusion, right thigh	890402.1,1	Unknown	Unknown
Abrasion, upper left thigh, below inguinal crease	890202.1,2	Child seat harness	Probable
Abrasion, right calf	890202.1,1	Unknown	Unknown
Contusion, left knee cap	890402.1,2	Unknown	Unknown

Abrasions, L shaped, posterior surface of left calf	890202.1,2	Glass	Possible
Contusion, left back over lower end of rib cage	690402.1,2	Child seat back	Probable

OCCUPANT INJURIES - Chrysler Pacifica

	Injury	OIC Code	Injury Mechanism	Confidence Level
Driver:	Forehead laceration, 8.0 cm (3.1 in) long with 2.0 cm (0.8 in) of missing tissue ⁵	290802.1,7	Windshield	Possible
	Eyelid/brow laceration, 3.0 cm (1.2 in)	290602.1,7 297602.1,1	Windshield	Possible
	Right hip dislocation	850610.2,1	Center console/center IP	Probable
	Ecchymosis, right lateral thigh	890402.1,1	Center console	Probable
	Bilateral arm abrasions	790202.1,1 790202.1,2	Air bag	Possible
	Anterior chest contusion	490402.1,9	Shoulder harness	Possible
	Right pointing finger laceration	790600.1,1	Unknown	Unknown

⁵Coded as an avulsion

OCCUPANT KINEMATICS - 2004 Volkswagen Beetle

Driver Kinematics

The 55-year-old female driver of the Volkswagen Beetle was seated in the fabric covered bucket seat in a normal, upright fashion. The seat was adjusted to the rear most track position. The seat back was slightly reclined. She was wearing the available lap and shoulder belt. Her right foot was on the brake, the left on floor. She reported that she did not take an evasive steering actions. Both hands were on the steering wheel. At impact with the Chrysler Pacifica, the frontal air bag deployed. The female driver exhibited a forward and slightly left trajectory in response to the 11 o'clock direction of the impact force. She loaded the safety belt—causing hip and torso contusions. She flexed forward and engaged the deployed air bag. Both of her knees and lower legs engaged the lower instrument panel—causing a right fibula fracture, lower leg abrasions, and an indirect loading type right femur fracture. The driver's right foot flexed laterally due to the braking and impact and she sustained an open fracture/dislocation to her right ankle.



Figure 29. Left lower instrument panel and foot controls

Front right seat occupant kinematics

The 25-year-old female front right passenger was seated in the fabric covered bucket seat in a normal, upright fashion. The seat was adjusted to the rear most track position. The seat back was slightly reclined. She was wearing the available lap and shoulder belt. Both of her feet were likely on the floor. At impact with the Chrysler Pacifica, the frontal and right side air bags deployed. This female occupant exhibited a forward and slightly left trajectory in response to the 11 o'clock direction of the impact force. She loaded the safety belt—causing right side rib fractures and a pulmonary contusion from contact to the shoulder belt. Her right knee contacted the glove box door—causing a knee laceration and indirect loading to the right acetabulum causing dislocation of the right femur. This same motion caused a full thickness tear through the right abductor muscle.



Figure 30. Contact to glove box door

Rear right child kinematics

The 8-month-old male rear right seat occupant had been placed in an Evenflo Discovery rear-facing 3-point infant seat. The child was properly restrained with the carrying handle left in the up position. The infant seat was designed with a detachable stay-in-vehicle base. The base was anchored to the vehicle using the available lap and shoulder belt. At impact, the child and infant seat responded to the 11 o'clock direction of force by moving forward and to the left. There are clear indications that the child was initially held in place by the infant seat harness. There were bilateral shoulder contusions/abrasions, most significantly on the right side. He engaged the shoulder harness on the right side—causing a right side clavicle fracture. The child's head engaged and loaded the interior of the infant seat—causing the skull fractures and brain injuries. The skull injuries appear to be loading type injuries that formed along the skull sutures. The child seat was being reinforced by the front right seat back. The plastic shell of the child seat was fractured due to contact with the front seat back.

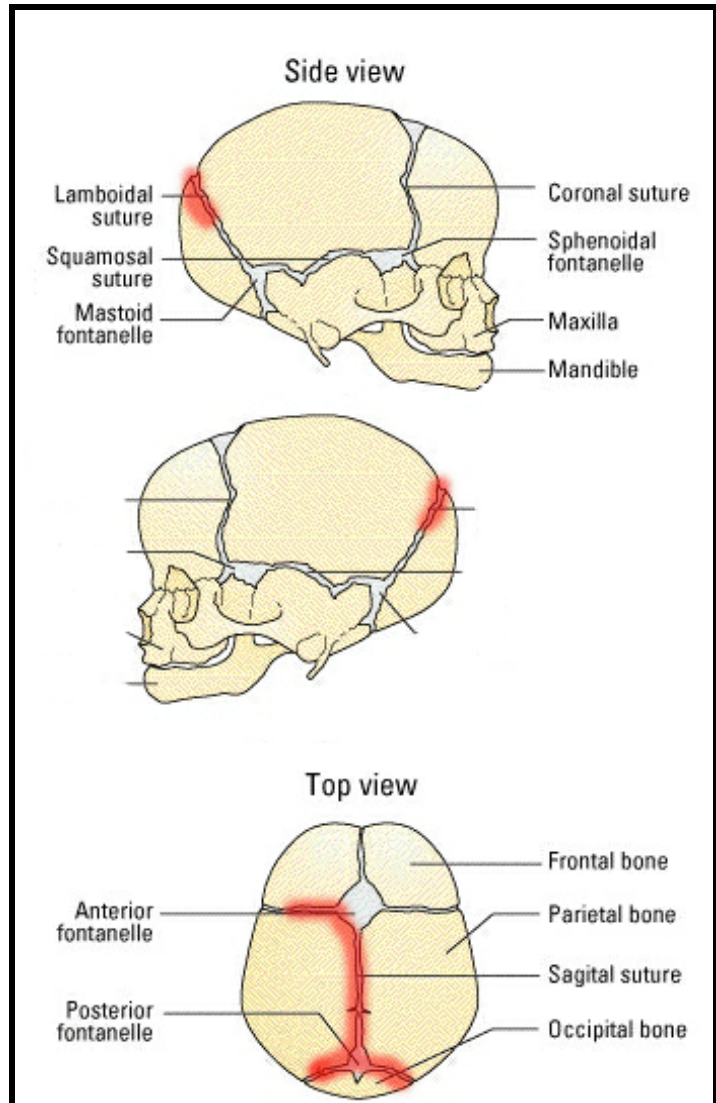


Figure 31. Fracture lines along sutures (fractures in red)

Attachment 1. Scene Diagram

