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# REMOTE AIR BAG REPORT

CASE NUMBER - IN00-009
LOCATION - TEXAS
VEHICLE - 1996 LEXUS ES300
CRASH DATE - October, 1999

Submitted:

November 10, 2000

Revised Submission:

May 24, 2001


Contract Number: DTNH22-94-D-17058


Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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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.

**Technical Report Documentation Page**

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Remote air bag deployment investigation involving a 1996 Lexus ES300, four-door sedan, with manual safety belts and dual front air bags, and a 1991 Dodge Grand Caravan LE, three-door minivan

16. *Abstract*

This report covers a remote investigation of an air bag deployment crash that involved a 1996 Lexus ES300 (case vehicle) and a 1991 Dodge Grand Caravan LE (other vehicle). This crash is of special interest because the case vehicle's front right infant passenger (4-month-old male), who was restrained in a rear facing child safety seat (RFCSS), sustained a critical brain injury from the deploying front right passenger air bag, resulting in his death. The case vehicle was traveling east in the center, eastbound, through lane of a seven-lane, divided, city roadway (i.e., both the east and westbound roadways had three through lanes, and there were opposing left-hand turn lanes on both the east and west legs of the four-leg intersection). The Dodge had been stopped heading north in northbound lane of a two-lane, undivided, city street and accelerated forward, attempting to make a left-hand turn. The crash occurred in the center through lane of the eastbound roadway within the intersection of the two city trafficways. The front left half of the case vehicle impacted the left quarter panel of the Dodge, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's front right seat track was located between its middle and rearmost positions. According to the driver's deposition, the front right infant passenger's child safety seat was restrained by the available, active, three-point, lap-and-shoulder, safety belt system. According to his autopsy, the front right passenger sustained critical craniocerebral injuries which included: bilateral subdural hemorrhages; epidural and subarachnoid hemorrhages; cerebral edema; a contusion to the upper posterior portion of the right frontal lobe; skull fractures involving the right frontal and parietal bones; abrasions across the top of the scalp near the frontoparietal area; and a large contusion along the top right side of the scalp. The case vehicle's driver (26-year-old female) was seated with her seat track located in its forward-most position, and the tilt steering wheel was located near its middle position. The case vehicle's driver was restrained by her available, active, three-point, lap-and-shoulder, safety belt system. She sustained air bag-related burns (i.e., friction abrasions) but claims that she did not receive any treatment for her injuries. The specific injuries sustained by the case vehicle's driver are unknown.

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## BACKGROUND

IN00-009

This remote report was brought to NHTSA's attention on March 29, 2000 through the Fatality Analysis Reporting System. This crash involved a 1996 Lexus ES300 (case vehicle) and a 1991 Dodge Grand Caravan LE (other vehicle). The crash occurred in October, 1999, at 4:26 p.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle's front right infant passenger [4-month-old, White (Hispanic) male], who was restrained in a rear facing child safety seat (RFCSS), sustained a critical brain injury from the deploying front right passenger air bag, resulting in his death. This contractor obtained from the attorney representing the case vehicle's driver a deposition given by the driver; however, no interview was obtained. This report is based on the Police Crash Report, on-scene police photographs, occupant kinematic principles, a deposition given by the case vehicle's driver, the front right infant passenger's autopsy report, and this contractor's evaluation of the evidence.

## CRASH CIRCUMSTANCES

The case vehicle was traveling east in the center, eastbound, through lane of a seven-lane, divided, city roadway (**Figure 1**) and intended to continue traveling eastward (i.e., both the east and westbound roadways had three through lanes, and there were opposing left-hand turn lanes on both the east and west legs of the four-leg intersection). The Dodge which had been stopped heading north in the northbound lane of a two-lane, undivided, city street (**Figure 2** and **Figure 3** below), accelerated forward, attempting to make a left-hand turn and travel west on the westbound roadway. A noncontact vehicle had been traveling eastbound in the outside, eastbound lane, and it turned right and traveled south on the two-lane city street, blocking the Dodge's line-of-sight. The case vehicle's driver braked (without depositing any skid marks) and steered to the right, attempting to avoid the crash. The crash occurred in the center through lane of the eastbound roadway within the Tee intersection of the two city trafficways. It should be noted that a driveway access junction overlaid the Tee intersection. The driveway access (**Figure 3** below) formed the north leg, making the combination junction a four-leg intersection. In addition, a left-hand turn lane provided access to the driveway from the eastbound roadway.

**Figure 1:** Case vehicle's eastward travel path in center eastbound through lane of divided seven-lane, divided trafficway approaching four-leg intersection (case photo #01)

**Figure 2:** View from case vehicle's eastbound center lane of other vehicle's pre-impact position on south leg of four-leg intersection (case photo #02)

The east and westbound roadways of the city trafficway are divided by a raised concrete median. The eastbound roadway was straight and level at the area of impact. The pavement was concrete, and the width of the inside, center, and outside through lanes were each 3.4 meters (11 feet). The city roadway intersecting from the south was also straight and level. Its pavement was concrete, and the width of the roadway was 7.6 meters (25 feet). All roadways were bordered by barrier curbs. For the eastbound roadway, raised white pavement markers (**Figure 1** above) are used to delineate and separate the three through lanes and the left-hand turn lane. There were no pavement markings or edge lines present on any of the roadways. The estimated coefficient of friction for the eastbound roadway was 0.62. There were no visible traffic controls for the eastbound roadway. A regulatory STOP sign (Manual on Uniform Traffic Control Devices, R1-1) was located on the east side of the south leg of the intersection, controlling the movement of northbound traffic (**Figure 3**). The statutory speed limit was 56 km.p.h. (35 m.p.h.) for the divided, city trafficway and 48 km.p.h. (30 m.p.h.) for the two-lane, city roadway. No regulatory speed limit sign was posted near the crash site. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the road pavement was dry. Traffic density is unknown, and the site of the crash was urban and a combination of residential and commercial. Once again, a commercial driveway formed the north leg of the four-leg intersection (**Figure 3**).


**Figure 3:** Other vehicle's travel path on south leg approaching four-leg intersection; Note: drive-way access in background constitutes fourth (northern) leg (case photo #05)

The front left half (**Figure 4** and **Figure 5** below) of the case vehicle impacted the left quarter panel (**Figure 6** below) of the Dodge, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle came to rest, on the west leg of the intersection, in the outside eastbound lane, adjacent to the curb heading east-southeast. After being struck, the Dodge rotated approximately 170 degrees counterclockwise and came to rest straddling the center lane of the eastbound roadway heading in a southerly direction. The Dodge, subsequently, was driven back into the southbound lane of the north/south roadway and was parked against the curb in the southbound lane heading south-southwest.

**Figure 4:** Case vehicle's front left damage viewed from front (case photo #08)

**Figure 5:** Case vehicle's front left damage viewed from left of front (case photo #09)

The 1996 Lexus ES300 was a front wheel drive, five-passenger, four-door sedan (VIN: JT8BF12GXT0------) equipped with a 3.0L, DOHC, SMPFI, V-6 engine and a four-speed automatic transmission. The case vehicle was equipped with four-wheel, anti-lock brakes. The case vehicle's wheelbase was 262 centimeters (103.1 inches) and, according to the Police Crash Report, no odometer reading at inspection could be obtained (i.e., most likely because the case vehicle was equipped with an electronic odometer).

**Figure 6:** Damage to other vehicle's left quarter panel from impact with case vehicle; Note: left back glazing was shattered (case photo #45)

The case vehicle's contact with the Dodge involved the front left half. Direct damage began near the midline of the front bumper and extended along the bumper to the front left corner. Maximum crush was estimated as 18 centimeters (7.1 inches) at $C_1$. The case vehicle's front bumper, bumper fascia, grille, hood, front left headlight and turn signal assemblies, and left fender were directly damaged and crushed rearward. The case vehicle's left front tire, however, did not appear to be restricted, deflated, or otherwise damaged. Based on the available photographs, no other obvious damage was present.

Based on the on-scene photographs, the CDC for the case vehicle was estimated as: **12-FYEW-1 (10)**. The WinSMASH reconstruction program, CDC only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 12.4 km.p.h. (7.7 m.p.h.), -12.2 km.p.h. (-7.6 m.p.h.), and -2.2 km.p.h. (-1.4 m.p.h.). This contractor feels these results are slightly low, and the reconstruction should be considered marginal. The case vehicle was towed but not due to damage.

The case vehicle's driver air bag was located in the steering wheel hub, and the front right passenger air bag was located in the top of the right instrument panel. Police photographs of the driver's air bag revealed that the cover flaps opened at the designated tear points, and there was no visible evidence of damage during the deployment to the air bag or cover flaps (**Figure 7**). Because this case is a remote investigation, it is unknown if the driver's air bag was designed with tethers and/or vent ports. Police photographs of the front right air bag revealed that there was no visible evidence of damage to the air bag during the deployment, but the cover flap appeared to be bent along the front/leading edge (**Figure 8**) from contact

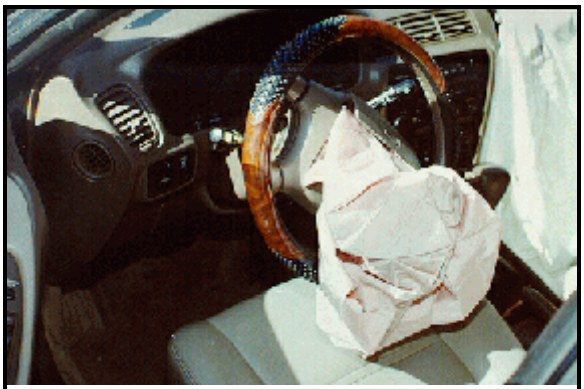

**Figure 7:** Case vehicle's driver seating area showing deployed driver air bag; Note: driver's seat is near its forward-most position (case photo #17)

with the back of the rear facing child safety seat. Photographs of the front right air bag revealed that it had at least one vent port and was not tethered (**Figure 9**), and there was a blue cloth transfer on the top portion of the air bag's fabric (**Figure 10**) from its interaction with the back surface of the rear facing child safety seat.

**Figure 9:** Case vehicle's front right seating area showing deployed, untethered, front right passen-ger air bag extended over Rear Facing Child Safety Seat (case photo #23)

**Figure 8:** Interior view from driver's seat of case vehicle's Rear Facing Child Safety Seat and de-ployed front right passenger's air bag; Note: bent corner (highlighted) of module's cover flap (case photo #19)

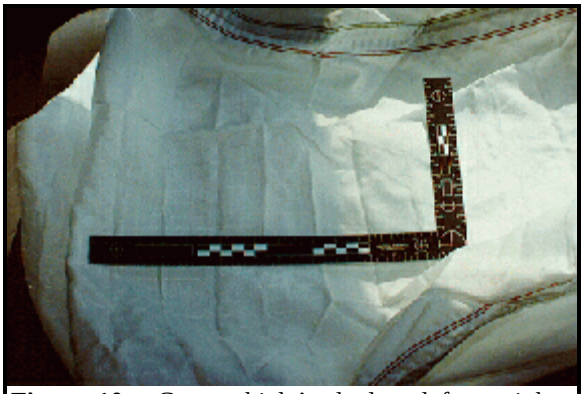

**Figure 10:** Case vehicle's deployed front right passenger air bag showing blue cloth transfer fromRear Facing Child Safety Seat to top portion of air bag's fabric (case photo #25)

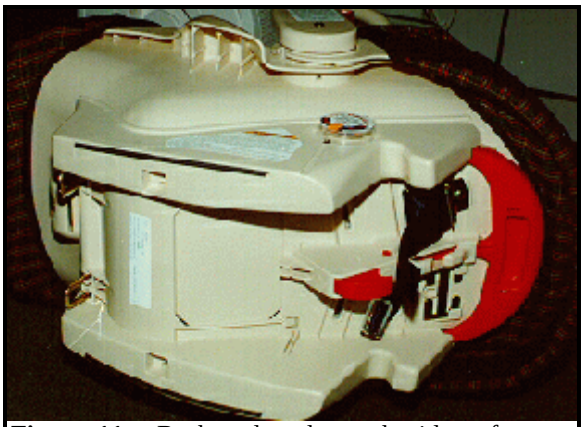

**Figure 11:** Back and underneath sides of case vehicle's Rear Facing Child Safety Seat showing no visible evidence of damage (case photo #34)

## REAR FACING CHILD SAFETY SEAT

The infant child safety seat used by the case vehicle's front right infant passenger was manufactured by Graco Products on February 25, 1999 and was identified by Model number 7497SY, Serial #JJ0225995186; however, the exact model name is unknown. The seat was made of a hard plastic one piece shell and equipped with a three-point harness with two different height levels that the webbing could be adjusted too. The seat was also designed with a carry handle that either reclined or snapped upwards in order to be used as a infant carrier. Based on the police photographs, there was no visible evidence of damage to the rear facing child safety seat (**Figure 11**). Furthermore, it appears that the child safety seat was being used without its base.

Immediately prior to the crash the case vehicle's front right infant passenger was seated in a rear facing child safety seat (RFCSS), in a reclined posture with his back against the back of the child seat, his feet on the child seat toward the seat back, and both arms on his lap. From the photographs, his seat track appears to be located between its middle and rearmost positions, and the seat back was sightly reclined. Based on the Police Crash Report, the rear facing child safety seat rested only 23 centimeters (9 inches) in front of the front right air bag module (**Figure 12**).

**Figure 12:** Case vehicle's front right seating area showing distance [23 cm (9 in)] from back of Rear Facing Child Safety Seat to front right passenger's air bag module (case photo #24)

According to the deposition given by the case vehicle's driver, the front right infant passenger [66 centimeters and 7.7 kilograms (26 inches, 16.9 pounds)] was restrained in a rear facing child safety seat which was secured by the available, active, three-point, lap-and-shoulder, safety belt system. Although the case vehicle's front right seating position was equipped with a switchable retractor, it is unknown whether the retractor had been switched. Furthermore, no "locking clip" was used on the restraint webbing.

The case vehicle's driver braked and steered to the right, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the use of his secured rear facing child safety seat, the infant passenger most likely moved slightly forward and to his right against the back right side of his child safety seat just prior to impact. The case vehicle's impact with the Dodge enabled the front right infant passenger to continue forward and slightly upward and leftward toward the 10 degree Direction of Principal Force as the case vehicle decelerated. The right lower corner of the front right passenger air bag module's cover flap (**Figure 8** above), followed by the deploying air bag, impacted the back surface of the rear facing child safety seat, forcing the child safety seat to move upwards and backwards toward the front right seat back. Initially the infant's head loaded the back surface and the upward angled bottom surface of the child safety seat. In fact, in this contractor's opinion, the horizontal abrasions that were noted across the apex of the child's scalp most likely resulted from the top the infant's head impacting the top edge of the back surface of the child safety seat. As a result of the child safety seat's upwards and backwards deflection by the air bag module's cover flap and air bag, the infant's head was also driven upward and rearward. The use of the child safety seat's harness kept the infant in his rear facing child safety seat. According to the driver's deposition, at final rest the front right infant passenger remained in his rear facing child safety seat near his original reclined position.

## FRONT RIGHT PASSENGER INJURIES

The front right infant passenger was transported by ambulance to the hospital. He sustained critical injuries and was hospitalized prior to being pronounced dead two days post-crash. The craniocerebral injuries sustained by the case vehicle's front right infant passenger included: subdural hemorrhages

bilaterally over the vertices of the cerebrum; epidural and subarachnoid hemorrhages, at unspecified locations; cerebral edema; a contusion to the upper posterior portion of the right frontal lobe; skull fractures involving the right frontal and parietal bones; abrasions across the top of the scalp near the frontoparietal area; and a large contusion along the top right side of the scalp.

| Injury Number | Injury Description (including Aspect) | NASS Injury Code & AIS 90 | Injury Source (Mechanism) | Source Confidence | Source of Injury Data |
|---|---|---|---|---|---|
| 1 | Traumatic brain injury with hypoxic ischemic[1] encephalopathy | 115299.7 unknown | Air bag, front right passenger's[2] | Certain[3] | Autopsy |
| 2 | Hemorrhage, subdural, overlying the vertices of both cerebral hemispheres with 1.5 cm (0.6 in) over parasagittal regions | 140654.5 critical | Air bag, front right passenger's[2] | Certain[3] | Autopsy |
| 3 | Hemorrhage, epidural, location not further specified (i.e., recent epidural blood extra-vasation[4]) [Aspect = Unknown] | 140630.4 severe | Air bag, front right passenger's[2] | Certain[3] | Autopsy |
| 4 | Hemorrhage, subarachnoid, location not further specified (i.e., areas of subarachnoid extra-vasation[4]) [Aspect = Unknown] | 140684.3 serious | Air bag, front right passenger's[2] | Certain[3] | Autopsy |

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[1] The following terms are defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:

***hypoxemia (hi"pok-se!e-a)***: deficient oxygenation of the blood; hypoxia.

***hypoxia (hi-pok!se-a)***: reduction of oxygen supply to tissue below physiological levels despite adequate perfusion of the tissue by blood. Compare with ***anoxia***.

***hypoxia-ischemia (hi-pok!se-a-is-ke!me-a)***: the changes occurring in tissues when the blood supply is cut off, particularly in a fetus or infant with asphyxia.

[2] This deploying front right passenger air bag compressed the interior surface of the rear facing child safety seat against this infant's head; therefore, the child seat was just a medium through which the force of the deploying air bag was transmitted.

[3] It is possible that the front right passenger air bag module's cover flap may have struck the back of the rear facing child safety seat; however, since this investigation is a remote and this contractor has no access to the child safety seat other than police photographs, which do not show any evidence of damage to the seat, then this contractor assigns the deploying front right passenger air bag as the source with Certainty.

[4] The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:

***extravasation (ek-strav"ə-sa!shən)***: 1. a discharge or escape, as of blood, from a vessel into the tissues. 2. the process of being extravasated. 3. blood or other substance which has been extravasated.

| Injury Number | Injury Description (including Aspect) | NASS Injury Code & AIS 90 | Injury Source (Mechanism) | Source Confidence | Source of Injury Data |
|---|---|---|---|---|---|
| 5 | Edema, cerebral: brain parenchyma[5] is markedly softened and is friable[5]; sections show edema[6]; anterior fontanelle[5,7] is tense and bulging and there was prominent suture diastasis[5] involving all of the sutures[7] | 140668.3 serious | Air bag, front right passenger's[2] | Certain[3] | Autopsy |
| 6 | Contusion, 0.4 cm (0.2 in) on parasagittal cortex of posterior right frontal lobe[8] | 140606.3 serious | Air bag, front right passenger's[2] | Certain[3] | Autopsy |
| 7 | Fracture, 7.6 cm (3 in) involving right frontal bone extending from junction of coronal and sagittal sutures and running diagonally | 150402.2 moderate | Air bag, front right passenger's[2] | Certain[3] | Autopsy |
| 8 | Fractures right vault including: (1) a 10.2 cm (4 in) fracture of the right parietal bone extending from the sagittal suture; and (2) 7.6 cm (3 in) fracture of the parietal bone extending from squamosal suture to the lambdoidal suture | 150402.2 moderate | Air bag, front right passenger's[2] | Certain[3] | Autopsy |

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[5] The following terms are defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:

***diastasis (di-as!tc-sis)***: 1. a form of dislocation in which there is separation of two bones normally attached to each other without the existence of a true joint; as in separation of the pubic symphysis. Also, separation beyond the normal between associated bones, as between the ribs, or the ulna and radius. 2. a relatively quiescent period of slow ventricular filling during the cardiac cycle; it occurs in mid-diastole, following the rapid filling phase and just prior to atrial systole.

***diastatic (di"c-stat!ik)***: pertaining to diastasis.

***fontanel (fon"tc-nel!)***: fontanelle.

***fontanelle (fon!tc-nel!)***: a soft spot, such as one of the membrane-covered spaces *(fonticuli cranii)* remaining in the incompletely ossified skull of a fetus or infant.

***friable (fri!a-bal)***: easily pulverized or crumbled.

***parenchyma (pc-reng!ki-mc)***: the essential elements of an organ; used in anatomical nomenclature as a general term to designate the functional elements of an organ; as distinguished from its framework, or stroma.

***parenchymal (pc-reng!ki-mcl)***: pertaining to or of the nature of parenchyma.

[6] An intracranial pressure monitor was present (i.e., during the autopsy) in the right frontoparietal region.

[7] See **Figure 13** in the Selected Photographs section below.

[8] This lesion is consistent with fracture contusion.

| Injury Number | Injury Description (including Aspect) | NASS Injury Code & AIS 90 | Injury Source (Mechanism) | Source Confidence | Source of Injury Data |
|---|---|---|---|---|---|
| 9 | Abrasions scalp including: (1) a 2.5 x 1 cm (1 x **d** in), horizontally oriented abrasion near apex of head in frontoparietal region and extending 1.9 cm (¾ in) to left of mid-line; and (2) a 0.6 cm (¼ in) abrasion on superior left parietal scalp | 190202.1 minor | Rear facing child safety seat's interior surface | Probable | Autopsy |
| 10 | Contusion, subgaleal/subscalpular[9], 12.7 x 7.6 cm (5 x 3 in) extending from right frontoparietal to occipital regions near midline | 190402.1 minor | Air bag, front right passenger's[2] | Certain[3] | Autopsy |

**CASE VEHICLE DRIVER**

The exact posture of the case vehicle's driver [26-year-old, White (Hispanic) female] is unknown; however, she was most likely seated with her back against the seat back, her left foot on the floor, her right foot on the brake, and both hands on the steering wheel. From the available police photographs, her seat track was located in its forward-most position, with the seat back upright and the tilt steering wheel located near its middle position. The case vehicle's driver [160 centimeters and 54 kilograms (63 inches, 120 pounds)] was restrained by her available, active, three-point, lap-and-shoulder, safety belt system.

The case vehicle's driver braked and steered to the right, attempting to avoid the crash. As a result of these attempted avoidance maneuvers and the use of her available safety belts, she most likely moved slightly forward and to her left against her safety belts and toward the driver air bag module just prior to impact. The case vehicle's impact with the Dodge enabled the case vehicle's driver to continue forward and slightly upward and rightward toward the 10 degree Direction of Principal Force as the case vehicle decelerated. The case vehicle's driver loaded her safety restraints and impacted the deploying driver air bag. Most likely she was driven backwards toward her seat back as the case vehicle continued forward in its east-southeasterly direction. According to the driver's deposition, at final rest, she was essentially in her pre-crash position.

[9] The exact description of this lesion was given as either an obvious subgaleal hemorrhage or an extensive subscalpular hemorrhage. In the subscalpular hemorrhage description the hemorrhage was cited as being up to 1 centimeter (0.375 inches) in thickness in the right parietal region.

The driver was transported from the scene to the hospital by bystanders at the scene. She sustained, according to the available evidence, abrasions (i.e., friction burns) but claims that she did not receive any treatment for her injuries. The specific injuries sustained by the case vehicle's driver are unknown.

**OTHER VEHICLE**

The 1991 Dodge Grand Caravan LE was an all-wheel drive, seven-passenger, three-door, extended minivan (VIN: 1B4GK54R0MX------) equipped with a 3.3L, EFI, V-6 engine and a three-speed automatic transmission. Four wheel anti-lock brakes are an option for this model, but it is unknown if the Dodge was so equipped. The Dodge's wheelbase was 303 centimeters (119.3 inches), and the odometer reading at inspection was 195,431 kilometers (121,435 miles).

Based on the on-scene photographs, the CDC for the Dodge was estimated as: **11-LBEW-2 (320)** [maximum crush was estimated at 19 centimeters (7.5 inches)]. The WinSMASH reconstruction program, CDC only algorithm, was used on the Dodge's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 11.4 km.p.h. (7.1 m.p.h.), -8.8 km.p.h. (-5.5 m.p.h.), and +7.3 km.p.h. (+4.5 m.p.h.). Once again, this contractor feels these results are slightly low, and the reconstruction should be considered marginal. The Dodge was driven from the scene.

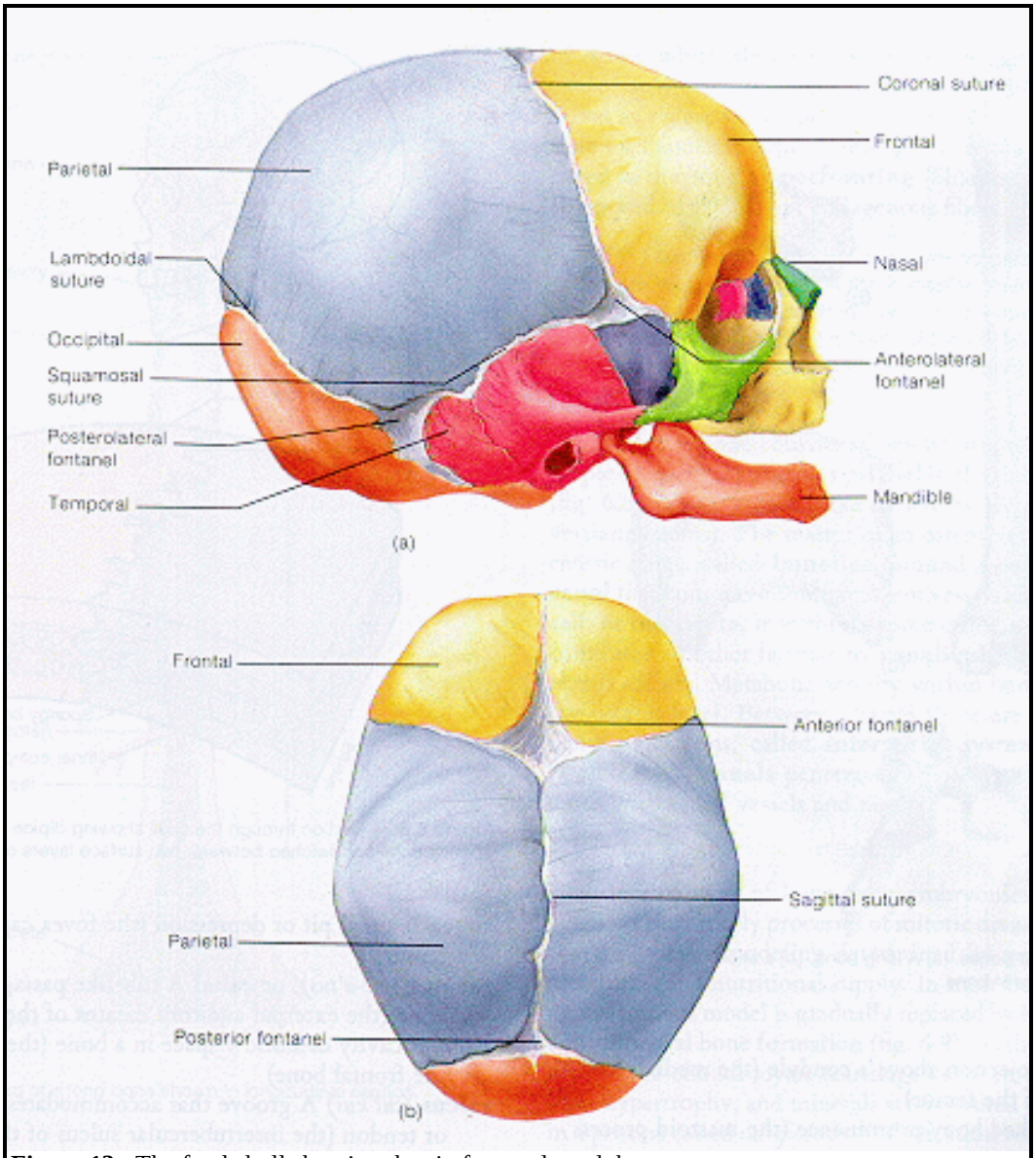


**Figure 13:** The fetal skull showing the six fontanels and the sutures;
(a) a right lateral view and (b) a superior view.

1. **Anterior** (frontal) **fontanel**–The anterior fontanel is diamond-shaped and is the most prominent of the six. It is located on the anteromedian portion of the skull
2. **Posterior** (occipital) **fontanel**–The posterior fontanel is positioned at the back of the skull on the median line.
3. **Anterolateral** (sphenoidal) **fontanels**–The paired anterolateral fontanels are found on both side of the skull directly below the anterior fontanel.
4. **Posterolateral** (mastoid) **fontanels**–The paired posterolateral fontanels are located on the posterolateral sides of the skull.

A prominent **sagittal suture** extends the anteroposterior median length of the skull between the anterior and posterior fontanels. A **coronal suture** extends from the anterior fontanel to the anterolateral fontanel. A **lambdoidal suture** extends from the posterior fontanel to the posterolateral fontanel. A **squamosal suture** connects the posterolateral fontanel to the anterolateral fontanel. (case photo #13)