Child Safety Seat Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS04001
2003 Toyota Corolla
California
January, 2004

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*Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.*

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16. Abstract

This three vehicle crash occurred in January, 2004 at 0750 hours. The crash occurred in the eastbound lanes of a divided four lane US highway. The speed limit is 105 km/h (65 mph). The case vehicle was a 2003 Toyota Corolla driven by a lap and shoulder belt restrained 28-year-old female. The rear right seat was occupied by a 6-month-old female infant who was seated in a Graco Quattro Tour child safety seat. The first other vehicle was a 1992 Ford Aerostar van driven by a 20-year-old male. The second other vehicle was a 1997 Buick LeSabre four door sedan driven by a 73-year-old male. There was one additional vehicle that played a role in the crash but did not sustain any damage. This was a 1999 Volkswagen Passat driven by a 50-year-old male.

The case vehicle and the Volkswagen Passat were traveling westbound. The Ford Aerostar van and Buick LeSabre were traveling eastbound. The Passat was traveling to the right and in front of the case vehicle. The driver was talking on a cell phone and the vehicle drifted into the adjacent lane. The driver of the Toyota Corolla steered left to avoid the Passat, lost control of her vehicle, and crossed the depressed grass covered. The case vehicle continued on into the oncoming eastbound travel lanes. It was in a counterclockwise yaw at this time. The driver of the Aerostar van saw the Toyota Corolla and began braking and steering right. The driver of the Aerostar was unable to stop in time and the front of the Aerostar struck the Toyota Corolla in the right side. There was a second impact between the right side of the Corolla and the left rear of the Aerostar. This was a side slap type impact. As a result of Impact 1 and secondary sideslap, the Corolla rotated clockwise and swerved into the adjacent eastbound lane. The driver of the Buick LeSabre saw the Toyota and began braking. He was unable to stop in time. The front of the Buick struck the front of the Toyota. The Corolla was redirected to the south, left the eastbound roadway, and traveled down a grass embankment where it struck a fence before coming to rest. The Buick continued forward and appears to have slightly contacted the rear of the Aerostar. Damage was likely minimal. The driver of the case vehicle sustained multiple injuries, including: pelvic fractures, a foot fracture, and multiple abrasions and contusions. The 6-month-old child was badly injured and died shortly after transport to a local hospital.

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**Dynamic Science, Inc.**
**Crash Investigation**
**Case Number: DS04001**

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## BACKGROUND:

| | |
|---|---|
| Description: | This child safety seat case was identified through a news article by NHTSA staff members. DSI was assigned the case on January 29, 2004. All field work was completed on February 10, 2004. The child safety seat inspection took place in the offices of the investigating police agency. The vehicle inspection took place at a police holding facility. At the time of the inspection the vehicle was still on hold and the police had not completed their inspection. |
| Investigation Type: | Child safety seat |
| Crash Location: | California |
| Crash Date: | January, 2004 |
| Notification Date: | January 29, 3004 |
| Field Work Completed: | February 10, 2004 |

## SUMMARY

### Crash Site

This three vehicle crash occurred in January, 2004 at 0750 hours. The crash occurred in the eastbound lanes of a divided four lane US highway. The eastbound and westbound travel lanes are divided by a dirt center median. The westbound roadway is bordered on the north by a solid white painted line and an asphalt shoulder and is bordered on the south by a solid white painted line and an asphalt/dirt center median. The eastbound roadway is bordered on the north by a solid white painted line and an asphalt shoulder. The roadway was dry and free of defects. According to the National Weather Service, the visibility was 16 km (10 miles), the wind was calm, and the temperature was 2 degrees C (36 degree F). The speed limit is 105 km/h (65 mph).

**Figure 1**. Path of travel (Corolla), westbound

**Figure 2**. Road departure path of travel (Corolla), westbound

**Pre-Crash**

The case vehicle was a 2003 Toyota Corolla (VIN: JTDBR38E530xxxxxx) driven by a lap and shoulder belt restrained 28-year-old female (68 kg/150 lbs, 173 cm/68 in). The rear right seat was occupied by a 6-month-old female (9 kg/19[1] lbs, 71 cm/28 in) infant who was seated in Graco Quattro Tour child safety seat (Model Number: 7411LV). The Corolla was equipped with dual stage front air bags, seat back mounted side air bags for the front seating positions, and retractor mounted seat belt pretensioners for the front seating positions.

**Figure 3**. Path of travel (Buick LeSabre/Ford Aerostar), eastbound

The first other vehicle was a 1992 Ford Aerostar van (1FMDA11U2NZxxxxxx) driven by a 20-year-old male. The second other vehicle was a 1997 Buick LeSabre four door sedan (VIN:1G4HR52K2VHxxxxxx) driven by a 73-year-old male. There was one additional vehicle that played a role in the crash but did not sustain any damage. This was a 1999 Volkswagen Passat driven by a 50-year-old male.

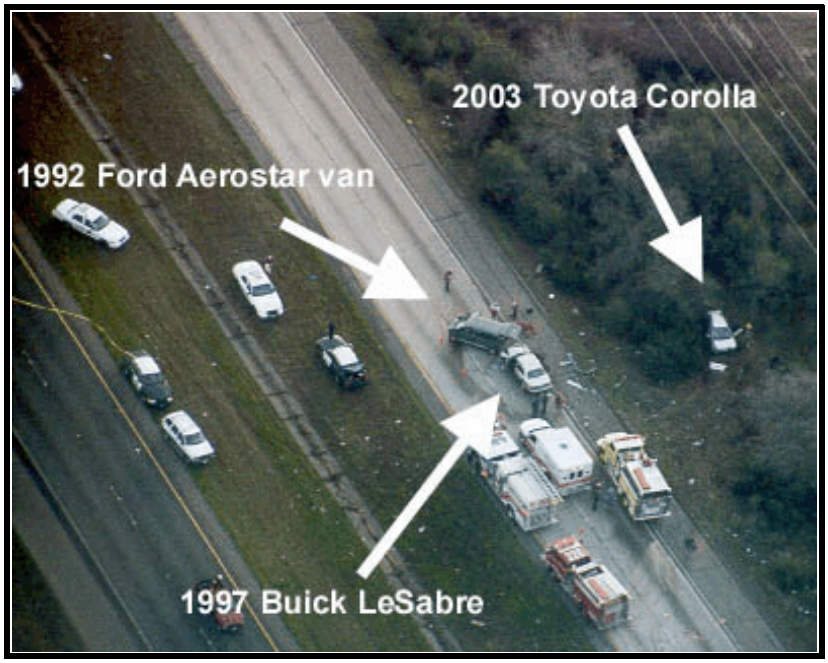


**Figure 4**. Aerial view of crash scene, North is to the left of photo

The case vehicle and the Volkswagen Passat were traveling westbound. The Ford Aerostar van and Buick LeSabre were traveling eastbound. The Passat was traveling to the right and in front of the case vehicle. The driver indicated that he was traveling approximately 89 km/h (55 mph). At some point he recalled that he needed to call someone. He looked over to the right front passenger's seat and grabbed his cell phone. When he looked up he saw that he had drifted into the adjacent lane 0.6-0.9 m (2-3 ft). He swerved back to the right and heard tires squealing beside him.

[1]EMS prehospital care report indicates a weight of 10 kg (22 lbs)

**Crash**

*Impact 1*:
The driver of the Toyota Corolla steered left to avoid the Passat, lost control of her vehicle, and crossed the depressed grass covered median–traveling diagonally approximately 62 m (204 ft). The case vehicle continued on into the oncoming eastbound travel lanes. It was in a counterclockwise yaw at this time. The driver of the Aerostar van saw the Toyota Corolla and began braking and steering right, depositing 17 m (55 ft) of locked wheel skids. The driver of the Aerostar was unable to stop in time and the front of the Aerostar (12FDEW3) struck the Toyota Corolla in the right side (03RZAW4). The Toyota had a maximum crush of 51.0 cm (20.0 in) at C3. The total velocity change as calculated by the WinSmash program was 72.2 km/h (44.9 mph). The longitudinal and lateral delta V components were -12.5 km/h (-7.8 mph) and -71.1 km/h (-44.2 mph), respectively. The front right passenger side air bag in the Toyota Corolla deployed at this time. The driver's air bag in the Aerostar also deployed at this time.

*Impact 2*:
There was a second impact between the right side of the Corolla and the left rear of the Aerostar. This was a side slap type impact. As a result of Impact 1 and this impact, the Corolla rotated clockwise entering the adjacent eastbound lane.

*Impact 3*:
The driver of the Buick LeSabre saw the Toyota and began braking, depositing 29 m (96 ft) of locked wheel skids. He was unable to stop in time. The front of the Buick (12FDEW2) struck the front of the Toyota (01FDEW2). The front bumper and backing bar were both missing from the vehicle at the time of inspection. The total velocity change as calculated by the WinSmash program was 50.3 km/h (31.3 mph). The longitudinal and lateral delta V components were –43.6 km/h (-27.1 mph) and -25.2 km/h (-15.6 mph), respectively. Both front air bags in the Toyota deployed at this time. The driver and front right passenger seat belt pretensioners also both actuated. The front air bags in the Buick LeSabre deployed at this time.

*Impact 4*:
The Corolla was redirected to the south, left the eastbound roadway, and traveled down a grass embankment where it struck a fence (unknown CDC) before coming to rest.

*Impact 5*:
The Buick continued forward and appears to have slightly contacted the rear of the Aerostar. Damage was likely minimal.

**Post-Crash**

The driver of the case vehicle sustained multiple injuries, including: pelvic fractures, a foot fracture, and multiple abrasions and contusions. She was removed from the vehicle by EMS personnel and transported by ground ambulance to a local hospital where she was admitted and hospitalized for four days.

The 6-month-old child was badly injured. She was removed from the child seat and placed on the ground. She was given CPR by a bystander nurse and a police officer shortly after the crash.

She was then transported by air to an area trauma center. The following is a compilation of transport and arrival times.

| | |
|---|---|
| Ambulance call received | 0755 |
| Unit dispatched | 0755 |
| Ambulance en route | 0801 |
| Arrived at scene | 0811 |
| Initial patient contact | 0812 |
| Departed scene | 0829 |
| Time ER activated | 0830 |
| Arrival time | 0852 |
| Declared dead by trauma team | 0855 |

The EMS pre-hospital care report indicated that she had a Glasgow Coma Scale score of 3 (indicating no eye, verbal, or motor responses), as well as a Pediatric Coma Scale of 3. The report indicated that she had sustained hematomas to the right maxillary area and the anterior of the frontal skull. She also had sustained bilateral thigh contusions and a left arm contusion. She was pronounced dead an hour after arriving at the hospital. According to the autopsy report, she sustained the following injuries: comminuted fractures of the skull, subarachnoid hemorrhage, cerebral contusion, multiple facial contusions/abrasions, left clavicle fracture, bilateral rib fractures, bilateral lung contusions, lacerations to the liver and spleen, contusions to the thymus glands, and multiple contusions to the torso and extremities. The cause of death was listed as "blunt force head and thoracoabdominal injuries."

**Figure 5**. Final rest, Toyota Corolla

The driver of the Buick LeSabre was taken to the hospital with "moderate" injuries.

All the vehicles were towed from the scene.

**Figure 6**. Final rest positions for Buick LeSabre and Ford Aerostar

**VEHICLE DATA -2003 Toyota Corolla**

The case vehicle was a 2003 Toyota Corolla four-door sedan. The vehicle was equipped with a 4-cylinder, 1.8 L (109 CID) engine, 4-speed automatic transmission, front wheel drive, air conditioning, power steering, and a tilt steering wheel.

| | |
|---|---|
| VIN: | JTDBR38E530xxxxxx |
| Odometer: | 34,839 km<br>(21,648 miles) |
| Reported Defects: | None based on police mechanical inspection. |
| Cargo: | Child seat in passenger compartment, stroller in trunk. |

The 2003 Toyota Corolla was equipped with Gillette Golden Bear Touring SE P205/55R16 tires with Maxxim alloy rims. The specific tire data is as follows:

| Tire | Tread | Measured pressure | Manufacturer recommended pressure |
|---|---|---|---|
| LF | 6 mm (8/32 in) | 179 kPa (26 psi) | 241 kPa (35 psi) |
| LR | 8 mm (10/32 in) | flat | 241 kPa (35 psi) |
| RF | 6 mm (8/32 in) | 76 kPa (11 psi) | 241 kPa (35 psi) |
| RR | 8 mm (10/32 in) | flat | 241 kPa (35 psi) |

The front seating positions in the 2003 Toyota Corolla were configured with fabric covered bucket seats with adjustable head restraints. The rear seating positions were configured with a fabric covered bench seat with a 60/40 folding back and integral head restraints for the outboard positions.

## VEHICLE DAMAGE

### Exterior Damage - 2003 Toyota Corolla

| | | |
|---|---|---|
| Damage Description: | Major damage to front end, right side, and rear. The front bumper, hood, and fenders sustained damage. The right side intruded into the passenger compartment. | |
| CDC: | Impact 1: 03RZAW4 (Ford van)<br>Impact 2: Unknown (Ford van)<br>Impact 3: 01FDEW1 (Buick LeSabre)<br>Impact 4: Unknown (fence) | |
| Delta V (Impact 1): | Total | 72.2 km/h (44.9 mph) |
| | Longitudinal | -12.5 km/h (-7.8 mph) |
| | Latitudinal | -71.1 km/h (44.2 mph) |
| | Energy | 136,553 joules<br>(100,716 ft-lbs) |
| Delta V (Impact 3): | Total | 50.3 km/h 31.3 mph) |
| | Longitudinal | -43.6 km/h (-27.1 mph) |
| | Latitudinal | -25.2 km/h (-15.6 mph) |
| | Energy | 135,674 joules<br>(100,068 ft-lbs) |

Direct damage from Impact 1 (Ford van) began 153.0 cm (60.2 in) rearward from the front axle. It measured 180.0 cm (70.8 in) and extended to the rear of the vehicle. A crush profile was taken above the sill which measured: C1= 25.0 cm (9.8 in), C2= 46.0 cm (18.1 in), C3=51.0 cm (20.0 in), C4=27.0 cm (10.6 in), C5=0 cm (0 in), C6=1.5 cm (0.6 in).

**Figure 7**. Right rear, Toyota Corolla

Direct damage from Impact 3 (Buick LeSabre) began and the front left corner of the vehicle and extended across the entire front end. The bumper, bumper fascia, bumper backing bar, and radiator had been removed prior to the vehicle inspection.

**Interior Damage - 2003 Toyota Corolla**

**Figure 8**. Front, Toyota Corolla

Interior damage to the Toyota Corolla was significant and was attributed to occupant contact and passenger compartment intrusion. The windshield sustained fracture damage from impact forces and the front right passenger's air bag. The back light and all the glass on the right side was disintegrated by impact forces. There was extensive right side intrusion, including intrusion through both right side doors, the sill, and the B/C pillars. The maximum intrusion was the sill into the right rear seating position and measured 39.0 cm (15.3 in) laterally. The rear right door intruded 32.0 cm (12.6 in) laterally into this same area. There was loading damage to the right rear door arm rest from contact with the child seat in this location. There was loading damage to center console and center mounted shifter from contact with the driver.

**Figure 9**. Center console driver contacts

**Figure 10**. Right rear door intrusion

**MANUAL RESTRAINT SYSTEMS - 2003 Toyota Corolla**

The Toyota Corolla was configured with manual 3-point lap and shoulder belts with sliding latch plates for all five seating locations. The front seat restraints were configured with adjustable shoulder belt anchorages with the driver's side adjusted to the mid position and the front right passenger's adjusted to the full down position. 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. Both front restraints were equipped with seat belt pretensioners that actuated as a result of the impact with the1997 Buick LeSabre.

**Figure 11**. Driver's seat belt

**Figure 12**. Load marks to driver's seat belt

**FRONTAL AIR BAG SYSTEM - 2003 Toyota Corolla**

The Toyota Corolla was equipped with dual stage deployment frontal air bags that deployed as a result of the impact with the 1997 Buick LeSabre. The driver's air bag was housed in the steering wheel hub split H configuration cover flaps. The top flap measured 15.0 cm (5.9 in) in width at the tear seam and 6.0 cm (2.4 in) in height. The bottom flap measured 15.0 cm (5.9 in) in width across the entire top tear seam and 4.0 cm (1.6 in) in height at both the outer tear seams and the center vertical tear seam. 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 ports located at the 11 and 1 o'clock positions on the rear aspect. The air bag was tethered by a single internal strap. There were no indications of damage or occupant contacts to either the air bag or the cover flaps.

**Figure 13**. Face of driver's air bag

**Figure 14**. Cut on upper left portion of front right passenger's air bag

The front right passenger's air bag deployed from a top mount module with a single cover flap. The flap measured 23.0 cm (9.0 in) wide by 6.0 cm (2.4 in) high. The air bag measured 42.0 cm (16.5 in) in width and 54.0 cm (21.2 in) in height. The air bag was not tethered and was vented by two circular ports that were located at the 9 and 3 o'clock positions. There were no occupant contacts to the air bag or the cover flap. The air bag sustained a 3.0 cm (1.2 in) cut that was 8.0 cm (3.1 in) from the left edge and 29.0 cm (11.4 in) from the top of the air bag face. The cut was as a result of contact to the windshield during deployment.

**SIDE AIR BAGS - 2003 Toyota Corolla**

The Toyota Corolla was equipped with seat back mounted side air bags for the front seating positions. The front right passenger's side air bag deployed as a result of the impact with the Ford Aerostar van. This air bag was shaped in a half-circle that measured 31.0 cm (12.2 in) in height and projected forward 21.0 cm (8.3 in) at the apex of the circle. The air bag was not tethered and did not have any vents. There were no indications of damage or occupant contacts to the air bag.

**Figure 15**. Front right side air bag

**CHILD SAFETY SEAT - 2003 Toyota Corolla**

The Graco Quattro Tour child safety seat (Model Number: 7411LV, manufacture date 12/09/02, serial number JJ12090210165) is part of a three-piece set that includes the Quattro Tour stroller, the child car seat, and a stay-in-car base. The stroller was in the trunk at the time of the crash. The manufacturer recommends that the seat be used with children weighing 9 kg (20 lbs) or less and whose height is 66 cm (26 in) or less. The child in this crash weighed 9 kg (19 lbs), putting her in the high range recommended by the manufacturer. The child seat was placed in the right rear seat position in a rear-facing fashion. The seat was attached to the stay-in-car bas, the locking handle was in the up position, and the seat was equipped with a 5-point harness which had been threaded through the bottom set of slots. The seat base is designed to allow four different recline positions. The recline position is not known. The seat base was anchored to the vehicle using the available Lower Anchors and Tethers for Children (LATCH) system. According to the police, the seat was being tightly held in place at the time of the crash. It was necessary for the investigating police agency to cut the LATCH tethers to remove the child seat.

**Figure 16**. Graco Quattro Tour, Model Number: 7411LV. Image from www.gracobaby.com.

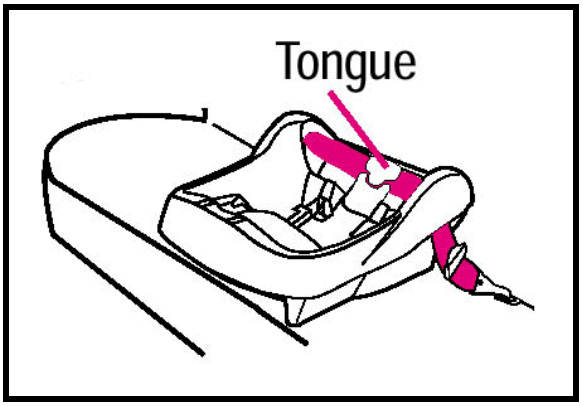


**Figure 17**. LATCH installation (Graco)

The right and left sides, as well as the front, of the base was cracked and deformed from the impact with the Ford and the resultant interior intrusion. The seat itself did not appear to have sustained any damage. There were no indications of any occupant contact to the inner seat shell.

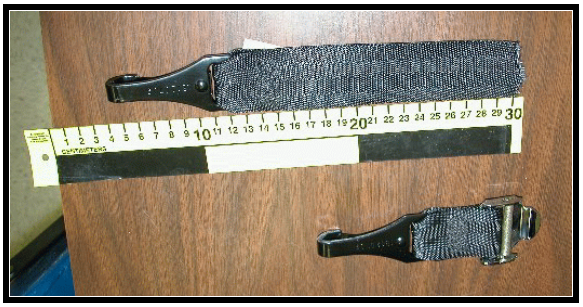

**Figure 18**. LATCH tethers

The investigating officer had been trained as a Child Passenger Safety Technician. It was his opinion that the seat usage and installation met applicable state motor vehicle laws. He did note the following issues:

1. The passenger harness straps were folded at the point where they passed through the retaining clip reducing their width.
2. The carrier handle was in the full upright position.
3. There were toys hanging from the carrier handle above the head of the child. .


**Figure 19**. Front of Graco child seat

**Figure 20**. Fractures to front of child seat base.

**Figure 21**. Left side of seat (nearest impact). Seat attached to base.

**VEHICLE DATA -** 1992 Ford Aerostar

| | | |
|---|---|---|
| Description: | 1992 Ford Aerostar XL 4x2 van | |
| VIN: | 1FMDA11U2NZxxxxxx | |
| Odometer: | Unknown | |
| Engine: | 3.0 L V6 | |
| Reported Defects: | None based on police mechanical inspection. | |
| Cargo: | Unknown | |
| Damage Description: | Major front end damage. Vehicle towed from the scene. | |
| CDC: | 12FDEW3 (impact with Toyota Corolla)<br>Unknown (impact with rear of Buick) | |
| Delta V: | Total | 53.5 km/h (33.3 mph) |
| | Longitudinal | -52.7 km/h (-52.7 mph) |
| | Latitudinal | 9.3 km/h (5.8 mph) |
| | Energy | 266,950 joules<br>(196,892 ft-lbs) |

**Figure 23**. Front left, Ford Aerostar

**Figure 22**. Right rear, Ford Aerostar

**VEHICLE DATA -** 1997 Buick LeSabre

| | | |
|---|---|---|
| Description: | 1997 Buick LeSabre Limited 4-door sedan | |
| VIN: | 1G4HR52K2VHxxxxxx | |
| Odometer: | 103,988 km<br>(64,615 miles) | |
| Engine: | 3.8 L V6 | |
| Reported Defects: | None based on police mechanical inspection. | |
| Cargo: | Unknown | |
| Damage Description: | Major front end damage. Vehicle towed from the scene. | |
| CDC: | 12FDEW2 (impact with Toyota)<br>Unknown (impact with rear of Aerostar) | |
| Delta V: | Total | 36.6 km/h (22.7 mph) |
| | Longitudinal | -36.0 km/h (-22.4 mph) |
| | Latitudinal | 6.4 km/h (3.9 mph) |
| | Energy | 119,238 joules<br>(87,945 ft lbs) |

**Figure 24**. Front left, Buick LeSabre

**Figure 25**. Front air bags, Buick LeSabre

**OCCUPANT DEMOGRAPHICS - 2003 Toyota Corolla**

| | Driver | Occupant 2 |
|---|---|---|
| Age/Sex: | 28/Female | 6 month/Female |
| Seated Position: | Front left | Rear right |
| Seat Type: | Fabric covered bucket seat. The seat track was found in the rear most position, but the seat was likely moved prior to inspection. Seat back slightly reclined. | Fabric covered bench seat with 60/40 folding back. Seat back slightly reclined by design. |
| Height: | 173 cm (68 in) | 71 cm (28 in)[2] |
| Weight: | 68 kg (150 lbs) | 9 kg (19 lbs) |
| Occupation: | Unknown | NA |
| Pre-existing Medical Condition: | None | None |
| Alcohol/Drug Involvement: | None | NA |
| Driving Experience: | Approximately 10 years | NA |
| Body Posture: | Normal, upright | Upright in infant safety seat |
| Hand Position: | Both hands presumed to be on steering wheel, involved in steering maneuver | NA |
| Foot Position: | Right foot on brake, left on floorboard | NA |
| Restraint Usage: | Lap and shoulder belt available, used. | Lap and shoulder belt available. Not used. |
| Air bag: | Steering wheel mounted front air bag, deployed. | None |

[2]Additional measurements: crown-rump length 50.0 cm (19.6 in), head circumference 45.0 cm (17.7 in), chest circumference 44.5 cm (17.5 in), abdominal circumference 44.0 cm (17.3 in).

**OCCUPANT DEMOGRAPHICS -** 1992 Ford Aerostar

| | Driver |
|---|---|
| Age/Sex: | 20/Male |
| Seated Position: | Front left |
| Seat Type: | Unknown |
| Height: | 185 cm (73 in) |
| Weight: | 84 kg (185 lbs) |
| Occupation: | Unknown |
| Pre-existing Medical Condition: | None noted |
| Alcohol/Drug Involvement: | None |
| Driving Experience: | Unknown |
| Body Posture: | Unknown |
| Hand Position: | Unknown |
| Foot Position: | Left foot on floor, right presumed to be on brake |
| Restraint Usage: | Lap and shoulder belt used, per police |

**OCCUPANT DEMOGRAPHICS -** 1997 Buick LeSabre

| | Driver |
|---|---|
| Age/Sex: | 73/Male |
| Seated Position: | Front left |
| Seat Type: | Bucket |
| Height: | 180 cm (71 in) |
| Weight: | 77 kg (170 lbs) |
| Occupation: | Unknown |
| Pre-existing Medical Condition: | None noted |
| Alcohol/Drug Involvement: | None |
| Driving Experience: | Presumed to be greater than 20 year |
| Body Posture: | Unknown |
| Hand Position: | Unknown |
| Foot Position: | Left on floor, right presumed to be on floor board |
| Restraint Usage: | Lap and shoulder belt used, per police report |

**OCCUPANT INJURIES -2003 Toyota Corolla**

Driver: Skeletal injuries obtained from consultation report, emergency room report, physician's record, progress notes, and radiology reports. A CT scan was completed for the head with no pathological findings. There were notes regarding a possible pulmonary contusion, possible rib fractures, and some type of back injury. None of these were confirmed.

| Injury | OIC Code | Injury Mechanism | Confidence Level |
|---|---|---|---|
| Comminuted left superior and inferior ramus fracture | 852604.3,2 | Center console | Probable |
| Minimally displaced right superior ramus fracture | 852602.2,1 | Center console | Probable |
| Left medial malleolus fracture (coded under fibula) | 853412.2,2 | Foot controls | Possible |
| Head contusions/abrasions, left frontal region | 190402.1,5<br>190202.1,5 | Driver's air bag | Possible |
| Chin contusions/abrasions | 290402.1,8<br>290202.1,8 | Driver's air bag | Probable |
| Teeth mark laceration, lower inner lip | 290600.1,8 | Driver's air bag | Probable |
| Abrasion, left shoulder extending down onto the left breast | 790202.1,2<br>490202.1,2 | Torso belt | Probable |
| Ecchymosis, left upper arm | 790402.1,2 | Left side door panel | Probable |
| Abrasions, abdomen | 590202.1,9 | Lap belt | Certain |

Right rear Occupant: Injuries obtained from autopsy report and the EMS pre-hospital care report from the air ambulance. Virtually all injuries were as a result of contact to the interior of the child seat that exacerbated by the right side vehicle intrusion.

| Injury | OIC Code | Injury Mechanism | Confidence Level |
|---|---|---|---|
| Bilateral parietal bone fractures | 150402.1,1<br>150402.1,2 | Interior, child safety seat | Certain |
| Subarachnoid hemorrhage | 140684.3,9 | Interior, child safety seat | Certain |
| Contusion hemorrhage, left thalamus | 140602.3,2 | Interior, child safety seat | Probable |
| Fracture, right temporal bone | 150402.2,1 | Interior, child safety seat | Probable |
| Comminuted fracture, left middle cranial fossa | 150404.3,2 | Interior, child safety seat | Certain |
| Laceration, liver, 1cm on inferior surface at porta hepatis, 0.5 cm deep | 541820.2,1 | Interior, child safety seat | Probable |
| Laceration, spleen, 1 cm, upper pole | 544222.2,2 | Interior, child safety seat | Probable |
| Rib fractures, right 1st- 2nd, left 1st-3rd | 450220.2,3 | Interior, child safety seat | Certain |
| Left clavicle fracture, midline | 752200.2,2 | Interior, child safety seat | Certain |
| Lacerations/abrasions right parietal scalp, 4x2 cm, faint dicing pattern | 190202.1,1 | Interior, child safety seat | Certain |
| Contusion, right occipital scalp, ovoid, 2 cm.<br>Contusion, lower right mid occipital scalp, 4x3 cm. | 190402.1,6 | Interior, child safety seat | Probable |
| Contusion, right ear | 290402.1,1 | Interior, child safety seat | Probable |
| Contusion/abrasion, near right ear | 290402.1,1 | Interior, child safety seat | Probable |

| | | | |
|---|---|---|---|
| Abrasion, from right eyebrow to right cheek, 5.5 x 1 cm, curved | 290202.1,1 | Interior, child safety seat | Probable |
| Contusion, right cheek, 4 x 1.2 cm. Contusion, right temple. | 290402.1,1 | Interior, child safety seat | Probable |
| Abrasion, right forehead | 290202.1,7 | Interior, child safety seat | Probable |
| Abrasions, left upper parietal scalp, 2 x 1.5 cm | 190202.1,2 | Interior, child safety seat | Certain |
| Contusion, left forehead, 2 x 0.5 cm. Contusion, left lateral forehead extending over the lateral orbital rim, 5 x 2.5 cm | 290402.1,7 | Interior, child safety seat | Certain |
| Abrasions, left side of face | 290202.1,2 | Interior, child safety seat | Certain |
| Abrasion, left chin, 2.5 x 0.8 cm, ovoid | 290202.1,8 | Interior, child safety seat | Certain |
| Contusion, left jaw line, 1.5 cm | 290402.1,8 | Interior, child safety seat | Certain |
| Abrasion, above left ear, 2cm, ovoid | 290202.1,2 | Interior, child safety seat | Certain |
| Abrasion, left parietal scalp, 1.2 cm | 190202.1,2 | Interior, child safety seat | Certain |
| Contusion, left cheek, 2 cm | 290402.1,2 | Interior, child safety seat | Certain |
| Linear marks, red, top of left shoulder | Unknown | Harness | Probable |
| Contusion, left upper pectoral area, 2.5 x 1 cm | 490402.1,2 | Interior, child safety seat | Child seat harness |
| Contusion, left lateral abdomen, 4 cm | 590402.1,2 | Unknown | Unknown |
| Contusion, right index finger | 790402.1,1 | Unknown | Unknown |
| Contusion, lateral upper right arm, 1.5 cm | 790402.1,1 | Interior, child safety seat | Probable |

| | | | |
|---|---|---|---|
| Contusion, right anterior upper arm extending onto ventral forearm, 9.5 x 6 cm | 790402.1,1 | Interior, child safety seat | Probable |
| Contusion, left dorsal wrist, 1.5 cm | 790402.1,2 | Interior, child safety seat | Certain |
| Contusion, left dorsal forearm, 4.5 x 2 cm | 790402.1,2 | Interior, child safety seat | Certain |
| Contusion, anterior upper left arm, 6 x 5.5 cm, ovoid | 790402.1,2 | Interior, child safety seat | Certain |
| Contusion, anterior upper left arm, 3 cm, ovoid | 790402.1,2 | Interior, child safety seat | Certain |
| Contusion, lateral left upper arm, oblique oriented from upper anterior to lower posterior, 7 x 1 cm, with 3 x 2 cm angle at end | 790402.1,2 | Interior, child safety seat | Certain |
| Contusion, right hip to medial thigh, 16 cm long by up to 2 cm wide | 890402.1,1 | Child seat harness | Probable |
| Abrasion, right hip, 1.2 cm | 890202.1,1 | Interior, child safety seat, rebound | Probable |
| Contusion, right lateral knee, 3.5 x 2 cm | 890402.1,1 | Interior, child safety seat, rebound | Probable |
| Contusion, 2 cm, lower leg, unknown aspect | 890402.1,9 | Unknown | Unknown |
| Contusion, right calf, 1.5 cm | 890402.1,1 | Interior, child safety seat | Probable |
| Contusion, left upper thigh onto the medial thigh, 7 x 2.5 cm (almost merges with contusion of abdomen) | 890402.1,2 | Interior, child safety seat | Certain |
| Contusion, left medial thigh, 6 x 2.5 cm with 1.5 cm abrasion | 890402.1,2 | Interior, child safety seat | Certain |
| Contusion, left medial knee, 3 x 1 cm | 890402.1,2 | Interior, child safety seat | Certain |

| | | | |
|---|---|---|---|
| Contusion, left lower leg, 0.7 cm, ovoid | 890402.1,2 | Interior, child safety seat | Certain |
| Contusion, left lateral lower leg, 3 cm | 890402.1,2 | Interior, child safety seat | Certain |
| Contusion, left calf, 1 cm, ovoid | 890402.1,2 | Interior, child safety seat | Certain |
| Contusions, both lobes of thymus[3] | 490402.1,3 | Child safety seat harness | Probable |
| Fracture, right petrous bone | 150402.2,1 | Interior, child safety seat | Certain |
| Contusion, behind left ear | 290402.1,2 | Interior, child safety seat | Certain |

**OCCUPANT INJURIES -1992 Ford Aerostar**

Driver: No reported injuries.

**OCCUPANT INJURIES - 1997 Buick LeSabre**

Driver: Injuries obtained from police report.

| Injury | OIC Code | Injury Mechanism | Confidence Level |
|---|---|---|---|
| Multiple abrasions, entire body | 990200.1,0 | Unknown | Unknown |
| Multiple contusions, entire body | 990400.1,0 | Unknown | Unknown |

[3]A lymphoid organ situated in the center of the upper chest just behind the sternum.

**OCCUPANT KINEMATICS - 2003 Toyota Corolla**

The 28-year-old female driver of the case vehicle was seated in a normal, upright fashion in a fabric covered bucket seat. The seat was found adjusted to the rear most track position but given the driver's height (173 cm/68 in) it is more likely that the seat had been moved prior to the vehicle inspection. The seat back was slightly reclined. The driver was using the available lap and shoulder belt. The shoulder belt anchorage was adjusted to the mid position. Prior to impact, the case vehicle had been involved in an evasive maneuver. Both hands were on the steering wheel actively involved in efforts to steer out of the counterclockwise vehicle rotation. The right foot was on the brake, the left on the floorboard. At impact with the Aerostar, the driver responded to the 3 o'clock direction of force by pitching sharply to the right. While the restraint system kept her generally in place, her hips went to the right and engaged the shifter and center console–causing the bilateral pelvic fractures–and her lower legs pitched to the right and engaged the foot controls–causing the medial malleolus fracture. The case vehicle was redirected in a clockwise direction before being struck in the front by the Buick LeSabre. The driver responded to the 1 o'clock direction of force by moving forward and to the right. At impact, the driver's air bag deployed and the driver's seat belt pretensioner actuated. The driver pitched forward and engaged the locked seat belt system–causing abrasions to her shoulder and hip. Her face engaged the deployed air bag–causing abrasions and contusions to her face/head and also caused her to bite her lip.

**Figure 26**. Contact to shifter and center console

**Figure 27**. Damage to right rear door side panel due to impact, intrusion, and contact with infant safety seat

The 6-month-old female rear right occupant was seated in a Graco Quattro Tour infant safety seat placed on the fabric covered 60/40 bench seat. The infant seat was placed in the right rear seat position in a rear-facing fashion. The seat was attached to the stay-in-car base, the locking handle was in the up position, and the seat was equipped with a 5-point harness which had been threaded through the bottom set of slots. The seat base was anchored to the vehicle using the available Lower Anchors and Tethers for Children (LATCH) system. According to the police, the seat was being tightly held in place at the time of the crash. At impact with the Aerostar, this occupant initially moved sharply to the right within the confines of the seat and engaged the

child seat interior with essentially the whole left side of her body. As the impact progressed, the right rear door intruded into and fractured the child seat exacerbating the left side injuries, including the clavicle and skull fractures. This occupant also sustained right side skull and rib fractures and lacerations to the spleen and liver. Given the amount of intrusion and the fact that the restraint remained in place, the injuries were a combination of impact and compression as the child safety seat was intruded on by the right door panel. At impact with the Buick, this occupant would have responded to the 1 o'clock direction of force by moving forward (with her back) and to the right.


**Figure 28**. Front of Graco child seat

**Attachment 1. Scene Diagram**