Remote Passenger Air Bag Fatality Investigation
Dynamic Science, Inc. (DSI), Case Number DS08007
1996 Geo Metro
California
November 2005

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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.

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16. Abstract

This remote passenger air bag fatality investigation was initiated in response to a police reported description of an air bag related child fatality in the front right seat of a 1996 Geo Metro. This three-vehicle, chain-reaction crash occurred in November 2005 on a five-lane divided interstate highway. The subject vehicle was a 1996 Geo Metro that was being driven by a 35-year-old female. There were five additional occupants in the vehicle. The front right seat was occupied by a 27-year-old male and a 5-year-old female. The 5-year-old was seated in the lap of the adult male. The lap and shoulder belt in the front right seating position was being used by both occupants. There were two additional vehicles involved in this crash: a 1989 Nissan Sentra that was being driven by a 22-year-old male and a 2005 Toyota Corolla that was being driven by a 51-year-old male. The Geo Metro was initially traveling at an unknown speed westbound in the second lane from the right. The other two vehicles were stopped in the first lane from the right due to traffic congestion. The driver of the Geo changed lanes from the second lane into the first lane. The driver of the Geo did not notice that traffic was stopped ahead until it was too late. She braked but the front of the Geo struck the rear of the Sentra and pushed the Sentra into the back of the Corolla. The 5-year-old front right seat occupant sustained severe injuries from the deploying air bag. She was removed from the Geo by one of the vehicle occupants and was transported to a local hospital by a witness to the crash. She was later transferred to a trauma center where she died four days after the crash. The Geo and the Sentra were towed from the scene due to damage. The Corolla was driven from the scene.

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BACKGROUND

This remote passenger air bag fatality investigation was initiated in response to a police reported description of an air bag related child fatality in the front right seat of a 1996 Geo Metro (**Figure 1**). This three-vehicle, chain-reaction crash occurred in November 2005 on a five-lane divided interstate highway. The subject vehicle was a 1996 Geo Metro that was being driven by a 35-year-old female. There were five additional occupants in the vehicle. The front right seat was occupied by a 27-year-old male and a 5-year-old female. The 5-year-old was seated in the lap of the adult male. The lap and shoulder belt in the front right seating position was being used by both occupants. There were two additional vehicles involved in this crash: a 1989 Nissan Sentra that was being driven by a 22-year-old male and a 2005 Toyota Corolla that was being driven by a 51-year-old male. The Geo Metro was initially traveling at an unknown speed westbound in the second lane from the right. The other two vehicles were stopped in the first lane from the right due to traffic congestion. The driver of the Geo changed lanes from the second lane into the first lane. The driver of the Geo did not notice that traffic was stopped ahead until it was too late. She braked but the front of the Geo struck the rear of the Sentra and pushed the Sentra into the back of the Corolla. The 5-year-old front right seat occupant sustained severe injuries from the deploying air bag. She was removed from the Geo by one of the vehicle occupants and was transported to a local hospital by a witness to the crash. She was later transferred to a trauma center where she died four days after the crash. The Geo and the Sentra were towed from the scene due to damage. The Corolla was driven from the scene.

Figure 1. Subject vehicle, 1996 Chevrolet Geo Metro

The police report was identified through a review of Fatality Analysis Reporting System (FARS) police crash reports. DSI was assigned the case on February 29, 2008. The following information was obtained from the police report, on-scene police photos, and an autopsy report.

SUMMARY

Crash Site

This three-vehicle crash occurred on a north/south designated US highway (**Figure 2**). However, in the area of the crash the highway actually runs east and west. All references will be made in the true compass direction. The roadway consisted of five traffic lanes on the westbound side. The asphalt roadway was straight and level. The lanes were bordered on the south by a solid yellow line and a concrete center median barrier. The five lanes of traffic were delineated with broken painted white lines with raised ceramic tiles and raised reflectors. The traffic lanes were bordered on the north by a solid painted white fog line. The weather was cool and the crash occurred during the hours of darkness with minimal overhead lighting provided by light poles. The lights were working at the time of the crash. There were no roadway defects noted. The posted speed limit was 105 km/h (65 mph). The scene schematic is included as Attachment 1 to this report. A satellite

image of the scene is included as Attachment 2.

Figure 2. Overview of crash scene - looking west

Pre Crash

The subject vehicle was a 1996 Geo Metro that was being driven by a 35-year-old female. There were five additional occupants in the vehicle. The following table provides an overview of their demographics, seat locations and injuries.

Occupant No.	Age/Sex	Seat location	Restraint usage	Injuries
1	35/Female	Front left	Lap and shoulder belt used	No reported injuries.
2	27/Male	Front right	Lap and shoulder belt used in combination with Occupant 3.	No reported injuries.
3	5/Female	Front right	Lap and shoulder belt used in combination with Occupant 2	Severe head and facial injuries. Fatally injured.
4	13/Male	Second row left	Lap and shoulder belt used.	No reported injuries.
5	15/Female	Second row middle	Lap belt used	No reported injuries.
6	9/Female	Second row right	Lap and shoulder belt not used.	Complained of pain to back of neck.

There were two additional vehicles involved in this crash: a 1989 Nissan Sentra that was being driven by a 22-year-old male and a 2005 Toyota Corolla that was being driven by a 51-year-old male. The Geo Metro was initially traveling at an unknown speed westbound in the second lane from the right. The other two vehicles were stopped in the first lane from the right due to traffic congestion. The driver of the Geo changed lanes from the second lane into the first lane.

Crash

The driver of the Geo did not notice that traffic was stopped ahead until it was too late to stop. She braked but the front of the Geo struck the rear of the Sentra (**Figure 3**). The impact was moderate and resulted in the deployment of the frontal air bag system in the Geo. The CDC Only algorithm of the WinSmash program computed a total delta V of 15 km/h (9.3 mph) based on the frontal damage to the Geo. The longitudinal and lateral components were -15 km/h (-9.3 mph) and 0 km/h, respectively. After the initial impact, the Sentra was pushed forward into the rear of the stopped Corolla (**Figures 4-5**).

Figure 3. Rear damage to Nissan Sentra

Post Crash

All the vehicles came to rest in their initial lanes of travel. They were moved out of traffic prior to the arrival of the police by their respective drivers.

The 5-year-old front right seat occupant sustained serious head and facial injuries. She was removed from the Geo by one of the vehicle occupants. A witness arrived on-scene and noticed the child was being held in the arms of her mother outside the vehicle. As the witness approached them, the mother indicated that the child was not breathing. The witness tried to call 911 but could not get through. A number of other parties also tried to get through to 911 and were not successful. The witness decided to take the mother and the child to the hospital directly in the witness's vehicle. The witness took them the nearest hospital. The child was later transferred to an area trauma center where she passed away four days after the crash. The cause of death was a subdural hematoma due to, or as a consequence of, complications of blunt force trauma to the head

Figure 4. Frontal damage to Nissan Sentra

Figure 5. Rear damage to Toyota Corolla

VEHICLE DATA - 1996 Geo Metro

The 1996 Chevrolet Geo Metro was identified by the Vehicle Identification Number (VIN): 2C1MR5290T6xxxxxx. The Geo Metro was a 4-door, 5-passenger sedan that was equipped with a 1.3 liter, 4-cylinder engine, a 3-speed automatic transmission, and front wheel drive. The vehicle manufacturer's recommended tire size was a P155/80R13 with a recommended cold tire pressure of 221 kPa (32 psi). The seating in the Geo was configured with front bucket seats and a rear bench seat.

Vehicle Damage - 1996 Geo Metro

Exterior Damage

The Geo Metro sustained moderate frontal damage as a result of the impact with the rear of the Nissan Sentra (**Figure 6**). The hood was crushed rearward, the front bumper fascia was broken off, the plastic bumper backing bar was fractured and the right front fender was buckled. The police reported that the vehicle had prior damage to the left rear fender. The Collision Deformation Classification (CDC) for the impact with the Nissan Sentra was 12FDEW1.

Figure 6. View of frontal damage to Geo Metro

Interior Damage

Based on the available police photos, there did not appear to be any substantive damage to the vehicle's interior. The police did report that the windshield was cracked.

Manual Restraints

The 1996 Chevrolet Geo Metro was equipped with 3-point manual lap and shoulder belts for the outboard seat positions and a lap belt for the second row center seat position.

Figure 7. Driver's air bag

Supplemental Restraint Systems

The 1996 Chevrolet Geo Metro was equipped with first generation single stage frontal air bags for the driver and front right passenger positions. The frontal air bags deployed as a result of the longitudinal deceleration of the Geo Metro during the impact with the Nissan Sentra (Event 1).

The driver's air bag deployed from the center of the steering wheel hub through H-configuration module cover flaps (**Figure 7**). It is not known if there were any contacts to the air bag or any damage to either the air bag or the cover flaps.

The front right passenger's air bag deployed from a top-mount module with a rectangular cover flap that was hinged at the forward aspect (**Figure 8**). It is not known if there was any residual contact evidence to the air bag or any damage to the cover flap.

Figure 8. Front right passenger air bag

VEHICLE DATA - 1989 Nissan Sentra

The 1989 Nissan Sentra was identified by the VIN: JN1GB22S9KUxxxxxx. The Nissan was a 2-door coupe that was equipped with a 1.6 liter, 4-cylinder engine, a 5-speed manual transmission, and front wheel drive. The vehicle was being driven by a 22-year-old male and was stopped in traffic prior to the crash. The Nissan sustained rear damage from the impact with the Geo and front damage from the subsequent impact with the Toyota that was in front of the Nissan. The CDCs for the impacts with the Geo and the Toyota were 06BYEW2 and 12FYEW1, respectively. The Nissan was towed from the scene due to damage.

VEHICLE DATA - 2005 Toyota Corolla

The 2005 Toyota Corolla was identified by the VIN: 1NXBR32E65Zxxxxxx. The Toyota was a 4-door sedan that was equipped with a 1.8 liter, 4-cylinder engine and front wheel drive. The vehicle was being driven by a 51-year-old male and was stopped in traffic prior to the crash. The Toyota sustained right rear bumper damage from the impact with the Nissan. The CDC for the impact with the Nissan was 06BZLW1. The tow status for this vehicle was not known.

OCCUPANT DEMOGRAPHICS - 1996 Geo Metro

	Driver	**Front Row Right Occupant (02)**
Age/Sex:	35/Female	27/Male
Seated Position:	Front left	Front right
Seat Type:	Bucket	Bucket
Seat Track Position:	Unknown	Unknown
Height:	165 cm (65 in)	Unknown
Weight:	52 kg (115 lbs)	Unknown
Alcohol/Drug Involvement:	None	N/A
Body Posture:	Unknown	Unknown

Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt	Lap and shoulder belt used with Occupant 03
Air bag:	Steering wheel mounted air bag, deployed	Top instrument panel mounted air bag, deployed

	Front Row Right Occupant (03)	**Second Row Left Occupant (04)**
Age/Sex:	5/Female	13/Male
Seated Position:	Front right, on lap of Occupant 02	Second row left
Seat Type:	Bucket	Bench
Seat Track Position:	Unknown	N/A
Height:	117 cm (46 in)	Unknown
Weight:	22 kg (49 lbs)	Unknown
Alcohol/Drug Involvement:	N/A	N/A
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used with Occupant 02	Lap and shoulder belt used
Air bag:	Top instrument panel mounted air bag, deployed	None

	Second Row Middle Occupant (05)	**Second Row Right Occupant (06)**
Age/Sex:	15/Female	9/Female
Seated Position:	Second row middle	Second row right
Seat Type:	Bench	Bench
Seat Track Position:	N/A	N/A
Height:	Unknown	Unknown
Weight:	Unknown	Unknown

Alcohol/Drug Involvement:	N/A	N/A
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap belt used	Lap and shoulder belt not used
Air bag:	None	None

OCCUPANT KINEMATICS

Driver Kinematics

The 35-year-old female driver was seated in an unknown posture and was restrained by the 3-point manual lap and shoulder belt. The seat track position was not known. Prior to impact, the driver began braking. At impact, the frontal air bags deployed. The driver initiated a forward trajectory and likely contacted the deployed air bag. The driver was not injured. She was able to exit the vehicle under her own power.

Front Row Right Occupant (02) Kinematics

The 27-year-old male front right occupant was seated in an unknown posture. Occupant 03 was seated in the lap of this occupant. The 27-year-old was using the 3-point manual lap and shoulder belt. The belt was being used to secure this occupant and occupant 03. Prior to impact, the driver began braking. Both occupants in this seat position were displaced slightly forward. At impact, the front right passenger's air bag deployed. The front right occupant was displaced forward, but likely did not contact the deployed air bag because of the position of occupant 03. There were no indications that there was any intra-occupant contact. The front right occupant was not injured. He was able to exit the vehicle under his own power.

Front Row Right Occupant (03) Kinematics

The 5-year-old female child was seated in the lap of Occupant 02. According to the police report, the lap and shoulder belt in this seat position was being used by both occupants. Prior to impact, the driver began braking. Both front right seat occupants were displaced slightly forward. At impact, the front right passenger's air bag deployed. The 5-year-old was contacted fully in the face by the deploying air bag. The child sustained serious facial and head injuries. She was removed from the vehicle by witnesses to the crash. She was unconscious and bleeding from the mouth. A witness arrived on-scene and noticed the child was being held in the arms of her mother outside the vehicle. As the witness approached them, the mother indicated that the child was not breathing. The witness tried to call 911 but could not get through. A number of other parties also tried to get through to 911 and were not successful. The witness decided to take the mother and the child to the hospital directly in the witness' vehicle. The witness took them the nearest hospital. The child was transported to a local hospital for treatment of severe head trauma. Several hours later she was transferred to a local trauma center where she underwent a hemicraniectomy and an evacuation of

a subdural hematoma. She was declared brain dead due to her injuries at 1630 hours, four days after the crash. Cardiac death occurred two days later after organ procurement.

Second Row Left Occupant (04) Kinematics

The 13-year-old male second row left occupant was seated in an unknown posture on a bench seat. He was secured by the 3-point manual lap and shoulder belt. Prior to impact, the driver began braking. This occupant was displaced forward slightly. At impact, he initiated a forward trajectory and loaded the lap and shoulder belt. He did not report any injuries and was able to exit the vehicle under his own power.

Second Row Middle Occupant (05) Kinematics

The 15-year-old female second row middle occupant was seated in an unknown posture on a bench seat. She was secured by the manual lap belt. Prior to impact, the driver began braking. This occupant was displaced forward slightly. At impact, she initiated a forward trajectory and loaded the lap belt. She did not report any injuries and was able to exit the vehicle under her own power.

Second Row Right Occupant (06) Kinematics

The 9-year-old female second row right occupant was seated in an unknown posture on a bench seat. She was not using the manual lap and shoulder belt. Prior to impact, the driver began braking. This occupant was displaced forward slightly. At impact, she initiated a forward trajectory. It is not known if she contacted an interior surfaces. She did not report any injuries and was able to exit the vehicle under her own power. She did complain of pain to her neck.

OCCUPANT INJURIES - 1996 Geo Metro

The driver and Occupants 02, 04, 05, and 06 did not report any injures.

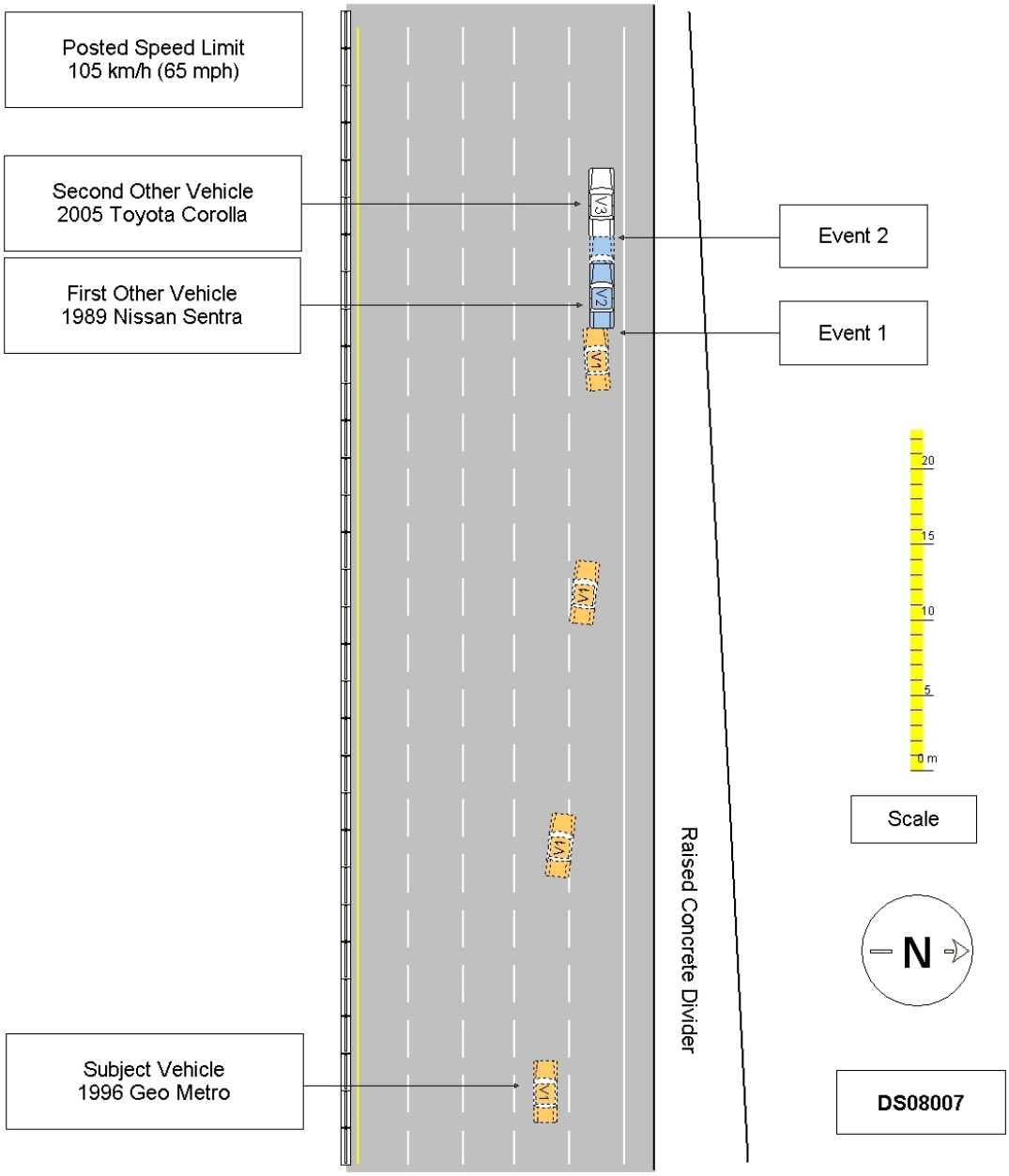
Front Row Right Occupant Injuries (03): Injuries obtained from autopsy report.

Injury	OIC Code	Injury Mechanism	Confidence Level
Duret's hemorrhages of the pons[1]	140210.5,8	Passenger air bag	Probable
Numerous frontal brain lobe contusions	140611.3,9	Passenger air bag	Probable
Massive brain swelling	140660.3,9	Passenger air bag	Probable
Anterior mandible fractures, slightly displaced	250610.2,3	Passenger air bag	Certain

[1]Small linear hemorrhages in the midline of the brainstem and upper pons caused by traumatic downward displacement of the brainstem.

Linear non-displaced fracture, right occipital skull	150400.2,1	Passenger air bag	Probable
Upper and lower teeth fractures	251404.1,8	Passenger air bag	Certain
Gum line laceration, right lower jaw, 2.5x 1.3 cm (1.0 x 0.5 in)	243204.1,8	Passenger air bag	Certain
Upper and lower frenulum lacerations	290600.1,8	Passenger air bag	Certain
Tongue laceration	243402.1,8	Passenger air bag	Certain
Left elbow contusion, 3.8 x 1.3 cm (1.5 x 0.5 in)	790402.1,2	Unknown	Unknown
Left knee contusion, 2.5x 1.3 cm (1.0 x 0.5 in), right leg contusion	890402.1,3	Right instrument panel	Possible
Right upper lateral arm lacerations	790600.1,1	Unknown	Unknown
Anterior neck contusion, 10.1 x 6.4 cm (4.0 x 2.5 in)	390402.1,5	Passenger air bag	Certain
Right side of face, abrasion involving frontal and maxillary regions, 10.1 x 7.6 cm (4.0 x 3.0 in)	290202.1,1	Passenger air bag	Certain
Left frontal forehead contusion, 2.5 x 1.3 cm (1.0 x 0.5 in)	290402.1,7	Passenger air bag	Possible
Scalp abrasion, left parietal area, 3.8 x 2.0 cm (1.5 x 0.8 in)	290202.1,2	Passenger air bag	Possible
Left lower jaw and lateral neck abrasions, 6.4 x 5.0 cm (2.5 x 2.0 in)	290202.1,8 390202.1,2	Passenger air bag	Possible

Attachment 1. Scene Diagram



Attachment 2. Satellite Image of Scene (arrow indicates area of impact)