

Child Safety Seat Fatality Investigation / Vehicle to Pole
Dynamic Science, Inc. / Case Number: DS06020
2006 Toyota Matrix
California
September 2006

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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.

1. Report No. DS06020	2. Government Accession No.		3. Recipient Catalog No.	
4. Title and Subtitle Child Safety Seat Fatality Investigation			5. Report Date February 10, 2007	
			6. Performing Organization Report No.	
7. Author(s) Dynamic Science, Inc.			8. Performing Organization Report No.	
9. Performing Organization name and Address Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401			10. Work Unit No. (TRAVIS)	
			11. Contract or Grant no. DTNH22-01-C-27002	
12. Sponsoring Agency Name and Address U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590			13. Type of report and period Covered [Report Month, Year]	
			14. Sponsoring Agency Code	
15. Supplemental Notes				
16. Abstract This on-site investigation focused on two child seats installed in the rear seat of a 2006 Toyota Matrix. The Toyota Matrix was occupied by a 23-year-old female driver, a 36-year-old female front right seat occupant, a 5-year-old female second row left occupant, and a 6-year-old female second row right occupant. The two rear seat occupants were seated in convertible child safety seats that were being used as booster seats. Both rear seat occupants were improperly restrained; the vehicle shoulder belts had been placed behind the respective child safety seats. This single vehicle crash occurred in September 2006 at 1028 hours. The Toyota Matrix was traveling westbound on a two lane roadway. As the vehicle entered a left hand curve, the driver lost control of the vehicle and departed the roadway on the right side. The right side of the Matrix then struck a wooden pole at a relatively shallow angle. The Matrix came to rest off the roadway facing east. The wooden pole was severed during the crash. The driver of the Matrix sustained cervical and lumbar strains, as well as a facial abrasion. The front right occupant sustained abrasions to her right elbow, right upper arm, and forehead. The second row left seat occupant sustained a left lung contusion, a forehead laceration, and a contusion to the right iliac crest area. The second row right seat occupant was fatally injured with major head trauma.				
17. Key Words Air bag, deployment, injury, side curtain, child safety seat, booster seat, fatality, passenger.			18. Distribution Statement	
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price	

Dynamic Science, Inc.
Crash Investigation
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BACKGROUND

This on-site investigation focused on two child seats installed in the rear seat of a 2006 Toyota Matrix. The Toyota Matrix was occupied by a 23-year-old female driver, a 36-year-old female front right seat occupant, a 5-year-old female second row left occupant, and a 6-year-old female second row right occupant. The two rear seat occupants were seated in convertible child safety seats that were being used as booster seats. Both rear seat occupants were improperly restrained; the vehicle shoulder belts had been placed behind the respective child safety seats.

This single vehicle crash occurred in September 2006 at 1028 hours. The Toyota Matrix was traveling westbound on a two lane roadway. As the vehicle entered a left hand curve, the driver lost control of the vehicle and departed the roadway on the right side. The Matrix began a counterclockwise rotation as it left the roadway. The right side of the Matrix then struck a wooden pole at a relatively shallow angle. The impact resulted in sufficient longitudinal and lateral decelerations to deploy the frontal air bags, the front right passenger side air bag, and the right side air curtain. The Matrix came to rest off the roadway facing east. The wooden pole was severed during the crash. The driver of the Matrix sustained cervical and lumbar strains, as well as a facial abrasion. She was transported by ambulance to an area trauma center. The front right occupant sustained abrasions to her right elbow, right upper arm, and forehead. She was transported by ambulance to an area trauma center. The second row left seat occupant sustained a left lung contusion, a forehead laceration, and a contusion to the right iliac crest area. She was transported by air to a pediatric trauma center. The second row right seat occupant was fatally injured with major head trauma. She was treated at the scene and transported to a local emergency room. The triage start time was 1105 hours. She arrived unresponsive to all stimuli with a Glasgow Coma Scale (GCS) score of 3. She sustained major head and face trauma. Due to the severity of the injuries no resuscitation efforts were attempted and she was pronounced dead at 1109 hours



Figure 1. Damaged 2006 Toyota Matrix



Figure 2. Exemplar view of 2006 Toyota Matrix

This Child Safety Seat case was identified by NHTSA as a child booster seat related fatality from a message posted to the child passenger safety list server. On September 26, 2006 DSI obtained the police accident report, located the vehicle and received permission to inspect the vehicle. The vehicle and scene inspections were conducted September 27, 2006. Three officers who were involved in the on-scene investigation were present during the vehicle inspection.

SUMMARY

Crash Site

This single vehicle crash occurred in September 2006 at 1028 hours. The crash occurred in a semi-rural area of northern California. At the time of the crash, there were no adverse weather conditions and the worn asphalt surface was dry. The east/west roadway was configured with a single lane in each direction that were separated by a dashed yellow painted centerline. The roadway is bordered on both sides by dirt/gravel shoulders separated from the roadway by solid white lines. The approach to the crash site was straight. Just prior to the road departure and pole impact, the roadway curves to the left. There is a positive 5.8% roadway superelevation at the area of departure and a negative 10.2% for the area adjacent to the roadway approaching the pole. The pole was 2.7 m (8.8 ft) off the roadway and was 36.0 cm (14.2 in) wide. The posted speed limit was 72 km/h (45 mph).



Figure 3. Approach to pole impact

Pre-Crash

The 2006 Toyota Matrix was traveling westbound. The Matrix was occupied by a properly restrained 23-year-old female driver, a properly restrained 36-year-old female front right seat occupant, a 5-year-old female second row left occupant, and a 6-year-old female second row right occupant. The two rear seat occupants were seated in Cosco Alpha Omega convertible child safety seats that were being used as booster seats. Both occupants were improperly restrained; the vehicle shoulder harnesses had been placed behind the respective child safety seats. As the vehicle entered the left hand curve, the driver lost control of the vehicle and departed the roadway on the right side.



Figure 4. Area of roadway departure and impact with pole (pole has been replaced)

Crash

The Matrix began a counterclockwise rotation as it left the roadway. The right side of the Matrix then struck a wooden pole at a relatively shallow angle. The impact resulted in sufficient longitudinal and lateral decelerations to deploy the frontal air bags, the front right passenger side air bag, and the right side air curtain. The barrier routine of the WinSmash program computed a total delta V of 20.0 km/h (12.4 mph), based on the Toyota's right side crush profile. The longitudinal and lateral components were -17.3 km/h (-10.8 mph) and -10.0 km/h (-6.2 mph), respectively. The results are low and borderline. The wooden pole was sheared at its base. The Matrix rotated in a counterclockwise direction and came to rest facing east.

Post-Crash

The driver of the Matrix sustained cervical and lumbar strains and a facial abrasion. She was transported by ambulance to an area trauma center. She arrived with a Glasgow Coma Scale (GCS) score of 15. She was treated and then discharged at 1307 hours.

The front right occupant sustained abrasions to her right elbow, right upper arm, and forehead. She was transported by ambulance to an area trauma center. She arrived with a GCS score of 15. She was treated and then discharged at 1355 hours.

The second row left seat occupant sustained a left lung contusion, a forehead laceration, and a contusion to the right iliac crest area. She was transported by air to a pediatric trauma center. She arrived with a GCS score of 15. She was hospitalized and discharged at 1145 hours the following day.

The second row right seat occupant was fatally injured with major head trauma, including multiple skull fractures, brain swelling and hemorrhages. She had agonal respirations and was pulseless at the scene. She was treated at the scene and transported to a local emergency room. The triage start time was 1105 hours. She arrived unresponsive to all stimuli with a GCS score of 3. She sustained major head and face trauma. Due to the severity of the injuries no resuscitation efforts were attempted and she was pronounced dead at 1109 hours.

The Matrix was towed from the scene and placed on a police hold.

VEHICLE DATA -2006 Toyota Matrix

The 2006 Toyota Matrix XR four-door hatchback was identified by the Vehicle Identification Number (VIN): 2T1KR30E06Cxxxxxx. The vehicle's mileage according to the digital odometer was 17,712 km (11,006 miles). The Matrix was a four-door hatchback was equipped with a 1.8 liter, four-cylinder engine, an automatic transmission, front wheel drive, front disc/rear drum power brakes, daytime running lights, power steering, and a tilt steering wheel. The Matrix was configured with Continental ContiTouring P205/55R16 tires. The manufacturer's recommended cold tire pressure was 220 kPa (32 psi). The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	159 kPa (23 psi)	6 mm (7/32 in)	No	No
RF	165 kPa (24 psi)	6 mm (8/32 in)	No	No
LR	152 kPa (22 psi)	6 mm (8/32 in)	No	No
RR	Flat	6 mm (8/32 in)	No	No

The seating in the Toyota Matrix was configured with front bucket seats, adjustable head restraints, and a rear bench seat with a folding back. The driver's seat was located at the forward most track position. The seat back was at a 30 degree angle from the vertical; the seat bottom was at a 13 degree angle from the horizontal. The front right seat was located between the mid and rear most track position. The seat back was at a 30 degree angle from the vertical; the seat bottom was at a 13 degree angle from the horizontal. The rear seat was equipped with adjustable head restraints at the outboard seat positions. The rear seat back was at a 24 degree angle from the vertical; the seat bottom was at a 13 degree angle from the horizontal.

VEHICLE DAMAGE

Exterior Damage - 2006 Toyota Matrix

The 2006 Toyota Matrix sustained moderate right side damage as a result of the impact with the wooden pole. The direct damage began with an initial contact to the right mirror. This damage was located 84.0 cm (33.1 in) rear of the front right axle. The more substantive damage began at the door and was located 108.0 cm (42.5 in) rear of the front right axle. The direct damage measured 112.0 cm (44.1 in). Dark colored long brown hair and bloody fluids were found embedded, and on the rear of the right door near the C pillar. Body fluids were located on the front of the right rear passenger door frame. The external door panel layer from the right rear passenger door was sheared off, exposing the inside of the door. The front of the right rear door frame was shifted rearward, exposing the vehicle interior. Both right side doors were deformed and jammed shut. The side glass for each door had disintegrated. The direct damage extended vertically from the sill level to the roof level. The windshield header and roof sustained lateral buckling and the windshield was fractured from impact forces. The sun roof was dislodged from the lateral buckling. Small amounts of blood were found on the fuel door cover, in front of the right rear tail light, the left rear bumper and below the left tail light. Six crush measurements were documented at the mid door levels as follows: C1=0 cm (0 in), C2=3.0 cm (1.2 in), C3=14.0 cm (5.5 in), C4=27.0 cm (10.6 in), C5=8.0 cm (3.1 in), C6=0 cm (0 in). The Collision Deformation Classification (CDC) for the impact with the pole was 01RPAW3.



Figure 5. Overhead view of right side crush

Delta V:	Total	20.0 km/h (12.4 mph)
	Longitudinal	-17.3 km/h (-10.8 mph)
	Latitudinal	-10.0 km/h (-6.2 mph)
	Energy	23,524 joules (17,350 ft lbs)

Interior Damage - 2006 Toyota Matrix

The 2006 Toyota Matrix sustained moderate interior damage as a result of passenger compartment intrusion, normal air bag deployment related damage, and passenger injury evidence. The right side doors, B pillar, and roof side rail sustained lateral intrusion.

The center console was deformed by occupant contact and seat movement. The right rear door was deformed by intrusion and contact with the child seat in that location. Blood and body fluids were pooled in the center of the rear seat. The right rear seat belt had been cut by emergency personnel. Broken glass was found throughout the vehicle.

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
RF	Door	7.0 cm (2.8 in)	Lateral
RF	B pillar	27.0 cm (10.6 in)	Lateral
RF	Roof rail	9.0 cm (3.5 in)	Lateral
RF	Seat back	2.0 cm (0.8 in)	Lateral
RR	Roof rail	11.0 cm (4.3 in)	Lateral
RR	Door	32.0 cm (12.6 in)	Lateral

MANUAL RESTRAINT SYSTEMS - 2006 Toyota Matrix

The 2006 Toyota Matrix was configured with manual 3-point lap and shoulder belts for each of the five seating positions. Both front safety belts were equipped with retractor pretensioners and adjustable D rings that were in the full up position for the driver and full down for the front right seat passenger. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). At the time of the vehicle inspection, the driver's retractor was restricted in the used position as a result of pretensioner actuation. The B pillar plastic fascia was pulled away from the pillar due to the pretensioner actuation. The belt was spooled out and lying on the seat.

The remaining safety belts were configured with sliding latch plates and switchable ELR/Automatic Locking Retractors (ALR). The front right safety belt was restricted in the used position as a result of pretensioner actuation. The belt was spooled out and lying on the seat. Both front seat belt were equipped with after-market comfort pads.

The second row left safety belt was used to secure the occupant seated in a forward facing convertible booster seat. At the time of the vehicle inspection, the belt was fully retracted. There were no indications of loading or damage. According to police investigators and first responders, the lap portion of the belt was being used and the shoulder portion was behind the child seat back.

The second row right safety belt was used to secure the occupant seated in a forward facing booster seat. According to police investigators and first responders, the lap portion of the belt was being used and the shoulder portion was behind the child seat back. Rescue personnel had cut the webbing at the lap area. The latch was found in the receiver.

The two outboard second row seating positions were equipped with the lower anchor points that are part of this vehicle's Lower Anchors and Tethers for Children (LATCH) system. All three seating positions were also equipped with child safety seat top tether anchor points.

Supplemental Restraint Systems - 2006 Toyota Matrix

The 2006 Toyota Matrix was equipped with dual-stage frontal air bags, safety belt pretensioners for the driver and front right passenger positions, seat back mounted side air bags for the driver and front right passenger positions, and side air curtains for the outboard front and rear seat positions. The impact with the pole resulted in sufficient longitudinal and lateral decelerations to deploy the frontal air bags, the front right passenger side air bag, and the right side air curtain. Both front seat belt pretensioners actuated during the crash.



Figure 6. Driver's air bag

The driver's air bag deployed from the center of the steering wheel hub through Y configuration module cover flaps. The top flap measured 15.0 cm (5.9 in) in width and 4.0 cm (1.6 in) in height. The bottom flaps each measured 4.0 cm (1.6 in) vertically in the center and 8.0 cm (3.1 in) laterally. The deployed driver's air bag measured 60.0 cm (23.6 in) in diameter in its deflated state. The air bag was tethered by a single internal strap. The tether was attached to a 17.0 cm (6.7 in) circular stitch in the center of the air bag face. There were two circular vent ports that were located at the 10 and 2 o'clock positions. There was no damage to the air bag or indications of occupant contact.

The front right passenger's air bag deployed from a top-mount module with H-configuration cover flaps. The top flap measured 24.0 cm (9.4 in) wide by 6.0 cm (2.4 in) high. The bottom flap measured 24.0 cm (9.4 in) wide by 7.5 cm (3.0 in) high. The deployed front right passenger's air bag measured 33.0 cm (13.0 in) wide seam to seam by approximately 60.0 cm (23.6 in) high in its deflated state. Two circular vent ports were located at the 3 and 9 o'clock aspects of each side panel of the air bag.

The front right passenger's side air bag deployed from the front right seat back in a forward direction. The deployed side air bag measured 25.0 cm (9.8 in) high by 18.0 cm (7.1 in) wide. There were three circular vent ports arranged in a triangular pattern in the center of the air bag. There was blood found on the inside facing portion of the air bag.

The right side air bag curtain deployed from the roof cladding on the right side of the vehicle. The side curtain was generally rectangular in shape and measured 152.0 cm (59.8 in) in length and 48.0 cm (18.9 in) in height. The curtain covered both right side seating positions. The bottom of the curtain fell 11.0 cm (4.3 in) below the bottom of the side window frame. The curtain was secured at the front by a 27.0 cm (10.6 in) long tether attached to the A pillar. The side air curtain may not have fully deployed. At a point approximately 66.0 cm (26.0 in) rear of the front of the curtain, the curtain was entrapped against the B pillar by the front right seat head restraint. There was blood and tissue found on the exterior of the side curtain at the right rear location.



Figure 7. Front right passenger's air bag



Figure 8. Front right passenger's side air bag



Figure 9. Right side air curtain at B pillar



Figure 10. Overview of side curtain at right rear location



Figure 11. Right side air curtain at C pillar



Figure 12. Right side air curtain at A pillar



Figure 13. Close up of blood/tissue contacts to exterior of side air bag



Figure 14. Side air curtain entrapped by head restraint at B pillar

Child Safety Seat

Cosco Alpha Omega (second row left)

A Cosco Alpha Omega high back booster child safety seat was positioned in the left rear of the Matrix. The model number and manufacturer date label had been removed prior to the crash. The harnesses and buckles had been removed. The seat was being used as a booster seat. The reclining foot was found in the stowed position. The manufacturer recommended usage for this seat is for children weighing 2.3 to 36.2 kg (5-80 lbs) and who are between 48-130 cm (19-51 in) in height. A label on the seat outlined the recommended use of the seat as follows: Rear-facing 2.3 kg (5-22 lbs), forward-facing 10-18 kg (22-40 lbs). The child in this seat position weighed 30 kg (66 lbs) and was 112 cm (44 in) tall. At the time of the crash, the child was using this seat in conjunction with the lap belt only.



Figure 15. Cosco Alpha Omega seat, left rear

Cosco Alpha Omega (second row right)

A Cosco Alpha Omega high back booster child safety seat was positioned in the right rear of the Matrix. The model number and manufacturer date label had been removed prior to the crash. The harnesses and buckles had been removed. The seat was being used as a booster seat. The reclining foot was found in the stowed position. The splitter plate was tied in a knot under the seat. The right shoulder belt guide comfort clip top screw was stripped out. Blood was found on the left side of the seat. The manufacturer recommended usage for this seat is for children weighing 2.3 to 36.2 kg (5-80 lbs) and who are between 48-130 cm (19-51 in) in height. The child in this seat weight 30 kg (67 lbs) and was 124 cm (49 in) tall, which was within the manufacturer's recommended weight guideline. A label on the seat outlined the recommended use of the seat as follows: Rear-facing 2.3-9.9 kg (5-22 lbs), forward-facing 10-18 kg (22-40 lbs). At the time of the crash, the child was using this seat in conjunction with the lap belt only. The shoulder harness had been placed behind the child seat back.



Figure 16. Cosco Alpha Omega seat, right rear

OCCUPANT DEMOGRAPHICS - 2006 Toyota Matrix

	Driver	Occupant 2
Age/Sex:	23/Female	36/Female
Seated Position:	Front left	Front right
Seat Type:	Fabric covered bucket seat in full forward track position	Fabric covered bucket seat, adjusted to between the middle and rear most track position
Height:	152 cm (60 in)	163 cm (64 in)
Weight:	45 kg (100 lbs)	68 kg (150 lbs)
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None	None
Alcohol/Drug Involvement:	None	None
Driving Experience:	Unknown	NA
Body Posture:	Normal, upright	Normal, upright
Hand Position:	Hands on steering wheel	Unknown
Foot Position:	Right foot presumed to be on brake	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used
Air bag:	Driver's frontal air bag, deployed. Side air curtain, did not deploy. Seat back mounted side air bag, did not deploy.	Front right passenger's frontal air bag, deployed. Side air curtain, deployed. Seat back mounted side air bag, deployed.

OCCUPANT DEMOGRAPHICS

	Occupant 3	Occupant 4
Age/Sex:	5/Female	6/Female
Seated Position:	Second row left	Second row right
Seat Type:	Fabric covered bench seat with folding back	Fabric covered bench seat with folding back.
Height:	112 cm (44 in)	124 cm (49 in)
Weight:	30 kg (66 lbs)	30 kg (67 lbs)
Occupation:	NA	NA
Pre-existing Medical Condition:	None	None
Alcohol/Drug Involvement:	NA	NA
Driving Experience:	NA	NA
Body Posture:	Upright in child seat	Upright in child seat
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap portion of lap and shoulder belt used in conjunction with child safety seat	Lap portion of lap and shoulder belt used in conjunction with child safety seat
Air bag:	Side air curtain, did not deploy.	Side air curtain, deployed.

OCCUPANT INJURIES -2006 Toyota Matrix

Driver: Injuries obtained from Admissions, ER, Radiology, and Post-ER medical records.
Occupant was transported on a backboard, wearing a rigid cervical collar.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Strain, cervical spine, acute with no fracture or dislocation	640278.1,6	Impact forces	Probable
Strain, lumbar spine, acute with no fracture or dislocation	640678.1,8	Impact forces	Probable
Abrasion, left side chin	290202.1,8	Air bag	Possible

Front right occupant: Injuries obtained from Admissions, ER, Radiology, and Post-ER medical records.
Occupant was transported on a backboard, wearing a rigid cervical collar.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Abrasions, right elbow	790202.1,1	Side door surface	Probable
Abrasions, right upper arm	790202.1,1	Side door surface	Probable
Abrasion, forehead	290202.1,7	Air bag	Probable

Second row left occupant: Injuries obtained from Admissions, ER, Radiology, and Post-ER medical records.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Lung contusion, left	441403.3,2	CSS shell	Possible
Laceration (minor), forehead	290602.1,7	Flying glass	Probable
Contusion, right iliac crest	590402.1,1	Vehicle lap belt	Probable

Second row right occupant: Injuries obtained from Autopsy Report and Toxicology Report.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Multiple complex basilar skull fractures; all of the fractures are hemorrhagic	150206.4,8	Wooden pole	Probable
Hinge-type fracture to middle fossa and posterior sella turcica			
Multiple fractures to the bilateral posterior and frontal fossae			
Multiple fractures to the anterior fossae involving the bilateral orbital plates, ethmoid bone and sphenoid bone			
Epidural hemorrhage, posterior fossa, approximately 5 mL			
Subdural hemorrhage, approximately 5-10 mL			
Multiple contusions, scalp; right frontal-parietal, right and left occipital regions	190402.1,9	Wooden pole	Probable
Multiple lacerations, brain stem, involving hemorrhage	140212.6,8	Wooden pole	Probable
Subarachnoid hemorrhages over the brain stem, cerebellum and base of the brain			
Brain swelling, cerebellum	140450.3,6	Wooden pole	Probable
Displaced fracture, mandible, right side	250610.2,1	Wooden pole	Probable
Fracture, loss of lower tooth; associated with mandible fracture	251404.1,8	Wooden pole	Probable

The autopsy report noted the presence of multiple fragments of broken glass present in the skin on the left side of the face, and in the hair

Multiple abrasions, “dicing type,” face, extending to head and neck	290202.1,9	Right side window glass	Probable
Multiple minor lacerations, face, extending to head and neck; the longest of these was 4.5 inches in length	290602.1,9	Right side window glass	Probable
Multiple contusions, face, extending to head and neck	290402.1,9	Wooden pole	Probable
Contusions, anterior left lower leg; three total, measuring 0.5, 1.0 and 1.5 inches in diameter,	890402.1,2	Unknown	Unknown
Abrasion, right thigh, covering area 3.0 x 1.5 inches	890202.1,1	Door side panel	Probable

OCCUPANT KINEMATICS - 2006 Toyota Matrix

Driver Kinematics

The 23-year-old female driver was likely seated in an upright posture. She was wearing the 3-point manual lap and shoulder belt. The shoulder belt anchorage was in the full down position. The fabric covered bucket seat was in the fully forward track position. The seat back was at a 30 degree angle from the vertical; the seat bottom was at a 13 degree angle from the horizontal. She likely had both hands on the steering wheel and was actively steering to the left and braking prior to impact. The driver was likely leaning to the right to some degree in response to centrifugal forces. At impact, the frontal air bag deployed and the seat belt pretensioner actuated. The female driver initiated a forward and slightly right lateral trajectory. She likely loaded the seat belt to some degree as she pitched forward and to the right. Her right hip likely came into contact with the center console. She complained of pain to her neck, right shoulder, back and right hip and groin. She was transported by ground ambulance for treatment.



Figure 17. Driver's seated position

Front Right Seat Occupant Kinematics

The 36-year-old female front right seat occupant was likely seated in an upright posture. She was wearing the 3-point manual lap and shoulder belt. The shoulder belt anchorage was in the full up position. The fabric covered bucket seat was adjusted to between the middle and rear most track position. The seat back was at a 30 degree angle from the vertical; the seat bottom was at a 13 degree angle from the horizontal. The driver was actively steering to the left and braking prior to impact. This passenger was likely leaning to the right to some degree in response to centrifugal forces. At impact, the frontal air bag, seat back mounted side air bag, and side air curtain deployed. The front right seat belt pretensioner actuated. The front right seat occupant initiated a forward and slightly right lateral trajectory. She likely loaded the seat belt to some degree as she pitched forward and to the right. The right side of her body likely contacted the door side panel, side air bag, and side air curtain. She sustained abrasions to her right elbow, right upper arm, and her forehead. She was transported by ground ambulance for treatment.



Figure 18. Right front door side panel

Second Row Left Occupant Kinematics

The 5-year-old female second row left seat occupant was likely seated in an upright posture. She was seated in a Cosco Alpha Omega high back booster child safety seat. The harnesses and buckles had been removed. The seat was being used as a booster seat. The reclining foot was found in the stowed position. She was using the lap portion of the manual 3-point lap and shoulder belt. The shoulder belt had been placed behind the child seat. The fabric covered split bench seat was equipped with adjustable head restraints. The rear seat back was at a 24 degree angle from the vertical; the seat bottom was at a 13 degree angle from the horizontal. The driver was actively steering to the left and braking prior to impact. The second row left occupant was leaning to the right to some degree in response to centrifugal forces. At impact, she initiated a forward and slightly right trajectory. She likely engaged and loaded the lap belt to some degree. She probably flexed forward about the lap belt, causing a hip contusion. It has been reported that she sustained pulmonary contusions; likely due to contact with the CSS shell at some point. She was transported by air ambulance for treatment.

Second Row Right Seat Occupant Kinematics

The 6-year-old female second row right seat occupant was likely seated in an upright posture. She was seated in a Cosco Alpha Omega high back booster child safety seat. The harnesses and buckles had been removed. The seat was being used as a booster seat. The reclining foot was found in the stowed position. She was using the lap portion of the manual 3-point lap and shoulder belt. The shoulder belt had been placed behind the child seat. The fabric covered split bench seat was equipped with adjustable head restraints. The rear seat back was at a 24 degree angle from the vertical; the seat bottom was at 13 degree angle from the horizontal. The driver was actively steering to the left and braking prior to impact.



Figure 19. Exterior view of child seat, side air curtain

The second row right occupant was leaning to the right to some degree in response to centrifugal forces. Based on the evidence of injury to the exterior of the side air curtain, the skin and blood transfers on the vehicle exterior, and the report of skin and blood transfers to the struck pole, it is nearly certain that this occupant had pitched far to the right and may have engaged the side glass just prior to impact. At impact, the side air curtain deployed. This occupant's head was outside of the curtain and came into direct contact with the wooden pole. She was fatally injured with major head trauma. She rebounded from the impact and came to rest still seated in the child seat and leaning over the left side of the child seat. She had agonal respirations and was pulseless at the scene. She was treated at the scene and transported to a local emergency room. The triage start time was 1105 hours. She arrived unresponsive to all stimuli with a Glasgow Coma Scale (GCS) score of 3. She sustained major head and face trauma. Due to the severity of the injuries no resuscitation efforts were attempted and she was pronounced dead at 1109 hours.

Attachment 1. Scene Diagram

