

Remote Combination Child Seat Investigation
Dynamic Science, Inc. (DSI), Case Number 2008-81-043B
1998 Mercury Mystique
Washington
April 2008

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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 <p>This remote combination investigation focused on the injuries sustained by a second row occupant seated in a rear facing child seat while traveling in a 1998 Mercury Mystique. This two vehicle crash occurred in April 2008 at 1650 hours. The subject vehicle was occupied by an 18-year-old female driver, a 16-year-old front right seat passenger, and a 5-month-old male who was restrained in a rear-facing infant safety seat. The other vehicle was a 1997 Ford Ranger pickup that was being driven by a restrained 34-year-old male. The crash occurred within an interchange area. The front end of the Ford Ranger impacted the right side of the Mystique. The Mystique traveled off the north edge of the roadway and came to rest facing southeast. The Ford Ranger rotated clockwise and came to rest facing east in the outboard westbound travel lane. The driver of the Mystique sustained a concussion, a facial contusion, and minor lacerations. She was hospitalized for one day. The front right occupant sustained brain injuries, a skull fracture, rib fractures, hip fractures, spinal fractures, lung and liver contusions, liver and kidney lacerations, as well as multiple soft tissue injuries. She was transported to an area trauma center and was hospitalized for twenty days. The second row middle seat occupant was fatally injured. He sustained a spleen laceration, lung and colon contusions, multiple skull fractures, a subarachnoid hemorrhage, and facial and head lacerations. The driver of the Ford Ranger sustained a possible injury. Both vehicles were towed due to damage.</p>				
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Background

This remote combination investigation focused on the injuries sustained by a second row occupant seated in a rear facing child seat while traveling in a 1998 Mercury Mystique (**Figure 1**). This two vehicle crash occurred in April 2008 at 1650 hours. The subject vehicle was being driven by a restrained 18-year-old female. The front right seat was occupied by a restrained 16-year-old female. The second row middle seat was occupied by a 5-month-old male who was restrained in a rear-facing Graco SnugRide Infant Safety Seat (ISS). The other vehicle was a 1997 Ford Ranger pickup that was being driven by a restrained 34-year-old male. The crash occurred within an interchange area.

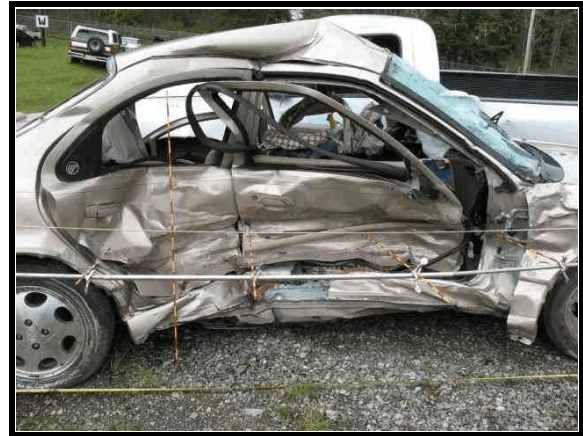


Figure 1. 1998 Mercury Mystique

The front end of the Ford Ranger impacted the right side of the Mystique. The Mystique traveled off the north edge of the roadway, while the Ford Ranger rotated clockwise and came to rest facing east in the outboard westbound travel lane. The driver of the Mystique sustained a concussion, a facial contusion, and minor lacerations. She was hospitalized for one day. The front right occupant sustained brain injuries, a skull fracture, rib fractures, hip fractures, spinal fractures, lung and liver contusions, liver and kidney lacerations, as well as multiple soft tissue injuries. She was transported to an area trauma center and was hospitalized for twenty days. The second row middle seat occupant was fatally injured. He sustained a spleen laceration, lung and colon contusions, multiple skull fractures, a subarachnoid hemorrhage, and facial and head lacerations. The driver of the Ford Ranger sustained a possible injury. Both vehicles were towed due to damage.

This investigation was initiated in response to a report of a fatally injured child in a child seat by the local National Automotive Sampling System (NASS) team. DSI was notified and assigned the case on June 10, 2008. The following information was obtained from the electronic data system.

SUMMARY

Crash Site

This crash occurred in April 2008 at 1650 hours within an interchange area. The eastbound lane of the roadway travels beneath an interstate roadway overpass. The eastbound lane curves to the right and merges with the westbound lanes to become a four-lane, undivided roadway (**Figure 2**). The eastbound lane was bounded on the right by a solid white line, an asphalt shoulder, and an ascending grass-covered embankment, and on the left by two sets of double yellow painted lines. The westbound lanes were separated from the



Figure 2. Westbound approach to area of impact

eastbound lanes by a double yellow painted centerline east of the merging area (**Figure 3**). Two sets of double yellow lines comprised a painted divider as the two roadways began to merge. The westbound roadway was bordered on right by a solid white line, an asphalt shoulder, and a grass covered embankment. There was freezing rain at the time of the crash and the asphalt roadway was wet. The speed limit was 80 km/h (50 mph).



Figure 3. Eastbound approach to area of road departure and impact

Pre Crash

The Mercury Mystique was traveling eastbound and was being driven by a restrained 18-year-old female. The front right seat was occupied by a restrained 16-year-old female. The second row middle seat was occupied by a 5-month-old male who was restrained in a rear-facing Graco SnugRide ISS. The other vehicle was a 1997 Ford Ranger pickup that was being driven westbound by a restrained 34-year-old male. As the Mystique negotiated the curve to the right, the vehicle departed the roadway to the right, and traveled onto the right side embankment. The driver steered back to the left and, as the Mystique reentered the roadway, began crossing the westbound travel lanes in a northbound direction.

Crash

The front end of the Ford Ranger impacted the right side of the Mystique. The Mystique sustained severe damage and the frontal air bags deployed. The Damage Only algorithm of the WinSmash program computed a total Delta V of 44 km/h (27.3 mph), based on the Mystique's right side crush profile. The longitudinal and lateral components were -22 km/h (13.7 mph) and -38 km/h (23.6 mph), respectively. The program computed a total Delta-V of 37 km/h (22.9 mph), based on the Ford's frontal crush profile. The longitudinal and lateral components were -35 km/h (21.7 mph) and 13km/h (8.0 mph), respectively. The Mystique traveled off the north edge of the roadway. The Ford Ranger rotated clockwise and came to rest facing east in the outboard westbound travel lane.

Post Crash

The driver of the Mystique was transported from the scene to a trauma center and was hospitalized for one day. The front right occupant sustained serious injuries. She was transported to an area trauma center and was hospitalized for twenty days. The second row middle seat occupant was fatally injured. He was transported from the scene to an area trauma center where he was pronounced dead nine hours after the crash. The driver of the Ford sustained a possible injury. He was transported to an area medical clinic where he was treated and released. Both vehicles were towed due to damage.

Vehicle Data - 1998 Mercury Mystique

The 1998 Mercury Mystique was identified by the Vehicle Identification Number (VIN): 1MELM6537WKxxxxxx. The vehicle mileage was 158,630 km (98,570 miles). The Mystique was a four-door sedan that was equipped with 2.0 liter, 4-cylinder engine, an automatic transmission, front wheel drive, front disc/rear drum brakes, power steering, and a tilt-steering wheel. The Mystique was configured with a Federal Supersteel 621 tire on the left front, a Multimile Grand Am tire on the left rear, a Firestone Firehawk GTA on the right rear, and a Kumho (unknown model) tire on the right front. All the tires were size P20560R15.

The specific tire information was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	221 kPa (32 psi)	6 mm (8/32 in)	None	None
LR	41 kPa (6 psi)	5 mm (6/32 in)	None	None
RR	34 kPa (5 psi)	4 mm (5/32 in)	None	None
RF	276 kPa (40 psi)	4 mm (5/32 in)	None	None

The seating in the Mystique was configured with front bucket seats with adjustable head restraints and a rear bench seat. The track settings for the front seats was not known. The rear seat was deformed by passenger compartment intrusion.

Vehicle Damage

Exterior Damage - 1998 Mercury Mystique

The Mercury Mystique sustained severe right side damage as a result of the impact with the Ford Ranger (**Figure 4**). The direct damage began 13 cm (5.1 in) forward of the right rear axle and extended 220 cm (86.7 in) forward along the right side plane. The maximum lateral crush was located at C3 and measured 71 cm (27.9 in). Both right side doors were deformed and jammed shut. The damage to the front right door slightly overrode the right sill. The front door was forced rearward which formed a gap between the forward aspect of the door and the A-pillar. The gap extended upward to include the area between the A-pillar and the door/window frame. The direct damage extended vertically to include the entire height of the door panels. The right side view mirror was broken away. The right roof side rail sustained induced lateral crush as a result of the right side doors and B-pillar crush. The combined direct and induced damage began 26 cm (10.2 in) rearward of the right rear axle and extended 284 cm (111.8 in) forward along the right side plane. Six crush measurements were documented at the mid-door level as follows: C1 = 0 cm, C2 = 19 cm (7.5 in), C3 = 71 cm (27.9 in), C4 = 61 cm (24.0 in), C5 = 30 cm (11.8 in), C6 = 0 cm. The Collision Deformation Classification was 02RYEW5.



Figure 4. Right side damage, Mercury Mystique

Interior Damage - 1998 Mercury Mystique

The 1998 Mercury Mystique sustained severe right side interior damage as a result of passenger compartment intrusion (**Figure 5**). The specific passenger compartment intrusions were as follows:

Row/Position	Intruded Component	Magnitude of Intrusion	Direction
Second row right	Door trim	>=41 to <61 cm (>=16 to <24 in)	Lateral
Front row right	Door/Rear lower quadrant	>=30 to <46 cm (>= 12 to <18 in)	Lateral
Second row right	Door/Forward lower quadrant	>=30 to <46 cm (>= 12 to <18 in)	Lateral
Front row right	Front seat back	35 cm (13.7 in)	Lateral
Front row right	B-pillar	45 cm (17.7 in)	Lateral
Second row middle	Interior trim panel from RR door	>=30 to <46 cm (>= 12 to <18 in)	Lateral

Front row right	Instrument panel right	20 cm (7.9 in)	Lateral
Front row right	Roof side rail	25 cm (9.8 in)	Lateral
Front row right	Glove box	23 cm (9.0 in)	Longitudinal
Second row right	Roof side rail	26 cm (10.2 in)	Lateral
Second row right	C-pillar	29 cm (11.4 in)	Lateral
Front row right	A-pillar	20 cm (7.9 in)	Lateral
Front row right	Side panel	≥ 8 to < 15 cm (≥ 3 to < 6 in)	Lateral
Front row right	Floor pan	≥ 8 to < 15 cm (≥ 3 to < 6 in)	Lateral
Second row right	Floor pan	≥ 8 to < 15 cm (≥ 3 to < 6 in)	Lateral

There was blood located on the right door and the right B-pillars. There was also blood located on the shell of the CSS and on the driver's air bag. The right front door panel and right armrest were cracked and deformed by the front right occupant. The plastic fascia covering the right A-pillar was dislodged and the fascia on the upper portion of the right B-pillar was missing. The center console was displaced laterally to the left due to contact from the right front occupant. There was integrity loss to the right front door, the side windows, and the backlight. Both right side doors were jammed shut.

Manual Restraints - 1998 Mercury Mystique

The 1998 Mercury Mystique was equipped with 3-point manual lap and shoulder belts for each of the five seating positions. The front safety belts were configured with adjustable D-ring anchorages that were in the middle position. All the safety belts were configured with sliding latch plates. The driver's belt and the second row middle belt were cut by rescue personnel during the extrication effort. The second row middle safety belt was configured with a switchable Emergency Locking Retractor/Automatic Locking Retractor (ELR/ALR). The retractor mode for this belt was not known. The belt was used to secure the rear-facing child safety seat. There were no anchors or tethers available at this seat location.

Supplemental Restraint Systems - 1998 Mercury Mystique

The 1998 Mercury Mystique was equipped with redesigned frontal air bags for the driver and front right passenger seat positions. The frontal air bags deployed as a result of the longitudinal deceleration of the Mystique during the impact with the Ford.

The driver's air bag deployed from the center of the steering wheel hub through H-configuration module cover flaps (**Figure 5**). The deployed air bag had a circular stitching pattern in the front center that corresponded to an unknown number of internal tether straps. It also had two circular vent ports on the back of the bag at the 11 and 1 o'clock positions. There was blood located on the air bag face, primarily across the top quadrant. There were no other reported occupant contacts to the air bag.

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 6**). There was damage to air bag as a result of contact with the windshield. There were no reported occupant contacts to the air bag.



Figure 5. Driver's deployed air bag



Figure 6. Front right passenger's deployed air bag

Child Safety Seat

Graco Snug Ride

A Graco Snug Ride ISS was positioned in the second row of the Mercury Mystique (**Figure 7**). The model number was 7F02GLM3 and the date of manufacture was November 15, 2006. The serial number was JJ1115060543. The ISS was designed for rear-facing use only and was configured with a stay-in-vehicle base. The ISS was configured with a 5-point internal harness system and a two-piece, locking harness retainer clip. The harness shoulder straps had been adjusted to the lower slot position. The harness retainer clip was used but its position was not known. The seat was equipped with a sun shield that was broken during the crash but remained attached to the seat. According to a label found on the seat base, this ISS was rated for children who weighed 9 kg (20 lbs) or less and were 66 cm (26 in) or less in height. According to the Graco manual, this seat was rated for children who weighed between 2.3-10 kg (5-22 lbs) and whose height was 73 cm (29 in) or less. The child's height was 62 cm (24.4 in) and his weight was 13 kg (28.6 lbs), which was within the manufacturer's recommended height guidelines and over the recommended weight guidelines.

The ISS was installed in a rear-facing orientation, using the seat base, and was secured to the vehicle by the vehicle's lap and shoulder belt. The belt was routed through the rear facing belt path. The safety belt was configured with a switchable retractor but the retractor mode was not known.

The ISS sustained minor damage as a result of the crash (**Figure 8**). The middle to forward most portion of the left side of the seat base sustained minor deformation/crazing from engagement against the right rear door interior, and sustained induced buckling to the back of the base. There was deformation to the outboard aspect of the left side of the ISS shell, primarily between the carrying handle and the seat belt guide. There was blood located on the left upper portion of the ISS padding.



Figure 7. Graco Snug Ride ISS



Figure 8. ISS damage (left side of seat in rear-facing orientation).

Vehicle Data - 1997 Ford Ranger

The 1997 Ford Ranger pickup was identified by the VIN: 1FTR14A7VPxxxxxx. The Ranger was configured with a 2.3 liter, 4-cylinder engine, a manual transmission, and rear wheel drive.

Vehicle Damage

1997 Ford Ranger sustained moderate front end damage as a result of the impact with the Mercury Mystique (**Figure 9**). The direct damage began at the front right bumper corner and extended 146 cm (57.4 in) laterally along the frontal plane. The maximum longitudinal crush was located at the front right bumper corner and measured 27 cm (10.6 in). The direct contact damage extended vertically from the bumper into the hood. There was induced damage to the left fender, the hood, and the right fender. Both front tires were restricted.

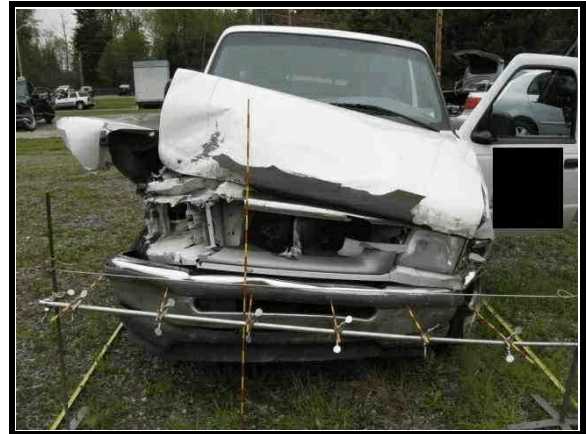


Figure 9. Other vehicle, 1997 Ford Ranger pickup

Six crush measurements were documented at the bumper level as follows: C1 = 26 cm (10.2 in), C2 = 14 cm (5.5 in), C3 = 12 cm (4.7 in), C4 = 14 cm (5.5 in), C5 = 13 cm (5.1 in), C6 = 27 cm (10.6 in). The CDC for the impact with the Mystique was 11FDEW2.

OCCUPANT DEMOGRAPHICS - 1998 Mercury Mystique

	Driver	Front Right Passenger
Age/Sex:	18/Female	16/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket	Bucket
Height:	152 cm (60 in)	168 cm (66 in)
Weight:	55 kg (121 lbs)	50 kg (110 lbs)
Alcohol/Drug Involvement:	None	N/A
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used.	Lap and shoulder belt available, used.
Air bag:	Driver air bag available, deployed.	Front right passenger air bag available, deployed.

Second Row Middle Passenger

Age/Sex:	5 months/Male
Seated Position:	Second row middle
Seat Type:	Bench
Height:	62 cm (24.4 in)
Weight:	13 kg (28.6 lbs)
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt, used with ISS

OCCUPANT INJURIES - 1998 Mercury MystiqueDriver: Injuries obtained from Emergency Room Records

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Length of Unconsciousness < 1 hour; whole region	160202.2,0	Right door panel in forward upper quadrant	Certain
Facial skin contusion; superior/upper	290402.1,7	Right door panel in forward upper quadrant	Certain
Skin abrasion; whole region	990200.1,0	Flying glass	Certain

Front Right Passenger: Injuries obtained from ER and Post-ER Records.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Pelvis fracture open/displaced/comminuted; anterior/front/ventral	852604.3,5	Right door panel armrest/hardware in rear lower quadrant	Certain
Pelvis fracture open/displaced/comminuted; posterior/back/dorsal	852604.3,6	Right door panel armrest/hardware in rear lower quadrant	Certain
Symphysis pubis separation	853000.3,5	Right door panel armrest/hardware in rear lower quadrant	Certain
Lumbar spine fracture transverse process, L1; inferior/lower	650620.2,8	Right door panel armrest/hardware in rear lower quadrant	Certain
Lumbar spine fracture transverse process, L2; inferior/lower	650620.2,8	Right door panel armrest/hardware in rear lower quadrant	Certain
Lumbar spine fracture transverse process, L3; inferior/lower	650620.2,8	Right door panel armrest/hardware in rear lower quadrant	Certain
Basilar skull fracture without CSF leak; right	150202.3,1	Right B-pillar	Certain
Cerebrum hematoma/hemorrhage subdural small; right	140652.4,1	Right B-pillar	Certain

Cerebrum hematoma/hemorrhage intracerebral small; right	140640.4,1	Right B-pillar	Certain
Rib cage fracture open/displaced /comminuted with hemo-/pneumothorax, Rib 2, Rib 3, Rib 4, Rib 5, Rib 8, Rib 9, Rib 10, Rib 11; right	450252.4,1	Right door panel armrest/hardware in rear lower quadrant	Certain
Lung contusion unilateral with or without hemo-/pneumothorax; right	441406.3,1	Right door panel armrest/hardware in rear lower quadrant	Certain
Liver contusion minor (OIS Grade I or II); right	541812.2,1	Right door panel armrest/hardware in rear lower quadrant	Certain
Liver laceration minor (OIS Grade I or II); right	541822.2,1	Right door panel armrest/hardware in rear lower quadrant	Certain
Kidney laceration minor (OIS Grade I or II); right	541622.2,1	Right door panel armrest/hardware in rear lower quadrant	Certain
Lower extremity skin laceration minor; right buttock	890602.1,2	Belt restraint webbing/buckle	Certain
Upper extremity skin abrasion; bilateral	790202.1,3	Flying glass	Certain
Upper extremity skin laceration minor; right; forearm; hands/digits	790602.1,1	Flying glass	Certain
Lower extremity skin abrasion; bilateral; hip	890202.1,3	Belt restraint webbing/buckle	Certain
Abdomen skin abrasion; inferior/lower	590202.1,8	Belt restraint webbing/buckle	Certain
Abdomen skin contusion; inferior/lower	590402.1,8	Belt restraint webbing/buckle	Certain

Second Row Middle Passenger: Injuries obtained from Autopsy

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Spleen laceration major (OIS Grade IV); left	544226.4,2	Right door/right door panel in forward upper quadrant	Certain
Vault skull fracture comminuted; right	150404.3,1	Right door/right door panel in forward upper quadrant	Certain
Vault skull fracture comminuted; left	150404.3,2	Right door/right door panel in forward upper quadrant	Certain
Basilar skull fracture without CSF leak; inferior/lower	150202.3,8	Right door/right door panel in forward upper quadrant	Certain
Cerebellum subarachnoid hemorrhage; posterior/back/dorsal	140466.3,6	Right door/right door panel in forward upper quadrant	Certain
Cerebrum subarachnoid hemorrhage; right	140684.3,1	Right door/right door panel in forward upper quadrant	Certain
Cerebrum subarachnoid hemorrhage; left	140684.3,2	Right door/right door panel in forward upper quadrant	Certain
Lung contusion unilateral with or without hemo-/pneumothorax; left	441406.3,2	Right door/right door panel in forward upper quadrant	Certain
Colon contusion (OIS Grade I), inferior/lower	540810.2,8	Right door/right door panel in forward upper quadrant	Certain
Facial skin abrasion; superior/upper	290202.1,7	Right door/right door panel forward upper quadrant	Certain

Facial skin laceration minor; superior/upper	290602.1,7	Right door/right door panel in forward upper quadrant	Certain
Scalp abrasion; right	190202.1,1	Right door/right door panel in forward upper quadrant	Certain

OCCUPANT KINEMATICS

Driver Kinematics

As the subject vehicle re-entered the roadway after losing control in a turn, the vehicle traveled northbound across the westbound travel lanes. The front of the Ford Ranger impacted the right side of the Mystique. The 18-year-old female driver occupied a bucket seat and was restrained by the 3-point manual lap and shoulder belt. During the impact, both frontal air bags deployed, and the driver initiated a forward but mostly right leading trajectory. The right side of her head contacted the intruding right side door panel, causing a concussive head injury and a contusion to the right side of her face. The Mystique was displaced in a clockwise rotation after the initial impact. There was movement of the driver back to the left from both the rotational forces and rebound from the door panel contact. The driver also sustained lacerations from flying glass. She was transported to an area trauma center where she was hospitalized for 1 day.



Figure 10. Second row seat, showing right rear door panel.

Front Right Passenger Kinematics

The 16-year-old female front right passenger occupied a bucket seat and was restrained by the 3-point manual lap and shoulder belt. At impact, both frontal air bags deployed and the front right passenger initiated a right side leading trajectory. She engaged the intruding door panel with her torso and lower body and the B-pillar with her head. She sustained brain injuries, a skull fracture, rib fractures, hip fractures, spinal fractures, lung and liver contusions, liver and kidney lacerations, as well as multiple soft tissue injuries. She was transported to an area trauma center and was hospitalized for 20 days.

Second Row Middle Passenger Kinematics

The 5-month-old male child was seated in a Graco Snug Ride ISS. The child was restrained by the seat's 5-point harness. The ISS was placed on a bench seat in the rear-facing configuration and was

secured to the vehicle using the switchable ELR/ALR lap and shoulder belt. The mode of the switchable retractor was not known. The internal harness had been adjusted to the lower slot position and the harness retainer clip was being used. Its position was not known. During the impact with the Ford Ranger, the child was displaced to the right. Simultaneously, the right side door and side panel intruded laterally into the passenger compartment (**Figure 10**). The side panel contacted the child and the left side of the rear-facing ISS. He sustained a spleen laceration, a left lung contusion, a colon contusion, a comminuted left vault fracture, a basilar skull fracture, a right vault fracture, abrasions and lacerations to the left forehead, and a subarchnoid hemorrhage. All of the injuries were attributed to the intruding right side door panel, though there was likely some contact between the child and the internal portion of the ISS shell. He was transported from the scene to an area trauma center where he was pronounced dead nine hours after the crash.

Attachment 1. Scene Diagram

