CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE CHILD SAFETY SEAT CRASH INVESTIGATION

CASE NO.: CA05-061

VEHICLE: 2002 FORD EXCURSION

LOCATION: PENNSYLVANIA

DATE OF CRASH: DECEMBER 2005

Contract No. DTNH22-01-C-17002

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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 are 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 on-site investigative effort focused on the performance of two child safety seats and the resulting injuries to the 1 and 3-year-old female passengers of a 2002 Ford Excursion. The 1-year-old female was restrained by the five-point harness in a forward facing manner within a convertible child safety seat in the second row left position. Due to the severity of her injuries, she was transported to the hospital within the child safety seat where it was subsequently discarded. The 3-year-old female was seated in a Cosco Voyager belt positioning booster seat in the third row right position. The belt positioning booster seat was captured by intrusion in the Ford and was inspected in this position. The Ford was also occupied by a restrained 31-year-old female driver and a restrained 13-year-old male front right passenger.

The Ford departed the right roadside of the highway where it struck a delineator post, three trees, and rolled over. The vehicle was equipped with redesigned frontal air bags and retractor mounted pretensioners for the driver and front right positions. As a result of the collision, the frontal air bag system deployed and the front safety belt retractor pretensioners fired. The driver and the three child passengers sustained minor to moderate severity injuries and were transported to a local hospital where they were treated and released approximately seven hours post-crash.

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CALSPAN ON-SITE CHILD SAFETY SEAT CRASH INVESTIGATION
SCI CASE NO.: CA05-061
LOCATION: PENNSYLVANIA
VEHICLE: 2002 FORD EXCURSION
CRASH DATE: OCTOBER 2005

BACKGROUND

This on-site investigative effort focused on the performance of two child safety seats and the resulting injuries to the 1 and 3-year-old female passengers of a 2002 Ford Excursion **(Figure 1)**. The 1-year-old female was restrained by the five-point harness in a forward facing manner within a convertible child safety seat in the second row left position. Due to the severity of her injuries, she was transported to the hospital within the child safety seat where it was subsequently discarded. The 3-year-old female was seated in a Cosco Voyager belt positioning booster seat in the third row right position. The belt positioning booster seat was captured by intrusion in the Ford and was inspected in this position. The Ford was also occupied by a restrained 31-year-old female driver and a restrained 13-year-old male front right passenger.

Figure 1. 2002 Ford Excursion subject vehicle.

The Ford departed the right roadside of the highway where it struck a delineator post, three trees, and rolled over. The vehicle was equipped with redesigned frontal air bags and retractor mounted pretensioners for the driver and front right positions. As a result of the collision, the frontal air bag system deployed and the front safety belt retractor pretensioners fired. The driver and the three child passengers sustained minor to moderate severity injuries and were transported to a local hospital where they were treated and released approximately seven hours post-crash.

This crash was identified by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) through an Internet news article. The CID forwarded the news article to the Calspan Special Crash Investigations (SCI) team due to the presence of the child safety seats in the 2002 Ford Excursion. The Ford and the child safety seat were located at the owner's residence and cooperation was established to inspect the vehicle and the CSS. An on-site investigation was assigned to the Calspan SCI team on November 28, 2005. The vehicle and child safety seat inspections were conducted on November 29.

SUMMARY

Crash Site

This run-off road crash occurred on the north roadside of a four-lane east/west interstate. The travel lanes were constructed of concrete and were delineated by broken white lane lines and bordered by a white fog line on the north edge and a yellow fog line on the south edge. Outboard of the north fog line was a 3.3 meter (10.8 feet) concrete shoulder with perpendicular rumble strips. The north roadside consisted of an 8.6 meter (28.2 feet) wide grass embankment with a negative grade and a tree line. The struck trees were 24 cm (9.4”), 18 cm (7.1”), and 38 cm (15.0”) in diameter, respectively. The posted speed limit was 105 km/h (65 mph). The scene schematic is included as **Figure 11** of this report.

Vehicle Data

2002 Ford Excursion

The subject vehicle in this crash was a 2002 Ford Excursion. The Ford was identified by the Vehicle Identification Number (VIN) 1FMSU43F32 (production number deleted). The odometer reading at the time of the SCI inspection was unknown due to the expended vehicle battery. The owner of the Ford stated that the vehicle had approximately 188,288 kilometers (117,000 miles) on the odometer. The vehicle was a large four-door sport utility vehicle that was equipped with a conventionally mounted 7.3 liter turbo diesel V8 engine linked to a four-speed automatic transmission with four-wheel drive. The service brakes were four wheel disc with ABS. The vehicle was equipped with OEM five-spoke alloy wheels with T265/75R16 tires. The tires on the Ford were Firestone SteelTex A/T. The specific measured tire data at the time of the SCI inspection was a follows:

Position	Measured Tire Pressure	Measured Tread Depth	Damage
Left Front	0 kPa	6 mm (8/32”)	De-beaded
Left Rear	0 kPa	5 mm (6/32”)	De-beaded
Right Front	0 kPa	6 mm (8/32”)	De-beaded
Right Rear	303 kPa (44 PSI)	5 mm (5/32”)	None

The interior of the Ford was configured with leather upholstered front and second row bucket seats with integrated head restraints for the front row and height adjustable head restraints for the second row. The left second row head restraint was adjusted to the full-down position and right head restraint was adjusted 7 cm (2.8”) above the seat back. Additionally, the Ford was equipped with a three-passenger third row bench seat.

Crash Sequence

Pre-Crash

The 31-year-old female driver was operating the vehicle westbound on the right lane **(Figure 2)** at high speed. As the vehicle continued westbound, the driver allowed the Ford to drift to the left. The Ford traversed the left travel lane and entered the inboard (south) shoulder. The driver applied a sharp right steering input to return to the roadway. Due to the right steering input, the Ford re-entered the roadway and began to yaw clockwise (CW). The vehicle traversed both travel lanes and departed the north roadside at angle of 45 degrees in relation to the roadway. A 10.2 meter (33.5 feet) left rear yaw mark was present on the shoulder, which continued onto the embankment. Also present were a 2.1 meter (6.8 feet) left front tire and 2.0 meter (6.6 feet) right front yaw marks and on the shoulder.

Figure 2. Ford's pre-crash travel.

Crash

The left front fender area of the Ford impacted a delineator post that was located 4.8 meters (15.7 feet) north of the fog line. The resultant direction of force for this impact was 9 o'clock. A delta-V was not calculated for this impact due to the overlapping damage from a subsequent impact. The impact separated the delineator from its mounting post.

The Ford traveled down the 8.5 meter (27.9 feet) grass embankment where the front of the vehicle bottomed out allowing the front bumper system to contact the embankment. The ground impact was located at the transition point where the ground leveled. This impact resulted in minor damage to the front of the Ford. The direction of force for this impact was non-horizontal; therefore, it was outside the scope of the WINSMASH program.

Figure 3. Yaw marks and tree impacts.

The left front fender area aft of the left front axle impacted a 24 cm (9.4") diameter tree which induced a rapid clockwise rotation. The left rear door impacted an 18 cm (7.1") diameter tree. These trees deflected at impact which allowed the Ford to ramp up the trees and induce a rollover event. As the Ford began to roll onto its left side, the left quarter panel struck a 38 cm (15") diameter tree. The vehicle continued to roll as it engaged the tree resulting in vertical crush across the full width of the roof. The Excursion came to rest on its left side facing a northeasterly direction against the 38 cm

(15") diameter tree. The location of final rest was 10.5 meters (34.5 feet) north of the road edge. As a result of this crash sequence, the frontal air bag deployed and the retractor mounted safety belt pretensioners fired. It should be noted that the frontal air bags deployed as a result of the lateral impacts.

The severity of the crash could not be calculated by the WINSMASH model. The yielding impact of the trees and non-horizontal crash forces were beyond the limitation of the model.

Post-Crash

Police and Emergency Medical Services (EMS) personnel responded to the crash site. The driver of the Ford was extricated from the vehicle approximately one hour post-crash. The local fire department utilized hydraulic tools to cut the front row section of the roof. The driver and the three child passengers sustained minor to moderate severity injuries and were transported to a local hospital where they were treated and released approximately seven hours post-crash. The Ford was subsequently deemed a total loss by the insurance company.

Vehicle Damage

Exterior – 2002 Ford Excursion

The 2002 Ford Excursion sustained minor damage from impact with the embankment **(Figure 4)** and severe damage to the left and top planes **(Figures 5 and 6)** as a result of the impacts with the trees. The delineator post impact damage was overlapped by the subsequent tree impact. The Collision Deformation Classification for this impact was estimated at 09-LFEN-1.

Figure 4. Frontal damage from the delineator post.

The frontal damage resulted from the impact with the ground. The maximum crush was 10 cm (4.0"), located 5 cm (2.0") right of the vehicle centerline on the bumper beam. The bumper beam was also displaced vertically by the non-horizontal impact force. The direct contact damage was located on the underside of the bumper fascia and began 70 cm (27.5") left vehicle centerline and extended 147 cm (57.8") to the right. The direct contact damage terminated inboard of the bumper corners. The residual crush was measured along the full width of the bumper beam (Field L) of 179 cm (70.5").

Figure 5. Overall view of the left side damage.

Six equidistant crush measurements were documented at this level and were as follows: C1 = 0 cm, C2 = 0 cm, C3 = 8 cm (3.1”), C4 = 6 cm (2.4”), C5 = 0 cm, C6 = 0 cm. The damaged components included the bumper fascia and bumper beam. The CDC for this impact was 00-UFDW-1.

Figure 6. Vertical damage to the left roof side rail and roof.

The left front fender area of the Ford impacted a 24 cm (9.4”) diameter tree. The direct contact damage measured 25 cm (9.8”) and began 5 cm (1.9”) rear of the left front axle and extended 20 cm (7.9”) rearward. The maximum crush on the left fender measured 64 cm (25.2”) and was located 12 cm (4.7”) rear of the left front axle. A crush profile was documented along the fender for this impact using a combined direct and induced damage width of 62 cm (24.4”) and was follows: C1 = 21 cm (8.3”), C2 = 64 cm (25.2”), C3 = 59 cm (23.2”), C4 = 40 cm (15.7”), C5 = 25 cm (9.8”), C6 = 20 cm (7.8”). The CDC for this impact was 09-LFEN-3.

The mid aspect of the left rear door area impacted an 18 cm (8”) diameter tree. The direct contact damage measured 29 cm (11.4”). The direct contact began 75 cm (29.5”) forward of the left rear axle and ended 104 cm (40.1”) forward of the left rear axle. The maximum crush was located at the rear aspect of the left rear door and measured 39 cm (15.3”). The crush profile was documented at the mid-door level and was as follows: C1 = 17 cm (6.7”), C2 = 39 cm (15.3”), C3 = 37 cm (14.6”), C4 = 21 cm (8.3”), C5 = 14 cm (5.5”), C6 = 9 cm (3.5”). The CDC for this impact was 09-LPEN-3.

During the rollover sequence, the Ford struck a 38 cm (15.0”) diameter tree with the left rear quarter panel. The tree also engaged the left roof side rail and extended laterally the full width of the vehicle. The damage to the left side plane was documented at the mid-door level on the left rear quarter panel. The direct contact damage measured 62 cm (24.4”). The direct contact began 6 cm (2.4”) and ended 68 cm (26.7) rear of the left rear axle, respectively. The maximum crush on the left side was 26 cm (10.2”). The crush profile at this level was as follows: C1 = 17 cm (6.7”), C2 = 19 cm (7.5”), C3 = 22 cm (8.7”), C4 = 26 cm (10.2), C5 = 24 cm (9.4”), C6 = 18 cm (7.1”). A crush profile was documented along the left roof side rail which was the area of maximum vertical crush. The crush profile at this location was as follows: C1 = 58 cm (22.8”), C2 = 37 cm (14.6”), C3 = 20 cm (7.9”), C4 = 23 cm (9.1”), C5 = 32 cm (12.6”), C6 = 34 cm (13.4”). The CDC for this impact was 00-TBDW-4.

The Ford rolled one-quarter turn and came to rest on its left side. The damage for this event was masked by the deformation from the multiple tree impacts. The CDC for this impact was 00-L99O-9.

Additional damage included disintegrated left front, left rear, backlight, and right rear glazing. The windshield was fractured; however, it was unknown if the windshield was holed due to the extrication efforts by the fire department. The left side and rear right doors were jammed closed. The right front door remained operational.

Interior

The interior of the Ford sustained severe damage that was attributed to passenger compartment intrusion and occupant contacts. The driver's contact points consisted of a black scuffmark to the left knee bolster, deformed door panel mounted arm rest, and deformed brake and parking brake pedals. The front right passengers contact points consisted of two laterally oriented black scuffmarks to the face of the glove box door. The front row section of the roof was cut from the vehicle by the fire department. The cut roof was not present at the time of the SCI inspection; therefore, it was unknown if possible occupant contact points were present to this area. Also, the front seats were cut from the vehicle during the extraction process of the driver. **Figure 7** is an overall view of the first row.

The second row left seat was occupied by the 1-year-old female passenger. The left roof side rail over this passenger's location intruded. A 22 cm (8.7") by 9 cm (3.5") area of denting/pocketing and body fluid were noted on the roof side rail **(Figure 8)**. This was considered a possible occupant contact point by the 1-year-old female passenger's head.

The 3-year-old female passenger was seated in the third row right position of the Excursion. Although no distinct occupant contacts points were present in this location, an area of pooled body fluid was noted on the roof over the left seating position. This was indicative of the 3-year-old females final rest position. Also noted was body fluid on the rear header which appeared to be smeared by this passenger as she was removed from the vehicle.

Figure 7. Overall view of the first row.

Figure 8. Left roof side rail denting/pocketing and body fluid.

The passenger compartment intrusions are identified in the following table:

Seat Position	Intruded Component	Magnitude	Direction
Second Row Left	B-pillar	10 cm (3.9”)	Lateral
Second Row Left	Roof Side Rail and C-pillar	10 cm (3.9”)	Lateral
Second Row Left	Roof Side Rail and C-pillar	30 cm (11.8”)	Vertical
Second Row Left	Roof	19 cm (7.5”)	Vertical
Second Row Center	Roof	6 cm (2.4”)	Vertical
Third Row Left	Roof Side Rail	36 cm (14.1”)	Vertical
Third Row Left	Roof	41 cm (16.1”)	Vertical
Third Row Center	Roof	45 cm (17.7”)	Vertical
Third Row Right	Roof Side Rail	45 cm (17.7”)	Vertical
Third Row Right	Roof	41 cm (16.1”)	Vertical

Frontal Air Bag System

The Ford was equipped with redesigned frontal air bags for the driver and front right passenger positions. The frontal air bag system probably deployed as a result of the initial tree impacts.

The driver’s air bag was contained within the center hub of the two-spoke steering wheel rim and concealed by two H-configuration cover flaps. The top cover flap was 17 cm (6.7”) in height and 19 cm (7.4”) in width. The lower cover flap measured 9 cm (3.5”) in height and 19 cm (7.4”) in width. The air bag membrane measured 60 cm (23.6”) in diameter in its deflated stated and was tethered by two internal tethers at the 12 and 6 o’clock positions. Two vent ports that were located on the backside of the bag at the 11 and 1 o’clock sectors vented the bag into the passenger compartment. There was no damage or evidence of driver contact to the deployed air bag. Several areas of dirt were present on the membrane due to post-crash exposure.

The front right passenger air bag was a top-mount design, incorporated into the right instrument panel. A single cover flap concealed the bag which measured 34 cm (13.4”) wide and 18 cm (7.1”) in depth. The cover flap was tethered by a 14 cm (5.5”) tether to the right instrument panel. There was no damage or contact evidence to the cover flap. The air bag measured 60 cm (23.6”) in width and 56 cm (22.0”) in height. No occupant contact evidence or damage was noted to the front right air bag. An area of body fluid was noted on the face of the air bag at the 3 o’clock sector. Dirt was also present on the air bag membrane.

Manual Safety Belt Systems

The Ford Excursion was equipped with three-point lap and shoulder belt systems for the six outboard seated positions. The front and second row safety belts consisted of continuous loop webbing, sliding latch plates, and height adjustable D-rings. The front left D-ring was adjusted between the mid and full-down position and the front right was adjusted to the full-up position. The height adjustment for the second row D-rings were not determined due to the roof intrusion. The driver's safety belt retracted onto an Emergency Locking Retractor (ELR) and the front right retracted onto a switchable ELR/Automatic Locking Retractor (ALR). Additionally, the front safety belts were equipped with retractor pretensioners that fired as a result of the crash. The third row outboard safety belts retracted onto switchable retractors. The third row center safety belt was a lap belt with a locking latch plate.

The driver and the front right passenger utilized their safety belt in the crash, which was evidenced by minor frictional abrasions on the D-ring and latch plates. The second row left safety belt was used to install a child safety seat. The third row right safety belt was used to retrain the 3-year-old female passenger in a belt positioning booster seat.

Child Safety Seats

The 1-year-old female was seated in the second row left seat and was restrained by the integrated five-point harness system of an unknown type forward facing child safety seat. The child safety was not inspected during this on-site investigation. The child passenger was transported in the child safety to a local hospital where it was discarded.

The 3-year-old female was seated in the third row right seat in a Cosco Voyager belt positioning booster seat and was restrained by the vehicles lap and shoulder belt. Due to the severe intrusion, the child safety seat was captured between the roof and seat cushion; therefore, the child safety was not fully inspected **(Figure 9)**. The driver stated to the SCI investigator that the child safety seat was a Cosco Voyager. A fracture was noted to the right outboard aspect of the shell 22 cm (8.6") below the top from compression against the seat and roof **(Figure 10)**. The total length of the fracture measured 19 cm (7.5"). Numerous stress marks were noted to the child safety seat shell which resulted from compression. Additionally, a cut was noted to the right aspect of the fabric cushion.

Figure 9. Belt positioning booster seat trapped by roof intrusion.

Figure 10. Damage to the right side of the belt positioning booster seat.

Occupant Demographics/Data

Driver Demographics

Age/Sex:	31-year-old/Female
Height:	165 cm (65.0”)
Weight:	82 kgs (180 lbs)
Seat Track Position:	Unknown track position
Eyewear:	None
Manual Safety Belt Usage:	Manual lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Extricated from vehicle
Mode of Transport from Scene:	Transported by ambulance to a hospital
Type of Medical Treatment:	Treated and released

Driver Injuries

Injury	**Injury Severity AIS90/Update 98**	**Injury Source**
Fractured left ulna, NFS	Moderate (753200.2,2)	Exterior of vehicle
Fractured left radius, NFS	Moderate (752800.2,2)	Exterior of vehicle
Contusion from left chest to right hip	Minor (490402.1,0)	Lap and shoulder belt
Whiplash	Minor (640278.1,6)	Impact forces

Source – Driver interview

Driver Kinematics

The 31-year old female driver of the 2002 Ford Excursion was seated in an upright driving posture, restrained by the safety belt. The front seats were cut out of the vehicle during the extrication process; therefore, the driver’s seat track adjustment was unknown at the time of the crash.

The vehicle departed the left roadside where the driver applied a sharp right steering input. The steering input displaced the driver laterally left and she loaded the door panel with her torso and hip. The Ford impacted a delineator post with the left front fender; this impact was minor and did not alter the driver’s motion.

The front undercarriage of the Ford contacted the embankment as it continued its off-road travel. This impact was minor and probably did not displace the driver. At impact, with the initial two trees the left side glazing disintegrated and the driver continued to load the left front door. This lateral motion resulted in the whiplash injury. This impact sequence probably resulted in the deployment of the frontal air bags and firing of the retractor prentensioners.

As the vehicle began to rollover left side leading, the driver loaded the belt system which resulted in the contusion from the left chest to the right hip. Additionally, the driver's left arm was ejected through the disintegrated left front glazing. The driver stated to the SCI investigator that her left arm was trapped under the vehicle post-crash.

The vehicle struck a third tree with the left rear quarter panel and roof area as it continued to rollover. The Ford came to final rest on its left side on the driver's left arm resulting in the fractured ulna and fractured radius.

The driver was extricated from the vehicle by the local fire department which cut the front section of the roof off of the vehicle. The driver was transported to a local hospital where she was treated and released.

Front Right Passenger Demographics

Age/Sex:	13-year-old/Male
Height:	165 cm (65.0")
Weight:	66 kgs (145 lbs)
Seat Track Position:	Unknown track position
Restraint Use:	Lap and shoulder belt system
Usage Source:	Vehicle inspection
Egress from Vehicle:	Exited with assistance
Mode of Transport from Scene:	Transported by ambulance
Type of Medical Treatment:	Treated and released

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90, Update 98)	Injury Source
Contusion to the right side of the neck	Minor (390402.1, 1)	Shoulder belt

Source – Driver interview

Front Right Passenger Kinematics

The 13-year-old male front right passenger was seated in an upright posture and was restrained by the safety belt system.

The left roadside departure resulted in a sharp right steering input by the driver. This resulted in the right front passenger being displaced laterally left and load the center console with his hip. The Ford impacted a delineator post with the left front fender which did not alter his motion.

The front undercarriage of the Ford impacted the embankment; however, this resulted in minor impact forces and did not displace this passenger. At impact, with the initial two trees the frontal air bag deployed and the retractor pretensioner fired as the 13-year-old male continued to load the center console. As the vehicle began to rollover left side leading the vehicle struck a third tree with the left rear quarter panel and roof area. The

right front passenger loaded the belt system resulting in the contusion to the right side of the neck.

The 13-year-old male was assisted out of the vehicle and was transported to local hospital where he was treated and released.

Second Row Left Child Passenger

Age/Sex:	1-year-old/Female
Height:	Unknown
Weight:	14 kgs (30 lbs)
Seat Track Position:	N/A, fixed
Eyewear:	None
Child Restraint Use:	Child Safety Seat with 5-point harness
Usage Source:	Vehicle inspection
Egress from Vehicle:	Removed from the vehicle with the child safety seat
Mode of Transport from Scene:	Ambulance to hospital
Type of Medical Treatment:	Treated and released

Second Row Left Child Injuries

Injury	Injury Severity AIS90/Update 98	Injury Source
Left skull fracture, NFS	Moderate (150400.2,2)	Left roof side rail
Contusion to the left kidney, NFS	Moderate (541699.2,2)	Child safety seat shell
Spleen laceration, NFS	Moderate (544220.2,2)	Child safety seat shell
Left facial abrasions	Minor (290099.1,2)	Left roof side rail

Source – Driver interview

Second Row Left Child Kinematics

The 1-year-old female child passenger was seated in the second row left in an unknown forward facing child safety seat and was restrained by the integrated five-point harness system. The installation of the child safety was described by the owner of the Ford as tight and would not move after buckling the safety belt. The impact to the delineator post and embankment were minor and did not displace this passenger. The child passenger responded to the crash forces from the two left tree impacts by loading the shell of the child safety seat which resulted in the contusion to the left kidney and the spleen laceration.

Although the installation was described as tight, the child safety was displaced vertically upward during the rollover event which allowed the 1-year-old female to contact the intruding left roof side rail with her head. This contact was supported by the

denting/pocketing and pooled body fluid at this location. This contact resulted in the left skull fracture and the left facial abrasions.

The 1-year-old female passenger was removed from the vehicle with the child safety seat and transported to local hospital where she was treated and released approximately seven hours post-crash. The child safety was discarded by the medical facility and was not inspected during this on-site investigation.

Third Row Right Child Passenger

Age/Sex:	3-year-old/Female
Height:	91 cm (36.0”)
Weight:	20 kgs (45 lbs)
Seat Track Position:	N/A, fixed
Eyewear:	None
Child Restraint Use:	Belt positioning booster seat with lap and shoulder belt
Usage Source:	Vehicle inspection
Egress from Vehicle:	Assisted from vehicle
Mode of Transport from Scene:	Ambulance to hospital
Type of Medical Treatment:	Transported and released

Third Row Right Child Injuries

Injury	Injury Severity AIS90/Update 98	Injury Source
Left orbit fracture	Moderate (251200.2,2)	Intruding roof
Nasal bridge fracture	Minor (251099.1,4)	Intruding roof
Right clavicle fracture	Minor (751299.1,1)	Intruding roof
Unknown fractured left ulna or radius, NFS	Moderate (751800.2,2)	Unknown

Source – Driver interview

Third Row Right Child Kinematics

The 3-year-old female child passenger was seated in a Cosco Voyager belt positioning booster seat and was restrained by the lap and shoulder belt system. Although she was restrained by the lap and shoulder belt system, the passenger’s father stated that the lap belt was loosely positioned over her hips. The loosely positioned lap belt allowed excess movement by the 3-year-old female during the crash sequence.

The initial impacts to the delineator post and embankment did not displace this occupant. The two tree impacts to the left front and left door resulted in lateral crash forces to which the 3-year-old female responded. She was displaced laterally left and loaded the left aspect of the belt positioning booster seat.

As the vehicle began to rollover it struck a tree with the left rear quarter panel and roof area. The 3-year-old female responded to the crash force by moving laterally left and vertically upward. The intruding roof contacted the 3-year-old female which resulted in the left orbit fracture, nasal bridge fracture, and the right clavicle fracture. The father stated that she also sustained either a fractured ulna or fractured radius. The source of this injury could not be identified. The 3-year-old female was transported by ambulance to a local hospital where she was treated and released.

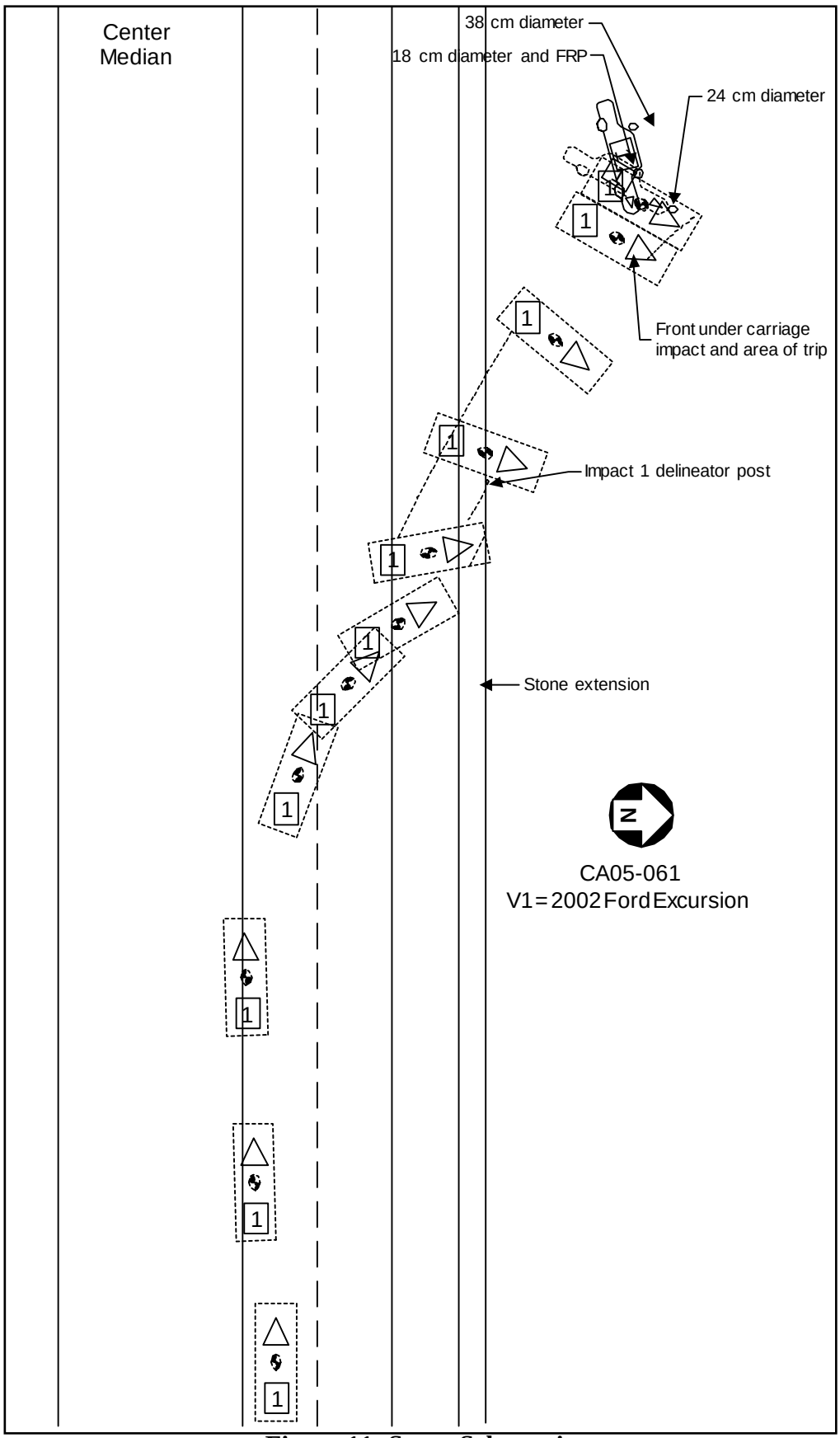

Figure 11: Scene Schematic