Remote, Redesigned Air Bag Special Study

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Dynamic Science, Inc., Case Number (1998-079-803E)

1998 Toyota Corolla

California

August/1998

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16. Abstract

This remote investigation focused on the redesigned air bag system deployment of a 1998 Toyota Corolla 4-door sedan. This minor injury crash occurred in August, 1998 in the early evening. The weather was clear and the bituminous roadways were dry. The crash occurred in a four-legged intersection. The eastbound leg of the intersection is a two-way undivided roadway and is comprised of two travel lanes; one eastbound lane and one westbound lane. The speed limit for this road is 40 kmph (25 mph). The intersection is controlled by stop signs for eastbound and westbound traffic. The road is level at the area of impacts. The southbound leg of the intersection is a two-way undivided roadway and is comprised of two travel lanes; one southbound lane and one northbound lane. The speed limit for this road is 40 kmph (25 mph). There are no traffic controls at the intersection for southbound or northbound traffic. The road is level at the area of impacts. Vehicle 1, a 1976 Ford E-Series passenger van driven by a 35 year old male, was traveling east in the eastbound travel lane approaching the intersection at an unknown speed. The driver was preparing to travel straight through the intersection. The front right seat was occupied by a 24 year old male. It is unknown if either occupant of Vehicle 1 was restrained. Vehicle 2, a 1998 Toyota Corolla 4-door sedan (case vehicle) driven by a 41 year old female (152 cm/ 60 in, 68 kg/ 150 lbs), was traveling south in the southbound travel lane approaching the intersection at a driver estimated speed of 48 kmph (30 mph). The driver was preparing to travel straight through the intersection. The driver was restrained by the available manual lap/shoulder restraint. There were no other occupants in Vehicle 2. Vehicle 1 entered the intersection and crossed the path of Vehicle 2. The front plane of Vehicle 2 (01FDEW2) impacted the left plane of Vehicle 1 (10LBEW99) in the intersection (event 1). The vehicles then impacted a second time due to rotation (event 2) with the left plane of Vehicle 2 (09LFEW3) contacting the left plane of Vehicle 1 (09LFEW99). Vehicle 1 rotated counter-clockwise approximately 90 degrees after impacts and came to rest in the intersection facing north. Vehicle 2 rotated counter-clockwise approximately 40 degrees and came to rest in the intersection facing southeast. A Delta V was calculated for event 1 for Vehicle 1, utilizing the Missing Vehicle Algorithm of WinSMASH, as 41 kmph (25 mph). No Delta V was calculated for the second event. As a result of the first event frontal impact, the supplemental restraint system (driver's and passenger's frontal redesigned air bags) of the case vehicle deployed. Neither occupant of Vehicle 1 was reportedly injured. The driver of Vehicle 2 sustained minor injuries in the crash and was transported by land to a trauma center where she was treated and released. Vehicle 1 was not disabled in the crash and was driven from the scene. Vehicle 2 was disabled in the crash and was towed from the scene.

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Summary

This remote investigation focused on the redesigned air bag system deployment of a 1998 Toyota Corolla 4-door sedan. This minor injury crash occurred in August, 1998 in the early evening. The weather was clear and the bituminous roadways were dry. The crash occurred in a four-legged intersection. The eastbound leg of the intersection is a two-way undivided roadway and is comprised of two travel lanes; one eastbound lane and one westbound lane. The speed limit for this road is 40 kmph (25 mph). The intersection is controlled by stop signs for eastbound and westbound traffic. The road is level at the area of impacts. The southbound leg of the intersection is a two-way undivided roadway and is comprised of two travel lanes; one southbound lane and one northbound lane. The speed limit for this road is 40 kmph (25 mph). There are no traffic controls at the intersection for southbound or northbound traffic. The road is level at the area of impacts.

Figure 1. Exterior, Vehicle 1 (Ford E-Series)

Vehicle 1, a 1976 Ford E-Series passenger van driven by a 35 year old male, was traveling east in the eastbound travel lane approaching the intersection at an unknown speed. The driver was preparing to travel straight through the intersection. The front right seat was occupied by a 24 year old male. It is unknown if either occupant of Vehicle 1 was restrained.

Vehicle 2, a 1998 Toyota Corolla 4-door sedan (case vehicle) driven by a 41 year old female (152 cm/ 60 in, 68 kg/ 150 lbs), was traveling south in the southbound travel lane approaching the intersection at a driver estimated speed of 48 kmph (30 mph). The driver was preparing to travel straight through the intersection. The driver was restrained by the available manual lap/shoulder restraint. There were no other occupants in Vehicle 2.

Figure 2. Exterior, Vehicle 2 (Toyota Corolla)

Crash Events

Vehicle 1 entered the intersection and crossed the path of Vehicle 2. The front plane of Vehicle 2 (01FDEW2) impacted the left plane of Vehicle 1 (10LBEW99) in the intersection (event 1). The vehicles then impacted a second time due to rotation (event 2) with the left plane of Vehicle 2 (09LFEW3) contacting the left plane of Vehicle 1 (09LFEW99).

Vehicle 1 rotated counter-clockwise approximately 90 degrees after impacts and came to rest in the intersection facing north. Vehicle 2 rotated counter-clockwise approximately 40 degrees and came to rest in the intersection facing southeast.

Figure 3. Crash scene. Vehicle 2 approach path.

A Delta V was calculated for event 1 for Vehicle 1, utilizing the Missing Vehicle Algorithm of WinSMASH, as 41 kmph (25 mph). No Delta V was calculated for the second event.

As a result of the first event frontal impact, the supplemental restraint system (driver's and passenger's frontal redesigned air bags) of the case vehicle deployed.

Neither occupant of Vehicle 1 was reportedly injured. The driver of Vehicle 2 sustained minor injuries in the crash and was transported by land to a trauma center where she was treated and released.

Vehicle 1 was not disabled in the crash and was driven from the scene. Vehicle 2 was disabled in the crash and was towed from the scene.

Table 1. Delta V

	Case Vehicle		Other Vehicle	
	km/h	mph	km/h	mph
Total	41	25.5	27	16.8
Longitudinal	-36	-22.4	-14	-8.7
Lateral	-21	-13	24	14.9
Barrier speed	26	16.2	41	25.5

Exterior of Case Vehicle

Table 2. Vehicle Information

Model year, make and model	1998 Toyota Corolla
VIN	1NXBR12E0WZ
CDC	01FDEW2

Figure 4. Exterior, Vehicle 2 (1998 Toyota Corolla)

Figure 5. Exterior, Vehicle 2 (1998 Toyota Corolla)

Table 3. Crush Measurements

Plane of Impact	Field L cm/in.	C1 cm/in.	C2 cm/in.	C3 cm/in.	C4 cm/in.	C5 cm/in.	C6 cm/in.
Bumper	117	2	16	27	35	34	12
	46.1	0.8	6.3	10.6	13.8	13.4	4.7

Interior of Case Vehicle

The interior of the Toyota Corolla sustained no damage from occupant contact. There were no areas of intrusion into the passenger compartment. No evidence of occupant contact was found in the vehicle.

The case vehicle was equipped with bucket seats in the front left and front right seating positions. The front left seat was adjusted to the forward most track position (per interviewee). The front right seat was adjusted to the rear most track position. Both front seats were equipped with adjustable head restraints which were not damaged. The rear of the vehicle was equipped with bench seats which were no adjustable.

Case Vehicle Occupant Protection Systems

The Toyota Corolla 4-door sedan was equipped with a redesigned air bag system which consisted of front left and front right air bag modules which housed air bags and depowered inflator units.

The front left air bag was housed in the steering wheel hub and was concealed by symmetrical I-configuration cover flaps which were no damaged in the crash. The circular air bag was equipped with four tether straps and two vent ports. No contact evidence was found on the air bag and the bag was not damaged.

The front right air bag was housed in the top-instrument panel position and was concealed by a single rectangular configuration cover flap which was not damaged in the crash. The rectangular air bag was equipped with two vent ports and no tether straps. No contact evidence was found on the air bag and the bag was not damaged.

Case Vehicle Occupant Demographics

Table 4. Case Vehicle Occupant(s) Demographics

	Occupant 1	
Age/Sex:	41/Female	
Seated Position:	Front left	
Seat Type:	Bucket - cloth covered	
Height (cm/in:):	152	60
Weight (kg/lbs).:	68	150
Pre-existing Medical Condition:	None noted	
Body Posture:	Normal - upright in seat facing forward	
Hand Position:	Both on steering wheel - unknown o'clock positions	
Foot Position:	On floor or foot controls	
Restraint Usage:	Manual lap & shoulder restraint	
Air bag:	Deployed redesigned air bag system	

Figure 7. Passenger's frontal air bag.

Occupant Injuries

Table 5. Case Vehicle Occupant(s) Injuries

Injury	Injury Severity (AIS)	Injury Mechanism
Abdominal skin contusion	1	Lap belt
Chest skin contusion (right)	1	Shoulder belt
Chest skin contusion (left)	1	Shoulder belt
Cervical spine strain	1	Driver's frontal air bag
Lumbar spine strain	1	Seat, back support

Occupant Kinematics

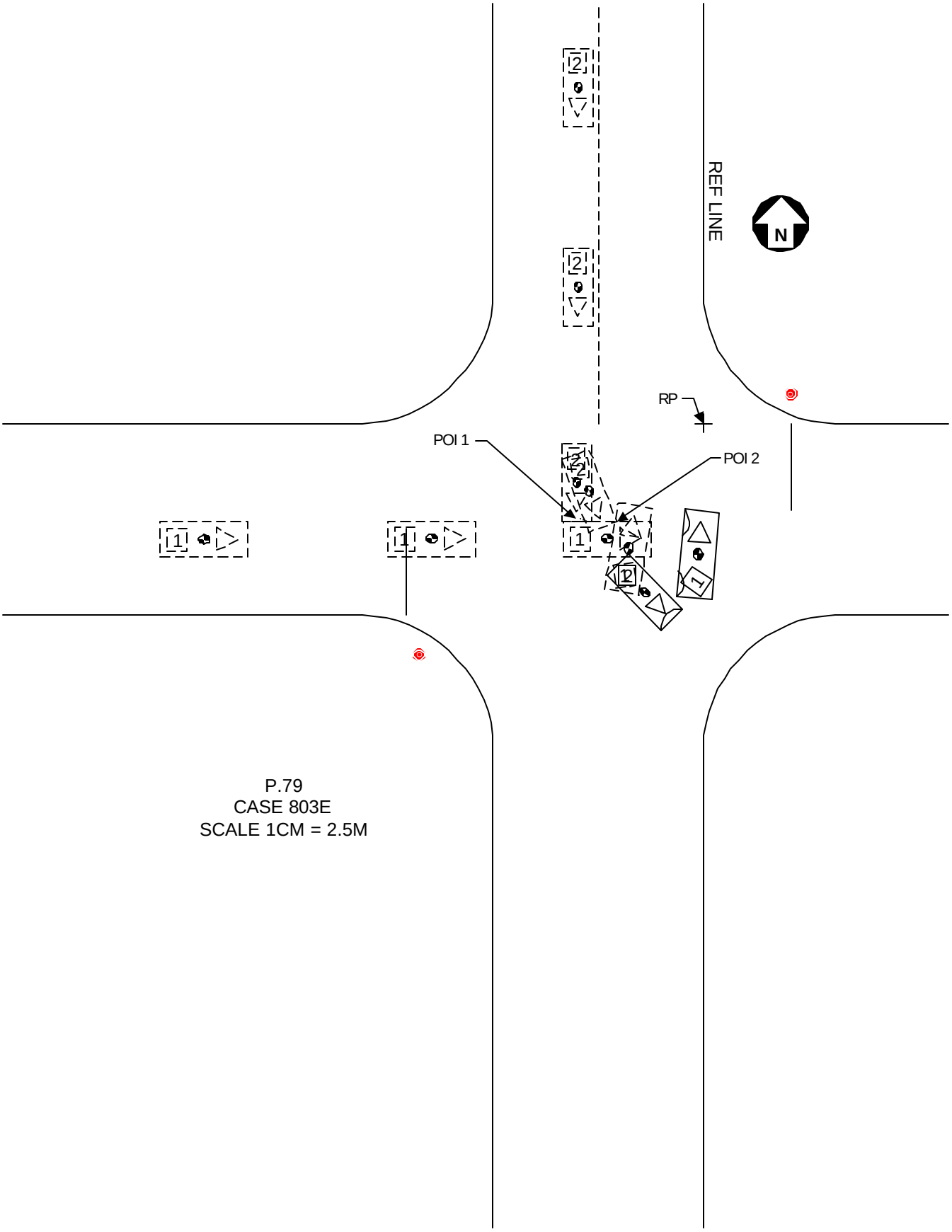
The driver (case occupant) of the Toyota Corolla was seated in a normal upright posture in the front left position of the vehicle. She was wearing the manual lap/shoulder restraint. Seat belt usage was determined through visual inspection by the researcher, the lack of frontal contact evidence, and observations by the investigating police officer at the scene of the crash. Prior to impact, the driver applied the brakes with lock-up and the occupant began loading the manual lap/shoulder restraint.

At impact, the case occupant reacted to the 30 degree principle direction of force by moving forward and to the right, further loading the lap/shoulder restraint. At the restraints locked, further forward movement of the driver was prevented. Although no physical evidence was found on the bag, it is assumed that the case occupant contacted the deploying driver's frontal air bag-causing the cervical spine strain. Contact with the locked lap/shoulder restraint caused the abdominal and chest contusions. The lumbar spine strain appears to have been caused by contact with the seat back support. The case occupant was transported from the scene to a trauma center where she was treated and released.

Figure 8. Interior, case vehicle.

Figure 9. Interior, case vehicle.

Scene Diagram



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