Advanced 208-Compliant Investigation/ Vehicle to Object
Dynamic Science, Inc. / Case Number: DS03034
2004 Toyota Corolla S Four-Door Sedan
California
August, 2003

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract

This on-scene, in-depth investigation focused on the non-deployment of dual frontal advanced air bag units in a FMVSS 208 compliant vehicle. This single vehicle crash occurred during a weekday morning on August 21, 2003 at 0925 hours. The weather was clear and the level concrete roadway surface was dry and free of any defects at the time of the crash. The crash occurred on the northbound HOV/bus travel lanes of an elevated interstate freeway. The roadway consists of two north and southbound HOV/bus lanes that are elevated over the main north and southbound travel lanes of an interstate roadway. The northbound roadway is bordered on both the east and west roadsides by concrete raised barrier walls (not jersey barriers). An emergency lane/shoulder is present on the west (left) roadside. This emergency lane/shoulder is delineated by a solid yellow lane line. There are no traffic controls present for the north/southbound roadway and the posted speed limit is 105 km/h (65 mph).

The case vehicle is a 2004 Toyota Corolla S Four-Door Sedan that was being driven by a fully restrained 20 year-old female. A 20 year-old female occupied the front, right seated position and was also wearing the available continuous loop manual three-point lap and shoulder belt.

The driver of the case vehicle was traveling northbound on the interstate freeway in lane 1 (right lane) at a driver estimated speed of 105 km/h (65 mph). The driver became distracted as a picture that was wedged in the visor fell and startled her. In response to the picture that fell from the visor, the driver applied an inadvertent right steering input as the front, right corner impacted the concrete wall barrier in a sideswipe type impact. The entire right side plane of the case vehicle swiped the concrete wall surface resulting in surface scraping along the right side lower sill and rear bumper fascia area. The driver then applied an overcorrecting left steering input as the case vehicle traversed both northbound travel lanes and impacted the concrete barrier wall located on the west roadside. The case vehicle came to rest on the left (west) emergency lane/shoulder and was facing northerly. The driver was uninjured and the front, right seated occupant sustained an abrasion to her right shoulder region.

Both the front right corner/right sideswipe impact and the left side sideswipe impact exhibited a very low deceleration potential, translating into a low Delta V and non-deployment of the front air bags. Both collisions violate energy dissipation calculations because a common velocity was never achieved.

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Dynamic Science, Inc.
Crash Investigation
Case Number:DS03034

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BACKGROUND:

This Certified Advanced 208-Compliant case was initially identified during a NHTSA review of GES police reports. This vehicle was certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The police report was faxed to DSI on September 25, 2003 with instructions to locate the case vehicle and gain permission to obtain the EDR, air bag sensor assembly, and conduct an on-site investigation. DSI located the case vehicle and was assigned the case on September 25, 2003. Field work was completed on November 8, 2003. The air bag sensor assembly was removed from the case vehicle and sent to NHTSA on October 31, 2003 for downloading the recorded crash data by Toyota Motor Company. At the time of this writing, no data recorder information has been received.

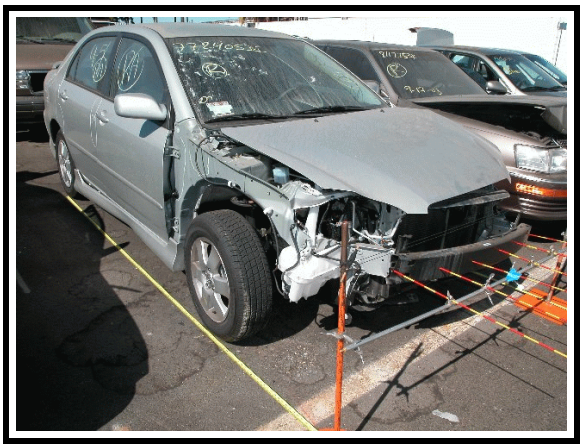

Figure 1. Front right, three-quarter view showing corner impact with continuos right plane sideswipe

SUMMARY

Crash Site

This single vehicle crash occurred during a weekday morning in August, 2003 at 0925 hours. The weather was clear and the level concrete roadway surface was dry and free of any defects at the time of the crash. The crash occurred on the northbound High Occupancy Vehicle (HOV)/bus travel lanes of an elevated interstate freeway. The roadway consists of two north and southbound HOV/bus lanes that are elevated over the main north and southbound travel lanes of an interstate roadway. The northbound roadway is bordered on both the east and west roadsides by concrete raised barrier walls (not jersey barriers). An emergency lane/shoulder is present on the west (left) roadside. This emergency lane/shoulder is delineated by a solid yellow lane line. There are no traffic controls present for the north/southbound roadway and the posted speed limit is 105 km/h (65 mph).

Figure 2. View showing the overhead, elevated HOV/bus northbound travel lanes.

Pre-Crash

The case vehicle is a 2004 Toyota Corolla S Four-Door Sedan that was being driven by a fully restrained 20 year-old female (160 cm., 63 in./ 59 kg., 130 lbs.). A 20 year-old female (163 cm., 64in./ 68 kg., 150 lbs.) occupied the front, right seated position and was also wearing the available continuous loop manual three-point lap and shoulder belt.

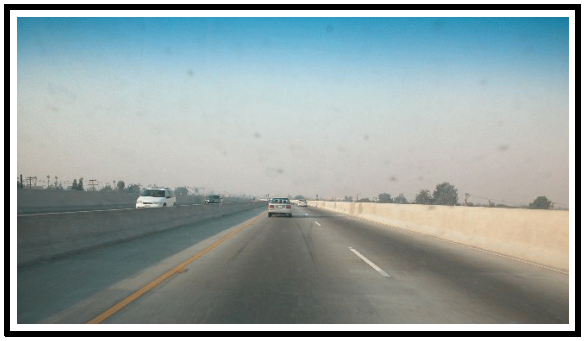

Figure 3. View showing pre-impact trajectory and approximate barrier wall impacts.

The driver of the case vehicle was traveling northbound on the interstate freeway in lane 1 (right lane) at a driver estimated speed of 105 km/h (65 mph). The driver had her left hand on the steering wheel rim and she reached with her right hand to grab a falling picture that was wedged in the sunvisor. The driver was seated in a fabric covered bucket seat that was adjusted to the rear most seat track position and the seat was in an upright position. The head restraint was in the full down position. The front right seated occupant was looking through an assortment of compact disks prior to the crash. The front right seated occupant was seated in a fabric covered bucket seat that was adjusted to the rear most seat track position and her seatback was in the upright position. The head restraint was in the full down position.

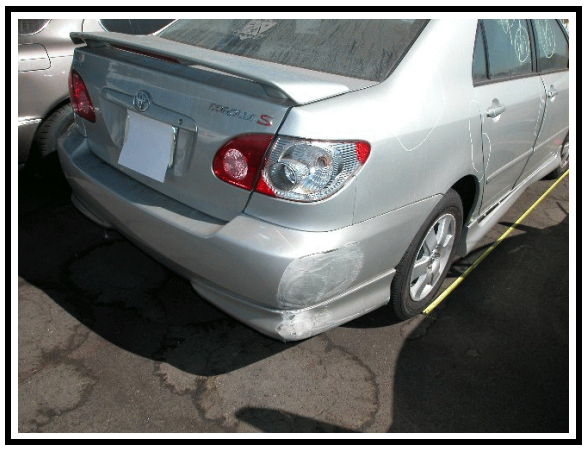

Figure 4. View showing wall contact damage to the right rear bumper fascia

Close inspection of the driver's continuous loop, three-point manual lap and shoulder belt revealed evidence of historical usage and documented latch plate scratches and striations. The lap and shoulder restraint upper anchorage adjustment was in the full down position. Inspection of the front right passenger's continuous loop, three-point manual lap and shoulder belt showed evidence of historical usage and evidence of loading on the seat belt webbing. The lap and shoulder belt upper anchorage adjustment was in the full up position.

Crash

In response to the picture that fell from the visor, the driver applied an inadvertent right steering input as the front, right corner impacted the concrete wall barrier (01FREE9) in a sideswipe type impact. The entire right side plane of the case vehicle swiped the concrete wall surface resulting in surface scraping along the right side lower sill and rear bumper fascia area. The driver then applied an overcorrecting left steering input as the case vehicle traversed both northbound travel lanes and impacted the concrete barrier wall (12LDLS1) located on the west roadside.

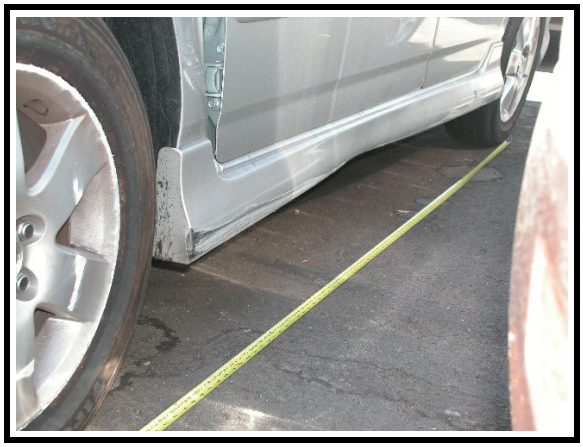

Figure 5. Left side sideswipe damage to left front rim and sill

The initial front, right corner impact resulted in an insignificant amount of front bumper bar engagement. Maximum front bumper crush was calculated to be 1.2 cm and was located at the front, right corner. The left frame rail end was deformed to the left which resulted as the vehicle rotated counterclockwise into the concrete barrier wall. Direct contact damage extended along the right side plane 346 cm (136.2 in.). The left side sideswipe damage was 314 cm (123.6 in.) in length and initiated 315 cm (124 in.) rearward of the left front wheel.

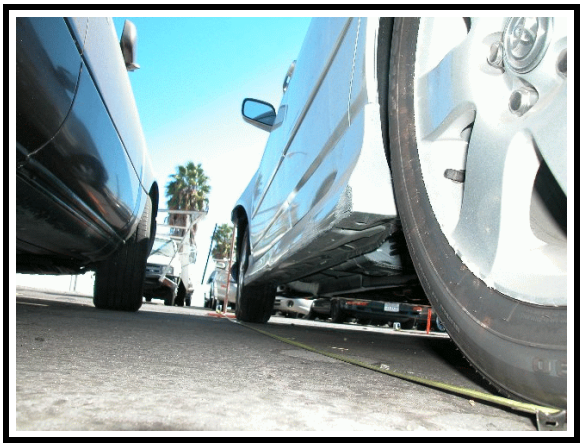

Figure 6. Left side sideswipe damage to left rear rim and sill

Both the front right corner/right sideswipe impact and the left side sideswipe impact exhibited a very low deceleration potential, translating into a low Delta V and non-deployment of the front air bags. Both collisions violate energy dissipation calculations because a common velocity was never achieved.

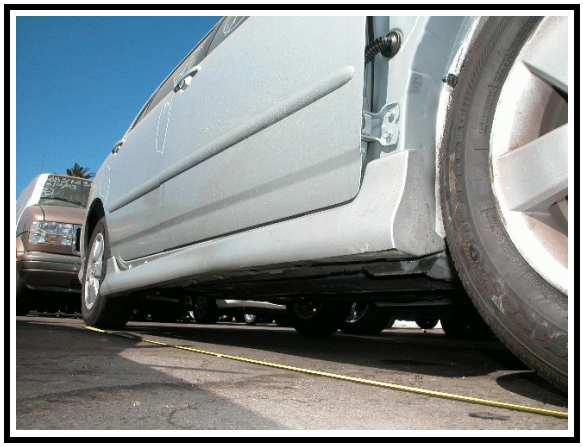

Figure 7. View showing direct contact to wheel rim and right sill area

Post-Crash

The case vehicle came to rest on the left (west) emergency lane/shoulder and was facing northerly. The driver was uninjured while the front, right seated occupant sustained an abrasion (AIS-1) to her right shoulder region. After the case vehicle came to its final rest, both the driver and the front, right seated occupant exited the vehicle unassisted.

The case vehicle was disabled due to the multiple impacts. After the investigating police collected all of the pertinent information, the case vehicle was towed from the crash scene. The vehicle was subsequently declared a total loss by the insurance company and was moved to an auto auction salvage facility.

VEHICLE DATA - 2004 Toyota Corolla S Four-Door Sedan

The 2004 Toyota Corolla S Four-Door Sedan was identified by the Vehicle Identification Number (VIN): 1NXBR32E44Zxxxxxx. The Toyota was equipped with a 1.8 liter, 16 valve, 4-cylinder/ 130 hp engine along with a 4-speed automatic transmission , and front wheel drive with rack-and-pinion steering. The odometer showed 6,345 km/h (3,943 miles) at the time of the vehicle inspection

The 2004 Toyota Corolla S Four-Door Sedan was equipped with Firestone P195/65R15 89S tires. The recommended cold pressure was 207 kPa (30 psi). The specific tire data is as follows:

Tire	Tread	Measured pressure	Tire Manufacturer Maximum Pressure
LF	6 mm (8/32 in)	248 kPa (36 psi)	303 kPa (44 psi)
LR	8 mm (10/32 in)	159 kPa (23 psi)	303 kPa (44 psi)
RR	8 mm (10/32 in)	255 kPa (37 psi)	303 kPa (44 psi)
RF	6 mm (8/32 in)	255 kPa (37 psi)	303 kPa (44 psi)

The front seating positions in the 2004 Toyota Corolla S four-door sedan were configured with fabric covered forward facing bucket seats. Both front bucket seats are equipped with adjustable head restraints that were undamaged and both front seats were adjusted at their rearmost seat track position. The second seating row consists of fabric covered, split bench seat equipped with a folding seat back.

VEHICLE DAMAGE

Exterior Damage - 2004 Toyota Corolla S Four-Door Sedan

Damage Description:	Minor/ Primary Front Right Corner Impact (Highest Delta V): Minimal longitudinal displacement measured with 1.2 cm of maximum crush at the front, right corner. Damaged components included the front bumper and fascia cover, hood, grille, upper/ lower radiator supports, both fenders, right side wheel rims, right sill and right rear bumper fascia cover. Minor/ Secondary Left Side Sideswipe Impact: Surface scraping extending along the left side plane. Damaged components include the left side tire rims, left sill and left bumper fascia.	
CDC:	Crash Event 1: 01FREE9 Crash Event 2: 12LDLS1	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

C measurements: Six equidistant crush measurements were documented at the bumper level and the crush profile is as follows; C_1=0 cm, C_2=0 cm, C_3=0 cm, C_4= 0 cm, C_5=0 cm, C_6= 1 cm Maximum crush was documented at C_6 or at the front, right bumper corner.

Interior Damage - 2004 Toyota Corolla S Four-Door Sedan

The interior greenhouse area of the case vehicle was void of any intruding components and the case vehicle's integrity was not compromised. There was no glazing damage and neither of the frontal air bag units deployed. A white (unknown substance) transfer was identified at the lower right instrument panel that was possibly due to lower extremity contact from the front, right seated occupant.

The interior of the case vehicle consisted of five passenger seated positions with fabric covered front bucket seats. The second row was comprised of a 60/40 fabric covered split bench seat with folding seat backs at the left and right side seated position. There was 1.0 cm (0.4 in) of lateral intrusion recorded at the forward center transmission tunnel/console region. This level of intrusion did not meet the minimum requirements for coding. There was no damage to the interior seats or head restraints.

MANUAL RESTRAINT SYSTEMS - 2004 Toyota Corolla S Four-Door Sedan

The driver's manual restraint system consisted of a continuous loop, three-point lap and shoulder belt with a free sliding latch plate and an adjustable shoulder belt upper anchorage that was in the full down position. The emergency locking retractor was located in the B-pillar. The front, right seated position was equipped with a continuous loop, three-point lap and shoulder belt with a free sliding latchplate and an adjustable shoulder belt upper anchorage that was in the full upward position. The switchable ELR/ALR retractor was harbored in the B-pillar shroud.

Figure 8. Non-deployed front, right air bag

The three rear seated positions were equipped with three-point lap and shoulder restraints with free sliding latch plates and switchable retractors. The outboard, rear seated positions are equipped with LATCH anchors.

Figure 9. View of non-deployed drivers air bag

FRONTAL AIR BAG SYSTEM - 2004 Toyota Corolla S Four-Door Sedan

This vehicle is equipped with Certified Advanced 208-Compliant dual stage/dual threshold driver and front right passenger air bags. *"The air bag sensor assembly consists of a safing sensor and air bag sensor. The front air bags will deploy if the severity of the impact is above the designed threshold level, comparable to an approximate 25 km/h (15 mph) collision when impacting straight into a fixed barrier that does not move or deform. This threshold velocity will be considerably higher if the vehicle strikes an object, such as a parked vehicle or sign post, which can move or deform on impact, or it is involved in an underride collision (e.g. a collision in which the nose of the vehicle "underrides", or goes under, the bed of a truck, etc.)."*[1]

Both the right side and left side collisions resulted in sidswipe type impacts that resulted in low deceleration potential and assumed lower than the threshold necessary for air bag deployment.

[1] Data regarding the front air bag system and the pretensioners was obtained from the owner's manual.

OCCUPANT DEMOGRAPHICS - 2004 Toyota Corolla S Four-Door Sedan

	Driver	Occupant 2
Age/Sex:	20/Female	20/Female
Seated Position:	Front, left	Front, right
Seat Type:	Bucket, fabric covered	Bucket, fabric covered
Height:	160 cm (63 in)	163 (64 in.)
Weight:	59 kg (130 lbs.)	68 kg. (150 lbs.)
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	Unknown	Unknown
Alcohol/Drug Involvement:	None	N/A
Driving Experience:	Unknown	N/A
Body Posture:	Upright, facing forward	Upright, looking through collection of compact discs
Hand Position:	Her left hand was on the steering wheel rim (unknown o'clock position) and her right hand was reaching for a picture that fell from the visor.	Looking through collection of CD's
Foot Position:	Her right foot was depressing the brake pedal while her left foot was on the floor	Both feet were on the floor
Restraint Usage:	Three-point, manual lap and shoulder restraint worn in a normal and correct fashion with the shoulder belt webbing extending across her chest and the lap belt webbing placed across her hips.	Three-point, manual lap and shoulder restraint worn in a normal and correct fashion with the shoulder belt webbing extending across her chest and the lap belt webbing placed across her hips
Air bag:	Steering wheel mounted air bag available/ non-deployed	Top mounted front, right passenger air bag/ non-deployed

OCCUPANT INJURIES - 2004 Toyota Corolla S Four-Door Sedan

Driver: Not Injured

Front, Right Passenger: Right Shoulder Abrasion

	INJURY	OIC CODE	ICD-9	SOURCE
Driver	Not Injured	N/A	N/A	N/A
Front, Right Passenger	Right shoulder abrasion	790202.1, 1	912.0	Shoulder belt webbing

OCCUPANT KINEMATICS - 2004 Toyota Corolla S Four-Door Sedan

Driver kinematics

The 20 year-old female driver (160 cm., 63 in./ 59 kg., 130 lbs.) was wearing the available three-point manual lap and shoulder belt with the shoulder belt webbing extending across her chest and the lap belt placed across her hips. The shoulder belt adjuster was in the full down position and the fabric covered bucket seat was adjusted to the rear-most seat track position. She responded to the initial 20 degree principle direction of force by moving forward and slightly to the right. The applied lap and shoulder restraint was likely loaded and the driver rebounded into the seatback support as the case vehicle separated from the initial right side wall impact. The secondary left side sideswipe impact resulted in a low longitudinal deceleration which and the driver was maintained in her respective seated position as the case vehicle came to final rest.

Both sideswipe type impacts resulted in low energy dissipation which related into a low Delta V and non-deployment of the frontal air bags.

Front, right occupant kinematics

A 20 year-old female (163 cm., 64 in./ 68 kg., 150 lbs.) occupied the front, right seated position and was wearing the available three-point manual lap and shoulder restraint. The shoulder belt webbing was placed across her chest while the lap belt webbing extended across her lap. The fabric covered bucket seat was adjusted to the full rearward seat track position and the shoulder belt adjuster was at the full-up position. She responded to the initial 1 o'clock, right side, sideswipe type impact by moving forward and slightly to her right. She loaded the applied lap and shoulder restraint webbing which resulted in a right shoulder abrasion (AIS-1). The secondary left side sideswipe impact likely did not significantly displace the front, right passenger as she was maintained in her respective seated position.

Attachment 1. Scene Diagram