

Remote Redesigned Air Bag Investigation
Dynamic Science, Inc. (DSI), Case Number DS05025
2004 Kia Optima
Arizona
July 2005

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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 The 2004 Kia Optima was traveling eastbound on a two lane, divided Interstate. A non-contact vehicle encroached into the passing lane, directly in front of the case vehicle. The 42 year-old driver steered left and successfully avoided a collision, but entered the rocky depressed median. As the case traveled through this rough terrain, the vehicle sustained undercarriage damage. During this time the driver side steering wheel mounted air bag deployed. She had been sitting in close proximity to the air bag. As it deployed it fractured her nose and left orbit. Additionally, she sustained a laceration to her left eyelid, and two black eyes. She also herniated a disc in her lumbar spine, but is uncertain whether this was a preexisting condition. She was transported to a local hospital, where she was treated in the emergency room and then released.			
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BACKGROUND:

Description

This remote investigation focused on the interaction between the driver and the driver's air bag. The case was initially investigated as an air bag related serious injury case and then changed to a redesigned air bag investigation. The highest air bag related Abbreviated Injury Scale (AIS) injury was not considered severe enough to be considered an air bag related serious injury. The case vehicle was a 2004 Kia Optima that was traveling eastbound on a two lane, divided interstate highway. The Kia was occupied by a 42-year-old female (155 cm-61 in/73 kg-160 lbs). A non-contact vehicle encroached into the passing lane, directly in front of the case vehicle. The driver of the case vehicle steered left and successfully



Figure 1. Front left bumper, 2004 Kia Optima

avoided a collision, but entered the rocky depressed median. As the case traveled through this rough terrain, the vehicle sustained undercarriage damage. During this time the driver side steering wheel mounted air bag deployed. She had been sitting in close proximity to the air bag. As it deployed it fractured her nose and left orbit. Additionally, she sustained a laceration to her left eyelid, and two black eyes. She also herniated a disc in her lumbar spine, but is uncertain whether this was a preexisting condition. She was transported to a local hospital, where she was treated in the emergency room and then released.

DSI was assigned the case on November 8, 2005 but the crash itself had taken place in July, 2005. By the time the case had been assigned, the case vehicle had already been repaired and was back on the roadway. The driver did not own the vehicle; it belonged to her son.

There was no field work done on this case, but photos of the crashed vehicle were obtained in March 2006 from the body shop that had completed the repairs. The photos that were provided were not of the best quality, as they did not photographically cover the entire exterior or interior of the vehicle.

SUMMARY

Crash Site

This single vehicle crash occurred on a summer morning in July of 2005 at 0835 hours. The restrained 42-year-old female was traveling between her residence and that of her son. She was taking care of his pets, and was traveling eastbound at the time of the crash. The eastern lanes consist of two asphalt travel lanes, and two western two travel lanes. The two eastern lanes are separated from the two western lanes by what the driver has described as an area of dirt and

rocks in a ditch.

Pre-Crash

The driver related that she had been traveling eastbound on the interstate. Her son and his wife were out of town, and she was making scheduled trips between his home and her apartment in order to care of their animals. She was driving her son's Kia, and therefore did not know the vehicle history. There was no cargo or luggage in the vehicle at the time, and she was the lone occupant.

Due to the driver's relatively short stature, she indicated that she had positioned the driver's seat very close to the steering wheel. Her seat back was fully upright, and she was wearing the manual 3-point lap and shoulder belt. She was not wearing glasses of any sort, nor was she wearing contact lenses. She further indicated that she did not have anything in her hands or mouth at the time of the crash.

Crash

On the day of the crash, the weather was clear, with atmospheric conditions which were conducive for traveling. The driver had been proceeding eastbound, in the inside passing lane, when a non-contact vehicle suddenly swerved into her travel lane. The driver of the case vehicle steered sharply to the left and successfully avoided striking this non-contact vehicle. This same avoidance maneuver resulted in the case vehicle departing the roadway to the left and going through the rocky, depressed, center median area. The case car sustained significant undercarriage damage from the rocks as it bounced through that area, and it was during this time that the steering wheel mounted air bag deployed.

After traversing both westbound travel lanes, the case vehicle came to rest on an entrance ramp situated on the far north side of the highway.

Post-Crash

As the case vehicle came to final rest, it sustained no additional impacts. The driver was able to exit the case vehicle unaided. The doors remained closed and operational. Because there appeared to be smoke inside the vehicle, the driver exited quickly because of concerns about a possible fire. There was in actuality no fire; the driver misinterpreted the air bag powder swirling about the vehicle interior, for smoke.

The driver was dazed, and indicated that she really did not have a clear recollection of events that followed. She theorized that she may have been in shock. An ambulance was called to the crash site, and subsequently transported her to a local medical center. She remained there all day, but indicated that she was never actually admitted to the facility. After being seen in the emergency room, she was subsequently discharged. She then stayed with a friend for five days due to her injuries.

The driver indicated that she had sustained two facial fractures; a fractured orbit to her left eye, and a fractured nose. Neither fracture was open, and both have been attributed to the deploying

front air bag. She also sustained what she has described as a laceration above the left eye, on the eyelid region. Although this laceration required no sutures, she indicated that it had bled a lot. She also sustained two black eyes. The left eye was swollen shut for a few days. These injuries were also attributed to the deploying steering wheel mounted air bag.

Since then, the driver added, she has been diagnosed with a herniated disc in her lower back, which is now pressing on her sciatic nerve. Two doctors have told her that she needs surgery. She is not sure whether this disc was the result of a pre-existing condition (which she may have been unaware of) or the result of her car bouncing through the median's dirt and rocks as the car proceeded to final rest.

VEHICLE DATA - 2004 Kia Optima

The 2004 Kia Optima 4-door sedan was identified on the police report by its Vehicle Identification number (VIN): KNAGD128645xxxxxx. The case vehicle was not inspected. The crash had occurred in July, and when the case was assigned in November, the case vehicle had already been fully repaired. According to the VIN, this 4-door sedan was equipped with a 2.7 liter six cylinder engine.

The Kia Optima tire information is unknown. The specific tire data was unavailable, due to the fact that the vehicle was not personally inspected. The police report indicated that the left-front tire was flat as a result of the crash, but no other information was forthcoming. A photo of the tire did show what appeared to be a horizontal cut in the sidewall of the tire. A closer review of the photos revealed some tire information. The front-right tire had the inscription Radial XSE P205/55R16 visible on the sidewall, but all other wording was unclear. An Internet review indicated that the standard tire size for this particular vehicle are P205/55R/16.

According to the driver, the seating in the 2004 Kia Optima was configured with two vinyl bucket seats with adjustable head restraints in the two outboard front seating positions, and a vinyl bench seat in the rear seating area.

VEHICLE DAMAGE

Exterior Damage - 2004 Kia Optima

Since the vehicle was not inspected, the only information available was a collaboration between the driver interview, and a few photos that were obtained from the body shop. The insurance company had not taken any photos (they indicated that this was due to the minor nature of the damage to the case vehicle). The body shop did provide their archived photographs, but these were fairly limiting in scope and did not provide complete photographic coverage.

The photos show that there was a single vertical scuff to the bumper fascia just inboard of the left headlights. There was also scuffing to the bottom edge of the fascia on the left side. There was abraded metal down the left side along the frame rail. This damage appeared to be the result of the vehicle bouncing along through the rocky depression which separated the east and westbound travel lanes. The plastic skirt on the bottom radiator support was pulled away on the left side. There were likely multiple impacts in this crash. The Collision Deformation Classification (CDC) for this crash based on the final appearance of the damage was 12FYLS2. There was a puncture visible along the outer sidewall, which was also visible in the picture. The police report indicated that this tire had been flattened, but it had been filled with air prior to the body shop photos being taken.

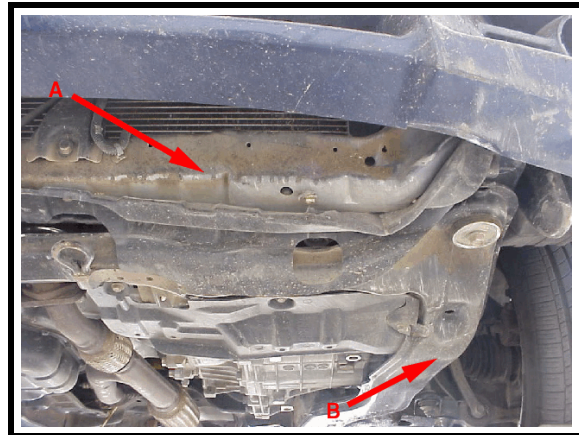


Figure 2. Undercarriage damage: (A) shows contact to radiator support, (B) shows the length of visible contact



Figure 3. Close up of contact to radiator support

Interior Damage - 2004 Kia Optima

There was very little photographic information available concerning the interior of the case vehicle. One photo showed the deployed air bag, but there were no views of the toe pan areas. Although it seems highly suspect that this area would have intruded vertically into the passenger area, it could not be ruled out.

MANUAL RESTRAINT SYSTEMS - 2004 Kia Optima

The vehicle was not inspected in person, but an Internet search indicated that this particular vehicle was equipped with lap and shoulder belts for both of the front bucket seat positions, as well as lap and shoulder belts for the three rear seating positions.

Although the driver's seat belt could not be inspected, neither she, the police officer, the insurance agent, nor the body shop at any time indicated that there had been a problem with the safety belt. The driver mentioned that the belt had done an excellent job of keeping her behind the wheel, and she was pleased with its overall performance.

FRONTAL AIR BAG SYSTEM - 2004 Kia Optima

The photograph showed the deployed steering wheel mounted air bag, but it had been folded and tucked underneath the steering wheel rim. Therefore, the fabric could not be inspected for signs of failures and occupant contact points.



Figure 4. Driver's air bag

OCCUPANT DEMOGRAPHICS - 2004 Kia Optima

	Driver
Age/Sex:	42/Female
Seated Position:	Front-left (driver)
Seat Type:	Fabric bucket seat
Height:	154.9 cm (61 in)
Weight:	73 kg (160 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	The driver indicated that she had sustained a herniated disc, but was unsure whether this was a preexisting condition or a direct result of undercarriage forces being applied through the seat bottom as the case vehicle bounced through the rocky, median depression
Alcohol/Drug Involvement:	None
Driving Experience:	> 10 years
Body Posture:	Upright
Hand Position:	On wheel
Foot Position:	Right on brake, left on floor
Restraint Usage:	Lap and shoulder belt
Air bag:	Steering wheel mounted air bag, deployed

OCCUPANT INJURIES -2004 Kia Optima

Driver: Injuries obtained from driver interview.

<u>Injury</u>	<u>OIC Code</u>	<u>Source</u>	<u>Confidence Level</u>
Fractured nose	251002.1,4	Air bag	Certain
Fracture left orbit	251202.2,2	Air bag	Certain
Lacerated left eyelid	297602.1,2	Air bag	Certain
Left eye contusion	297402.1,2	Air bag	Certain
Right eye contusion	297402.1,1	Air bag	Certain
Disc herniation (lumbar) NFS	650600.2,8	Forces	Possible

OCCUPANT KINEMATICS - 2004 Kia Optima

Driver kinematics

As the vehicle bounced along through the median depression which consisted of dirt and rocks, the restrained driver was driven downward, into the bottom cushion of the bucket seat. During this time her back would have been subjected to compressive forces, which may have resulted in the herniated disc injury she suffered. If this was a preexisting condition, these forces would have served to exacerbate this condition.

The driver also was seated in very close proximity to the steering wheel and consequently, the air bag module. As the vehicle sustained impact forces to the undercarriage area, with resulting damage, the deceleration of the car caused the air bag to deploy. The rapidly expanding fabric struck the driver's face, resulting in fractures to her nose and left eye orbit. It also caused a laceration to her left eyelid region, and contusions to both of her eyes.

Attachment 1. Scene Diagram

