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SCI/NASS COMBINATION CASE REPORT

CASE NUMBER - NASS-99-13-079E
LOCATION - Michigan
VEHICLE - 1998 NISSAN MAXIMA GLE
CRASH DATE - May 1999

Submitted:

June 21, 2000

Contract Number: DTNH22-94-D-17058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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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.

Technical Report Documentation Page

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15. *Supplementary Notes*
Combination SCI/NASS investigation involving a 1998 Nissan Maxima GLE, four-door sedan, with manual safety belts, redesigned front air bags and front outboard side air bags, and six fixed objects

16. *Abstract*

This report covers a SCI/NASS combination investigation concerning a 1998 Nissan Maxima GLE (case vehicle) and a series of fixed objects (guardrail, curb, low-hanging tree limb, and three oak trees). This crash is of special interest because the case vehicle was equipped with redesigned front air bags that deployed as a result of the collision events and the restrained driver (63-year-old male) sustained minor injuries. There was no other occupant in the case vehicle. The front right passenger seat back-mounted side air bag also deployed, but there was no occupant in that seat position. The case vehicle was traveling south in the outside, southbound lane of a two-lane roadway that was part of a four-lane, divided trafficway. As the case vehicle was traveling up a positive grade, the driver suffered a syncopal episode ("blacked out") and the case vehicle drifted to the right onto the west shoulder. The right side swiped a guardrail. Immediately after separating from the guardrail, the case vehicle's right front wheel and tire struck a concrete barrier curb. The case vehicle drifted back left (east) into the middle of the west shoulder as it traversed a bridge. After clearing the bridge, the case vehicle began to drift right (west) once again and exited the west shoulder at a shallow angle, continuing diagonally down an embankment. The case vehicle then struck a low-hanging evergreen limb, sideswiped a tree with its right side (deploying the front right passenger's side air bag), and collided head-on into a double-trunked tree (counted as two trees) which caused the driver and front right passenger front air bags to deploy. At final rest the case vehicle was at the bottom of the embankment, facing south. The case vehicle was towed from the scene due to disabling damage. The driver was transported from the scene by ambulance to a medical facility. He sustained only minor, soft tissue injuries but was hospitalized for two days as a precaution because he had a history of seizures and heart disease.

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BACKGROUND

NASS-99-13-079E

This combination SCI/NASS crash investigation concerns a 1998 Nissan Maxima GLE (case vehicle) and a series of fixed objects (guardrail, curb, low-hanging tree branch, and three oak trees). The crash occurred in May 1999, at 12:27 p.m., in Michigan, and was investigated by the applicable township police department. This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of collision events and the unrestrained driver (63-year-old male) sustained a closed head injury and multiple abrasions, contusions, and lacerations. There was no other occupant in the case vehicle. The case vehicle was also equipped with seat back-mounted side air bags and the right side air bag deployed, but there was no occupant in that seat position. The NASS investigator inspected the scene and case vehicle in May 1999, and obtained an interview with the case vehicle driver's wife and a partial driver interview in June. This report is based on the Police Crash Report; the NASS investigator's coded forms and photographs; the interview; the medical records; occupant kinematic principles; and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

Figure 1: Case vehicle's southbound approach toward crash sequence

Figure 2: Orange paint marks show case vehicle's path toward first contact with west guardrail

The case vehicle was traveling south in the outside, southbound lane of a two-lane roadway that was part of a four-lane, divided, U.S. trafficway **(Figure 1**). Presumably, the case vehicle's intent was to continue in a southerly travel path. As the case vehicle was traveling up a positive grade to the south, it approached a bridge. The driver suffered a syncopal episode ("blacked out") and the case vehicle drifted to the right onto the west shoulder and struck the west W-beam guardrail with its right side (**Figure 2**). Immediately after separating from the west guardrail, the case vehicle's right front wheel and tire struck a 15 centimeter (6 inch) concrete barrier curb, causing the

Figure 3: Case vehicle's diagonal descent along embankment toward trees

tire to deflate. The case vehicle drifted left (east), completely back onto the improved west shoulder, as it traversed the bridge. After exiting the south end of the bridge and its W-beam guardrail extension on the roadway's west side, the case vehicle began to drift right (west) once again. It exited the west shoulder at a shallow angle and continued diagonally down an embankment (**Figure 3**, above). The case vehicle then struck a low-hanging evergreen branch (**Figure 4**), sideswiped a tree with its right side (deploying the side air bag at the front right passenger seat area), and collided head-on into a double-trunked tree (counted as two trees) which caused the case vehicle's driver and front right passenger front air bags to deploy (**Figure 5**). The case vehicle likely rotated a few degrees clockwise after striking the first tree and a few degrees counterclockwise after striking the second tree. The third tree was lightly contacted by the front bumper fascia and the front hood edge. At final rest the case vehicle was at the bottom of the embankment facing south.

Figure 4: Case vehicle's path into impact #3 with an overhanging evergreen tree limb

The roadway was bituminous, dry, straight, and had a positive grade (greater than 2%) to the south. Improved shoulders were available on both east and west pavement edges. The posted speed limit was 113 km.p.h. (70 m.p.h.). Ambient conditions were daylight, cloudy, no adverse weather conditions, no vision obstructions, and no roadway defects. Pavement markings for southbound traffic included a single broken white center line, a single solid white edge line (west edge) and a single solid yellow edge line (east edge). Investigating officers did not report any pre-impact avoidance maneuvers. The crash site was rural and undeveloped.

Figure 5: Case vehicle's travel path into impacts #4 (tree on right), #5 (left trunk of double trunked tree, and #6 (right trunk)

CASE VEHICLE

The case vehicle was a front wheel drive, 1998 Nissan Maxima GLE, five passenger, four-door sedan (VIN: JN1CA21A5WM------) equipped with a 3.0 liter, V-6 gasoline engine and an automatic transmission with a console-mounted shift lever. Four-wheel anti-lock brakes were an option for this vehicle, but it is not known if it was so equipped. The wheelbase for the case vehicle was 270 centimeters [106.3 inches]. An odometer reading of 27,842 kilometers [17,300 miles] was reported. The case vehicle was towed from the scene due to disabling damage.

The interior of the case vehicle had front bucket seats with adjustable head restraints. It had manual, three-point, lap-and-shoulder safety belts at the four outboard seat positions. Anchorage adjustments were available at the front outboard seat locations on their respective B-pillars and were reported to be in the "full down" position for the driver and the "full up" position at the front right passenger position. The tilt steering wheel was adjusted at the center position. The second seat was a bench seat, with integral head restraints at the outboard positions and its center seat location was equipped with a lap only safety belt and no head restraint. The case vehicle was equipped with dual, redesigned front air bags and seat back-mounted side air bags at the driver and front right passenger seat positions. The front right passenger side air bag and the two front air bags deployed as a result of crash forces while the driver side air bag did not deploy.

CASE VEHICLE DAMAGE

This crash sequence had six events. The first impact involved a W-beam guardrail on the southbound roadway's west side and the right side of the case vehicle (determined CDC: **12-RDES-1 (010),** WinSMASH not applicable). Direct damage began at the front right bumper corner and extended 365 centimeters [143.7 inches] rearward. Sheet metal scraping was the only damage, involving the right front bumper corner, the right front fender, the right front door, the right rear door, and the right rear quarterpanel (**Figures 6** and **7**). The second of six events was the right front wheel and tire striking a 15 centimeter [6 inch] concrete barrier curb, breaking the tire bead and deflating the tire. Rim gouges defined the case vehicle's location as it traveled south on the west shoulder and, ultimately, off road (determined CDC: **12-FRWN-3 (000)**, WinSMASH not applicable). The third of six impacts involved a low-hanging evergreen tree limb and the front right two-thirds of the case vehicle. Again, damage was negligible with, perhaps, some paint scratching that was not identifiable in the photographs (determined CDC: **12-FDEW-1 (000),** WinSMASH not applicable). Impact four was a sideswipe contact to the extreme front right corner of the case vehicle with the first struck tree (determined CDC: **12-FRES-6 (000)**, WinSMASH not applicable). Direct damage began 61 centimeters [24 inches] right of center front and extended to the front right bumper corner. Damage along the right front fender almost reached the center of the right front wheel well, displacing the right front wheel and tire rearward into the right lower A-pillar; also, the right

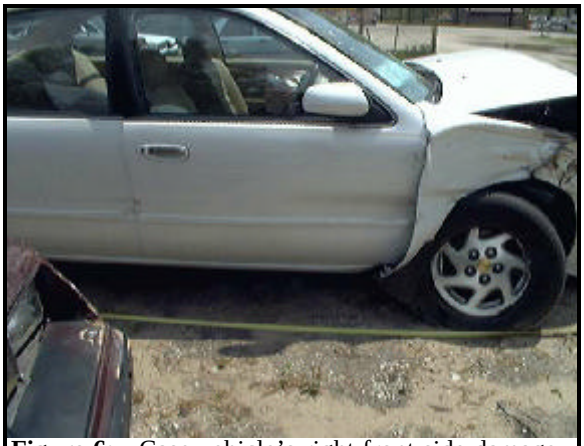


Figure 6: Case vehicle's right front side damage from guardrail contact (case photo #ID=70040)

Figure 7: Case vehicle's right rear side damage from guardrail contact (case photo #ID=70039)

side rearview mirror was contacted (**Figure 8**). Fifth of the six events, and the most severe impact sustained by the case vehicle, involved the second of the three trees. Direct damage began at the center front and extended 53 centimeters [20.9 inches] left, with a maximum crush of 41 centimeters [16.1 inches]. Direct damage of components included: the front bumper fascia (separated from the case vehicle) and its reinforcement bar were displaced rearward, the front grille shattered, the front left headlamp assembly dislodged from its original location, and the left half of the hood's forward edge shoved rearward (**Figure 9**). The last of the six events involved the westernmost trunk of the double-trunked tree (determined CDC: **12-FCEN-1 (000)**, WinSMASH not applicable). The case vehicle rotated slightly counterclockwise during impact number five and came to rest against the third tree with minimal contact. Damaged components included the front hood edge just right of center and the front bumper reinforcement bar vertically aligned with the hood damage.

Figure 8: Case vehicle's right front fender damage from impact #4's sideswipe with a tree

Figure 9: Case vehicle's front damage; Note: front left damage is from impact #5, while the front center damage is from impact #6

Induced damage included a buckled front hood, the left front fender slightly buckled, and the right lower A-pillar displaced slightly rearward from contact with the front right wheel and tire. The NASS investigator discovered no intrusions to the case vehicle's interior.

Based on the vehicle inspection, a CDC for impact #5 was determined to be: **12-FYEW-02 (000)**. The WinSMASH reconstruction program, CDC-only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 31.0 km.p.h. [19.3 m.p.h.], -31.0 km.p.h. [-19.3 m.p.h.], and 0.0 km.p.h. [0.0 m.p.h.]. Thus, the crash severity for the case vehicle was moderate (24-40 km.p.h. [15-25 m.p.h.]).

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with redesigned front air bags and seat back-mounted side air bags at the driver and front right passenger seat positions. The front right passenger side air bag deployed, probably during the fourth impact, a tree sideswipe. The right side air bag was located on the outboard side of the seat back. The single module cover flap was vinyl-covered (17 centimeters [6.7 inches] wide and 22 centimeter [8.7 inches] high) in a rigid, right-angle configuration and was hinged on the back surface of the seat back such that the cover flap rotated in a front-to-rear movement as it deployed. The side air bag was oblong in shape, with a width of 36 centimeters [14.2 inches] and a height of 30 centimeters [11.8

inches]. It was untethered but did have one vent port at the 3 o'clock position. No contact to the air bag fabric was identified by the NASS investigator (**Figure 10**). The side air bag cover flap deployed with such force that it shattered a portion of the vinyl covering over the lower right B-pillar and drove the unused male safety belt latch into the lower B-pillar's vinyl covering, where it was tightly wedged (**Figure 11**).

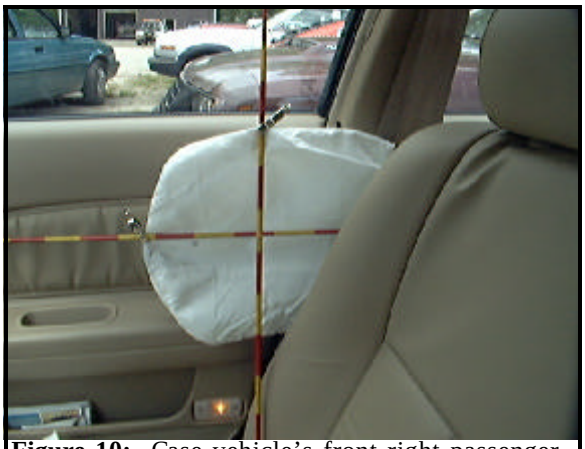


Figure 10: Case vehicle's front right passenger deployed side air bag; Note: there was no occupant in this seat position

Figure 11: Case vehicle's lower right B-pillar damage from module cover flap contact

The two front air bag modules deployed, possibly during the crash sequence's fourth impact, a tree sideswipe, but more likely during the fifth impact's frontal contact with a tree trunk. The driver's front air bag was located in the steering wheel hub. Module cover flaps were in a slightly asymmetrical "H" configuration. Both cover flaps were 15 centimeters [5.9 inches] wide, with the top flap 7.5 centimeters [2.9 inches] high and the lower flap 7.0 centimeters [2.8 inches] high. They opened at their designated tear points with no flap damage noted. The driver's air bag was round, with a 55 centimeter [21.6 inch] diameter, and was untethered. It had two vent ports at the 11:30 and 12:30 clock locations. No occupant contacts were reported by the NASS investigator.

The front right passenger air bag was mounted on the top of the instrument panel. The single module cover flap rectangular, with a width of 25 centimeters [9.8 inches] and a height of 7.5 centimeters [2.9 inches]. The cover flap opened at its designated tear points and probably caused the glazing damage to the bottom right of the windshield. The passenger's front air bag was rectangular, with a height of 50 centimeters [19.7 inches] and a width of 40 centimeters [15.7 inches]. This air bag was untethered and without vent ports. Blood and mucus were detected by the NASS investigator above and below the horizontal center, and immediately to the left of the vertical center of the air bag's fabric (**Figure 12**).

Figure 12: Case vehicle's front right passenger front air bag; Note: yellow tape outlines presence of blood and mucus on the fabric

The case vehicle driver (63-year-old, White, non-Hispanic male; 163 centimeters and 75 kilograms [64 inches, 165 pounds]) was wearing his available, manual, three-point, lap-and-shoulder, safety belt system. Prior to the crash sequence, the case vehicle driver believes he fell asleep and he may have slumped over. The medical records indicate that the driver had a history of seizures, was under medication for this problem and suffered a syncopal episode ("blacked out"). The driver was transported from the scene via ambulance and was hospitalized for two days as a precaution, in consideration of his medical history.

When the case vehicle began to sideswipe the guardrail, the driver's body would have had the tendency to move slightly forward but that movement would have been negligible. Separation from the guardrail would have resulted in no body movement but the right front wheel and tire impact with the curb would have been sufficient to jostle the driver's body in a down-up-down movement. This movement was not sufficient, however, to rouse the driver. The case vehicle continued southbound in the west shoulder over a 65 meter [213 feet] bridge span and departed the west shoulder's west surface edge approximately 40 meters [131 feet] south of the bridge's south end. It then diagonally descended an embankment and flat ground surface for 148 meters [486 feet]. The driver would have leaned right as the case vehicle descended the embankment. Impact three was contact with a low, overhanging evergreen limb which would have resulted in negligible velocity change to the case vehicle and little, if any, force vector on the driver. Impact four, however, was a sideswipe with a large tree which deployed the front right passenger side air bag. This impact and the subsequent, slight clockwise rotation would have resulted in the driver moving forward and then left as the rotation began. Nearly simultaneously, the case vehicle separated from impact four and struck the eastermost trunk of a double-trunked tree. This impact most likely deployed the dual front air bags of the case vehicle and resulted in the following injuries to the driver as he contacted his air bag: a closed head injury, a forehead abrasion, a swollen left eye, a swollen nose, a contused chin, contused lips, a lacerated bottom lip, and a lacerated and contused gingival mucosa. As his body moved forward, the driver also sustained a contused right knee from contact with the left lower instrument panel and abrasions to the right lower chest and abdomen from loading the safety belt webbing. The case vehicle rotated slightly counterclockwise and came to rest against the westernmost trunk of the double-trunked tree, with the contact only sufficient to dent the front center of the hood. This sixth impact was minor and resulted in little, if any, force acting upon the driver. The driver's posture at final rest is not known.

CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Through-and-through laceration, lower lip	290602.1 minor	Driver air bag	Probable	Discharge Summary
2.	Laceration, gingival mucosa	243204.1 minor	Driver air bag	Probable	Discharge Summary

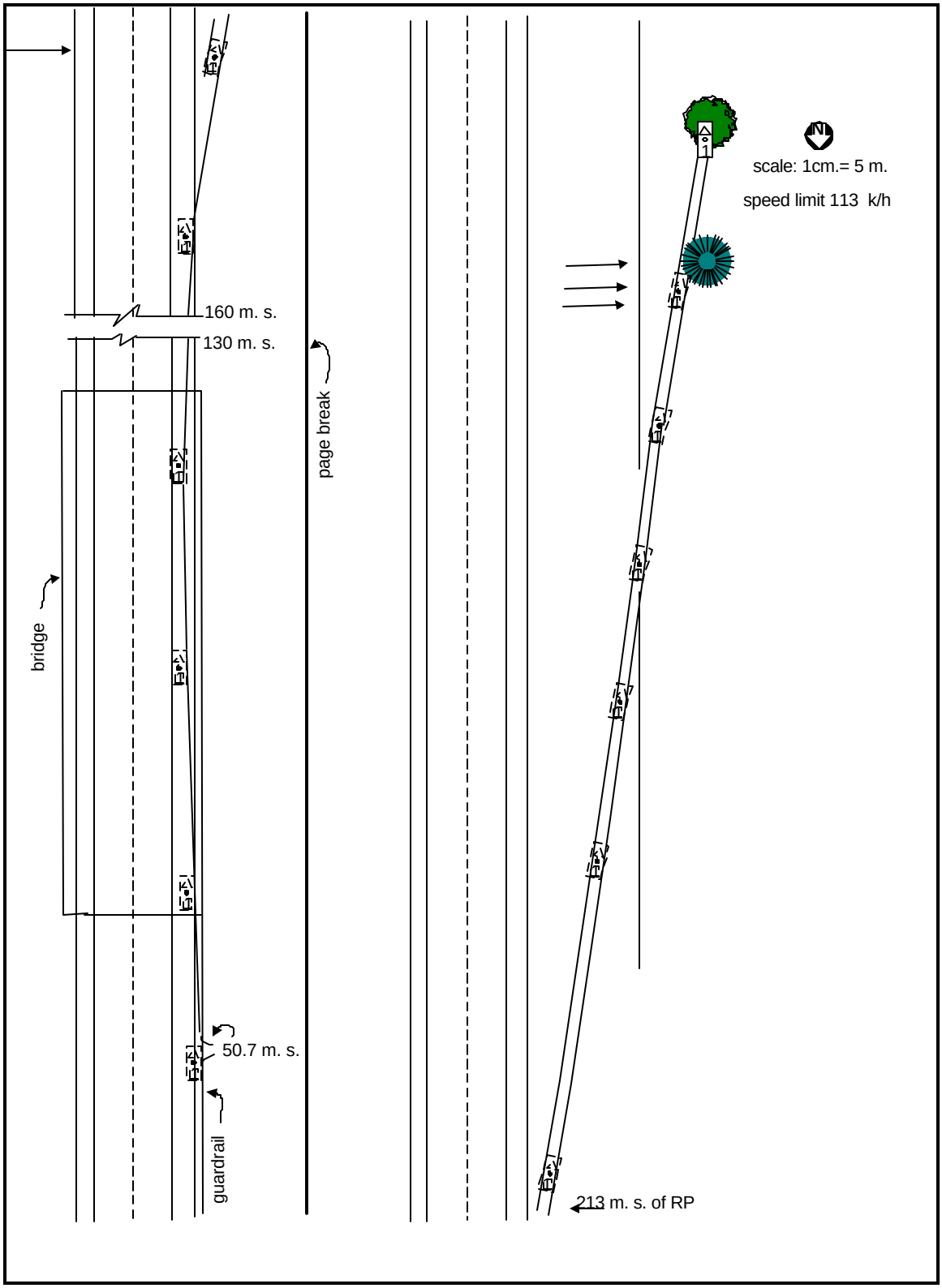
Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
3.	Non-anatomic brain injury[1]	160499.1 minor	Driver air bag	Possible	Emergency Room
4.	Abrasion, right lower chest	490202.1 minor	Belt restraint webbing	Probable	Emergency Room
5.	Contusion, right knee	890402.1 minor	Left instrument panel	Probable	Interviewee
6.	Contusion, gingival mucosa	243202.1 minor	Driver air bag	Probable	Discharge Summary
7.	Contusion, chin	290402.1 minor	Driver air bag	Probable	Discharge Summary
8.	Abrasion, right lower abdomen	590202.1 minor	Belt restraint webbing	Possible	Discharge Summary
9.	Redness on forehead (abrasion)[2]	290202.1 minor	Driver air bag	Probable	Interviewee
10.	Swollen left eye (contusion)[2]	297402.1 minor	Driver air bag	Probable	Interviewee
11.	Swollen nose (contusion)[2]	290402.1 minor	Driver air bag	Probable	Interviewee

OBJECTS CONTACTED

The case vehicle sustained six impacts during this crash sequence. First impact was to the right side with a W-beam guardrail and the second was the front right wheel and tire against a 15 centimeter (6 inch) concrete barrier curb (**Figure 2**, above). The third impact was with a low, overhanging evergreen tree limb (**Figure 4**, above). The fourth impact involved the right side of the case vehicle sideswiping a large tree [greater than 10 centimeters (3.9 inches)]. The fifth and sixth impacts were with a double-trunked tree [both trunks with diameters greater than 10 centimeters (3.9 inches)] (**Figure 5**, above). The easternmost trunk was struck first, then the westernmost tree was impacted. None of the trees were fractured nor moved.

[1]The hospital Discharge Summary indicates that this driver had a history of seizures and was under medication for this problem. He suffered a syncopal episode and lost of control of his vehicle resulting in this crash. The Emergency Department records indicate that he was confused about the crash and thought there was another occupant in the car, when there was none.

[2]The NASS case coding does not include this minor, interview-reported injury.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130 m. s.
page break
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guardrail
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