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February 2025

Special Crash Investigations: Remote Frontover Incident Investigation; Vehicle: 2022 Toyota Highlander; Location: Nevada; Incident Date: August 2022

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15. Supplementary Notes

Each crash represents a unique sequence of events and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.

16. Abstract

This report documents the remote investigation of the death of a 3-year-old male due to a 2022 Toyota Highlander SUV frontover incident. The Toyota was driven by a 36-year-old male with no other passengers. It is unknown if he was belted. The 3-year-old exited the apartment and ran toward the front of the Toyota, out of the driver's sight. The Toyota was moving forward and the child was knocked to the ground and driven over by the left front wheel. The child was taken to the trauma ER where he was pronounced deceased 48 minutes after arrival. He died as a result of blunt force head trauma that included skull fractures.

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Special Crash Investigations
Remote Frontover Incident Investigation
Case No. DS22023
Vehicle: 2022 Toyota Highlander
Location: Nevada
Incident Date: August 2022

Background

This report documents the remote investigation of the death of a 3-year-old male who died due to a frontover incident. The investigation was intended to determine the events leading up to the incident, the actions of the driver, the vehicle characteristics and equipment, the environment/scene conditions and layout, and activities of the involved child nonmotorist. The Special Crash Investigations (SCI) team initiated this investigation in response to a notification sent by the SCI team in December 2022 containing the state crash report, the autopsy report, and an online news report. The case was assigned as a remote investigation in December 2022. The on-scene police photos were obtained in April 2023.

The incident occurred in the afternoon hours in August 2022 in Nevada. The incident site was on a north/south travel lane within a gated apartment complex. Conditions at the time of the incident were clear, daylight, and dry. The vehicle was a 2022 Toyota Highlander SUV (Figure 1) that was being driven by a 36-year-old male.

Figure 1. 2022 Toyota Highlander (Police photo)

Summary

Incident Site

The crash site was on a two-way roadway in a gated apartment community (Figure 2). The north/south roadway was straight and level. When facing north it was bordered on the right by on-street parking, a sidewalk, and apartment entrances. It was bordered on the left by a red no-parking fire lane curb, a dirt separator, a concrete sidewalk, and apartment entrances. There was no posted speed limit. Conditions at the time of the incident were clear, daylight, and dry. The weather at the nearest reporting site was 37ºC (100ºF), 27 percent humidity, and the winds were calm. An incident diagram is included at the end of this report.

Figure 2. Northbound view (police photo)

Figure 3. Parked area, impact area, looking north (police photo)

Pre-Incident

Prior to the incident, the Toyota was being driven by a 36-year-old male. The front-right seat was occupied by a 15-year-old male, the second-row-right seat was occupied by the driver's wife (unknown age), the third-row-left seat was occupied by a 3-year-old male, and the third-row-right seat was occupied by a 5-year-old female. The family was returning to their apartment home after shopping. The driver parked the Toyota facing north (Figure 3) along the southbound curb in front of their apartment so they could unload the groceries. All three children exited the vehicle while the parents finished unloading the groceries. The driver then returned to the Toyota alone to move it to a parking space. The child's mother reported to police that the child always wanted to be with his father and would cry when the father left. The 3-year-old exited the apartment without the knowledge of his parents.

Incident

The focus of the driver's attention after re-entering the Toyota was unknown. The driver began accelerating forward to go to the parking place. The child ran toward the vehicle and was struck by the front bumper. He fell to the ground and was run over by the left front tire. The driver told the coroner's investigator that he "felt the vehicle go up on the left side like a bump" and saw his father-in-law running toward the vehicle.

Post-Incident

The child's parents immediately picked the child up, put him into the Toyota, and drove him to a local trauma center. The hospital was 10 km (6.4 miles) from their residence. They arrived approximately 10 minutes after the incident and brought him into the main lobby. The child was taken to the trauma ER where lifesaving measures were met with negative results. Full cardiopulmonary resuscitative efforts were attempted. The child arrived with a Glasgow coma scale score of 3 with fixed and dilated pupils. He was pronounced deceased 48 minutes after arrival, according to the autopsy report. He died as a result of blunt force head trauma that included skull fractures. The police were notified of the death by hospital staff.

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2022 Toyota Highlander

Vehicle Description

The 2022 Toyota Highlander SUV was identified by the Vehicle Identification Number (VIN) 5TDJZRAH5NSxxxxxx. The Toyota had a 3.5-liter 6-cylinder gasoline engine, 8-speed automatic transmission and front-wheel drive. The vehicle had five doors and seating for seven. The Toyota had a driving support system identified by the manufacturer as Toyota Safety Sense 2.5+. The system included pre-collision system, lane tracing assist, automatic high beam, road sign assist, and dynamic radar cruise control. According to the owner's manual, the pre-collision system uses a radar sensor and front camera to detect objects in front of the vehicle. When the system determines that the possibility of a frontal collision with an object is high, a warning operates to urge the driver to take evasive action and the potential brake pressure is increased to help the driver avoid the collision. The system can detect vehicles, bicyclists, and pedestrians. The limitations for detectable objects are shown in the following table from the owner's manual.

Detectable objects	Vehicle speed	Relative speed between your vehicle and object
Preceding and stopped vehicles	Approx. 7 to 110 mph (10 to 180 km/h)	Approx. 7 to 110 mph (10 to 180 km/h)
Oncoming vehicles	Approx. 7 to 110 mph (10 to 180 km/h)	Approx. 13 to 110 mph (20 to 180 km/h)
Bicyclists and pedestrians	Approx. 7 to 50 mph (10to 80 km/h)	Approx. 7 to 50 mph (10to 80 km/h)

Based on available information, in particular the low speed involved, the pre-collision system would not have been expected to activate in this incident.

Exterior Damage

The Toyota did not sustain any crush damage during this incident. Police photos identified an area on the left front fender where dust had been disturbed (Figure 4) and a dark mark on the tread of the left tire (Figure 5). The police report stated that the child was initially struck by the front bumper. The estimated collision deformation classification (CDC) was 12FLWN3.

Front Visibility

An exemplar Toyota was examined to obtain general front visibility information. The following baseline items were obtained from the vehicle, vehicle specifications, anthropometric documents[1] and a New Car Assessment Program report for this vehicle.

[1] Kovacevic, S., Vučinić, J., Kirin, S., & Pejnović, N. (2010). Impact of anthropometric measurements on ergonomic driver posture and safety. *Periodicum Bilogorum*, *112*(1), 51—54.

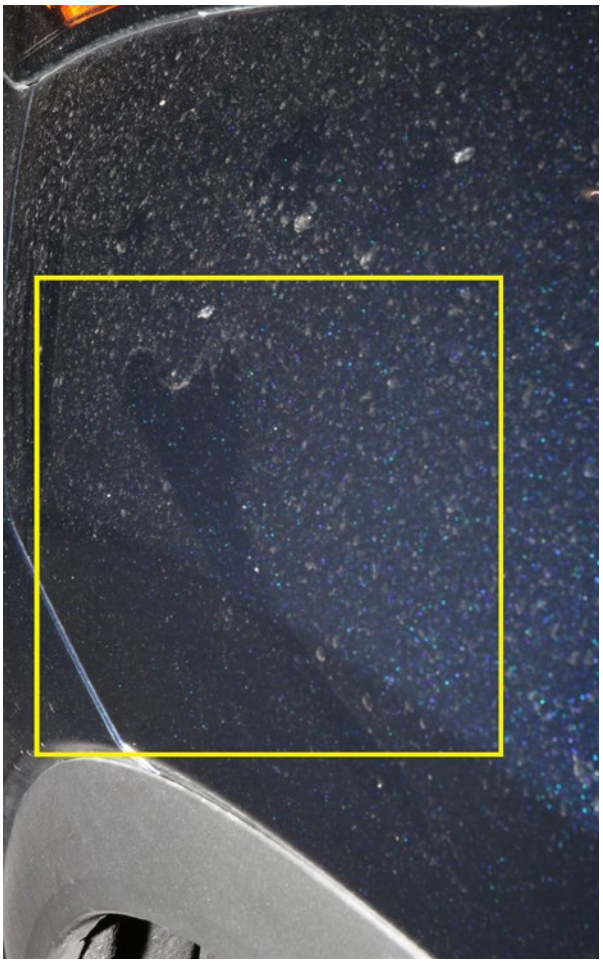

Figure 4. Dust disturbance, left front fender, 2022 Toyota Highlander (police photo)

Figure 5. Mark on left front tire, 2022 Toyota Highlander (police photo)

Item	Measurement
Front overhang	99 cm (38.9 in)
Front bumper to base of windshield	138 cm (54.3 in)
Front bumper height (top)	64.0 cm (25.1 in)
Hood edge height	102.7 cm (40.4 in)
Base of side window to ground	118.1 cm (46.5 in)
Windshield base to front bumper	99 cm (38.9 in)
Ground to driver's eye height (estimated)	147 cm (58 in)
Ground to front camera height	82 cm (32.2 in)
Seat to eye height according to average body height	77.5 cm (30.5 in)
Driver's head to side window (NCAP dummy position)	37.8 cm (14.8 in)

Based on available data, the sight distance to the ground for the driver looking forward over the left hood, over the center of the hood, and over the right hood was 7.4 m (24.1 ft), 7.9 m (25.9 ft), and 8.0 m (26.2 ft), respectively (Figure 6).

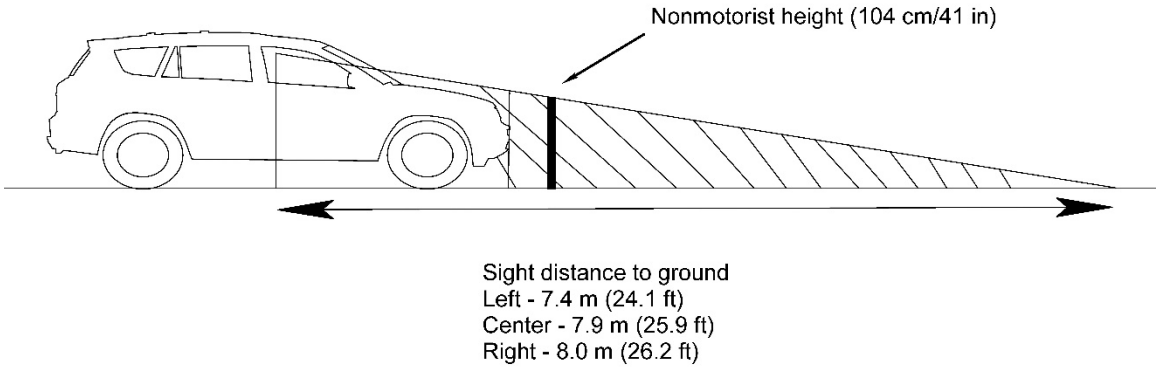

Figure 6. Sight visibility diagram

Visibility Discussion

No information was available as to the focus of the driver's attention as he put the Toyota in gear and moved forward. Specifically, it is unknown if the driver was looking forward, left, right, or focused on an interior component/control. These measurements are provided for reference only. No determination can be made with respect to a blind spot or visibility issue.

The driver A-pillar was a potential blind spot area as the child came from the left to the right. The lateral width of the A-pillar directly correlates to the projected width of a blind spot. For the Toyota, the width dimensions for the A-pillar were 18 cm (7.0 in), 12 cm (4.7 in), 12 cm (4.7 in) for the bottom, middle, and top, respectively. One study focused on A-pillar driver obscuration/location and A-pillar passenger obscuration, which determines the interaction between the driver and vehicle's pillar, which affects the driver's ability to see external objects, including pedestrians.[2] In the study, vehicle pillars are measured in the all-around view from the driver's monocular eye point 63.5 cm above the seating reference point taking into account all obstructive elements. For the study, measurements and data were collected from approximately 75 vehicles. The minimum A-pillar obscuration was determined to be 18.1º and the maximum was reported as 29.5º (Figure 7). The authors noted that there are other interior dimensions that affect obscuration/location, including seating reference point to ground front, seat height, and torso angle.

There was also a blind spot created by the left side mirror (Figure 8). The mirror was 27 cm (10.6 in) wide with a 9 cm (3.5 in) gap between the mirror and the lower A-pillar. Additional factors to consider are what the driver may have been looking at in the vehicle before the incident and the normal limits of human vision. Human visual acuity drops approximately 18° from the center of focus, so it is possible that the driver did not notice the nonmotorist even though the nonmotorist partially entered the lateral portion of the driver's field of view.

[2] Santos, A., Gerez, A., Pádua, A., Genaro, P., Silva, R., & Ferreira, S., (2019, October 14-18). *The influence of A-pillar obscuration/location on driver visibility* (SAE Technical Paper 2019-36-0062). 2019 SAE Brasil Congress & Exhibition, Sao Paulo, Brazil.

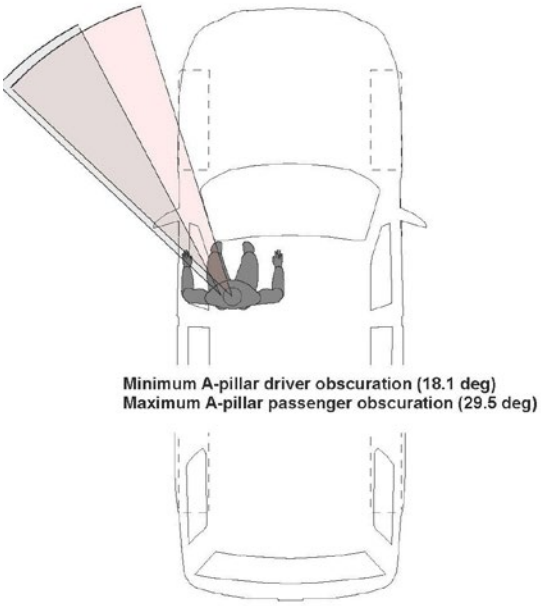

Figure 7. Driver A-pillar obscuration

Figure 8. Left A-pillar, 2022 Toyota Highlander (exemplar)

Interior Damage

The Toyota did not sustain any interior damage.

Manual Restraint Systems

The vehicle had three-point lap and shoulder belts available at all seating positions. It is unknown if the driver's seat belt was used in this incident.

Supplemental Restraint Systems

The Toyota's supplemental restraint systems included driver's and passenger's frontal air bags, front row outboard seat-mounted side-impact air bags, front row knee air bags, and front and second row inflatable curtain (IC) air bags. There were no air bag deployments during this incident.

NHTSA Recalls and Investigations

VIN-based searches in August 2022 and September 2024 found no unrepaired recalls associated with this vehicle.

2022 Toyota Highlander Occupant

Driver Demographics

Age/sex:	36 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Bucket
Seat track position:	Unknown
Manual restraint usage:	Lap and shoulder belt available, unknown if used
Usage source:	None
Air bags:	Frontal, knee, seat-mounted, and IC air bags available, no deployments
Alcohol/drug data:	None reported
Egress from vehicle:	Exited under own power
Transport from scene:	None
Type of medical treatment:	None

Driver Injuries

The Toyota driver was not injured or transported.

Driver Kinematics

The driver reported that he felt the car go up on the left side, like a bump. He remained in place during the incident.

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Nonmotorist

Child Demographics

Age/Sex:	3 years/male
Height:	104 cm (41 in)
Weight:	18 kg (40 lb)
Transport from scene:	Transported to hospital by parents
Type of medical treatment:	Fatal prior to admission

Nonmotorist Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Depressed comminuted vault fractures with fractures extending into the basilar skull	150206.4	Left front tire/ground	Certain
2	Mid-facial fractures across orbital midface	251200.2	Left front tire/ground	Certain
3	Fracture, right mandibular ramus	250608.1	Left front tire[3]	Certain
4	Abrasion, right frontal scalp	110202.1	Left front tire	Certain
5	Abrasion, right zygoma, right cheek	210202.1	Left front tire	Certain
6	Abrasion, right underside of chin	210202.1	Left front tire	Certain
7	Medial maxillary incisor teeth, traumatically avulsed	251406.1	Left front tire	Certain
8	Abrasions, right dorsal forearm	710202.1	Left front tire	Certain
9	Laceration, upper lip on left side	210600.1	Left front tire	Certain
10	Contusions, left side of forehead and face	210402.1	Left front tire	Certain
11	Ecchymosis, left eyelid	210402.1	Left front tire	Certain
12	Abrasions, left anterior thigh	810202.1	Left front tire	Certain

Source: Autopsy report

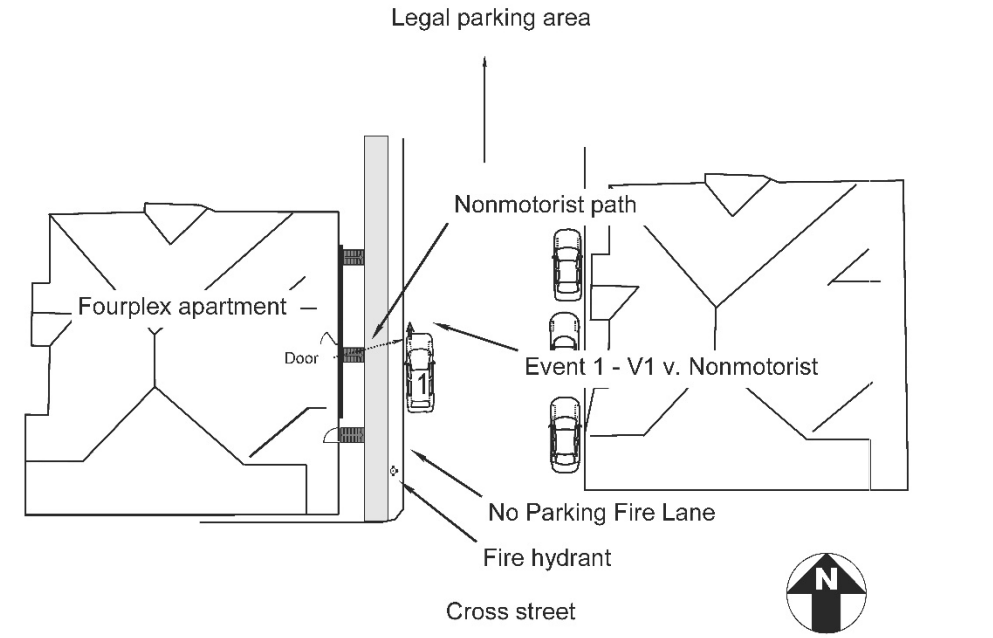
Nonmotorist Kinematics

The 3-year-old male child was originally in the residence. He was wearing a light blue pajama shirt and a diaper and was barefoot. He exited the residence and ran east toward the Toyota. He got in front of the Toyota, probably beneath the driver's line of sight, and was struck by the front

[3] Only one IPC can be used for BioTable short form injury

bumper. He fell to the ground and was run over by the left-front tire. He was transported by the parents to a hospital in the Toyota. He was pronounced deceased 48 minutes after arrival, according to the autopsy report.

Incident Diagram



Remote Frontover Incident Investigation
Nevada
August 2022
V1: 2022 Toyota Highlander
Nonmotorist: 3-year-old male
Daylight, clear and dry

Diagram based on satellite images and police photos

Case Number:	DS22023

DOT HS 813 666
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U.S. Department
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**National Highway
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