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Penetrating Orbital Injury by Automobile Wiper-Control Stalk

A restrained driver fell asleep at the wheel and crashed his truck into a tree. He was found walking near the crash site with a windshield wiper stalk impaled in his right cheek. It had penetrated the right maxillary sinus, both ethmoid sinuses, and the left orbit, contusing his left optic nerve and rendering him blind in that eye. To our knowledge, no such injury has ever been documented. Using data obtained from the crash site, we present a hypothetical reconstruction of the accident.

Figure 1. *Preoperative view of the windshield wiper stalk impaled in patient's right cheek.*

Report of a Case. A 21-year-old man fell asleep at the wheel and crashed his truck into a tree. He was found fully alert and walking near the scene, with the windshield wiper stalk impaled into his right cheek (**Figure 1** and **Figure 2**). It had pierced the gingiva and penetrated the right maxillary, both ethmoid sinuses, and the left orbit, deviating and contusing the left optic nerve (**Figure 3**). The injury rendered him blind in his left eye and partially ophthalmoplegic.

An injury of this nature has not been recorded in the forensic records of automobile companies in the United States. We present a hypothetical reconstruction by automotive crash analysts (L.S., J.M.).

Medical Aspects. The wiper stalk pierced the skin approximately 4 cm above the right upper lip margin. Apart from minor skin abrasions elsewhere and a rib fracture, there

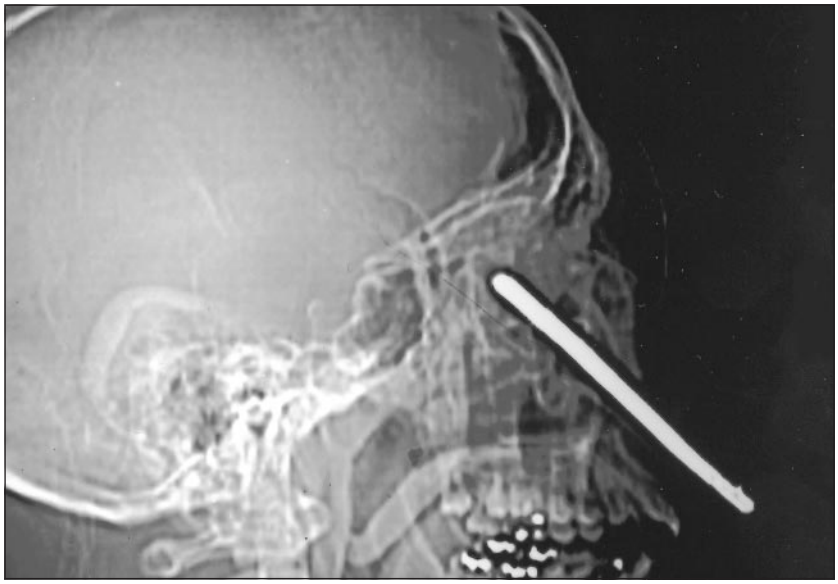

Figure 2. *Computed tomography scout film shows penetration of stalk through paranasal sinuses and left orbit.*

Figure 3. *Coronal computed tomography film shows stalk deviating left medial orbital wall.*

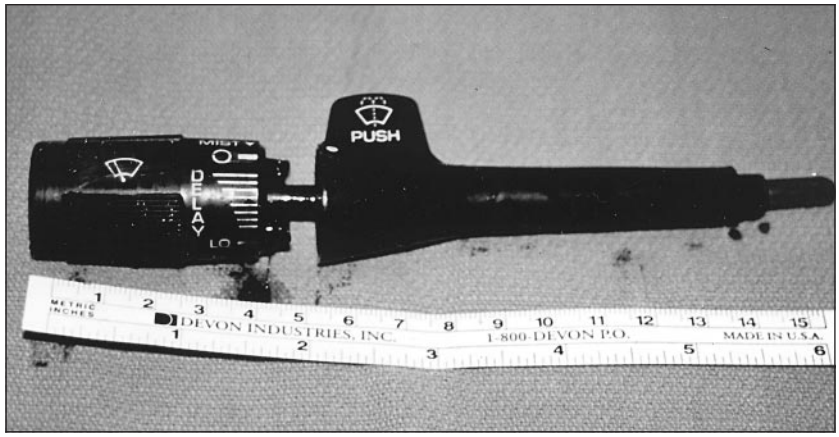

Figure 4. *Wiper stalk after removal.*

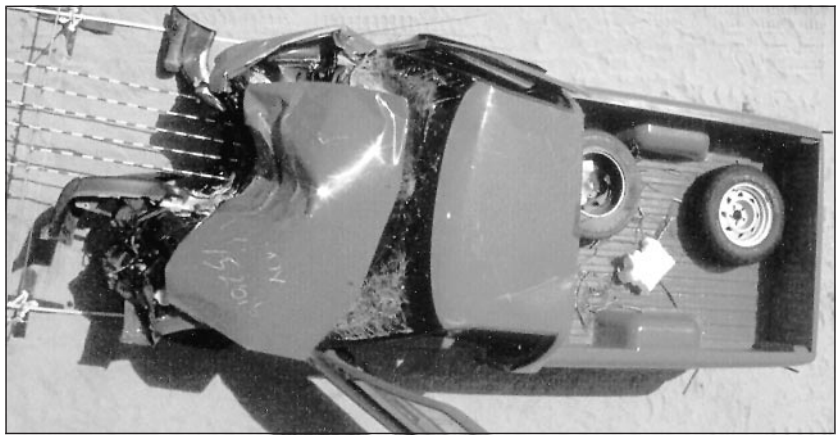

Figure 6. *Aerial view of crash vehicle. Note deformation from frontal impact with the tree to right of the vehicle's center line. Calibrated dowels measure crush, used to calculate crash severity.*

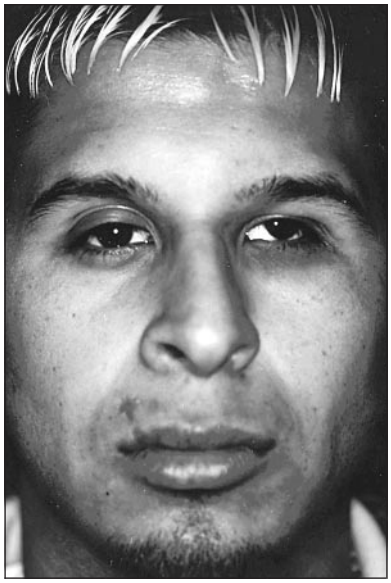

Figure 5. *Postoperative view of the patient at 6 months after the event.*

Figure 7. *Truck interior. Wheel column is separated from its attachment to the instrument panel and the socket for wiper-control stalk (arrow).*

were no other injuries. The patient was neurologically intact. Visual acuity was 20/20 OD and no light perception (NLP) OS. There were no abnormalities of the right eye and orbit. The left eye was 4 mm proptotic, had complete ptosis, and a pupil dilated to 8 mm that did not react to direct light. A left afferent pupillary was present. The left eye was located in midorbital position, and ductions were absent in all directions. Biomicroscopy images showed no abnormalities, and intraocular pressures were 14 mm Hg in the right eye and 20 mm Hg in the left eye. Ophthalmoscopy results were normal in the right eye and revealed retinal hemorrhages that obscured the optic disc of the left eye.

A bifrontal craniotomy gave access to the anterior cranial fossa, nasal structures, and left orbit. After orbital bone fragments surrounding the wiper stalk were removed, its protruding portion was grasped with a wrench and pulled out through the entry site. It measured 25 mm in diameter at its leading edge, and was 150 mm long (**Figure 4**).

Postoperatively, the patient's vision in the left eye remained NLP despite his being administered high doses of intravenous methylprednisolone. Several months after the procedure was performed, the left ptosis and proptosis had resolved (**Figure 5**), and the eye had regained nearly full motion, but it remained blind. Ophthalmoscopy images disclosed a pale optic disc.

Crash Analysis. The crash involved the high-speed, off-road, frontal impact of a 1994 Chevy S-10 (General Motors, Detroit, Mich) pickup truck. The driver, who had reportedly been drinking, had fallen asleep. His truck crossed the road's center line, drifted off of the left side of the road, and struck a large tree with the right front bumper, grille, and hood (**Figure 6**). Based on crush measurements and the WinSmash[1] crash-reconstruction program, the truck was traveling at a speed of 45 mph to 50 mph. The impact caused the vehicle to rotate clockwise so that it then struck a second tree near the front of the driver's door.

The driver was wearing the 3-point restraint, as evidenced by a clear imprint of the belt-webbing pattern on the plastic D-ring. There were no airbags. Although this impact was to the right of the vehicle's center line, it produced 20 cm of rearward intrusion of the toepan/footwell in the driver area and 5 cm

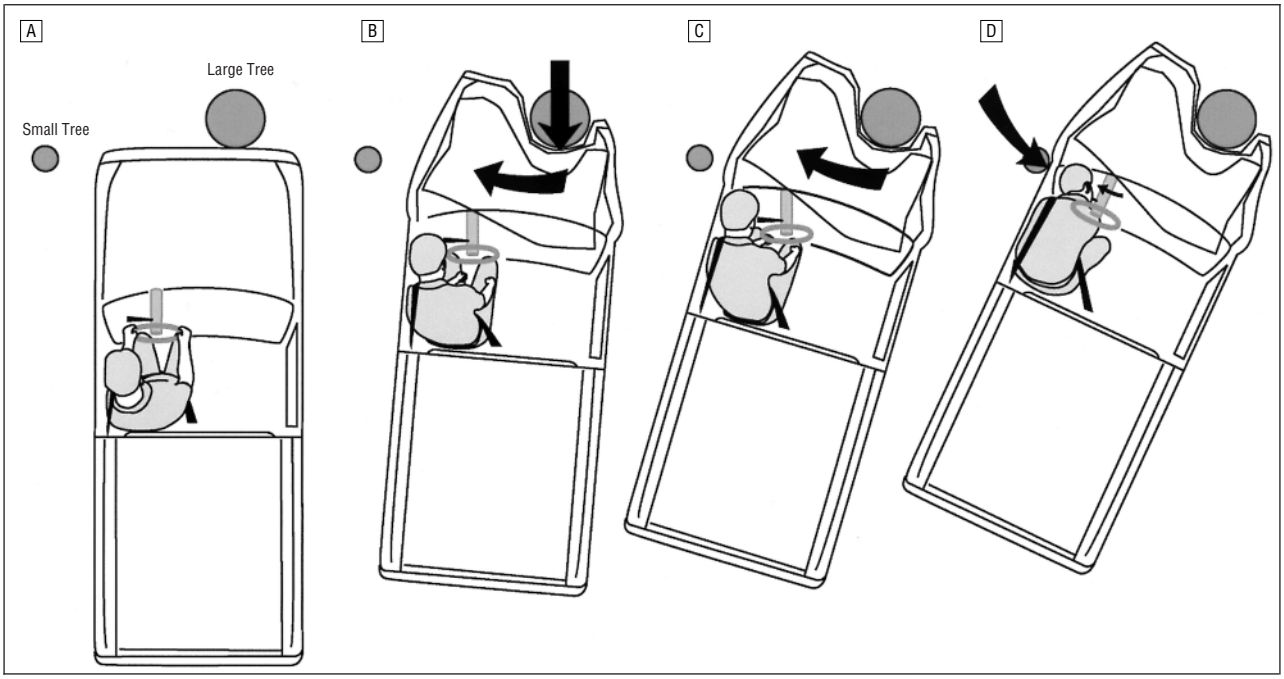

Figure 8. *Sequence of crash kinematics. A, Occupant falls asleep, head slumps forward. B, Vehicle hits tree, shears capsules that attach steering column to instrument panel, and rotates clockwise. C, Rightward movement of detached steering column allows head to move farther forward. D, Vehicle hits second tree, and wiper stalk is forced through driver's right cheek. The momentum of the steering column causes wiper stalk to detatch.*

of rearward intrusion of the driver instrument panel. The steering column's shear capsules separated during the impact (**Figure 7**), freeing the steering column to rotate laterally and vertically.

Comment. How could a wiper-control stalk located on the left side of the steering column have pierced the driver's right cheek? We believe that as he fell asleep, he slumped forward and leftward, pulling a length of shoulder belt webbing out of the retractor (**Figure 8**A). Physical evidence of clothing transfers on the interior door panel supports this hypothesis. On first impact with the large tree (Figure 8B), his head moved farther forward, locking the shoulder belt. The steering-column shear capsules then separated, allowing the steering column to move freely within the vehicle interior. Because of the offset nature of the impact to the right of the vehicle's center line (Figure 8B), the truck began a clockwise rotational acceleration around the tree, but the steering wheel lagged behind to the right, allowing the driver's face to move forward of the steering-wheel rim (Figure 8C).

The clockwise rotation of the truck moved it into the second tree to its left, causing a counterclockwise deceleration (Figure 8D), which stopped the clockwise rotation and leftward movement of the vehicle and driver. By this time, however, the steering wheel and column were rotating to the left. With the driver's face well forward of the steering-wheel rim, the leftward-moving steering column acted like a heavy pendulum and pushed the leftward-pointing wiper stalk through the driver's right maxilla.

This is a sobering tale. Shoulder restraints could not protect the driver from extreme forward and leftward deviation of the head, which placed the driver in a position to be impaled by the wiper stalk. He is fortunate to have escaped with the isolated obliteration of 1 optic nerve.

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