AUTOMOBILE OCCUPANT INJURIES
from
STRIKING THE WINDSHIELD

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SUMMARY

Facial lacerations resulting from head-to-glass impacts against newer (post-1965) automobile windshields are fewer, less extensive, and less severe than those caused by similar impacts against the pre-1966 windshields. When the thinner laminate of the pre-1966 windshield was impacted by the head, slicing lacerations were typically found. Head impact to the new windshield typically produces abrasions or small lacerations of the forehead which do not require sutures. Only rarely is the post-1965 laminated windshield perforated, and the head-to-glass impact speed required is more than double that required to perforate the pre-1966 thin-laminate windshield. When the thicker windshield laminate is torn by head impact, facial lacerations are sustained, but they tend to be less extensive and less severe than those caused by striking and perforating the old type of laminated windshield.

There is no evidence that the incidence of intercranial or neck injury is increased by striking the new windshield.

Our experience suggests that the frequency of severe, extensive multiple facial lacerations from striking the windshield will decrease markedly as the proportion of cars equipped with the new windshield rises, and that facial injuries incurred by striking the new laminated windshield will not be a significant clinical problem.
ca are equipped with a new type of laminated windshield which has a down.

Beginning with the 1966 models, cars manufactured in North Amer-

... of Lactations.

... the windshield, producing several distinct effects.

... the lower marquis of the hole. The front, opened up, and down as

... by the firing and broken glass. The holes were not present in the front, and

... these lacerations be not present in the windshield.

... the head-glass special, L-shaped bet-

... pendulum is dependent upon the head-glass in-

... pendulum impact is depended upon the pendulum found within the head-glass, the glass some 4 to 8 inches beneath the initial impact.

... the pendulum effect, some 1/2 wide per hour. next glass, and if the head-glass speed is above 1/2 wide per hour, the

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ble thickness plastic interlayer (0.030-inch) and balanced adhesion properties between the plastic and the glass. Laboratory tests on this glass indicate that rupture does not occur until a head-to-glass speed of approximately 29 miles per hour has been reached, a more than twofold increase in penetration resistance.

One frequent cause of interlayer rupture at relatively low head-to-glass velocities in pre-1966 windshields is the high interlayer-to-glass bond strength. The newer windshields incorporate a thicker interlayer, and a lower bond strength between the interlayer and the glass, thus providing much greater energy absorption upon impact by an occupant.

Recent automobile accident investigations presented here indicate that the new laminated windshield markedly reduces the number and severity of facial lacerations caused by head-to-glass impacts. Tears in the laminate from head impact are infrequent. In a few cases where the laminate has been torn (at car impact speeds of 30 mph or higher), the lacerations are similar to those seen when the head struck the thinner laminate windshield, but not as extensive.

When the new windshield is struck, the plastic area below the impact site will bulge outward a variable amount depending upon the head velocity. The inner layer of glass breaks into small particles. There has been some concern that these small slivers of glass would fly about the car and cause injuries, especially to the eyes. Ordinarily, however, a small pile of these glass particles is found on the instrument panel beneath the head impact site. To date our investigations of automobile accidents have found no ocular injury caused by these particles, nor are the particles found scattered about the interior of the car.

The newer windshield appears to be accomplishing its objectives of reducing head penetration and facial lacerations without increasing neck or intracranial injuries. When these injuries were noted, they were minor in extent, and very few neck pain complaints or intracranial injuries were found that could be related to the windshield glass impact alone.
ceed that of the post-1966 case in matched, hence the head-to-glass speed (or any pre-1966 case selected did not ex-
etion should afford some assurance that the occupant velocity (and to or less than those of the matched vehicle (in most cases), This ci-
pre-1966-model automobiles where car-impact speeds were equivalent made. Where possible, these cases are matched with cases involving
corresponded by photographs of the car and of the location of the head inj-
liminal whined (post-1965 models). Each case description is ac-

INTRODUCTION TO CASE DESCRIPTIONS
BIBLIOGRAPHY


(Case #101/3/7/66)

In crash

1966 Pontiac (Figures 1 and 2). Car

(impact)

1. The seat rear passenger (female, 26

156 higher (impact; weight 156 mph).

2. The left rear passenger (female, 26

156 higher (impact; weight 156 mph).

3. The right rear passenger (male, 26

156 higher (impact; weight 156 mph).

4. The left rear passenger (male, 26

156 higher (impact; weight 156 mph).

5. The right rear passenger (female, 26

156 higher (impact; weight 156 mph).
1967 Plymouth (Figures 3 and 4). Car- 

tree accident (impact velocity 25-30 

mph). The passenger (male, 22 years 

old) struck the windshield, sustaining 
a contused nose and a laceration of the 

lip. Head impact area was 9 inches 

from the right "A" pillar and 12 inches 

below the header. The windshield im-

pact area was not bulged outward. Seat 

belts were not worn. 
(Case #174/11/24/66)
worn

suites seat belts were not

restrains and multiple small

ears. He sustained extensive facial

onward. He sustained extensive facial

encephalogram. The windshield was bulged

17", the header and the impact from the right

impact below. The front windshield struck the header and 7 inches below

passenger (male, 19 years old)

1966 Rambler (Figures 5 and 6). car.
1966 Chevrolet (Figures 7 and 8). This station wagon left the roadway, went into a ditch, and struck a tree (impact velocity 25-30 mph). The front passenger (male, 14 years old) struck the windshield 10 inches from the right "A" pillar 9 inches below the header. He bulged the windshield outward at the point of impact. He had a mild concussion (unconscious for a short period of time) but no facial or scalp lacerations. Seat belts were not worn.
(Case #124/6/27/64)
1966 Mustang (Figures 9 and 10). Car-tree accident (impact velocity 25 mph). The driver (male, 40 years old, 6 feet 1 inch, 180 pounds) struck the windshield 3 inches below the header and 10 inches from the left "A" pillar. He sustained minor abrasions to his forehead at the hairline.
(Case #190/2/24/67)
1965 Mustang (Figures 11 and 12). This vehicle hit the rear of a parked car (impact velocity 20 mph). The passenger (female, 23 years old) struck the windshield 7 inches from the right "A" pillar and 3 inches below the header. She sustained a 5-cm laceration to her forehead. Seat belts were not worn. (Case #199/2/18/67)
1966 Chevrolet (Figures 13 and 14), Car-pole accident (impact velocity 30 mph). Three distinct windshield impact sites were found. The driver (male, 41 years old) sustained small forehead lacerations from impact to the windshield just to the left of the rear view mirror. The passenger (female, 40 years old), struck her head on the windshield 8 inches below the header and 11 inches from the right “A” pillar. She sustained small cuts and scratches to the right side of her face. Adjacent to the right “A” pillar was an impact site not typical of a head impact. Here, the laminate was torn, with blood and tissue on the glass, and the area was markedly bulged forward. This may have been produced by the rear right passenger who sustained a laceration of the hand. Seat belts were not worn. (Case #194/1/22/67)
1964 Dodge (Figures 15 and 16). Car-tree accident (impact velocity 25 mph). The driver (male, 57 years old) struck the center of the windshield, sustaining a long, undermined, flap-like laceration to the right cheek and lacerations to the chin, upper lip, left cheek, and back of the head. The passenger (female, 55 years old) struck the windshield 13 inches from the right “A” pillar and 6 inches below the header. She sustained lacerations of the scalp and both arms, and a frontal bone fracture. Seat belts were not worn. (Case #69/6/15/66)
1966 Falcon (Figures 20 and 21). This car was turning left when it was struck in the right side by a 1965 Chevrolet (impact velocity 20-25 mph). After impact, the car spun out; the driver (female, 44 years old) struck the right side of the windshield 14 inches from the right “A” pillar and 5 inches below the header. She sustained a small laceration to the left scalp area.
(Case #108/5/23/66)
1966 Cadillac (Figures 22 and 23). This vehicle, after being struck in the rear fender, hit a guard rail (impact velocity 25-30 mph). The passenger (male, 64 years old) sustained a laceration of his left elbow and forearm. He struck the windshield with his head but did not have any injuries from this impact. The windshield was fractured (matted) in many areas from frame distortion. Seat belts were not worn.
(Case #127/7/1/66)
1966 Chrysler (Figures 24, 25, 26). This case #1153/9/6/66.

His fractured, seat belts were not worn.
His head and seat belt wear not worn.
Particular exception is the right side of
8 ring at central. He sustained minor su-

image below the header, markedly burst
image from the rear. "C" pillar and 2
years old) struck the windshield, 6
25 mph. The front passenger (male
impact velocity

vehicle was struck by another that had
1965 Dodge (Figures 27 and 28). This vehicle turned in front of another at an intersection and was struck (impact velocity 30-35 mph). The front center passenger (female, 35 years old) contacted the windshield 9 inches from the right "A" pillar and 4 inches below the header. She sustained a laceration of the forehead. Seat belts were not worn. (Case #80/12/2/65)
1965 Chevrolet (Figures 31 and 32). A head-on collision with the front corner of a van truck (impact velocity 35 mph). The driver (male, 54 years old) struck the center of the windshield and sustained multiple facial lacerations and a frontal bone skull fracture involving the frontal sinus. Seat belts were not worn. See figure 79.

(Case #222/5/14/67)
1967 Chevrolet (Figures 33 and 34). An intersection collision (impact velocity 25 mph). The front right passenger (female, 24 years old) struck the windshield 17 inches from the right "A" pillar and 4 inches below the header. She sustained a bruised forehead. Seat belts were not worn.
(Case #156/10/6/66)
1963 Buick (Figures 35 and 36). Car-
tree accident (impact velocity 15 mph).
The driver (male, 25 years old) struck
the windshield on the passenger's side.
He sustained lacerations of the fore-
head, right cheek, tip of nose, and of the
right ear and preauricular area. Seat
belts were not worn.
(Case #44/12/18/66)
1966 Chevrolet (Figures 37 and 38). An intersection collision (impact velocity 45 mph). The windshield of the Chevrolet had a head impact imprint 8 inches below the header and 9 inches from the left "A" pillar. The driver (male, 20 years old) sustained a 6.5-cm laceration on the back of his head. He flexed over the steering wheel to contact the windshield (hair found on the inner glass). There was only a slight outward bulge at the impact site. Seat belts were not worn.

(Case #37/10/7/66)
1965 Chevrolet (Figures 39 and 40). A head-on, car-to-car collision (impact velocity 20-25 mph). The driver (male, 49 years old) struck the windshield 14 inches from the left “A” pillar and 3 inches below the header. He sustained multiple lacerations of the forehead and chin. The passenger (female, 46 years old) struck the windshield 5 inches from the right “A” pillar and 4 inches below the header. She sustained a 5-cm laceration of the left forehead, a 5-cm laceration behind the left ear, and a 3-cm laceration behind the right ear. Seat belts were not worn.
(Case #5/3/5/67)
1966 Chrysler (Figures 41 and 42). A 1961 Ford Van turning left was struck by an oncoming Chrysler (impact velocity 40-45 mph). The driver of the Chrysler was not injured. His passenger (female, 33 years old) struck her forehead on the windshield 18 inches from the “A” pillar and 9 inches below the header. The windshield impact area was bulged outward; the laminate was not perforated. The attending physician stated that her forehead was “chewed up.” After removing small glass particles from the multiple small lacerations, the area was bandaged and the patient sent home. No sutures were required to close the wounds. Seat belts were not worn. (Case #50/12/18/66)
1964 Mercury (Figures 43 and 44). This vehicle struck a guard rail (glancing impact at 40-50 mph). The passenger (female, 11 years old) struck the windshield 29 inches from the left “A” pillar and 11 inches below the header. She sustained a long laceration at the hairline. Seat belts were not worn.

(Case #167/10/9/66)
1966 Oldsmobile, 1966 Ford (Figures 45, 46, 47 and 48). The Ford went out of control, crossed an expressway median, and struck the Oldsmobile in the side (glancing impact at 50 mph). Because of frame deformation, especially at the “A” pillar, the windshield of the Oldsmobile was matted; the left half of the windshield had fallen rearward into the occupant area. The driver sustained lacerations of the lower lip and hand from side window glass. No injuries were sustained from windshield glass. Seat belts were not worn. The passenger in the Ford (male, 26 years old) struck the windshield 3 inches below the header and 3 inches from the “A” pillar. The laminate was perforated. He sustained a cervical sprain. The driver of the Ford (male, 28 years old) struck his right elbow against the windshield just to the right of the mirror; a minor elbow-forearm laceration was sustained from this impact. Seat belts were not worn.

(Case #203/3/10/67)
Case #969/5/10/67
Seat belts were not worn.

Signs of the force applied from the impact
in the lumbar spine sustained and car
windshield broken in outward and left
side.

1967 Ford (Figures 49 and 50). A head.
1965 Mercury (Figures 51 and 52). A head-on, car-to-car collision (impact velocity 35 mph). The driver (male, 34 years old) struck the windshield above the steering wheel and sustained a large vertical scalp laceration and a laceration to the forehead. The passenger (female, 31 years old) struck the windshield, sustaining minor lacerations and abrasions about the face. Seat belts were not worn.
(Case #207/2/11/67)
1967 Mustang (Figures 53 and 54). A head-on, car-to-car collision (impact velocity 35 mph). The driver of the Mustang (male, 18 years old, 5 feet 10 inches, 155 pounds) struck the rearview mirror and slid off of it, into the windshield. He sustained a 2-cm, U-shaped laceration above the left eyelid. Seat belts were not worn. (Case #2117/19/07)
1965 Mustang (Figures 55 and 56). This vehicle struck the right front of another that turned in front of it (impact velocity 25 mph). The passenger (female, 23 years old, 5 feet 5 inches, 125 pounds) struck the windshield 18 inches from the left “A” pillar and 9 inches below the header. She sustained a 5-cm laceration on the top of the left side of her head. Seat belts were not worn.
(Case #73/10/18/65)
1967 Barracuda (Figures 57 and 58). This vehicle went off the roadway, rolled and flipped over several times. The driver (male, 40 years old) struck the windshield just to the left of the rear-view mirror, and sustained multiple lacerations and abrasions of his forehead and face, one of which required sutures. The matted windshield is partially separated from the molding in the header area. No seat belts were worn.

(Case #216/4/18/67)
1963 Chevy II (Figures 59 and 60). A head-on, car-to-car collision (impact velocity 30 mph). The passenger (female, 24 years old) struck the windshield 11 inches from the right “A” pillar and 12 inches below the header. An adjacent windshield imprint was produced by the rear-view mirror striking the glass. She sustained a 20-cm laceration to the scalp. Seat belts were not worn.

(Case #128/7/23/66)
1967 Chevrolet (Figures 61 and 62). An intersection type collision (impact velocity 30 mph). The driver (male, 52 years old), struck the windshield 7 inches below the header and 8 inches from the left “A” pillar. The laminate was perforated. He sustained a scalp laceration above the left eyebrow. No seat belts were worn.
(Case #219/5/5/67)
1963 Chevrolet (Figures 63 and 64). A head-on, car-to-car collision (impact velocity 10 mph). The passenger (female, 18 years old) struck the windshield to the right of center, sustaining multiple lacerations of the forehead, right zygoma, and other smaller facial lacerations. Seat belts were not worn.
(Case #47/12/28/64)
(Case #157/10/7/66)

Due to ejection of windshield, impact force to the face and ears, it is not known whether the facial injuries were due to ejection or windshield impact. The windshield was cracked through the windshield wiper area. The driver was ejected from the rear of the vehicle and was found cracked, but intact, in an intersection.

1966 Ford Van (Figures 65 and 66).
1966 Chevrolet (Figures 67 and 68). This vehicle struck another in the rear (impact velocity 20 mph). The driver (male, 29 years old) hit the windshield 3 inches below the header and 8 inches from the left “A” pillar. The impact site was bulged outward. He sustained abrasions of the face and had mild neck pain. Seat belts were not worn.

(Case #228/7/2/67)
No seat belts were worn. The driver (male, 29 years old) struck the windshield at the forehead and the top of his head. He sustained multiple lacerations and abrasions over the face and scalp. The lower forehead and left cheek were cut. The windshield was broken. The passenger (male, 22 years old) struck the windshield 7 inches behind the driver of the car fell asleep and 1966.p pregn 497 70 and 71.}
1964 Falcon (Figures 72 and 73). A head-on, car-to-car accident (impact velocity 30 mph). The passenger (female, 19 years old) struck the windshield 14 inches from the right “A” pillar and 5 inches below the header. She sustained multiple lacerations of the left cheek and a mandibular fracture. Seat belts were not worn.

(Case 68/5/24/66)
1966 Chevrolet (Figures 76 and 77). This vehicle struck a railroad signal standard (impact velocity 40-45 mph). The windshield was matted; there was a separation of the windshield from the left “A” pillar and the left side of the header. The head impact area was just below the header, above the steering wheel. The driver (male, 25 years old) was subsequently ejected. In addition to other injuries, he sustained facial lacerations and a brain concussion. It is not known whether these injuries were sustained in the car or as a result of ejection. Seat belts were not worn. (Case #94/5/18/66)
1967 Mustang (Figure 78). This vehicle was forced off the road and flipped over in the snow. The matted windshield fell into the occupant area. No injuries were sustained from the windshield glass. Seat belts were worn. (Pre-1966 windshields usually shattered in rollover accidents, leaving sharp glass edges as potential injury areas.)
(Case #191/2/1/67)

1967 Dodge Van (Figure 79). This van was struck by a car that turned in front of it (impact velocity 35 mph). The entire windshield of the van "popped out" of its frame. The passenger in the van sustained a laceration of the nose from the windshield glass. See figures 31 and 32.
(Case #222/5/14/67)