HEAD INJURIES SYMPOSIUM 1979

MECHANISM AND PREVENTION OF INJURIES TO THE HEAD

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Most of the cases on which this paper is based have been selected from a study of a representative sample of road traffic accidents to which an ambulance was called in metropolitan Adelaide. This work was funded by the Office of Road Safety of the Commonwealth Department of Transport and by the Australian Road Research Board.* These cases have been chosen to illustrate the ways in which the various categories of road user sustain head injuries and to form a basis for brief discussions of the possibilities for the prevention of such injuries. While the mechanism of injury may often be peculiar to the road traffic accident situation, an attempt has been made to emphasise the basic principles underlying the search for possible preventive measures. These principles are, of course, of more general relevance to the prevention of head injury.

HEAD INJURIES AMONG VEHICLE OCCUPANTS

Collisions with roadside objects such as utility poles often result in very severe injuries to the occupants of the striking vehicle. In one such crash the unrestrained front seat passenger was thrown forwards, striking his knees on the lower part of the dashboard. His head then hit the windscreen, which shattered, allowing him to move forwards until his face struck the upthrust bonnet of the car at about the same instant that his chest struck the upper part of the dashboard. He sustained severe cerebral irritation, lasting for five days, a flail chest and myocardial contusion, among other injuries. He was hospitalized for 35 days, and still has some residual disability which can be attributed to his head injury.

In a crash which was similar both in type and severity the front seat passenger was wearing a seat belt. He sustained moderate bruising from the

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webbing of the belt and an abrasion to one finger. A correctly adjusted seat belt can be expected to greatly reduce, if not entirely eliminate, the risk of sustaining a head injury in, all but the most severe, frontal crashes. An alternative form of restraint, the air bag, is possibly even more effective in collisions of this type, but the seat belt has the added advantage of preventing the occupant from being ejected from the vehicle. It is unfortunate that the term "thrown clear" is still commonly used in connection with road crashes, for the person who is "thrown clear" is at much greater risk of being seriously injured or killed than a person who remains inside the vehicle.

Until such time as the interior of the passenger compartment is designed to reduce greatly the present risk of sustaining a head injury in a severe crash, or until it becomes fashionable for vehicle occupants to wear crash helmets, the protection of this category of road user against head injury relies primarily on preventing the head from striking any relatively rigid object, whether it be inside or outside the passenger compartment.

Head Injuries to Children in Cars

As with the adult car occupant, any child who is old enough to sit upright is best protected against head injury by being adequately restrained, whether it be in a child seat or harness or, for the older child, by an adult seat belt. Protection of an infant from injury poses some unusual problems, as illustrated by a case in which an infant being carried in a bassinet on the back seat of a car sustained a fatal head injury when the car was struck on the side in a collision with another car at an intersection. As the car containing the child was accelerated sideways during the collision the end of the bassinet came into contact with the rigid armrest on the inside of the rear door. This armrest deformed the end of the bassinet

and struck the child on the top of the head. It is important to position a bassinet in such a way that the infant's head is as close as possible to the centre of the car, and to have some means of ensuring that if the bassinet slides across the seat it will not come into direct contact with the inside of the door. This can be achieved by interposing some firm cushions between the ends of the bassinet and the doors.

HEAD INJURIES TO PEDESTRIANS

In common parlance we speak of pedestrians being run over by a car. In practice this rarely happens. An adult pedestrian is almost always run under when hit by a car simply because the initial impact is located below his centre of gravity. The small child may be run over, if the car is not braking on impact, but is more likely to be thrown along the road ahead of the stopping car. The small child pedestrian who is struck by a car sustains head injuries from two main sources: from a direct blow by the front of the striking car, and from the subsequent impact with the road surface. There is much that could be done to reduce the injury potential to small children of the fronts of cars, but the severity of the impact with the road surface is far less amenable to control.

As noted, the adult pedestrian is run under by the striking car. This means that the head is likely to be struck first by the rear section of the bonnet of the car or by the windscreen. The precise location of this head impact point is of critical importance in determining the severity of the associated injury. In one case the pedestrian's head struck the laminated glass windscreen. He then continued to rotate up over the roof of the car in a cart-wheeling fashion before falling to the road behind the striking vehicle. He was mildly concussed, and also sustained a torn ligament in his right knee. Had his head contacted a structural member of the vehicle, such as the section at the base of the windscreen, he may well have sustained a fatal head injury.

As with the child pedestrian the adult is also at risk of receiving further injuries, particularly head injuries, when he is thrown to the road surface after being struck by the car. It is now clear that the overall frontal shape of the striking car determines both the nature and the severity of the injuries sustained by a pedestrian when struck by that car at a given speed. There is also reason to believe that the physical attitude with which the pedestrian comes into contact with the road surface is also determined by the overall shape of the front of the car. A difference in the height of the leading edge of the bonnet of as little as five centimetres may result in a pedestrian subsequently striking the road either feet first or head first.

At the present time the possibilities for prevention of serious head injuries to pedestrians appear to be greatest in the area of the modification of vehicle design, assuming that we do not wish to wear crash helmets whenever exposed as pedestrians to the traffic environment.

HEAD INJURIES TO PEDAL CYCLISTS

The pedal cyclist is exposed to the risk of head injury in a manner which is very similar to that of the adult pedestrian. Once again the head impact area on the vehicle tends to be centred around the base of the windscreen. One middle aged cyclist was fortunate enough to strike his head on the ornamental grille above the air intake for the car's ventilating system. This grille readily deformed on impact and the cyclist suffered only a momentary loss of consciousness as a result of the impact. An eyewitness reported that the cyclist attempted to stand up almost immediately after coming to rest against a parked car at the side of the road but was prevented from doing so by a severe leg injury. Once again, had the head contact with the vehicle been located a few centimetres further back at the base of the windscreen a far more severe head injury would have been the expected outcome.

Unlike the pedestrian, it is reasonable to suggest that the pedal cyclist wear a crash helmet. Suitable educational programmes may encourage cyclists to wear helmets, and there is an obvious role for school teachers in this regard. At one time most school children were required to wear their school cap or hat when travelling to and from school. There are good reasons for suggesting that the modern equivalent should be a suitable lightweight crash helmet for those students who cycle to and from school.

HEAD INJURIES TO MOTORCYCLISTS

The motorcyclist is particularly vunerable to head injury both by virtue of his relatively unprotected situation on the road, when compared to the vehicle occupant, and because he is usually travelling very much faster than a pedal cyclist.

The currently available crash helmets for motorcyclists provide a high level of protection against injuries to the head, as illustrated by an accident in which a motorcyclist was struck by a turning car at an intersection and was thrown to the roadway with such force that the shell of his crash helmet was split open. Despite the severity of this impact the rider was only mildly concussed.

No helmet, however well designed, can be expected to provide any protection at all if it does not remain in place, which it is unlikely to do if the chin strap is not buckled. Not surprisingly, the intoxicated rider is likely to fail to do up the chin strap of his helmet and so may not be protected by it in the event of a crash, with fatal consequences in one of the crashes studied by our Unit. This emphasises the need to recognise in the development of any preventive measure the fact that the individuals who need to be protected may not always be completely sober at the time when that protection is most needed.

Finally, there will always be some cases in which the force of the impact is such that the helmet cannot be expected to protect the rider from sustaining a severe, or even fatal, head injury.

CONCLUSIONS

The possibilities for the prevention of head injury in road traffic accidents vary with the category of road user. The vehicle occupant can be protected from direct impacts to the head in certain types of collision if suitably restrained. The pedestrian cannot readily be protected from the risk of receiving a severe blow to the head in a collision but there is much which could be done at our present level of understanding to reduce the injury potential of the striking vehicle. The pedal cyclist is likely to benefit greatly in the collision situation from the protection afforded by a suitable crash helmet. Crash helmets for motorcyclists have been shown to be effective in minimising the severity of many head impacts, but there is a need to simplify the methods used to fasten chin straps so that even the intoxicated motorcyclist can reasonably be expected to ride off with his helmet correctly fastened.