

EYE INJURY IN ROAD TRAFFIC ACCIDENTS

S.J.Ashton, G.M.Mackay, P.F.Gloyns and J.L.G.Hardy
Department of Transportation and Environmental Planning,
University of Birmingham, U.K.

ABSTRACT

German and French authors have reported that eye injuries are a serious problem in road accidents whilst previous British work has not identified a problem. An analysis of accidents in which there was occupant eye injury has been undertaken from the cases investigated by the Accident Research Unit. Details of the accidents and injuries are reported. A study was made to determine the incidence of eye injury in the City of Birmingham.

PREVIOUS WORK

The occurrence of eye injuries resulting from shattered toughened glass windscreens in road traffic accidents was first reported in the mid sixties by Holland (1-3). The problem has been further investigated by Holland (4) and by others in Germany (5-12). A number of reports on eye injuries have been published in the last few years in France (13-16). Salient features of these French and German reports have been that the windscreen was the major cause of the eye injuries, that the front seat passenger was more likely to sustain an eye injury than the driver and that the eye injuries generally occurred in low speed accidents, indirect evidence for this being the frequent lack of other severe injuries to the injured occupant.

In the United Kingdom, however, there has been little published work on the problem of eye injuries sustained in road accidents. Gissane and Bull (17) noted, in a study of one year's admissions to the Birmingham Accident Hospital, that there were 4 cases of permanent disability resulting from eye injuries out of 79 vehicle occupants permanently disabled.

The TRRL, in a report on injuries from toughened glass windscreens published in 1969 (18), suggested that "injury to the eye, of a severity sufficient to cause impairment of visual function, would appear to be uncommon". A later report (19) suggested that the incidence of eye injury in seriously injured vehicle occupants was less than 1% - 9 cases of eye injury having been seen in a sample of 1423 vehicle occupants.

Mackay et al (20), in a study of injuries from toughened and laminated glass windscreens, noted 4 cases of eye injury in a sample of 177 front seat occupants.

EYE INJURY ACCIDENTS

Introduction

Since 1969 the Accident Research Unit of the Department of Transportation and Environmental Planning at Birmingham University has been engaged upon a retrospective study of serious occupant injury accidents involving current production models less than three years old. By the end of February 1973 some 700 vehicles had been studied and in 28 of these vehicles there was one occupant with an eye injury whilst in one case both front seat occupants received eye injuries. It is these 30 occupants with eye injuries and the vehicles in which they were travelling that are reported here. It must be stressed that the sample of accidents from which these eye injury cases were taken was not structured to be representative of United Kingdom accidents and therefore this sample of eye injuries may not be a representative sample. The methodology of accident investigation at Birmingham has been described elsewhere (21).

The Vehicles

Twenty-four (82.8%) of the twenty-nine vehicles sustained an impact to the front of the vehicle and in eighteen (75.0%) of these frontal impacts the direction of principal force was 12 o'clock. Table 1 shows the sample by impact direction and impact location - the impact conditions being described using the SAE Collision Deformation Classification (22). There were slightly more accidents in urban areas than rural areas - thirteen of the vehicles being involved in rural accidents and sixteen in urban accidents. The most frequent objects struck were other cars, accounting for 41.4% of all objects struck whilst the second most frequent objects struck were poles, accounting for a further 24.1% of the objects struck. The severity of the accident was assessed using the concept of Equivalent Test Speed. This is a method whereby the damage sustained by the case vehicle is related to the damage sustained by a vehicle of the same type which is crashed under known conditions. It is necessarily an approximate method due to the limited data available from experimental tests; the errors in assessment increasing as the case vehicle damage moves further away from the experimental test vehicle damage. However, even with these errors it is considered to be the best method currently available for assessing accident severity. Table 2 gives an analysis of the cases by Equivalent Test Speed and shows that the majority (72.4%) of the cases occurred in the 20 to 40 Km/hr Equivalent Test Speed range.

The Occupants

The twenty-nine vehicles contained 62 occupants of whom 30 sustained eye injuries. Eight of the vehicles contained only a driver; sixteen vehicles had two occupants, two had three occupants and four had four occupants. Sixteen (53.3%) of those sustaining eye injuries were drivers, twelve (40.0%) were front seat passengers and two were rear seat occupants. Both the rear seat occupants and one of the front seat occupants sustaining eye injuries were children. Half the drivers with eye injuries were in the age group 25-34 years, whilst only 16.7% of the front seat occupants were in that age group - the most common age group for front seat occupants was 35-44 years.

The Injuries

The definition of an eye injury used in this study was based on the classifications used in the International Classification of Injuries (23) and includes injuries to the eyelids as well as to the eyes. Four of the thirty nine cases of eye injury noted involved only injury to the eyelids. In the remaining twenty six cases of injury to the eye itself there were twenty three cases of injury to one eye and three cases (11.5%) of injury to both eyes. If injuries to the eyelids are included then there were injuries to both eyes in 20.0% of the cases. Table 3 details the nature of the injuries in the sample. There was impairment to the sight in 40.0% of the cases and in three (10.0%) of the cases both eyes were affected.

The eye injuries were normally associated with lacerations to the face in the region of the eyes. There was only one case of eye injury without associated facial laceration and this was an injury due to striking the corner of the rear view mirror with no windscreen breakage. In twenty (66.6%) of the cases extensive facial lacerations were sustained whilst in five cases (16.7%) there were facial fractures. Table 4 gives details of the associated head and face injuries.

The injuries occurring in association with eye injuries were analysed. The head was the most frequently injured and the most severely injured body area. Twenty nine of the thirty injured had head injuries, fourteen of which were moderate (AIS 02) injuries and one a severe (AIS 03) injury - classified on the Abbreviated Injury Scale (24). Two of the injured had minor (AIS 01) chest injuries; one a severe (AIS 03) abdominal injury; four had upper limb injuries - two minor (AIS 01) and two moderate (AIS 02) and twelve had lower limb injuries - nine minor (AIS 01), two moderate (AIS 02) and one severe (AIS 03).

Injury Causation

Table 5 gives details of the sources of eye injury. In three cases the rear view mirror was the cause of injury and in two of these cases the windscreen was unbroken. Sixteen of the eye injuries were caused by toughened glass windscreens whilst in a further four cases it could not be absolutely determined that the windscreen was the cause of injury as the rear view mirror had been impacted as well. It is considered that three of these four 'eye' injuries were probably caused by the windscreen. In this sample the windscreen was the cause of injury for just over two thirds (67.8%) of the injuries for which the cause was known.

In two cases, both belted occupants of the same vehicle, the eye injuries were associated with severe head and facial injuries caused by a motor cycle passing through the plane of the windscreen.

In one case the belted front seat passenger of a car involved in a severe head-on collision with another car sustained severe lacerations to the eyelids.

Representativeness of sample

Comparison of this sample of accidents with the total incidence study detailed in the next section showed that the sample was a representative sample of eye injury accidents.

INCIDENCE OF EYE INJURIES

Introduction

As the sample of accidents collected by the Accident Research Unit was not structured to be representative of accidents occurring in England, a total population study was undertaken to establish the incidence of eye injuries in the City of Birmingham. This study enabled the representativeness of the cases collected by the Accident Research Unit to be determined.

Methodology

Details of all injured persons who were recorded as sustaining an eye injury as a result of a road traffic accident in 1971 and who were treated as inpatients at hospitals in, and next to, the City of Birmingham were obtained from the computer records of the Birmingham Regional Hospital Board. A search was then made through the police records to identify which of the inpatients received their injury as a result of an accident in which they were a vehicle occupant in the study area. Examination of the police accident booklets gave information on the type of accident, number of occupants and occupant seating positions. A total of 27 vehicles in which an occupant sustained an eye injury were identified in this way.

The Vehicles

Twenty one (77.8%) of the vehicles were involved in accidents which involved damage to the front of the vehicle and in which the main impact forces were judged, from the recorded details of the accident circumstances, to be along the longitudinal axis of the vehicle. A further two cases involved damage to the front corner of the vehicle which resulted from intersection collisions.

Twelve (44.4%) of the vehicles were involved in collisions with other vehicles and seven (25.9%) were in collisions with poles.

Comparison of these results with a representative sample of all Birmingham accidents (25) indicates that eye injuries are a phenomena that generally occur in frontal impacts - frontal impacts accounted for 77.8% of the eye injury accidents although only 32.2% of all urban accidents are frontal impacts.

The Occupants

The twenty seven vehicles contained 53 occupants of whom 27 sustained eye injuries. Five of the vehicles contained only a driver, twenty had two occupants and two vehicles each had four occupants. All the occupants with

eye injuries were front seat occupants. Five were unaccompanied drivers. In the twenty two vehicles with both a driver and a front seat passenger there were fourteen cases (63.6%) of passenger eye injury and eight cases (36.4%) of driver eye injury. Eight (61.5%) of the drivers were under 25 years old.

The Injuries

The most commonly occurring injury was 'open wound of eye and orbit' accounting for 85.2% of the eye injuries. Other injuries recorded were 'superficial injury to face, neck and scalp,' includes abrasion of eye and eyelid - one case, 'contusion of eye and orbit,' - two cases, and 'foreign body in eye and adnexa,' - one case.

Incidence of eye injuries

In 1971 in the Birmingham City Police area 2,117 people sustained slight injuries, 660 sustained serious injuries and 35 people were killed whilst vehicle occupants. This study shows that 27 of the 660 seriously injured occupants sustained eye injuries. Table 6 gives details of the severity of injuries sustained by vehicle occupants in 1971.

Thirteen of the 330 seriously injured drivers sustained an eye injury, giving an incidence figure of 4%.

The fourteen passengers who sustained eye injury were all front seat occupants whilst the 330 seriously injured passengers noted in Table 6 include rear seat occupants. Data from the Birmingham Accident Hospital (17) indicates that the ratio of front to rear seat passengers sustaining serious injury is 5 : 2 which suggests that the 14 front seat passengers were drawn from a population of about 235 which gives an incidence figure of 6%.

CONCLUSIONS

Eye injuries are an identifiable injury in road traffic accidents.

They commonly occur in frontal impacts and are caused most frequently by glass from toughened glass windscreens. Just over two thirds (67.8%) of the eye injuries in this study resulted from toughened glass windscreens.

The front seat passenger is more likely to sustain an eye injury than the driver. Four per cent (4%) of seriously injured drivers sustain eye injuries and 6% of seriously injured passengers sustain eye injuries.

TABLE 1 IMPACT DIRECTION AND LOCATION

Impact Location		Impact Direction					Total
		10	11	12	01	02	
Front	D		1	8			9
	L			2			2
	C		2	5			7
	R			1	1		2
	Y			1			1
	Z		1	1		1	3
Left Side	F	1	1				2
	P	1					1
	Z	1					1
Right Side	P			1			1

TABLE 2 EQUIVALENT TEST SPEED

	Equivalent Test Speed kph								Total
	Unclass	0-10	11-20	21-30	31-40	41-50	51-60	61-70	
Front	2	1	1	7	10	2		1	24
Left			1	2	1				4
Right				1					1

TABLE 3 NATURE OF EYE INJURY

Eyelid injury - one eyelid _____	1	}	4
- both eyelids _____	3		
Eye injury - one eye - no sight impairment _____	14	}	14
- both eyes - no sight impairment _____	0		
Impairment of sight in one eye _____	6		
Loss of sight in one eye _____	3		
Impairment of sight in both eyes _____	1		
Loss of sight in one eye + impairment to sight of other eye _____	1		
Loss of sight in both eyes _____	1		

TABLE 4 ASSOCIATED HEAD AND FACE INJURIES

	No concussion or fracture	Concussion	Fracture	Concussion + fracture
No other injury	1			
Laceration in area of eyes	7	1	1	
Laceration in area of eyes + other facial lacerations	8	7	4	1

TABLE 5 SOURCE OF EYE INJURIES

	No.	%
Windscreen	16	53.3
Windscreen or rear view mirror	4	13.3
Rear view mirror	3	10.0
Spectacles	3	10.0
Intruding Object	2	6.7
Not Known	2	6.7
	30	100.0

TABLE 6 INJURIES 1971 BIRMINGHAM ACCIDENTS

	slight	serious	fatal	eye injury	eye % serious
Driver	935	330	19	13	3.94
Other Vehicle Occupants	1,182	330	16	14	4.24
All	2,117	660	35	27	4.09

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