Incidence of ocular injuries from road traffic accidents after introduction of seat belt legislation[1]

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Summary: A prospective study was performed to characterize any change in the pattern of ocular injuries following the introduction of compulsory front seat belt wear on 1 February 1983. During a 24-week period in 1981 (1 February to 31 July), 24 patients with eye and adnexal injuries as a result of motor car road traffic accidents (RTAs) were seen at the Bristol Eye Hospital: 12 of these patients required emergency surgery. In the identical period two years later (1 February to 31 July 1983), only 6 patients suffered ocular injury from RTAs: 3 of these required emergency surgery. All patients in the latter series obeying the legislation on seat belt use were injured by flying glass, indicating a possible change in pattern of injury. The decrease in incidence of ocular injuries from RTAs between the two series was shown to be statistically significant. The compulsory fitting of laminated glass to all new cars in Great Britain and Europe is strongly advised.

Introduction and methods

The Bristol Eye Hospital is a major regional centre eye hospital operating a 24-hour emergency service for the Avon area and environs. As part of a prospective study of all patients attending the casualty department of the hospital in a 24-week period in 1981 (1 February to 31 July), 24 patients with ocular injuries from motor car road traffic accidents (RTAs) were seen (Vernon 1983). Details of the extent of the injuries and the use or non-use of a seat belt were recorded. In order to ascertain any change in numbers or pattern of injury following the introduction of seat belt legislation, a similar prospective study, but limited to RTA victims, was performed two years later, between 1 February and 31 July 1983.

Results

In the 1981 series, the 24 patients who sustained eye and adnexal injuries from motor car RTAs were all front-seat occupants and none was wearing a seat belt at the time of injury (Table 1). Of the 12 (50%) who required emergency surgery, 7 sustained sight-threatening injuries to one or both globes. Of the other 12 patients, 10 sustained minor ocular injuries not requiring admission or emergency surgery, and 2 had blunt trauma to the eye and adnexa as a result of contact with the car steering wheel: these latter injuries can be considered to be potentially sight-threatening. A total of 14 patients therefore received emergency surgery and/or sight-threatening injuries. The other 10 patients were considered at the time to have had lucky escapes from head impact with the windscreen or from flying glass.

In the 1983 series, a total of 6 patients sustained eye injuries from motor car RTAs and again all were front-seat occupants (Table 1). Three of the 6 patients sustained sight-threatening injuries requiring emergency surgery: the 2 more seriously injured patients were not wearing seat belts, and the third was hit by a piece of shattered glass whilst wearing his belt. The remaining 3 patients sustained minor injuries from flying glass originating in windscreen, side window or mirrors. All of these patients were wearing seat belts.

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Table 1. Ocular injuries in front-seat occupants from road traffic accidents before and after the introduction of compulsory seat belt use

	February – July 1981 ($n = 24$)		February – July 1983 ($n = 6$)	
	Seat belt	No seat belt	Seat belt	No seat belt
Perforating eye injuries and corneal lacerations	0	7	1	2
Lid lacerations (severe)	0	5	0	0
Minor abrasions and lacerations not requiring surgery	0	10	3	0
Blunt trauma to eye and adnexa	0	2	0	0

According to official Avon County Constabulary figures, 787 car occupants were injured as a result of motor car RTAs in the county of Avon during the 24 weeks of the 1981 survey, and 607 during the same period in 1983. If it is assumed that any of those with eye injuries would be seen at the Bristol Eye Hospital, which is the only eye hospital in Avon, then 763 (787−24) would have suffered no eye injury in the 1981 study period and 601 (607−6) similarly escaped ocular injury during the 1983 survey. Despite applying Armitage's correction to the χ^2 test for fourfold tables, the decrease in incidence of ocular injuries from RTAs between the two time periods is statistically significant ($0.02 > P > 0.01$).

Discussion

The morbidity from ocular injuries as a result of RTAs is high. In a study of ocular injuries to the occupants of 700 cars involved in RTAs in 1973, 39% of patients suffered impairment or loss of vision in one or both eyes (Ashton *et al.* 1973). Our 1981 series supports this figure, with 9 of 24 patients (37.5%) sustaining sight-threatening injuries. The morbidity is not only to the patient but also to the National Health Service. Keightley (1983) found that of the 17 eyes with penetrating injuries from windscreens seen at the Western Ophthalmic Hospital between 1975 and 1981, only 4 regained 6/9 or 6/6 vision; and the average total cost to the National Health Service for each patient was estimated at £1324 compared with £845 for a cataract operation.

Seasonal bias is marked in eye injuries from RTAs in temperate climates, being more frequent in the winter months of October, November and December (Canavan *et al.* 1980). Seasonal bias is excluded from both our series by the nature of their timing. It therefore appears that the incidence of ocular injuries as a result of RTAs in the county of Avon has fallen since the introduction of compulsory seat belt use for front-seat occupants.

Although the general impression amongst ophthalmologists is that the recent legislation on front seat belt use has reduced the incidence of eye injuries from RTAs (Blake 1983), to date no direct comparative figures have been published to support this. Our results confirm that the legislation has succeeded in reducing ocular injuries from RTAs, but suggest that there may be a change in the pattern of injury.

Accidents resulting in facial and ocular injuries alone before February 1983 occurred in the main from low-velocity impact (<30 mph) between the head of the victim and a toughened glass windscreen (Mackay 1975). It is important to note that 4 of the 6 patients injured in our 1983 series sustained ocular injuries from flying shattered glass whilst wearing their seat belts, which indicates a possible change in the aetiology of injury.

Laminated glass, a sandwich of a layer of plastic between two layers of highly tempered glass, has been used as standard equipment on cars in the USA since the 1930s and a new thick interlayer glass laminate was introduced in 1966. This high penetration resistance (HPR) laminated glass does not shatter like the standard European toughened glass fitted to windscreens and windows, and is not penetrated until an object/screen impact velocity of at least 30 mph is reached (Patrick *et al.* 1965).

A study by Mackay and co-workers (1970) compared the injuries induced by laminated glass in vehicles imported into the USA with those arising from toughened glass in similar

cars in Europe which were involved in comparable accidents. They concluded that laminated glass caused statistically fewer and statistically less severe injuries than toughened glass.

Despite repeated recommendations that laminated glass be used for vehicle windscreens (Canavan *et al.* 1980, Mackay 1975, Soni 1973, Taylor 1974), it is disturbing to note that there are still 113 models of new cars on sale in the United Kingdom which are not fitted with laminated front windscreens as standard equipment (*Car Choice* 1983). The increased cost of fitting a laminated rather than toughened front windscreen is minimal, e.g. £46 excluding VAT on an Austin Metro (*Car Choice* 1983).

In the study of Ashton *et al.* (1973) the windscreen was found to be the source of eye injury in 53% of cases, the side windows and mirrors in 23%, with spectacles, intruding objects and not known in 24%. Despite obeying the regulations on seat belt use, 4 patients in our 1983 series (66%) suffered ocular injuries from flying glass. One was from a wing mirror and three from windscreens and side windows.

In conclusion, we applaud the recent seat belt regulations and suggest that as a result of these there may be a change in the future aetiology of ocular injuries from RTAs. We therefore strongly advise the compulsory fitting of laminated glass, not only to all windscreens but also to door windows and mirrors on new cars for sale in the United Kingdom and Europe.

References

Ashton S J, Mackay G M, Gloyns P F *et al.* (1973) International Conference on Biokinetics of Impacts. Amsterdam (June)

Blake J (1983) *British Medical Journal* **287,** 626

Canavan Y M, O'Flaherty M J, Archer D B *et al.* (1980) *British Journal of Ophthalmology* **64,** 618

Car Choice (1983) July; pp 120–149

Keightley S J (1983) *Journal of the Royal Society of Medicine* **76,** 911

Mackay G M (1975) *Transactions of the Ophthalmological Society of the United Kingdom* **95,** 311

Mackay G M, Sieval A W & Hight P V (1970) Proceedings of 14th Stapp Conference. Society of Automotive Engineers, New York; paper No. 700911, p 387

Patrick L M, Lange W A, Hodgson V R (1965) Proceedings of the 7th Stapp Conference. Charles C Thomas, Springfield, Illinois; p 541

Soni K G (1973) *Injury* **5,** 41

Taylor W O (1974) *Injury* **6,** 3

Vernon S A (1983) *Journal of the Royal Society of Medicine* **76,** 279