British Journal of Ophthalmology 1996;80:592–596

Incidence of cases of ocular trauma admitted to hospital and incidence of blinding outcome

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Abstract

***Aims*—To provide epidemiological data on the current burden of serious eye injuries utilising the hospital eye service, to inform the planning and provision of eye health care, and health and safety strategies for the prevention of ocular injuries.**

***Methods*—A prospective observational study was carried out of all patients with ocular trauma admitted to hospitals in Scotland, under the care of a consultant ophthalmologist, during a 1 year period. The population of Scotland represented the population at risk of injury. Visual outcome (Snellen visual acuity in the injured eye) was measured at the time of final discharge from ophthalmic care and at follow up.**

***Results*—All ophthalmic departments in Scotland participated and a total of 415 residents of Scotland were admitted. The 1 year cumulative incidence of ocular trauma necessitating admission to hospital is estimated to be 8.14 per 100 000 population (95% CI 7.38 to 8.97). Some 13.2% (n=26/197) of patients discharged from follow up had a poor visual outcome with a visual acuity less than 6/12 in the injured eye. Some 10.7% (21/197) patients at this time had a blinding outcome in the injured eye (visual acuity less than 6/60). No patient was registered blind or partially sighted during the study period. The home was the single most frequent place for blinding injuries to occur (52%, n=11/21), followed by the workplace 24% (n=5/21). The 1 year cumulative incidence of blinding outcome from serious ocular trauma is estimated to be 0.41 per 100 000 population per year (95% CI 0.26 to 0.64).**

***Conclusion*—The current burden of serious ocular trauma presenting to the hospital eye service has been quantified from this population based study, and for the first time, a direct estimate of the incidence of the subsequent blinding outcome from these injuries has been provided. Ocular trauma remains an important cause of avoidable and, predominantly, monocular visual morbidity (visual impairment and blindness), with over half of the blinding injuries now occurring in the home. Health education and safety strategies should now consider targeting the home for the prevention of serious eye injuries in addition to the traditional work, sports, and leisure environments and their related activities.**

(*Br J Ophthalmol* 1996;80:592–596)

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Accepted for publication
7 March 1996

Ocular trauma is an important cause of preventable visual morbidity, particularly among the younger age groups.[1–4] Although ocular trauma represents a significant burden of new cases presenting to ophthalmic services in the UK, many of these are minor injuries and are treated either in the accident and emergency department or as outpatients,[5–7] with only a small proportion (between 0.9% and 1.8%) being admitted to hospital.[5 8] Consequently, there are scant epidemiological data on moderate to severe injuries with potentially sight threatening sequelae that are available to inform not only planners and providers of eye health care, but also health and safety strategies for the prevention of ocular injuries. The data currently available for the UK relate to circumstances almost two decades ago.[1]

This paper reports on the incidence of ocular trauma of sufficient severity to warrant admission to hospital under a consultant ophthalmologist, together with the incidence of blinding outcome within 1 year of injury.

Method

This was a prospective observational study of all admissions for ocular trauma under the care of a consultant ophthalmologist in Scotland, during the calendar period 1 November 1991 to 31 October 1992. All patients were followed up until 31 December 1992 or discharge from ophthalmic care, whichever came first. The study population was that of Scotland which was estimated to be about 5.1 million in 1991[9] and represented the population at risk of injury during the study period.

All ophthalmic departments in Scotland were invited to participate by providing clinical data on patients (children and adults) admitted under their care with an ocular injury sustained during the study period. Patients with an ocular injury referred from another specialty were also included provided that the injury had been sustained during the study period. A consultant ophthalmologist was identified at each ophthalmic department to act as a local coordinator to supervise and facilitate data collection at each participating centre. Regular feedback on identification, recruitment, and follow up of patients was provided to each centre at 3 monthly intervals throughout the study period.

All data were collected by ophthalmologists, in standardised proforma booklets developed specifically for the study. These contained separate proforma for each stage of patient care: reporting the event (admission of an ocu-

Table 1 International Classification of Diseases (ICD 9) diagnostic codes for ocular trauma

ICD 9 code	*Description*
870	Open wound of ocular adnexa
871	Open wound of eyeball
918	Superficial injury of eye or adnexa
921	Contusion of eye or adnexa
930	Foreign body on external eye
940	Burn confined to eye and adnexa
950	Injury to optic nerve and pathways
802.6	Fracture of face bones: orbital floor (blow out) closed
802.7	Fracture of face bones: orbital floor (blow out) open

Table 2 Population estimates: Scotland, 1991[9]

	Population estimates (n)		
Age (years)	*Males*	*Females*	*All*
0–4	167 043	158 495	325 538
5–14	324 940	309 499	634 439
15–24	379 852	369 300	749 152
25–34	402 482	401 350	803 832
35–44	350 461	350 623	701 084
45–54	284 406	295 760	580 166
55–64	254 272	282 635	536 907
65–74	191 920	249 174	441 094
75–84	91 372	167 714	259 086
85 +	15 743	52 959	68 702
All ages	2 462 491	2 637 509	5 100 000

lar injury) and the process of care provided—the history and clinical assessment of the injury; clinical management on admission; follow up in the outpatient department; at discharge from ophthalmic care; and for reporting a tertiary referral at any stage. Also included in each booklet were instructions for completion of the proforma together with the definitions used in the study. An 'event' was defined as the first time after injury that a patient was admitted to hospital under the care of a consultant ophthalmologist. Subsequent referrals to another centre or readmissions were therefore not counted as the index 'event' but constituted details relevant to the overall process of care that the patient received.

Visual outcome was only considered at final discharge (from follow up and ophthalmic care). This time was taken as it represented a definite stage in the patient's recovery where stability was likely to have been achieved and no further medical care was required, irrespective of type or severity of injury. Visual outcome was defined in terms of the best corrected Snellen visual acuity in the injured eye (or in the case of bilateral injuries the worse affected eye was taken) at time of final discharge. A good visual outcome was defined as a Snellen visual acuity of 6/12 or better. Blindness was taken to be a visual acuity of less than 6/60 and visual impairment was taken as an acuity of 6/18 to 6/60 (inclusive). Definitions used by the World Health Organisation for blindness (less than 3/60) and visual impairment (6/24 to 3/60 inclusive) are also presented.

At the end of the study period, routine hospital activity returns for inpatients and day cases (Standard Morbidity Record 1—SMR1) to the Department of Health in Scotland were obtained to assess the completeness of reporting of admissions for eye injuries by ophthalmologists for the purposes of the study. The SMR1 data were provided for patients admitted as emergencies, by specialty, principal diagnosis on discharge, age, and sex for the study period.[9] Table 1 presents the ICD 9 diagnostic codes (International Classification of Diseases version 9) that were used. Where discrepancies occurred, a list of pertinent details of study patients (date of birth, sex, and hospital number), was sent to the Scottish Office of the Department of Health for comparison and validation.

The cumulative incidence for cases with ocular trauma admitted to hospital during one calender year is presented. This is a proportion given by the ratio of the number of patients admitted during the study period (1 year), to the number of persons at risk at the beginning of that period. It indicates the average risk that an individual has of sustaining an eye injury requiring admission to hospital under the care of an ophthalmologist in the specified period of time. Similarly the cumulative incidence for permanent blindness from injury is also presented. The population estimates for Scotland for 1991 were used[9] and are presented in Table 2.

The Fleiss quadratic approximation method[10] was used to calculate 95% confidence intervals (CI) for the estimated cumulative incidence proportions. In comparing males with females, incidence ratios (relative risks RR) were estimated using the EPI-INFO software.[11]

Results

There were 18 eligible ophthalmic departments in Scotland at the time of the study providing regular inpatient and outpatient services and all of these participated.

A total of 428 admissions were reported during the study period. Thirteen patients were identified as not being residents of Scotland and were not included in this analysis. One hundred and ninety seven patients were discharged from ophthalmic care and follow up during the study period. All of these patients were discharged by 12 months after injury (range for time to discharge: 1 day to 1 year; median 1 month). Losses to follow up accounted for a third of all cases, with most of these occurring within 3 months of injury by failure to reattend for outpatient assessment.

Analysis of routine SMR1 returns during the study period (1 November 1991 to 31 October 1992) gave a count of 637 patients who had emergency admissions under an ophthalmic service and were discharged with a principal diagnosis at discharge of ocular trauma. However, 113 (27%) patients entered and followed up in the study were not identified on the routine SMR1 returns.

The 1 year cumulative incidence for moderate to severe ocular trauma requiring admission to hospital under the care of a consultant ophthalmologist is presented in Table 3. The overall incidence for hospitalised ocular trauma is 8.14 per 100 000 of the population in 1 year, with incidence peaking at the age

Table 3 One year cumulative incidence of cases of ocular trauma admitted to hospital in Scotland

		Resident cases admitted without ocular trauma (n)			Cumulative incidence (per 100 000 population per year)				Incidence ratios (relative risk)	
	Age (years)	Males	Females	All	Males	Females	All	(95% CI)	Males/females	(95% CI)
	0–4	10	5	15	5.99	3.15	4.61		1.9	(0.65 to 5.55)
	5–14	49	21	70	15.08	6.79	11.03		2.22	(1.33 to 3.71)
Stratum summary	**0–14**	**59**	**26**	**85**	**11.99**	**5.56**	**8.85**	**(7.11 to 11.0)**	**2.16†**	**(1.36 to 3.43)**
	15–24	88	10	98	23.17	2.71	13.08		8.55	(4.45 to 16.45)
	25–34	75	10	85	18.63	2.49	10.57		7.48	(3.87 to 14.47)
	35–44	55	3	58	15.69	0.86	8.27		18.34	(5.74 to 58.62)
	45–54	33	3	36	11.60	1.01	6.21		11.44	(3.51 to 37.29)
	55–64	17	2	19	6.69	0.71	3.54		9.45	(2.18 to 40.89)
Stratum summary	**15–64**	**268**	**28**	**296**	**16.03**	**1.65**	**8.78**	**(7.82 to 9.85)**	**9.73†**	**(6.49 to 14.14)**
	65–74	7	6	13	3.65	2.41	2.95		1.51	(0.51 to 4.51)
	75–84	3	5	8	3.28	2.98	3.09		1.1	(0.26 to 4.61)
	85+	1	2	3	6.35	3.78	4.37		1.68	(0.15 to 18.55)
Stratum summary	**≥65**	**11**	**13**	**24**	**3.68**	**2.77**	**3.12**	**(2.04 to 4.72)**	**1.33†**	**(0.61 to 3.11)**
	Missing			10						
All strata		338	67	415*	13.73	2.54	8.14	(7.38 to 8.97)	5.4 †	(4.04 to 6.88)

The 1991 estimates for the population of Scotland were used.[9]
* 13 patients were known not to be residents of Scotland and were excluded from this analysis.
† Age adjusted incidence ratios (relative risks) : males/females.

groups 15–24 years and 25–34 years for males, and falling thereafter. For females the peak incidence occurs at the 5–14 year age group (Table 3 and Fig 1).

Controlling for age, males were at a higher risk of eye injury than females. The overall crude incidence ratio (relative risk, RR) was 5.4 (95% CI 4.04 to 6.88). Stratum specific age adjusted incidence ratios are also presented, demonstrating an effect modification by age. The risk of having an eye injury necessitating an admission to hospital is over nine times higher for males than females between the ages of 15–64 years (RR=9.73; 95% CI 6.49 to 14.14). The size of this relative risk is reduced at the younger age group 0–14 years (RR=2.16; 95% CI 1.36 to 3.43). Similarly, for the older age group of 65 years and older, the excess risk is still demonstrated but without reaching statistical significance (RR=1.33; 95% CI 0.61 to 3.11) (Table 3).

Twenty six (13.2%) patients had a poor visual outcome at final discharge from follow up. Of these, five (2.5%) had visual impairment achieving a visual acuity between 6/18 and 6/60 (inclusive) and 21 (10.7%) patients were blind with a visual acuity of less than 6/60 in the injured eye. Applying the WHO definitions, six (3.05%) patients had low vision and 18 (9.14%) patients had a blinding outcome as a consequence of injury (Table 4).

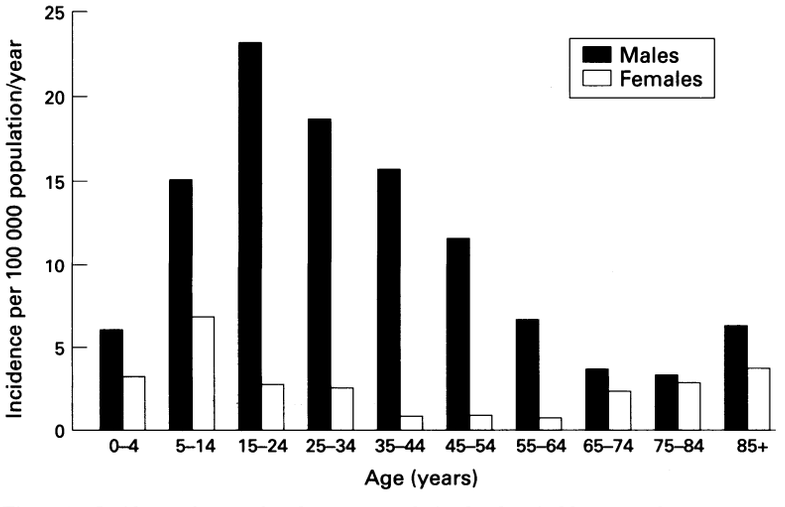

Figure 1 Incidence of cases of ocular trauma admitted to hospital by age and sex.

Table 4 Visual impairment and blindness from ocular trauma at final discharge from follow up (n=197)

Visual acuity *	No	%
Good visual outcome:		
Vision 6/12 or better	171	86.8
Poor visual outcome:		
Poor vision (less than 6/12)	26	13.2
Visual impairment (6/18 to 6/60) †	5	2.5
Blind (less than 6/60)	21	10.7
(NPL)	(12)	(6.1)
Total	197	100
WHO definitions:		
Low vision (6/24 to 3/60)	6	3.0
Blind (less than 3/60)	18	9.1

* Visual acuity in the injured eye
† Two of these patients had pre-existing amblyopia in the injured eye.
NB: In addition to the 12 NPL (no perception of light) cases above, there were a further seven patients still being followed up, with last recorded vision as NPL, all directly due to the injury, making a total of 19 NPL outcomes out of 415 cases (4.58%) by the end of the study period.

Two of the patients with visual impairment in the injured eye at final discharge (acuities of 6/18 and 6/36) had pre-existing amblyopia in that eye. Twelve of the patients with blinding outcome had no perception of light (NPL). There were a further seven patients with a last recorded visual acuity of NPL as a result of the injury, but as they were all still under follow up, they were not included in the analysis for blinding outcome at final discharge (Table 4). Twenty five patients sustained a bilateral injury. Of these 17 were discharged with good visual outcome and of those still under follow up, only one patient had visual impairment.

The overall 1 year cumulative incidence of blinding outcome by 1 year after injury was 0.41 per 100 000 population. (Using the WHO definitions, the overall incidence of blinding outcome was 0.36 per 100 000 population per year.) No patient was bilaterally blind following injury. No patient was registered blind or partially sighted during the study period. The single most frequent place for blinding injuries

Table 5 Incidence of blinding outcome in the injured eye at final discharge by place of injury*

Place of injury	*Blinding outcome (n)*	*Cumulative incidence (95% CI) (per 100 000 population per year) †*
Home	11	0.22
Workplace	5	0.10
Pavement	2	0.04
Road traffic accident	1	0.02
Other places	2	0.04
All places	**21**	**0.41 (0.26 to 0.64)**

* All of these patients were discharged within 1 year of injury.
† The denominator was the 1991 estimate for the population of Scotland.[9]
NB: Seven patients with last recorded visual acuity of no perception of light were not included as they were still being followed up.

to occur was at home (52%, n=11/21), followed by the workplace 24% (n=5/21) (Table 5).

Discussion

A wide discrepancy was clearly observed between the events reported directly by ophthalmologists for the study and routinely collected SMR1 data. Despite frequent feedback regarding recruitment and follow up, it is possible that some admissions were missed and not included in the study, compromising completeness of data collection. However, since the data for the study were collected by ophthalmologists, its quality regarding accuracy (diagnosis of ocular injury and other relevant details) may be considered to be of a high standard.

The routine SMR1 returns are not confined to the first admission following injury and include repeat episodes of admission for the same injury and admissions for injuries that may have occurred outside the study period. They are also likely to include patients who may not have been residents of Scotland. All of these, together with the possibility of coding errors occurring, may partially explain the larger number of admissions recorded in this manner. It is also notable that a considerable proportion (27%, n=113) of study patients were not identified within the SMR1 data set. These patients are known to have been treated for an eye injury and considerable amounts of data regarding details of their injuries, their admission, and process of care received have been collected and returned to the study centre by the attending ophthalmologists. Similar discrepancies between routinely and specifically collected data with respect to their completeness and accuracy, are well recognised within the National Health Service and have been widely reported.[12-15]

A third of all cases were lost to follow up (mostly within 3 months of injury). All of the patients in this analysis were residents of Scotland, with most patients travelling 15 miles or less to the hospital from the location where the injury was sustained (40% travelled less than 5 miles, 32% travelled 5–15 miles). It is possible that these patients did not return for follow up because they were satisfied with their recovery and visual status following injury. Although it is unlikely that the seven patients with a last recorded visual acuity of NPL would significantly improve on this status, this could not have been assumed to be the case until final discharge. As they were still under follow up, they were not included in the analysis for blinding outcome at final discharge.

Given these circumstances, the estimates reported in this paper for incidence of hospitalised ocular trauma of 8.14 per 100 000 population per year (95% CI 7.38 to 8.97), and the incidence of blinding outcome of 0.41 per 100 000 population per year (95% CI 0.26 to 0.64), must be considered to be minimum estimates.

Estimates from previous retrospective studies for hospitalised ocular trauma from the USA range from 4.1 to 13.2 per 100 000 population.[2-4] The lower estimate is from a defined locality with a given number of hospitals serving its residents for all outpatient and inpatient care, with information about eye injuries being obtained from the hospital records of patients sustaining a facial injury within a 1 year period (the ocular injuries representing a subset of these cases).[4] The higher estimates are from hospital discharge data collated either by a statewide institution in Maryland[2] or from sources of nationally aggregated discharge data.[3]

Our direct estimates from this prospective study lie between these extremes and are derived from data from individual patients, not aggregated episodes. Estimates from the routine SMR1 suggest an overall incidence of 13.2 per 100 000 population per year and are consistent with the estimates derived from other routine sources of aggregated discharge data.

The age specific patterns reflect those previously reported for the younger age groups.[1-3] There was some suggestion for the presence of a bimodal peak occurring at older age groups that has been previously reported.[2 3] Controlling for age, males were observed to be at increased risk for an eye injury necessitating admission to hospital. The greatest relative risk was between the ages of 15 and 64 years (RR=9.73). The relative risk was lower for both the 0–14 year age group (RR=2.16) and the 65 years and over age group (RR=1.33). The effect modification by age may reflect differences between males and females not only with respect to their daily activities that may be risk factors for injury, but also duration of exposure to these risk factors. In the 15–64 year age group males and females are more likely to have differences in their daily work, leisure, and domestic activities and the amount of time spent on these, with each of the related environments having their own inherent risk factors for injury. At the 0–14 years and 65 years and older age groups, it is possible that males and females are more likely to share similar environments throughout the day, sharing similar exposures to risk of an injury. The home (and activities related to this location) has been identified as being the most important environment for a serious eye injury to take place at all ages. It is the single most frequent place of injury in the 0–14 years and

65 years and over age groups, showing increasing frequency with age in the intermediate age groups.[16]

It has been difficult to quantify the burden of visual morbidity resulting from ocular trauma in the UK particularly as routine discharge returns to the Department of Health do not contain outcome information and monocular blindness or partial sight are not eligible for registration. In addition, registration data that are available from the blind and partially sighted registers have been identified as having some fundamental problems that compromise their use for epidemiological purposes. These include incomplete coverage, inconsistent interpretations of the definitions of blindness and partial sight, and misclassification of disease for the main cause of visual disability for registration.[17] Consequently, direct population based estimates of the incidence of blinding outcome from ocular trauma as reported in this paper have previously been unavailable.

Although our estimates for the incidence of eye injuries admitted to hospital and the incidence of blinding outcome from these injuries are minimum estimates, when applied to the population of the UK as a whole, they may serve to indicate the national burden of visual morbidity from ocular trauma. The 1991 population estimates for the UK do not demonstrate any important differences in the age structure of the populations of England and Wales, Northern Ireland, or Scotland.[9 18] It is thus estimated that annually about 4688 patients (95% CI 4250 to 5166) with ocular injuries are expected to be admitted to hospital under the care of a consultant ophthalmologist. Similarly, 236 (95% CI 150 to 369) patients a year may be expected to be permanently blinded in the eye sustaining such an injury, with over half of these blinding injuries occurring in the home.

Ocular trauma remains an important cause of preventable and predominantly monocular visual morbidity and blindness. With the home now being identified as the single most frequent place for a blinding injury to take place, health education and safety strategies should now be directed towards this previously unrecognised location for the prevention of serious eye injuries.

We thank all the ophthalmologists in Scotland and their clerical staff, without whose support and contribution this study could not have been conducted; Miss Kate Bullock and Miss Marisa Tomlinson at the Royal College of Ophthalmologists; and Miss Lynda Rose at the Department of Ophthalmology, Ninewells Hospital, Dundee; the Directorate of Information Services, Information and Statistics Division, The National Health Service in Scotland, Management Executive for their assistance with the routinely collated hospital discharge data.

This study was supported by a grant from the Scottish Home and Health Office, Clinical Resources and Audit Group, grant number CA 91/9.

PD was supported by Core Audit Funding from the Department of Health for the Royal College of Ophthalmologists, London, to conduct this study.

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