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A 10-year survey of eye injuries in Northern Ireland, 1967-76

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SUMMARY Ocular injuries of sufficient severity to necessitate admission to the Eye and Ear Clinic, Royal Victoria Hospital, Belfast, were sustained by 1707 male patients and 325 female patients. Blunt injury occurred in 1063 eyes (49·2%), perforating injury in 1037 (48%), and intraocular or intraorbital foreign bodies in 181 eyes (8·4%). More than three-quarters of the patients (77·4%) were less than 36 years of age and 84% of all injuries occurred in males. Normal visual acuity (6/6 or better) was regained by 41·2% of the patients in whom the final visual outcome was known. The benefit of wearing seat belts in road vehicles and protective goggles in industry and sport should receive more publicity on radio and television and via poster campaigns. Compulsory fitting of laminated windscreens in all road vehicles is recommended. The vulnerability of children to ocular injury should be highlighted through the mass media, schools, and health centres.

Few general surveys of ocular injuries have been published in the ophthalmic literature in this century. This reflects the difficulties encountered in the accumulation of data relating to ocular injuries, particularly the inadequate initial documentation of eye injuries and visual functions and the failure to code accurately the diagnosis to facilitate data retrieval at a later date. These disadvantages may be further compounded by failure of patients to attend for review and the difficulties encountered in tracing injured subjects who often are part of a young and mobile population.

Garrow[1] in 1923 presented the first comprehensive survey of ocular injuries. He analysed 1000 consecutive cases of eye injury admitted to the Glasgow Royal Infirmary between 1908 and 1913 and emphasised the occupational nature of the majority of the eye injuries. In 1967 Yuasa *et al.*[2] reported a large series of patients (2484) with eye injuries. Many of these injuries, however, were minor in nature and the patient did not require admission to hospital. In 1968 Lambah[3] reviewed over 1000 patients admitted to hospital with ocular injuries. This largely epidemiological survey concentrated on the cause of ocular injury. Johnston[4] conducted a selective survey of patients requiring treatment for eye injuries during the years 1965 to 1974 inclusive. He categorised the various types of injuries and highlighted the changing patterns of trauma during the years of the investigation. Most other studies relating to ocular trauma are limited to specific aspects of ocular injury such as the surgical management of perforating eye injuries and intraocular foreign bodies.[5–16] Particular subjects such as the management of traumatic hyphaema have also been analysed in depth,[17 18] and several studies compare the merits of medical or surgical treatment[19–21] and analyse the indications for monocular or binocular patching[22] and the use of urokinase.[23–25]

The present survey assesses the range and extent of eye injuries in patients admitted to the Eye and Ear Clinic, Royal Victoria Hospital, Belfast, over a 10-year period. The Eye and Ear Clinic provides general ophthalmological care for approximately 85% of the population of Northern Ireland and offers specialised ophthalmological facilities for the entire province. The population was 1 549 400 persons in 1972 (based on the 1971 census from the 51st Annual Registrar General's Report 1972). More than one-quarter (362 082 persons) live in the city of Belfast. Our analysis of the causes of ocular trauma attempts to identify areas in which prevention might be undertaken.

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Table 1 *Distribution of patients injured according to age and sex*

Age when injured (years)	Male No.	Male %	Male (N.I.)	Female No.	Female %	Female (N.I.)	All cases No.	All cases %	All cases (N.I.)
0–	550	32·2	(31·2)	136	41·8	(28·6)	686	33·7	(29·8)
15–	649	38·0	(23·8)	102	31·4	(21·6)	751	36·9	(22·7)
30–	260	15·2	(16·4)	36	11·1	(16·2)	296	14·6	(16·3)
45–	204	11·9	(19·8)	33	10·2	(20·9)	237	11·6	(20·5)
65+	45	2·6	(8·8)	18	5·5	(12·7)	63	3·1	(10·7)
Total	1708* (1707)	99·9	(100·0)	325	100·0	(100·0)	2033* (2032)	99·9	(100·0)

*One individual had the same eye injured on different occasions. Proportion in brackets relate to the population of Northern Ireland (estimated 30 June 1972).

Materials and methods

2032 patients (2162 affected eyes) who sustained eye injuries requiring hospital admission between 1 January 1967 and 31 December 1976, were admitted to the survey. They were selected according to the diagnosis available through the medical records department (case notes with International Classification of Disease numbers (Eighth Revision) N870 and N921 for the years 1967 to 1976). Each patient was given a consecutive code number, and data relating to age, sex, annual and seasonal variation, eye injured, and aetiology of injury were recorded in addition to the nature and severity of the ocular injury and the final outcome. The information on each patient was transferred to punch cards for computer analysis.

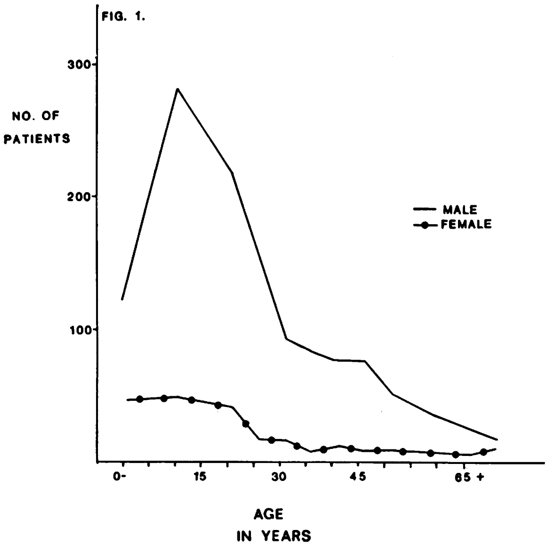

Fig. 1 *Distribution of patients injured according to age and sex.*

Results

SEX

The distribution of ocular injuries by the sex and age of the patient demonstrates a clear difference in the incidence of ocular injury between the sexes (Table 1, Fig. 1). Although the male:female ratio of the population was 0·98, the male:female ratio for ocular injury was 5·25 which is a highly significant difference ($\chi^2=15{\cdot}31$, DF=4, $P<0{\cdot}001$ for males, and $\chi^2=24{\cdot}80$, DF=4, $P<0{\cdot}001$ for females). Females are particularly vulnerable in the first decade and beyond the fifth decade (Table 2). For males the greatest incidence of eye injury occurs in the second to fifth decades.

Table 2 *Distribution of injured patients according to age and male/female ratio*

Age when injured (years)	No. of cases	Male/female ratio
0–	429	3·62
11–	612	5·67
21–	425	6·34
31–	196	7·57
41–	167	8·28
51–	110	4·79
61+	93	3·22
Total	2032	5·25

AETIOLOGY

In 1712 patients the cause of ocular injury was known. In the remaining 320 patients (15·7%) insufficient documentation made it impossible to identify the exact aetiology. Injuries occurring during play and sport to children were the most common aetiological factors (33·8%) with road traffic accidents (19·3%) and industrial injuries (15·4%) being next in frequency (Table 3 and Fig. 2). Together these latter 2 subgroups accounted for more than one-third of all injuries. Road traffic accidents were the most common cause of eye injury in females (35·9%), but for males injuries incurred during play and sport in childhood were the most common aetiological factors (33·9%).

INJURY AND AGE

The distribution of the number of eyes injured rather than individual patients injured is shown in Table 4 and Fig. 3. More than one-third (38·4%) of eye injuries in which the cause was known occurred in children under 16 years. In this age group over four-fifths (82·1%) of the injuries occurred to children engaged in play or sport and 7·7% resulted from accidents in the home. In older patients (16 years or older) approximately one-third (32·3%) of injuries were caused by road traffic accidents, with patients in the 16–25 year

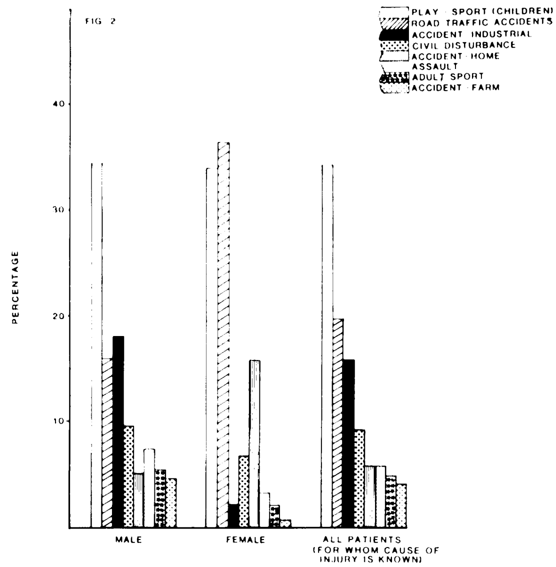

Fig. 2 *Percentage incidence of ocular injury related to cause of injury and sex of patient.*

Table 3 *Distribution of injury by cause and sex*

Cause of injury		*Play and sport (children)*	*RTA*†	*Industrial accidents*	*Civil disturbance*	*Home accident*	*Assault*	*Adult sport*	*Farm accident*	*Total*
Cases	No.	579*	330	262	156	117	117*	83	68	1713 (1712)
	%	33·8	19·3	15·4	9·1	6·8	6·8	4·8	4·0	100·0
Male/female ratio		5·09	2·24	42·83	7·21	1·60	12·0	12·83	33·0	5·03

*One individual had both eyes injured but the cause was different on each occasion. †RTA = road traffic accident.

Table 4 *Distribution of eye injury by cause and age at time of injury**

Cause of eye injury	*Age when injured (years)*										*All cases*
	Children (<16 years)				*Adults (>16 years)*						
	0–	*6–*	*11–*	*Total children*	*16–*	*26–*	*36–*	*46–*	*56+*	*Total adults*	
Road traffic accident	6	5	14	25	178	79	45	29	35	366	391
Civil disturbance	0	5	22	27	71	35	26	25	8	165	192
Adult sport	0	0	5	5	41	20	8	6	4	79	84
Play and sport (children)	126	224	229	579	7	0	0	0	1	8	587
Accident (home)	25	15	14	54	14	13	5	7	27	66	120
Accident (industrial)	0	0	9	9	109	64	46	33	12	264	273
Accident (farm)	0	1	1	2	11	7	15	14	19	66	68
Assault	0	0	4	4	51	27	12	11	18	119	123
Totals	157	250	298	705	482	245	157	125	124	1133	1838†

*This Table (and also Tables 5, 6, 7) counts the number of eyes injured and *not* the number of individuals injured.
†There were 324 eyes for which the cause of injury was not known; these are excluded from the above figures and from Table 5.

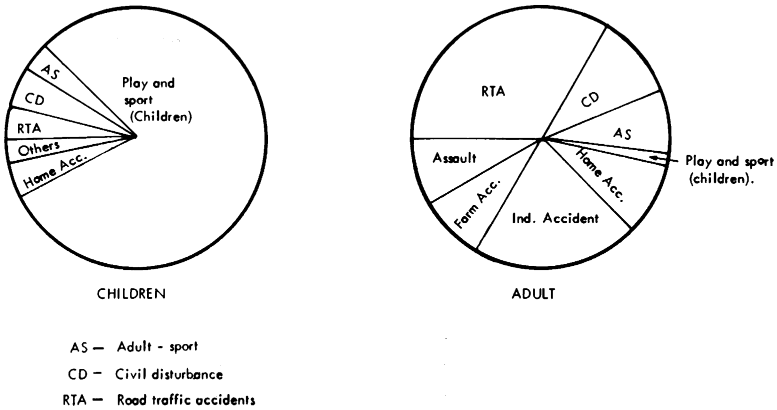

Fig. 3 *Distribution of cause of ocular injury in adults and children.*

age group accounting for nearly half (48·6%) of these injuries. Industrial accidents were responsible for 23·3% of ocular injuries with more than 41·3% of these occurring in the 16–25 year age group. Patients in the 16–25 year age group sustained more injuries in each aetiological category except those comprising accidents at home and on the farm. Patients age 56 years and over were most often involved in farming accidents.

SECULAR TRENDS

Comparison of the first and second quinquennials reveals a significant increase in the incidence of injury due to road traffic accidents ($\chi^2=29{\cdot}28$, DF=1, $P<0{\cdot}001$), civil disturbance ($\chi^2=63{\cdot}02$, DF=1, $P<0{\cdot}001$) and assault ($\chi^2=13{\cdot}67$, DF=1, $P<0{\cdot}001$). There is no significant trend for the other aetiological groups (Table 5). In the second quinquennium 4 out of the 5 years exhibit a male: female ratio below the average of 5·25. This is most marked in 1972, which was the peak year for female injuries.

SEASONAL VARIATION

Examination of the winter:summer ratio reveals a variation by season for all aetiological groups of eye injury (Table 6). This is greatest in relation to civil disturbance, children at sport and play, and farming accidents. Adult sports injuries and accidents in the home or on the farm were more common during winter, while the other aetiological groups occurred more commonly during summer. Road traffic accidents do not vary significantly according to the season of the year (at the 5% level), but these

Table 5 *Distribution of eye injury by cause and year of injury*

Cause of eye injury	*Admission year* 1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	*Total eyes*
Road traffic accident	23	28	26	23	42	56	58	44	49	42	391
Civil disturbance	0	0	16	7	18	45	27	25	20	34	192
Adult sport	10	9	6	8	7	13	4	10	10	7	84
Play and sport (children)	61	52	56	55	72	76	75	54	36	50	587
Home accident	9	14	8	13	15	14	10	8	16	13	120
Industrial accident	35	19	26	21	41	23	34	30	20	24	273
Farm accident	10	2	8	10	7	4	11	8	6	2	68
Assault	9	5	6	10	11	21	18	13	15	15	123
Total	157 (8·5)	129 (7·0)	152 (8·2)	147 (8·0)	213 (11·6)	252 (13·7)	237 (12·9)	192 (10·5)	172 (9·4)	187 (10·2)	1838* (100·0)
Male/female ratio	6·54	5·91	6·43	5·74	5·85	3·80	4·25	7·54	4·62	5·16	5·25

*See footnote to Table 4.

Table 6 *Distribution of eye injury by cause and month of admission*

Cause	Admission month												Total injuries	Winter/summer ratio*	χ^2 value†
	J	F	M	A	M	J	J	A	S	O	N	D			
Road traffic accident	29	25	34	29	30	30	25	38	25	38	36	52	391	1·21	3·50
Civil disturbance	8	14	10	9	20	20	26	33	10	23	14	5	192	0·63	10·08
Sport (adult)	7	12	3	3	6	8	4	10	8	8	8	7	84	1·15	0·43
Play and sport (children)	33	36	53	50	41	63	63	61	64	65	29	29	587	0·72	16·03
Home accident	8	10	13	13	12	7	4	11	11	14	9	8	120	1·07	0·13
Industrial accident	22	19	20	22	30	24	17	25	32	24	21	17	273	0·82	2·67
Farm accident	8	4	10	5	2	4	7	5	2	8	8	5	68	1·72	4·76
Assault	5	9	14	13	8	7	13	17	6	8	10	13	123	0·92	0·20
Total	120	129	157	144	149	163	159	200	158	188	135	136	1838	0·89	6·35

*Winter is defined as the first plus last quarters of same year; summer as the second plus third quarters.
†Calculated with 1 degree of freedom at 5% level = 3·84.

Table 7 *Distribution of 3 major causes of eye injury by year of admission*

Type of injury	Year of admission										Total eye injuries	χ^2 value*
	67	68	69	70	71	72	73	74	75	76		
Blunt	89	85	77	91	127	162	130	102	83	117	1063	60·28
Perforating	86	72	100	88	110	129	136	111	109	96	1037	33·18
Foreign body	14	12	21	16	18	21	28	15	16	20	181	11·11

*Calculated with 9 degrees of freedom at the 5% significance level = 19·675.

injuries increased in frequency during October, November, and December ($\chi^2=10{\cdot}89$, DF=3, $P<0{\cdot}05$).

INCIDENCE OF BLUNT AND PERFORATING OCULAR INJURY

There is a significant variation in the yearly incidence for both blunt ($\chi^2=60{\cdot}28$, DF=9, $P<0{\cdot}001$) and perforating ($\chi^2=33{\cdot}18$, DF=9, $P<0{\cdot}001$) types of injury, with the years 1971 to 1973 showing the peak incidence (Table 7 and Fig. 4).

Among those cases in which the cause of injury was known, blunt ocular injury occurred most frequently in the aetiological group of children at sport and play (38·7%). Road traffic accidents accounted for 30·2% of perforating injuries and accidents to children at sport or play for a further 24·1%. Industrial accidents caused 52·6% of intraocular or intraorbital foreign body injuries, the latter usually representing a through and through perforation of the globe.

VISUAL PROGNOSIS FOLLOWING INJURY

Examination of the outcome of all ocular injuries in which the final visual result was available revealed that more than two-fifths of eyes (41·2%) regained an acuity of 6/6 or better and a further one-fifth (22·4%) achieved an acuity of between 6/7·5 and 6/12 (Table 8). However, approximately 1 patient in every 10 (12·3%) required enucleation of the injured eye. Of the 215 eyes enucleated 66

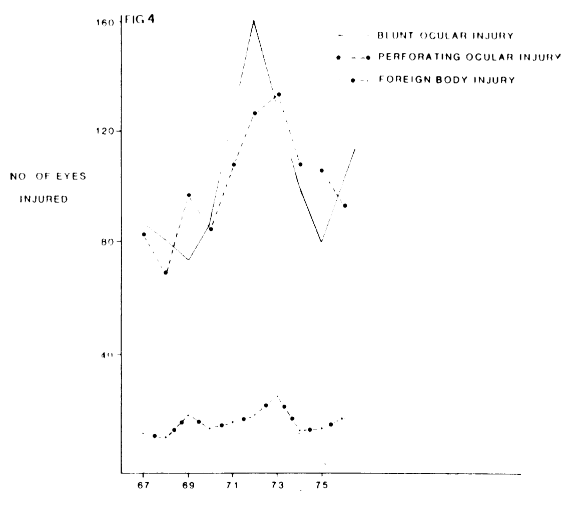

Fig. 4 *Incidence of blunt, perforating, and foreign body injury according to year of injury.*

Table 8 *Distribution of all eye injuries by final visual acuity*

Acuity	Eyes injured	
	No.	%
6/6 or better	721	41·2
6/7·5—6/12	391	22·4
6/18—6/36	157	9·0
6/60 or worse	197	11·3
Enucleation	215	12·3
No perception of light	67	3·8
Total	1748*	100·0

*There were 414 (19·1%) eyes for which the visual acuity was unrecorded or not available.

(63 patients) were removed as a primary surgical procedure, due to the extensive nature of the injuries. Secondary enucleation was required in 149 instances, 109 eyes being removed on account of severe structural damage, persistent intraocular inflammation, and risk of sympathetic ophthalmia. Some 61 eyes were enucleated within 14 days of injury, and the remainder at intervals up to several years post trauma. There were 2 cases of sympathetic ophthalmia, 1 of which was confirmed histologically. The other patient who developed sympathetic ophthalmia did not have surgical repair of the injuries because of poor general health. Enucleation was required most frequently following injuries sustained in road traffic accidents and civil disturbances, which were responsible for 27·8% and 23·9% respectively of all enucleations in the present series. A final visual acuity of 6/12 or better following blunt ocular trauma was obtained by 77·3% of patients in whom the final visual outcome was known, and 2·1% of patients in this category required enucleations. After perforating injury 45·5% of patients regained a visual acuity of 6/12 or better, but enucleation was required in 23·6% of cases. Intraocular and intraorbital foreign body injuries resulted in a visual acuity of 6/12 or better in 44·5% of patients, enucleation being required in 21·5%.

Discussion

Eye injuries were responsible for 8·7% of all ocular admissions to the Eye and Ear Clinic, Royal Victoria Hospital, Belfast, during the period 1967 to 1976. More than half (51·2%) of the patients were under 21 years of age and more than three-quarters (77·4%) were under 36 years of age. The high incidence of injury in males is illustrated by the male:female ratio of 5·25:1 compared with a ratio for the population of Northern Ireland of 0·98:1. Approximately two-fifths (41·2%) of those patients for whom the final visual acuity was known regained 6/6 vision. However, the remaining three-fifths of patients for whom the final visual acuity was known suffered permanent diminution of vision. The high enucleation rate in this series (12·3%) reflects the severe ocular damage that often follows road traffic accidents and certain injuries associated with civil disturbances. This underlines the need for preventative measures.

Nearly one-third (32·5%) of the adult eye injuries were the result of road traffic accidents. These injuries showed a significant increase in the second quinquennium of this survey and were particularly serious, accounting for nearly one-half of the bilateral injuries and one-quarter of all enucleations. The typical ocular damage following road traffic accidents, a perforating eye injury associated with facial lacerations, is generally sustained by the front seat passenger who does not wear a seat belt.[26] Müller-Jensen and Allmaras[26] discussed 133 patients who sustained injuries in road traffic accidents and found that in 34% of this series there was a horizontal injury involving both eyes and the bridge of the nose. They and others[27,28] emphasised the importance of safety belts and laminated glass windscreens in preventing eye injuries. Mackay[29] found that approximately 70% of serious eye injuries in road traffic accidents were attributable to splintering of toughened glass windscreens, while those countries using laminated glass windscreens reported almost no eye injuries. The present publicity campaign aimed at increasing the use of seat belts is to be encouraged and compulsory fitting of laminated windscreens to all vehicles is strongly recommended.

In 1923 Garrow[1] reported that occupational injuries accounted for 70·7% of all eye injuries in his series. These figures are similar to earlier reports and are consistent with the industrial and social conditions of the time, including long working hours, child labour, and negligible safety precautions. Today industrial eye injuries occur less frequently than at the beginning of this century. They represent 15·4% of injuries in the present survey and show little or no decline during the 10-year period studied. Further enforcement of safety precautions in industry is indicated, in particular the use of shatter-proof glasses and vizors which should be freely available. Their use should be encouraged by health education programmes arranged in collaboration with the trade unions. A further consideration might be to limit compensation paid for disability resulting from an ocular injury which could have been prevented if appropriate protective measures had been undertaken.

Adult sports accounted for 4·8% of ocular injuries in the present study. Football (28%) and squash (17·1%) are the sports commonly implicated. Localised ocular injury is particularly frequent in squash, unlike football, in which eye injury is less common than injury to other parts of the body. In many sports, particularly squash and badminton, protective goggles could prevent ocular damage. These safety aids should be widely publicised on television and radio and their use encouraged in schools. Also, they should be readily available in sports shops, sports clubs, and recreational centres. The importance of such aids while playing squash and badminton has been emphasised by Ingram and Lewkonia,[30] North,[31] and Chandran.[32] Boxing, one of the classic causes of traumatic retinal detachment, is now better controlled and does not appear to be a common cause of eye injury, although lacerations to the orbital region occur in 2% of boxing matches.[33]

Agricultural eye injuries were responsible for only 4% of the total injuries in this survey. This seems a low figure for a hospital in a community with a large rural population. Blake[34] reviewed injuries among agricultural workers and found that vegetable substances, particularly twigs and branches, caused most eye injuries. Injuries involving machinery and chemicals were less common and corresponded with figures published by Smith[35] in a similar survey in 1940.

It would have been anticipated that increased mechanisation of farm work would have led to a higher incidence of eye injury in recent years, although such an expectation is probably offset by a corresponding reduction in the number of workers employed in the agricultural industry. Since a large proportion of agricultural injuries in the present survey also were caused by vegetable substances, preventive measures should include protective goggles, and farm workers should be made more aware of their high risk with regard to this type of injury.

Eye injuries in the home encompass a wide variety of different types of accident and accounted for 6·8% of ocular injuries in this survey. These accidents predominate at either end of the age scale: 15·9% of injuries in the 0–5 year age group and 41·3% in the 66+ year age group. Accidents occurring to children at sport or during play were the most common cause of eye injuries in the present survey and were responsible for 33·8% of all known causes of ocular injury. Other types of injury in children were less common, comprising some 17·9% of childhood injuries. The general public should be made aware of the vulnerability of children to certain types of injuries, e.g. catapults, darts, pencils, and sharply pointed instruments. Radio and television features and posters distributed to schools, clinics and health centres could be used to publicise the risk of such injuries. Health visitors also could contribute by offering mothers safety advice during routine consultations and visitations. Children should be encouraged to wear protective goggles during certain sports and while playing squash in particular.

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