Perforating eye injuries due to intraocular foreign bodies

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Summary

The results of sixty-four perforating eye injuries with intraocular foreign bodies (IOFB) treated at University Hospital over ten years were reported. Compared to an earlier report we found that the population at risk was the same and consisted of patients under 35 years (70%), males (95.3%) and work related (86%). The commonest causes of IOFB were hand hammer (64.1%) and grass cutting (20.3%). We also noted that while the incidence of cases had increased by 23%, the final visual outcome has improved significantly due to advances in preoperative diagnosis and surgical techniques. Preoperative factors found to have a statistically significant effect on the final visual outcome were the size of the IOFB, poor initial visual acuity, and the presence of the following complications: cataract, iris damage and vitreous haemorrhage. The outcome was also worse in posterior segment IOFBs but this was not statistically significant.

Keywords: Perforating eye injuries, intraocular foreign body, ocular trauma, cataract, vitreous haemorrhage, retinal detachment

Introduction

A perforating eye injury with retained intraocular foreign body (IOFB) is a very serious eye injury and is one of the main causes of permanent loss of sight and impairment of working ability.

A previous study of this condition was performed at this hospital approximately ten years ago by Teoh and Yow.[1] In their report of IOFBs seen over a ten year period from 1970 to 1979, they concluded that there was a significant loss of sight and that a good number of young adults end up with monocular blindness.

Since then there has been no further reports in the local journals regarding these aspects of IOFBs. It was felt timely that another study of the condition should be carried out to see if there has been any changes in the occurence, presentation, severity and results of surgery now as compared to a decade ago.

We were also interested to see if the following factors had any significant influence on the visual outcome: age, sex, type of work, size of IOFB, site of the IOFB and the presence of serious complications.

Methods and Materials

All cases of IOFB injuries operated in University Hospital from 1980 to 1989 inclusive were considered for the study. Superficial foreign bodies on the cornea and sclera were excluded. Double perforations and orbital foreign bodies were also excluded.

Data on the history of the injury, the pre-operative visual acuity and state of the globe, and the management of the injury were collected retrospectively from the hospital records.

Out of a total of 98 cases operated for this condition during this period, the notes for only sixty-four were available for examination. This gave an average annual incidence of 9.8. In the paper by Teoh and Yow, the number of patients available for review was only forty-eight. Though the total number of IOFBs for 1970 to 1979 was not specified in their paper, we were able to determine from our operating theatre records that a total of seventy-five cases were treated for that period. This gave an annual incidence of 7.5. Comparison of the incidence rates of 9.8 and 7.5 showed that there has been a 23% increase in the occurence of IOFBs over the two decades.

Follow up of the patients ranged from three weeks to three years with a mean follow up period of six months.

The initial visual acuity was the best corrected acuity taken on presentation at the eye casualty. The final acuity was the best corrected vision taken on the last follow up visit.

There were sixty-one males (95.3%) and three females (4.7%).

Age distribution is shown in Figure 1. It can be seen that over 40% of the cases occured in patients under the age of 25 and 70% under the age of 35 years. There was only one case under 15 years, and it was a child of 5 years who sustained an IOFB at home while playing.

Ethnic distribution were as follows: Malays sixteen (25%), Chinese thirty-four (53.1%) and Indians fourteen (21.9%).

The injury was industrial or work related in fifty-five cases (86.0%). Home injuries accounted for six cases (9.4%). One case (1.6%) occured in school and two (3.0%) were the result of motor vehicular accidents.

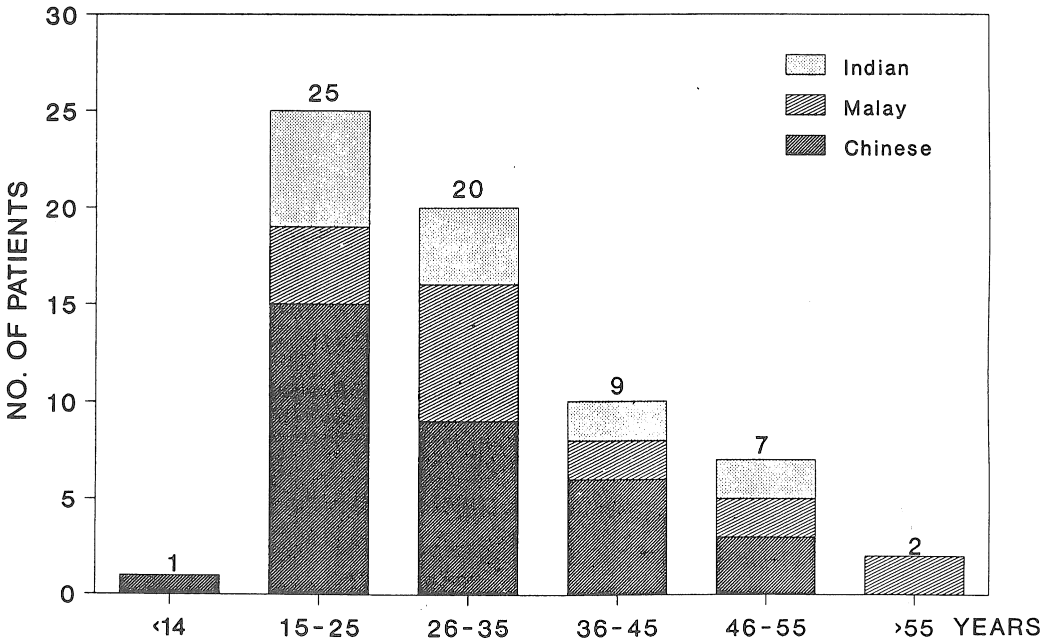

Fig. 1 : Distribution of IOFBs by age group and ethnic group

93.8% of the patients were labourers and semiskilled workers.

The cause of the injury in forty-one (64.1%) of the patients was because of the use of a hand hammer (Table I). In these cases, it was the high speed fragments broken off from the surface of the hammer or struck object on impact. None of these patients were wearing protective goggles at the time of the injury. Grass cutting injuries is a totally new type of injury as no cases were reported in the previous report. It accounted for thirteen (20.3%) of the cases. This form of injury was sustained with the use of a motorised, exposed grasscutting blade on a long handle which was used for trimming slopes, edges and small inaccessible areas. No cases were seen with the use of the usual lawn mowers.

Table I
Cause of Injury in Intraocular Foreign Body

Cause	No	%
Hammering	41	64.1
Grass cutting	13	20.3
Machining	2	3.1
Others	8	12.5
Total	**64**	**100.0**

The site of entry was recorded in Table II, where it was noted that the commonest site was corneal (78.1%). The final lodging site of the IOFB was in the anterior segment in twenty-three (35.9%) cases and posterior segment in forty-one cases (60.1%).

Table II
Site of Entry in Intraocular Foreign Bodies

Site	No	%
Corneal	50	78.1
Corneoscleral	5	7.8
Scleral	9	14.1
Total	**64**	**100.0**

Associated damage to the ocular tissues are detailed in Table III. The commonest involvement were corneal scarring in 50 cases; lens, with cataract formation seen in thirty (46.9%); and iris damage in thirty (46.9%). Of particular importance was vitreous haemorrhage which was seen in twenty-two (34.4%) patients.

Table III
Findings in intraocular foreign bodies

Findings	No	%
Corneal Scarring	50	78.1
Cataract	30	46.9
Hypopyon	5	7.8
Iris Damage	30	46.9
Vitreous Haemorrhage	22	34.4
Retinal Damage	4	6.3

Thirteen patients had immediate removal of the IOFB within 8 hours of occurence, twenty-one patients had surgery between 8 to 24 hours and the remaining 30 patients had delayed surgery after 24 hours.

Of the twenty-three patients with anterior segment IOFB, removal was successful in all cases, whereas in the forty-one patients with posterior segment IOFBs, successful removal was in only thirty-seven patients (90.2%). Of these, thirty-three were removed with a giant electromagnet and four were by vitrectomy and intraocular forceps. Of the four cases in which the IOFBs were not removed, one was a longstanding injury and the IOFB was noted to be encapsulated and his vision was good and therefore no attempt was made to remove it. The other three cases had failed removal with a giant magnet. These three cases occured in the earlier part of the study and there was not further recourse as vitreous surgery was not available then.

Of the sixty IOFBs that were retrieved for measurement, the size of the IOFB ranged from less than 1mm to over 10mm in the longest dimension (Table IV). The nature of the impact was such that most of the fragments thrown off were extremely minute and therefore it was not surprising that 60% of the IOFB are not more than 3mm in length.

Table IV
Size of IOFB in perforating injuries

Longest Dimension (mm)	No	%
< 1	13	21.7
2 – 3	23	38.3
4 – 5	13	21.7
6 – 10	8	13.3
> 10	3	5.0
Total	**60**	**100**

The IOFB was metallic in fifty-five cases, three were stone chips, one was a splinter of wood and one was of an indeterminate inorganic nature.

Results

In the assessment of the visual outcome the classification of visual impairment by WHO was used.[2] This classification was designed for ease of use by both doctors and paramedical staff as well as to aid uniformity in reporting internationally. In the classification, any visual acuity of 6/18 or worse was considered as visual impairment. Patients with visual impairment were further subdivided into various categories. These can be broadly divided into the low vision group (6/18 to 3/60) and the blind group (worse than 3/60).

Figure 2 compared the initial visual acuity with the final acuity. Of the sixty-four patients reviewed, the final visual acuity was better than or equal to 6/12 (good vision) in thirty-seven (57.8%), between 6/18 t0 3/60 (low vision) in twelve (18.8%) and worse than 3/60 (blind) in fifteen (23.4%). While it was noted that there was a higher number of patients able to achieve 6/12 or better vision postoperatively compared to the number presenting with similar vision, statistical analysis would not be valid because of the small number in many of the subgroups.

However we were interested to know the final outcome of patients who were blind (worse than 3/60) on presentation. We therefore separated the patients into blind and non-blind (better than 3/60) groups and analysed the final visual acuity in these two groups. The visual acuity at initial presentation was better than 3/60 in forty (62.5%) and less than 3/60 in twenty-four (37.5%) patients (Table V).

Of these forty patients with better than 3/60 vision at presentation, the final visual acuity was good vision in thirty (75%), and only three (7.5%) were blind. Of the twenty-four patients with less than 3/60 vision on presentation, the final visual acuity was good vision in only seven (29.2%) while a much larger proportion remained blind (12 patients or 50.0%). Statistical analysis by chi square test showed that initial visual acuity of worse than 3/60 correlated very significantly with poor final visual acuity. (p = 0.00019).

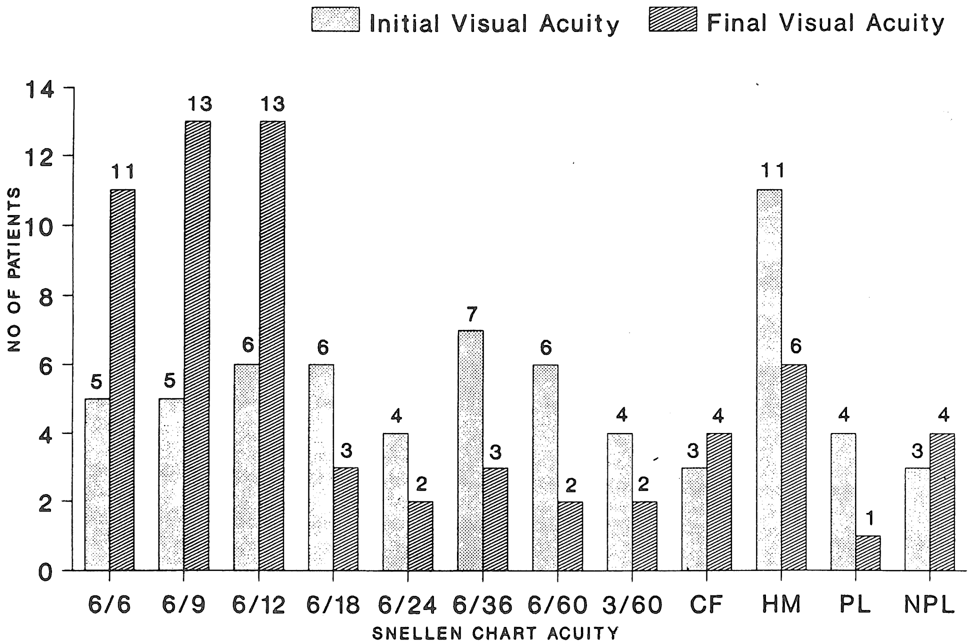

Fig. 2 : Comparison of initial visual acuity with final visual acuity

Table V
Factors influencing visual outcome

Risk Factors	**Final Visual Acuity**				**Chi Square Test**
	> 6/12 No (%)	6/18 – 3/60 No (%)	< 3/60 No (%)	Total No (%)	p value
Site of IOFB					0.143
Anterior	17 (74.0)	3 (13.0)	3 (13.0)	23 (100)	
Posterior	20 (48.8)	9 (22.0)	12 (29.2)	41 (100)	
IOFB Size					0.0226
Less than 3mm	24 (66.7)	8 (22.2)	4 (11.1)	36 (100)	
More than 4mm	11 (45.8)	3 (12.5)	10 (14.7)	24 (100)	
Initial VA					0.00019
> 3/60	30 (75.0)	7 (17.5)	3 (7.5)	40 (100)	
< 3/60	7 (29.2)	5 (20.8)	12 (50.0)	24 (100)	
Cataract					0.0076
Yes	12 (40.0)	6 (20.0)	12 (40.0)	30 (100)	
No	25 (73.6)	6 (17.6)	3 (8.8)	34 (100)	
Iris Damage					0.00078
Yes	10 (33.3)	6 (20.0)	14 (46.7)	30 (100)	
No	27 (79.4)	6 (17.7)	1 (2.9)	34 (100)	
Corneal Scarring					0.8214
Yes	29 (58.0)	10 (20.0)	11 (22.0)	50 (100)	
No	8 (57.1)	2 (14.3)	4 (28.6)	14 (100)	

Of the twenty-three patients with anterior segment IOFBs, the final visual acuity was good vision in seventeen (74.0%) and blindness in three (13.0%). Of the forty-one patients with posterior segment IOFB, the final visual acuity was good in twenty (48.8%) while twelve (29.2%) patients were ultimately blind compared to anterior segment IOFBs. However chi square test did not show that this was significant (p = 0.143).

For statistical analysis of visual outcome compared to the size of the IOFB, the patients were grouped into two categories only; those with IOFBs measuring 3 mm or less and those that are 4 mm or longer. This was necessary because of the small numbers present in some subgroups. Of the thirty-six patients with IOFBs of 3mm or less, twenty-four had good final vision, eight had low vision and four were blind. Of the twenty-three patients with IOFBs of 4mm or more, only eleven had a good visual outcome, three had low vision and ten were blind. There was a significant correlation between the size of the IOFB with a worse outcome. (p = 0.0226).

With regards to complications, the absence of cataract and iris damage correlated very significantly to a good visual outcome. Chi square tests revealed a p value of 0.0076 and 0.000078 respectively. These findings related well to the clinical impression that the greater the disruption to the eyeball, the poorer the final visual prognosis. Corneal scarring did not appear to be significant as a prognostic factor. This might be due to the fact that the term corneal scarring was too generalised and did not differentiate scarring involving the visual axis or causing severe astigmatism from trivial scarring.

Of the thirty-three patients who had successful electromagnetic extraction of the IOFB from the posterior segment, eighteen had associated vitreous haemorrhage. Of these eighteen patients eleven subsequently developed retinal detachment and required further surgery. Out of the remaining fifteen patients in this subgroup who did not have vitreous haemorrhage, only three subsequently developed a retinal correlation between vitreous haemorrhage and retinal detachment in this subgroup (p = 0.0428).

No significance was found for age, sex, ethnic group, place of work, occupation, cause of injury and duration before surgery in relation to the final visual outcome of the injury.

Discussion

Compared with the study done in this Hospital in 1981 there has been a 23% increase in the number of cases of IOFB treated. The enlarging population of Kuala Lumpur and Petaling Jaya due to urban migration may account for this increase. This is reflected in our hospital statistics[3] which showed that the total hospital outpatient attendance over the two periods has also increased by 25%. It is likely that the increase is also associated with the accelerated industralisation of the city and its as most of the injuries are industrial of work related. It is also possible that the occupation safety standards are not maintained at a high level in some workplaces and this has a role in the causation of eye injuries.

The population characteristics for the two studies were very similar. The injury was industrial and work related in 82% in the first study compared with 86% in this study. There was a preponderance of Chinese patients in both studies. The majority of patients were young (77% below 30 years in the first study compared with 70% below 35 years in the second). In both studies, the patients were predominantly male. It is clear that the population at risk is the young industrial workforce and this has not changed over the two decades. Serious and permanent injuries suffered in this age group has marked repercussions, as it not only involves the diminution of the able bodied workforce nationally and loss of potential income individually but the need for chronic care and social welfare for these young adults for very many years.

While the population characteristics have not changed and the incidence has increased, it is gladdening to report that the visual outcome has improved significantly over the interval of the two studies. In the previous report, only 37% of patients had an outcome of 6/12 or better, this present study has an outcome of 6/12 or better in 57.8% (p = 0.0333). This improvement reflects on a number of factors. Firstly there has been an improvement in preoperative diagnosis with the use of computerised tomography scanning which allows for more accurate localisation of the IOFB leading to safer removal of the IOFB.[4] Secondly surgical techniques and instrumentation has changed radically over this period. The introduction of vitreous microsurgery and intraocular removal of the IOFB with microforceps has reduced the uncertainty and unpredictability of the giant electromagnet and its subsequent complications. Thirdly the use of the new viscoelastic agents like hyaluronic acid to protect ocular tissues during surgical manipulation has allowed the surgeon more flexibility and manoeuvrebility in the eye. In fact this improvement was anticipated by Teoh and Yow in their paper as was reported in their conclusion.

We also agree with them and others[5] that a great number of such injuries are preventable and that those at risk should be made aware of the danger. Industrial safety standands should be maintained and enforced in all workplaces where workers are exposed to the risk of IOFBs. In particular we would recommend that all workers using hand hammers and grasscutters using the machine as described in this paper should wear protective goggles. The importance of wearing this simple device in preventing a serious eye injury should be stressed in health education programmes. Grasscutting machines should have a surrounding guard around the blade to prevent chips from being thrown in all directions so as to reduce the risk of injuring passerbys.

We also confirm that certain factors are of great prognostic significance on the final visual outcome. These are:

1. Size of the IOFB. Larger IOFBs have a worse prognosis.

2. The presenting visual acuity. Patients with poor visual acuity pre-operatively tend to have poor final vision.

3. The presence of cataract and iris damage related significantly to a worse visual outcome.

4. The presence of vitreous haemorrhage correlated to the higher risk of developing a subsequent retinal detachment.

These factors have been shown in other studies[6-9] to be significant risk factors. However we were not able to show that anterior segment IOFBs had a statistical significantly better visual outcome, though our figures showed that 73.9% of anterior segment IOFBs will get 6/12 vision or better while only 48.8% of posterior segment IOFBs have a similar outcome.

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