

Industrial accident-related ocular emergencies in a tertiary hospital in Singapore

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ABSTRACT

Introduction: We present a review of industrial accident-related ocular trauma, from the perspective of the emergency setting of a tertiary hospital in Singapore.

Methods: A retrospective analysis of patients seen by Tan Tock Seng Hospital's emergency ophthalmology service over a six-month period was performed. Data on clinical presentation, cause of injury, use of protective eyewear and subsequent losses of days-of-work were collected via a standardised telephone interview and review of case-sheets.

Results: A total of 300 persons presented with a diagnosis of industrial accident-related ocular trauma, out of the 1,460 patients seen during the study period. 95.7 percent were non-residents and the average age was 31 years. 99.3 percent were males. 66.0 percent were provided with protective eyewear, while 44.7 percent of those were non-compliant. The most common types of injuries were superficial foreign body (71.3 percent), chemical injury (10 percent) and blunt trauma (4 percent), while severe injury requiring admission and emergency surgery occurred in 15 cases. Average loss of days of work was 3.4 days.

Conclusion: Industrial accident-related ocular trauma comprises a relatively large proportion of the patients requiring ophthalmic review at the emergency service level in Singapore. These patients are mainly young, non-resident men and the injuries were generally minor. These are largely preventable with the use of well-fitting protective eyewear and strict compliance. This would greatly reduce the unnecessary loss of workdays. Therefore, there is a need to review the design, and reinforce the strict implementation of occupational eye safety programmes, especially among non-resident workers.

Keywords: eye injuries, industrial accidents, ocular

emergency, ocular foreign bodies, protective eyewear

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INTRODUCTION

Ocular trauma is a global cause of visual morbidity.⁽¹⁾ Worldwide, more than half a million blinding injuries occur every year.^(2,3) There is a bi-modal age distribution of severe ocular trauma, with a large preponderance of injuries affecting males.⁽⁴⁻⁸⁾ The overall financial costs are estimated to be more than hundreds of millions of dollars annually.⁽⁹⁾ Chiapella et al and Vernon estimated that approximately half of all patients who present to an eye casualty department do so because of ocular trauma.^(10,11) In 2001, Voon et al concluded that at the emergency service level in Singapore, ocular trauma involved mainly young, non-resident males who had sustained work-related injuries.⁽¹²⁾ In a more recent local study, Woo and Sundar found that more than half of all eye injuries (56.4%) were work-related, with 54.1% of patients having been injured on industrial premises.⁽¹³⁾ 46.6% involved non-residents. Other epidemiological studies worldwide have delineated a similar high-risk population.

Singapore has a work force of about 2.2 million. Labour shortages persist in the service sector and in blue-collared positions, such as in the construction industry. Foreign workers help make up for this shortfall.⁽¹⁴⁾ In 2000, there were about 600,000 foreign workers in Singapore, constituting 29.2% of the total work force.^(15,16) Singapore's safety standards have improved steadily over the last 20 years. However, industrial accident (IA) frequency rates have stagnated at 202 IA per million man-hours worked in the past few years. Industrial accident statistics for 2005 indicated that ocular injuries accounted for 3%, and this has been the trend for the last ten years.⁽¹⁷⁾ It can be seen that in Singapore, work-related injuries are a major source of ocular trauma, especially in foreign workers. This study tries to characterise the epidemiology of work-related ocular accidents in Singapore.

METHODS

This was a retrospective study of patients seen by the ophthalmology department at Tan Tock Seng Hospital's emergency service over a six-month period (March to

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Fig. 1 Graph shows ages of patients.

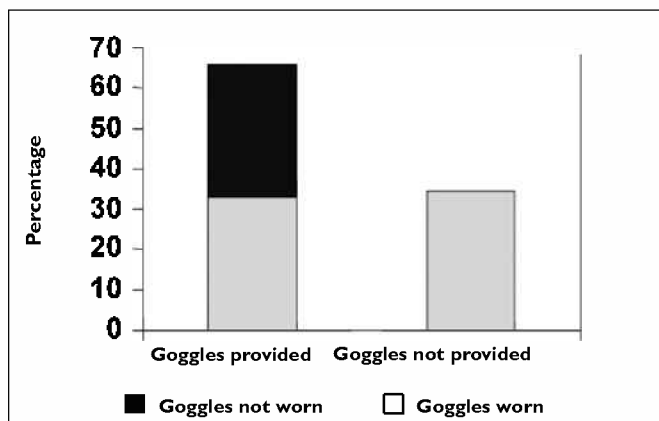


Fig. 2 Bar chart shows provision of safety wear.

September 2006). Tan Tock Seng Hospital is the second largest general hospital in Singapore, but its emergency service department is the busiest in the country as a result of its central location.⁽¹⁸⁾ All patients, who had sustained ocular injuries as a result of work-related accidents at the place of work, were included in the study. Data was obtained via review of case sheets and telephone interviews. Patient demographics, such as age, sex, race and nationality, were recorded. Race was classified as Chinese (includes persons of all dialect groups of Chinese origin), Indian (all persons of Indian, Pakistani, Bangladeshi and Sri Lankan origin), Malay (all persons of Malay or Indonesian origin) or others (comprising all persons other than the first three categories, such as Europeans, Eurasians, Arabics and Japanese). The nationality of the patient was classified as either Singaporean (inclusive of permanent resident status) or non-resident.

Details on clinical presentation, such as visual acuity using the Snellen chart, ocular injury sustained as found on examination by slit lamp biomicroscopy, intraocular pressure with applanation tonometry and fundus examination, were noted. The ocular injury sustained was classified using the Birmingham eye trauma terminology.⁽¹⁹⁾ Patients with superficial corneal foreign bodies, epithelial defects and chemical injuries were

classified as lamellar injury. Blunt trauma was classified as contusion and full thickness corneal lacerations were classified as penetrating lacerations.⁽¹⁹⁾ The type of work done during time of injury and association with any high-speed machinery, as well as the need for hospital admission, length of stay and any intervention performed, were recorded. Data, with regard to clinical condition during subsequent follow-up visits, visual acuity with the Snellen chart and final visual acuity upon discharge or last visit, was also recorded.

The cause of injury, use of protective eyewear, provision of protective eyewear and reason for not using them when provided and subsequent losses of days-of-work, were collected via a standardised telephone interview. The telephone interview was conducted by three masked interviewers and was conducted in English, Mandarin, Malay or Tamil. Patients were contacted via their personal handphone numbers or their supervisors at their worksite. Current employment status of the patients, reasons for loss of employment or department, if any, and use of protective eyewear after the injury, were noted. The ability to understand the local language (i.e. English, Mandarin, Malay and Tamil) of the involved patient was achieved through the telephone interview.

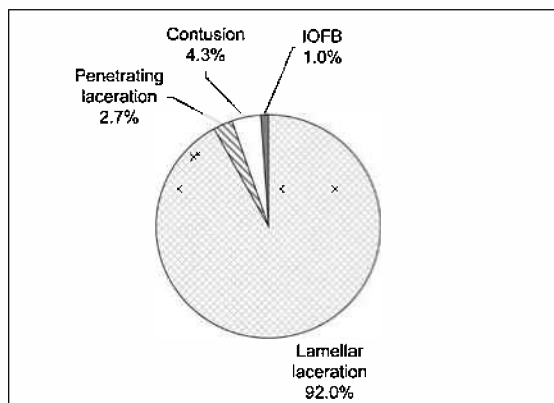
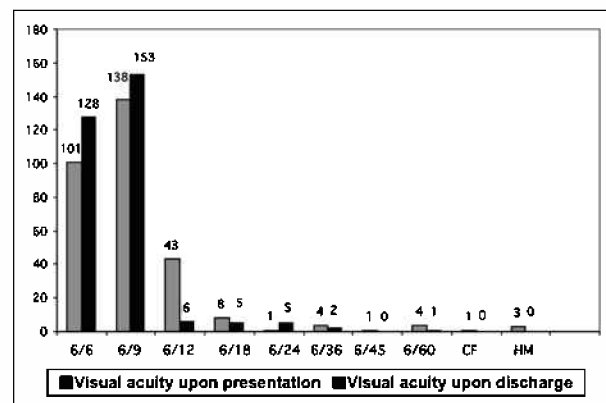
RESULTS

A total of 300 persons (20.5%) presented with a diagnosis of industrial accident-related ocular trauma, out of the 1,460 patients seen during the study period in the emergency department. 38 (12.7%) patients were either lost to follow-up or uncontactable for the telephone interview. 287 (95.7%) patients were non-residents, and the most common countries of origin of these patients were Bangladesh, China and India. The racial distribution was 74 (24.7%) Chinese, 199 (66.3%) Indians, 17 (5.7%) Malays, and ten (3.3%) from other racial groups. The mean age was 31 (range 17–55) years (Fig. 1), and the majority (99.3%) were mainly males. All the Chinese and Malays interviewed were able to understand Mandarin and the Malay language, respectively, while only 130 (74.7%) of the Indians interviewed were able to understand one of the four languages used.

Using the Birmingham eye trauma terminology,⁽¹⁹⁾ 276 (92%) sustained lamellar laceration, 13 (4.3%) suffered from contusion, eight (2.7%) had penetrating laceration, and there were three cases (1%) of intraocular foreign body (Fig. 3). Management of patients with lamellar laceration involved the removal of superficial foreign bodies and irrigation of the eye for those with chemical injury, followed by appropriate pharmacological management and follow-up in the outpatient clinic. Injury requiring admission and emergency surgery occurred in 15 (5%) cases (Table 1). 11 (3.7%) cases required emergency

Table I. List of ocular injuries sustained.

	Ocular injuries requiring admission	Ocular injuries seen as outpatient
Corneal laceration	4	11
Lid laceration	1	0
Scleral laceration	3	0
Corneal foreign body	1	214
Chemical injury	3	27
Intraocular foreign body	3	0
Corneal/conjunctival abrasions	0	21
Blunt trauma	0	12

**Fig. 3** Pie chart shows types of ocular accidents.**Fig. 4** Bar chart shows ocular injuries requiring admission.

surgery under general anaesthesia; eight of these required toilet and suture of corneal or scleral lacerations, and the other three cases required removal of an intraocular foreign body. The other four cases requiring admission were three cases of severe chemical injury requiring administration of intensive topical medications, and one case of infected superficial corneal foreign body requiring intensive topical antibiotics.

Upon presentation, 101 (33.7%) patients had a visual acuity of 6/6 on the Snellen chart, 138 (46%) had a visual acuity of 6/9, 43 (14.3%) had a visual acuity of 6/12, eight (2.7%) had a visual acuity of 6/18, and ten (3.3%) had a visual acuity 6/24 or worse. Upon discharge, 128 (42.7%) had a final visual acuity of 6/6, 153 (51%) had a visual acuity of 6/9, six (2%) had a visual acuity of 6/12, five (1.7%) had visual acuity of 6/18, and eight (2.7%) had a visual acuity of 6/24 or worse. Among these latter eight patients, four patients with penetrating laceration had a final visual acuity of 6/24, and one patient with lamellar laceration had final visual acuity of 6/24. Two patients with penetrating laceration had a final visual acuity of 6/36 and one patient with intraocular foreign body had final visual acuity of 6/60 (Fig. 4). 259 of the 300 (86.3%) patients recruited in the study are currently still employed, while 41 (13.7%) had lost their employment or had been deported back to their countries. Only 56 (21.4%) of cases used some form of protective eyewear, while 206 (78.6%) of those with ocular injury did not use any form

of protective device. 34% claimed they were not provided with any protective devices. 66% were provided with protective eyewear, while 44.7% were provided with protective eyewear but were non-compliant (Fig. 2). Common reasons cited were: ill-fitting protective eyewear and poor vision due to fogging from sweat. After injury, only 77 (29.4%) consistently wore protective eyewear.

Among all the cases of injuries that required admission, only two cases (13.3%) wore protective eyewear. The activities causing injury were nine cases of hacking, hammering, cutting or grinding, one case of falling from height, three cases of splash injury, and two cases of being hit by a falling object. The mean length of stay was 15.9 (range 7–30) days. The construction industry was the most common setting for lamellar lacerations, such as superficial corneal foreign body (71.3%; 214 cases). Grinding (16.7%), cutting metal (9.3%), welding (6%), hammering (5%) and drilling (4.7%) were the specific activities in the majority of the cases. Average loss of days of work was 3.4 days.

DISCUSSION

Industrial accident-related ocular trauma comprises a relatively large proportion of the patients requiring ophthalmic review at the emergency service level in Singapore. In our study, 20.5% of all patients with eye injury seen during the study period were work-related. These patients are mainly young non-resident men (95.7%)

and the injuries were generally minor (i.e. not requiring admission or emergency surgery). Most studies of ocular injuries were usually associated with a bi-peak age distribution with increased incidence in the very young or the elderly; however, in this study, the peak age was 27–31 years, and this was likely due to the age profile of the non-resident workers employed, which excludes the very young and the very old. A previous study done on foreign workers in Singapore in 2006 also found that a large group of the injured was within the 20–30-year-old age group.⁽²⁰⁾ A postulated reason for the dip in incidence beyond the age of 30, is the increased maturity and awareness levels from previous experience among the foreign workers.

Voon et al found the incidence of work-related ocular trauma in Singapore to be more than 70% in 1997,⁽¹²⁾ while Woo and Sundar reported in 2005 that 56.4% (n = 75) of all eye injuries in Singapore were work-related.⁽¹³⁾ Rates of work-related eye trauma vary worldwide from reports of 70% in the United Kingdom⁽²¹⁾ to 38.9% in Taiwan,⁽²²⁾ 32.8% in Greece,⁽²³⁾ 19.6% in Scotland⁽²⁴⁾ and 14.3% in the United States⁽²⁵⁾. A unique problem in Singapore, however, is the number of foreign workers here. The number of foreign workers employed in Singapore is steadily rising annually in an attempt to overcome our scarce local manpower resources. In 2006, Singapore's non-resident workforce increased 170% to 670,000.⁽²⁶⁾ Of these foreign workers, approximately 87% are lower-skilled workers, concentrated mainly in the construction and electronics industry.^(14,27) Foreigners constituted approximately 29% of Singapore's total labour force in 2000, the highest proportion of foreign workers in Asia.

Industrial accident frequency rates have stagnated over the last ten years despite various workplace safety measures being put in place.⁽²⁸⁾ Ocular trauma, in particular, has not decreased, despite legislative laws in place for workplace safety.⁽¹⁷⁾ In this study, among the cases of ocular injuries that required admission, nine (60%) were injured by high-speed machinery involving hacking and grinding activities. The most common cause of ocular injury in the construction industry was lamellar lacerations, such as superficial corneal foreign body (71.3%; 214 cases), and this was associated with grinding (16.7%), cutting metal (9.3%), welding (6%), hammering (5%) and drilling (4.7%). It is in this target group which more attention should be paid, for future prevention of injury. 94% of patients presented with a visual acuity of 6/12 or better, and upon discharge, 95.6% had a final visual acuity of 6/12 or better. However, 13 patients had poor final visual acuity outcomes despite treatment, and these were the patients who sustained severe ocular trauma, such as penetrating lacerations and intraocular foreign bodies, and had poor visual acuity upon presentation.

Ocular traumas in the industrial setting are largely

preventable with the use of well-fitted protective eyewear and strict compliance. Despite the work practice policy and legislation of strict guidelines on mandatory wear of protective eye devices, 34% of cases claimed they were not provided with any, while 44.7% were provided with protective eyewear but were non-compliant. This finding is similar to previous reports by Voon et al, who found that 43.7% had been provided with protective eyewear but had not used them at the time of injury and 34.6% had not been provided with any,⁽¹²⁾ and by Woo and Sundar, who found that 38.7% had been issued protective devices but had not used them and 32% reported that none had been issued.⁽¹³⁾ The high rate of not issuing protective eye devices by employers, non-compliance in employees, and the lack of change over the last few years, reflect that the current guidelines as set down by the Factories Act (Chapter 104) in Singapore, mandating the issue of suitable goggles and effective screens for all work processes that involve a special risk for eye injury,⁽²⁸⁾ are alarmingly inadequate. Perhaps, better education on workplace safety measures and effective preventive strategies for both employers and their employees need to be considered, as well as stricter legal action taken against the non-compliers.

In our study, 21.4% of cases used some form of protective eyewear and 13.3% of those with ocular injury requiring admission and emergency surgery used a protective eye device. Patients who sustained ocular injury despite use of protective eye device claimed that the device was ill-fitting or the eyewear was inappropriate. One patient had sustained lid lacerations as well as conjunctival lacerations when his protective eye piece shattered when hit by a metal pipe. Another patient also sustained lower lid and cannalicular lacerations when his eye piece broke when a light bulb fell on him. Patients also cited reasons, such as poor visibility due to fogging from sweat and discomfort, for non-compliance with protective devices. After injury, only 29.2% consistently wore protective eye devices. This data is consistent with findings by Connel et al, that reasons given by Irish construction workers for not wearing eye protection included poorly-fitted eyewear, habit, fogging of eyewear or non-availability of eyewear.⁽²⁹⁾ For those who sustained eye injuries in spite of using protective eyewear, attributed the cause to ill-fitting or inappropriate eyewear. 90% of the cases had previous ocular trauma and this did not influence their decision to use the safety eyewear. Perhaps there is a need to review the design of eye safety wear, and to improve the comfort and visibility, ergonomics, resistance and durability,⁽³⁰⁾ in order to increase compliance and provide maximum protection.

Results from our study show that a large majority of patients presenting with industrial accident-related ocular trauma were Indians (66.3%), followed by Chinese

(24.7%). This racial variation in Singapore had previously been reported by Wong and Tielsch, who found that persons of Indian origin had almost twice the risk of either Chinese or Malays in sustaining an eye injury.⁽³¹⁾ The main languages in Singapore are English, Mandarin, Malay and Tamil. The results from our telephone interview showed that 100% of the Chinese and Malays interviewed were respectively able to understand Mandarin and Malay, while only 74.7% of the Indians interviewed were able to understand any one of the four local languages used. The language barrier between foreign workers and their employers could be an important factor in effective safety training and communication, resulting in a low prevalence of protective eyewear use. This may be especially true among the Indians, hence resulting in a higher risk of sustaining eye injury. O'Conner et al had suggested that language barriers and inadequacy of training lead to higher injury and fatality rates in immigrant workers.⁽³²⁾ Lack of supervision as well as loose legislative efforts are all important factors that contribute to the low prevalence of using protective eyewear as well. In addition to the impact on affected individuals, including risk of using blindness, there are profound social implications regarding the lost productivity by young men, unnecessary loss of workdays and socioeconomic costs.

Our study is a retrospective analysis based on review of case sheets and telephone interviews with the patients. This provides a good overall perspective of industrial accident-related ocular trauma; however, there are limitations, such as recall bias, due to the retrospective nature of this study. Hence, a larger scale prospective study across various emergency departments in Singapore may be able to provide more uniform data collection and better documentation, as well as less geographical bias. Currently, a prospective study is ongoing to assess the severity of eye injuries across different industries and their relation to the use of any protective eyewear as well as to their design.

In conclusion, our study shows that industrial accident-related ocular trauma comprises a relatively large proportion of the patients requiring ophthalmic review at the emergency service level in Singapore. These patients are mainly young, non-resident men, their injuries were generally minor, and the majority had good final visual acuity outcomes. These injuries, however, are largely preventable with the use of well-fitted, durable, protective eyewear with good visibility, and strict compliance on its use. This would greatly reduce the unnecessary loss of workdays. There is thus a need to review the eyewear design and reinforce the strict implementation of occupational eye safety programmes, especially among non-resident workers.

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