ORIGINAL RESEARCH

Ocular trauma in Hong Kong: a prospective survey of 1799 patients

Chun-Yu Ko, MBBS, FRCS, Woon-Ming Chan, MBBS, FRCS, Raymond K. K. Tse, MBBS, FRCS
The NTS Ophthalmic Team, Department of Ophthalmology, Caritas Medical Centre, Sham Shui Po, Hong Kong, China.

Correspondence and reprint requests:
Chun-Yu Ko, Department of Ophthalmology, Caritas Medical Centre, Sham Shui Po, Hong Kong, China.

Acknowledgement
This research is supported by the Dr Timothy K. C. Liu Memorial Fund.

Abstract

Aim: To determine the incidence and nature of ocular trauma in Hong Kong.
Patients and methods: Patients with eye injuries presenting to the Ophthalmic Department of the Caritas Medical Centre from 1 January 2000 to 31 December, 2000. Age and sex, activity at the time of injury, place of injury, and identifiable objects causing injury were noted, as well as the use of eye protection, where appropriate, and the presence or absence of adult supervision in the case of injury to children.
Results: The workplace accounted for 62% of all injuries and work-related injury constituted the largest amount of severe ocular injury with visual impairment. Less than 7% of workers had been using proper eye protection at the time of injury. A disproportionately large amount of sight-threatening injuries also occurred at home. Children were particularly susceptible to eye injury, especially during unsupervised play and as a result of mishandling of household items. Thus, this study shows a large burden of potentially preventable eye trauma is borne by the young urban population.
Conclusion: Ocular trauma is an important cause of preventable visual morbidity, particularly among younger people who are at lower risk for chronic ocular diseases.

Key words: *Epidemiology, Eye injuries, Vision*

Introduction

Ocular trauma is a leading cause of major visual morbidity globally. Besides causing visual impairment, ocular trauma results in diminished quality of life and economic costs due to lost wages and health care expenses.[1,2] Prevention of ocular trauma, however, is frustrated by the lack of epidemiological data. Previously published local data has focused on severe injuries,[3] or a particular group of patients.[4] As these were retrospective studies, the exact circumstances surrounding eye accidents often could not be ascertained.

This prospective study reviewed patients with ocular injury presenting to a busy eye casualty department in Hong Kong during a 12-month period. Besides recording biographical data and diagnosis at the time of initial evaluation, the details of the context in which the ocular injury occurred were also noted. The aim was to obtain clinical and epidemio-logical data on the basis of which future preventive measures could be developed.

Patients and methods

This was a prospective survey of all patients with ocular trauma presenting to the Ophthalmic Department of the Caritas Medical Centre from 1 January 2000 to 31 December, 2000. The Caritas Medical Centre Ophthalmic Department serves the population in the New Territories South Region. The estimated population at risk for injury during the study period was 1.1 million. For each patient, the following details were noted on standardized forms: age and sex, activity at the time of injury, place of injury, and identifiable objects causing injury. For work-related accidents, the type of occupation at the time of injury, and whether protective eyewear was worn were also noted. For sports injuries, the type of sporting activity and the use of ocular protection was recorded. For children aged 16 years or younger, whether an adult was present at the time of injury was recorded. All forms were completed by a qualified eye doctor attending the patient.

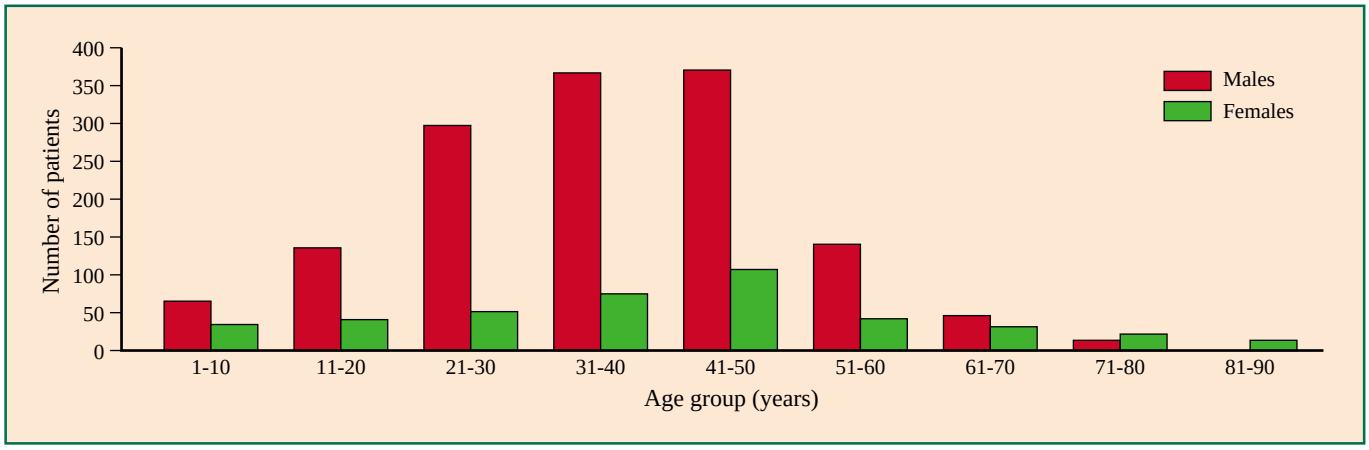

Figure 1. The incidence of ocular trauma for sex and age.

The most severe tissue injury in each of the following categories was recorded for each eye: anterior segment injury, posterior segment injury, periorbital injury, orbital injury, and nerve injury. Visual outcome was defined in terms of the best-corrected Snellen visual acuity in the injured eye (in the case of bilateral injuries, the more severely affected eye was noted). The definition of visual outcome was modified slightly from the definitions used by the World Health Organization.[5] A good visual outcome was defined as a Snellen visual acuity of 6/12 or better. Blindness was taken to be an acuity of less than 6/60 and visual impairment was taken as an acuity of 6/18 to 6/60 (inclusive). If admission to hospital was required, records were identified and further treatment, including operations performed, were determined.

Results

Of the 9717 patients with ocular emergency seen at the Caritas Medical Centre Eye Department over the study period, 1799 (18.5%) cases were due to ocular trauma — 1414 (78.5%) patients were male and 385 (21.4%) female. The mean age was 36.6 years (range, 1 to 89 years, SD 15.3), with 58% of patients aged in the first 4 decades of life. Children aged 16 years or younger accounted for 8% of patients. For males, the incidence of ocular trauma peaked in the 30 to 50 years age group, and decreased thereafter. For females, the peak incidence occurred in the 40 to 50 years age group (**Figure 1**).

The causes of injury are summarized in **Figure 2**. Work-related injury was the single most common cause of trauma, with 61.5% of injuries occurring in the workplace. This was followed by the home (20.4%), streets (5.9%), sports and recreational areas (4.1%), schools (2.6%), other public areas (2.5%), and roads (1.4%). Place of injury was not specified in 1.6% of cases.

Among the injured workers, 1005 (90.2%) were male. The mean age was 38.4 (age range, 16-72 years). Causes of eye injury in work-related accidents included injuries from projectiles (56%), burns (22.4%), sharp objects (11.1%), blunt objects (8.2%), and blasts (2.2%). The most common

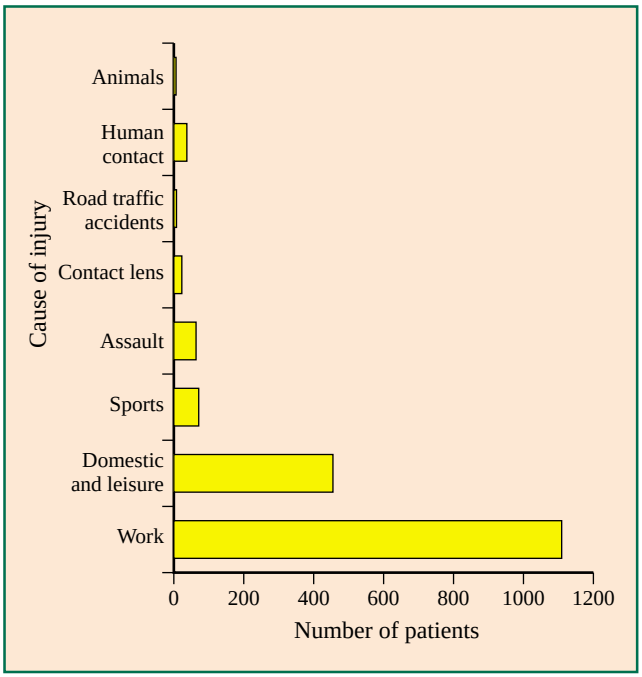

Figure 2. Causes of injury.

activity at the time of injury was drilling (223 cases) [**Figure 3**]. Projectile injuries by foreign bodies (metallic and non-metallic) contributed 48.8% of all work-related injuries (544 patients), resulting in 84 cases of poor visual outcome and 2 cases of blind eyes. Of the injured workers, 73 (6.6%) were wearing safety eyewear. 61 (5.5%) of whom either were using non-safety eyewear or using safety eyewear incorrectly. In all, 980 patients (88%) did not use any form of safety eyewear. The reasons given for not using safety protection were: protection not usually indicated (38.8%), unaware of potential hazards (43.2%), protective eyewear not available (5.6%), forgot to use protection (2.7%), inconvenience and discomfort (5.8%), or other unspecified reasons (3.9%).

Domestic and leisure activities (including falls) caused 457 injuries. Of these, 108 (23.6%) occurred in children aged 16 years or younger, and 78 (17%) in elderly citizens aged 60 years or older. In total, domestic and leisure activities contributed 25.4 % of all trauma cases. Accidents at home

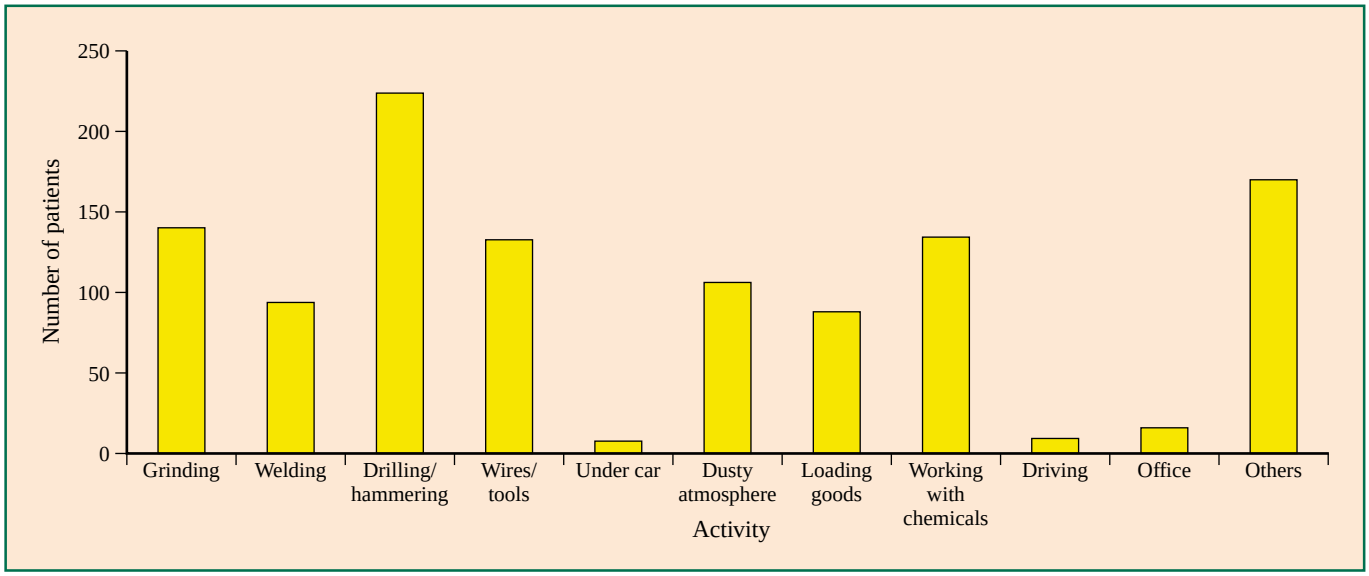

Figure 3. Activities during work-related injuries.

accounted for 20.5% of all ocular injuries (369 patients). The causes of domestic injuries were varied. Mishandling of domestic cleansing solutions and pharmaceutical lotions (such as skin ointment) was the single most important cause of eye injury at home (57, 15.4%). Foreign bodies in the eye ranked second as a cause of domestic injury (24, 6.5%), and there were 61 cases of visual impairment and 3 cases of blindness resulting from domestic injury. Of these patients, 56% were aged 16 years or younger or 60 years or older.

The total rate of ocular trauma in children aged 16 years or younger was 8% (145 cases). The causes of ocular injury in this age group are summarized in **Table 1**. Adults were present at the time of injury in only 12.4% of cases. There were 5 cases of suspected non-accidental injury, the youngest aged 1 year. The condition of shaken baby syndrome was diagnosed in that child, with deprivation amblyopia resulting from a unilateral premacular blood clot.

Sports injury ranked third as a cause of trauma overall (**Table 2**). The mean age in this patient group was 25.4 years. A male preponderance was seen, with a male to female ratio of 5:1. Of the 73 cases of sports injury, eye protection was not used by 71 patients, the most common reason being that protection was not usually indicated for that sporting activity. Most injuries occurred as a result of player contact during football (22 cases). No cases of blindness resulted from sports injury. There were 8 cases of visual impairment.

Injuries as a result of assault numbered 68 cases. There were 10 cases of visual impairment. One patient became blind due to compressive optic neuropathy. There were also 41 injuries due to non-assault contact. Blunt injury resulted in blindness due to retinal detachment in 1 adult.

Contact lens wear accounted for 30 cases of ocular trauma, mechanical abrasions and incorrect use of solutions being the major causes. Most of these injuries were superficial, with good recovery. Only 1 case of corneal abrasion resulted in visual impairment.

Table 1. Cause of ocular injury in children aged 16 years or younger.

Cause	Number of patients
Household items:	66
Sharp objects: paper, pens, glasses, wires, nails, tree branches	41
Domestic chemicals: cleansing agents, pharmaceutical solutions	16
Blunt objects: bungee cords, rods and sticks	9
Body part of another person	29
Projectiles:	22
Foreign bodies	9
BB pellets	5
Thrown toys and objects	8
Sports:	17
Basketball	6
Football	5
Badminton	2
Tennis	1
Squash	1
Other sports	2
Falls	6
Non-accidental injury	5

Table 2. Cause of sports injury in total patient group.

Type of sport	Number of patients
Football	22
Basketball	20
Badminton	9
Squash	3
Tennis	2
Shooting games	1
Other sports	16

Table 3. Tissue injury sustained in total patient group.

Tissue injury	Number of patients
Anterior segment injury	
Corneal abrasion	786
Corneal foreign body	388
Chemical injury	219
Subconjunctival hemorrhage	157
Corneo-scleral laceration	16
Traumatic glaucoma	4
Lens injury	4
Posterior segment injury	
Retinal edema	32
Vitreous and retinal hemorrhage	9
Retinal detachment	3
Traumatic macular hole	3
Periorbital/ocular adnexal injury	
Orbital contusion	105
Eyelid lacerations	55
Eyelid burns	9
Eyelid foreign bodies	7
Orbital injury	
Orbital fracture	5
Nerve injury	
Traumatic optic nerve compression	1

Road traffic accidents presented less commonly as a cause of ocular injury. Most were superficial injuries due to shattered glass or orbital contusion. Visual impairment due to corneal abrasion was seen in only 1 patient.

Ocular injuries were categorized into 5 groups: anterior segment injury, posterior segment injury, periorbital and ocular adnexal injury, orbital, and nerve injury. Some patients sustained more than one type of injury, thus the total number of injuries is greater than the total number of patients (**Table 3**). Corneal abrasion was the most frequent injury identified (786). A total of 65 patients required admission to hospital. Surgery was necessary for 50 (2.7%) patients in a total of 57 surgical sessions involving 64 operative procedures (**Table 4**). The commonest operations performed were repair of eyelid lacerations (19). Vitreoretinal surgery was indicated for three patients. Examination using general anesthesia was indicated, especially for very small children judged uncooperative with respect to detailed examinations (8 patients). In 1 young patient with traumatic endophthalmitis, 4 operations were performed in an attempt to salvage the eye.

Table 4. Major surgical procedures performed for ocular injuries in total patient group.

Surgical procedure	No. of procedures
Anterior segment procedures:	27
Removal of foreign bodies from ocular surface	9
Repair of corneo-scleral lacerations and wound dehiscence	15
Cataract extraction	2
Aqueous diagnostic tap	1
Posterior segment procedures:	7
Retinal detachment surgery	3
Vitrectomy	2
Removal of foreign body from posterior segment	1
Cryopexy	1
Eyelid and adnexal procedures:	22
Repair of lid lacerations	20
Eyelid reconstruction	1
Emergency canthotomy	1
Examination using general anesthesia	8

Final visual outcome was not documented for 419 patients. The majority of this group were patients with minor injuries who failed to attend follow-up appointments. A total of 299 patients had a poor visual outcome. Of these, 15 had eyes that were blind. There were 7 cases of blindness due to work-related accidents. All of these workers had not used any form of eye protection. The causes of poor visual outcome are summarized in **Figure 4**. Of the 191 cases of poor visual outcome due to work-related accidents, 174 patients were either using no eye protection or incorrect eye protection.

Discussion

Ocular trauma is an important, preventable public health problem worldwide. However, there has been little local data obtained on the cause, incidence, and severity of ocular injury. Previously published reports concentrated on the incidence of acute hospital-treated eye injuries.[3] This approach tends to underestimate the true incidence of ocular trauma as patients with less severe injuries not requiring admission are not included. The current report is the second part of a study gathering local epidemiological data on ocular injury. The strengths of this study are 2-fold — firstly, descriptive information concerning the context of the injury was collected at the time of presentation, and secondly, ocular injuries of all severity, including those not requiring hospitalization, were included in the study. To our knowledge, this is the first major prospective survey on this very important health issue in Hong Kong.

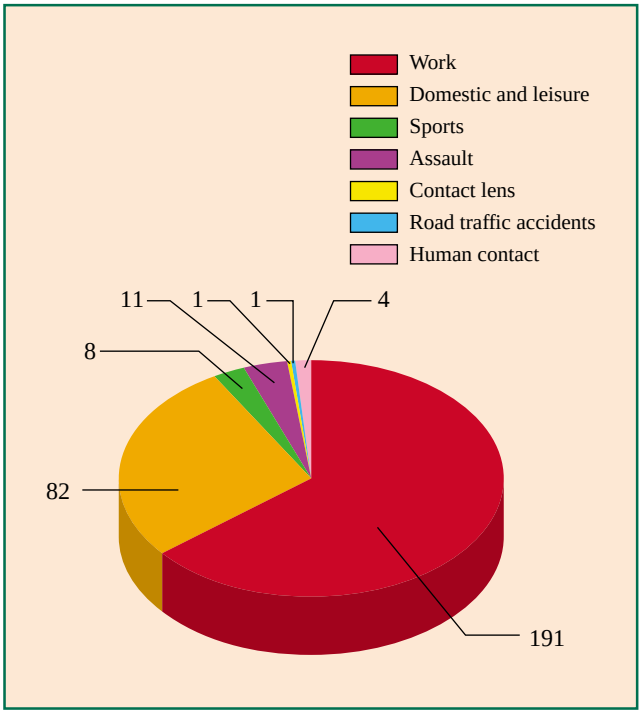

Figure 4. Causes of poor visual outcome.

The Ophthalmic Department at the Caritas Medical Centre treats patients with ocular emergency referred from 3 major Hospital Authority Casualty Departments and all private practitioners in the New Territories South Region. This situation provides a unique opportunity to survey the epidemiology of ocular trauma in this urban population. Although patients with trivial injury may not seek medical attention, or may consult private ophthalmologists, the entire spectrum of severity and etiology of trauma is likely to be represented. Estimation of the rate of ocular injury depends greatly on the source of data. Methods used to study the epidemiology of ocular trauma range from hospital discharge data analysis,[6,7] surveys in an emergency room setting,[8] and population-based interviews.[9] Using a definition of a principal hospital discharge diagnosis of ocular injury, the annual incidence was estimated to be 13.2 per 100,000 in 1 study in the USA,[7] and 8.1 per 100,000 in another study in Scotland.[10] In Singapore, the estimate was 12.6 per 100,000.[11] These data, however, may reflect bias towards more serious cases requiring hospitalization, and underestimate the true incidence of ocular trauma. Using an estimated at risk population of 1.1 million, the incidence of ocular injury observed in this study translates to 164 per 100,000. Annual incidence rates for ocular injury have been reported to be 0.98%[12] and 1.6%,[13] respectively, in localities in the USA. However, these figures are derived from population-based studies. Extremely minor injuries that do not require medical attention may thus be reported; there is also a strong chance of over-reporting due to inaccurate recall. Although a direct comparison of the incidence is not possible due to differences in methodology and definitions, this figure should nevertheless arouse concern. In 2000, the annual attendance at the Caritas Medical Centre Eye Department was over 111,000 with 9717 cases of ocular emergency. Ocular injuries accounted for approximately 18.5% of all visits to the emergency service of the Ophthalmic Department. This is in keeping with figures reported from other countries that ranged from 1.3%[14] to as high as 52%.[15] Trauma alone thus takes up a considerable proportion of casualty time.

The strong associations with younger age and male gender and ocular trauma have been consistently documented in other localities.[6,7,11] Age-incidence curves peak in the 30 to 50 years age group for both males and females. Approximately 58.1% of injuries occurred in those aged younger than 40 years. Overall, there was a strong male predominance, with a male to female ratio of 3.67:1. This male predominance exists across the age range with the exception of those aged 70 years and older, in which female predominance is seen. The higher risks in men in the younger age group may reflect a high incidence of work-related and sports-related activities. The preponderance of injuries in boys is possibly due to more aggressive play. In the older age groups, males and females are more likely to share similar lifestyle and occupational patterns, with similar exposures to risk of injury.

Work-related accidents accounted for the majority (62%) of injuries. A similar rate for work-related injuries (60%) was also reported in a major population-based study in Australia.[9] Only approximately 6.6% of the workers in the current study had been wearing eye protection at the time of injury. This figure is less than that reported in other major series (16% to 20%).[9,16] A significant proportion of workers (39%) not using proper eye protection gave the reason that safety eyewear was not usually indicated for their jobs (e.g. driving). Even taking that into account, more than 50% of work-related ocular injury could have been prevented, or the severity lessened, if safety precautions had been adopted. The most common reason cited for not using safety eyewear was a lack of awareness of potential hazards. For example, workers are frequently injured when a nearby coworker is hammering or welding; and workers are often injured when handling unlabelled chemicals that are corrosive. Although no statistically significant association between visual outcome and occupation was found, certain tasks or activities were associated with ocular injury. Activities such as grinding, welding, drilling, and working with wires and machinery accounted for 52.6% of all work-related injuries. Projectile injuries by foreign bodies were the single most important agents causing injury. These findings are not unexpected, as these manual activities are common in construction-related work. With the rapid development of the local airport, railway systems, and related infrastructure in recent years, work-related accidents on construction sites could be expected to surge. Projectile injuries often occur in predictable situations, and can be prevented with better safety awareness and the improved design of safety goggles (for example shielding particles coming from the side of the worker). Yet projectile injuries still represent a major cause of visual morbidity in work-related injury, occurring repeatedly in some patients. These data highlight the need for education and enforcement of regulations concerning ocular safety precautions in the workplace, especially those related to construction work.

Contrary to the belief that home is a safe place to be, accidents at home accounted for 20.5% of all cases of ocular injury. The causes of domestic injuries were varied, including falls and household work such as cleaning. Mishandling of domestic chemical and pharmaceutical agents was the single most important cause of eye injury at home. Foreign bodies in the eyes ranked second as a cause of domestic injury, presumably due to the popularity of do-it-yourself activities including household repairs. A large proportion of injuries with visual impairment occurred in children or elderly patients. Thus, besides educating the public on the use of safe consumer products, addressing potential home hazards is also clearly warranted, especially for those families with small children and elderly citizens. Domestic chemical agents should be clearly labelled. Proper precautions should also be taken when completing home maintenance and repairs.

Ocular trauma occurred in 8% of children (145) aged 16 years or younger. Mishandling of household items caused the majority of these injuries. Injuries during sports were a less common cause of eye injury. This contrasts with results

in other countries in which sporting activities represented the major cause of pediatric eye injuries.[17] Differences may reflect the limited number of large recreational areas in Hong Kong, with few children participating in vigorous sporting activities. The presence of adults at the time of injury was noted in only 12.4% of cases. Since the majority of these injuries were agent-related, they should have been preventable with better parental supervision. Adults control toy purchases, including those that are inherently hazardous such as BB guns. Even ordinary household items can be potentially dangerous if left unattended. Thus parents should review their homes to ensure that dangerous items are kept out of the reach of small children. Better parental supervision during children's play, especially in the local crowded environment, may also help prevent injuries.

There were 5 cases in which non-accidental child injury could not be excluded, including 1 case of shaken baby syndrome. Ophthalmologists are seldom the first doctors to see abused children, however.[18] Shaken baby syndrome may cause permanent visual impairment due to cortical visual impairment and retinal damage,[19] but milder cases could easily escape detection by non-ophthalmologists. Thus it may be appropriate for colleagues to refer younger children with non-accidental child injury for routine fundoscopic assessment.

Sport is an important cause of ocular injury, especially in the younger age group. Though there were no instances of blindness, 8 cases of visual impairment did occur as a result of sporting injuries. Patients with hyphema and angle recession may also carry a lifelong heightened risk of glaucoma.[20] Use of polycarbonate safety glasses for relevant sporting activities is of vital significance. Education of young children about the potential for serious eye injury during sports cannot be overemphasized.

The sequelae of ocular trauma can be determined in part from the visual outcome documented and the number of surgical procedures performed. Most injuries causing permanent morbidity occurred in the workplace or the home. However, it is important to note that visual outcome in terms of acuity is not the sole indicator of ongoing sequelae as a result of the injury. There may be loss of only 1 line of acuity in Snellen vision, but the glare and discomfort resulting from a corneal scar can be disabling, especially in a young working patient. Even a minor corneal injury by metallic foreign body takes almost 1 week to heal. If an average of 4 days sick leave is given for each case of work-related injury, assuming 300 workdays per year, the equivalent of 14.9 work years was lost during the study period. Likewise, even a small corneal scar in a young eye may cause amblyopia. The number of surgical procedures is again likely an underestimation of the burden of injury. Secondary procedures for rehabilitation (for example penetrating keratoplasty, cataract extraction) were not included. Late complications (for example traumatic angle recession glaucoma) that may manifest some years later are also not represented.

Conclusions

This paper presents the findings of a prospective survey of ocular trauma in a major eye referral center over a 1-year period. Particular attention was placed on the context of trauma and details of the circumstances surrounding the injury. Although this was not a population-based survey, the high incidence of injury and the implications in terms of visual morbidity are a cause for concern.

The workplace and the home were identified as the commonest places where ocular injury occurred. Contrary to the belief that eye injury is caused by 'misfortune' or 'bad luck', our data reveals that the majority of cases could have been prevented with simple health education and safety measures. The low rate of use of protective eyewear in the workplace is alarming. Although some injuries may be unavoidable because people cannot use eye protection during all activities, certain activities can be identified that put workers at high risk. Trades, especially those on construction sites that involve drilling and grinding, deserve special attention. Preventive measures in terms of enforcement of legislation, education, and improvement in the design of ocular protection should focus on these activities.

The home is also identified as a common place for eye injuries to occur. A disproportionately large amount of severe injuries were seen in young children. Most of these accidents were agent-related or due to lack of supervision. Thus, there exists a great need for parental and child education directed at the prevention of ocular trauma. The need for public education on the purchase and use of safe consumer products at home is also clearly warranted.

Ocular trauma remains an important cause of preventable visual morbidity and blindness, particularly among younger people who are at lower risk for chronic ocular diseases. As epidemiological data is gathered, a better understanding of identifiable risk factors emerges, hopefully leading to more effective preventive measures.

References

1. *Negro AD, Thylefors B. The global impact of eye injuries. Ophthalmic Epidemic 1998;5:143-169.*
2. *Schein OD, Hibberd PL, Shingleton BJ, et al. The spectrum and burden of ocular injury. 1988;95:300-305.*
3. *Ko CY, Chan WM, Tsang MK, et al. Severe ocular injuries that required hospitalization: a retrospectvie survey from a regional eye referral center. HK J Ophthalmol 1999;3:15-21.*
4. *Poon AS, Ng JS, Lam DS, Fan DS, Leung AT. Epidemiology of severe childhood eye injuries that require hospitalisation. Hong Kong Med J 1998;4:371-374.*
5. *World Health Organization. International classification of impairments, disabilities and handicaps. Geneva: WHO;*

1980:79-85.
6. *Tielsch JM, Parver L, Shankar B. Time trends in the incidence of hospitalized ocular trauma. Arch Ophthalmol 1989; 107:519-523.*
7. *Klopfer J, Tielsch JM, Vitale S, et al. Ocular trauma in the United States, eye injuries resulting in hospitalization, 1984 through 1987. Arch Ophthalmol 1992;110:838-842.*
8. *MacEwen CJ. Eye injuries: a prospective survey of 5671 cases. Br J Ophthalmol 1989;73:888-894.*
9. *McCarty CA, Fu CL, Taylor HR. Epidemiology of ocular trauma in Australia. Ophthalmology 1999;106:1847-1852.*
10. *Desai P, MacEwen CJ, Baines P, Minassian DC. Incidence of cases of ocular trauma admitted to hospital and incidence of blinding outcome. Br J Ophthalmol 1996;80:592-596.*
11. *Wong TY, Tielsch JM. A population-based study on the incidence of severe ocular trauma in Singapore. Am J Ophthalmol 1999;128:345-51.*
12. *Glynn RJ, Seddon JM, Berlin BM. The incidence of eye injuries in New England adults. Arch Ophthalmol 1988;106: 785-789.*
13. *Wong TY, Klein BE, Klein R. The prevalence and 5-year indicence of ocular trauma. The Beaver Dam Eye Study. Ophthalmology 2000;107:2196-2202.*
14. *Liggett PE, Pince KJ, Barlow W, et al. Ocular trauma in an urban population. Review of 1132 cases. Ophthalmology 1990; 97:581-584.*
15. *Chiapella AP, Rosenthal AR. One year in an eye casualty clinic. Br J Ophthalmol 1985;69:865-870.*
16. *Fong LP. Eye injuries in Victoria, Australia. Med J Aust 1995; 162:64-68.*
17. *Strahlman A, Elman M, Daub E, Baker S. Causes of Pediatric Eye Injuries. Arch Ophthalmol 1990;108:603-606.*
18. *Friendly DS. Ocular manifestations of physical child abuse. Trans Am Acad Ophthalmol Otolaryngol 1971;75: 318-332.*
19. *Kivlin JD, Simons KB, Lazoritz S, Ruttum MS. Shaken baby syndrome. Ophthalmology 2000;107:1246-1254.*
20. *Joao ACF, Henrique B, Correia JC. Sports-related ocular injuries. A three-year follow-up study. Ophthalmology 1997; 104:313-318.*