THE NEW ZEALAND MEDICAL JOURNAL
Journal of the New Zealand Medical Association

Ocular trauma epidemiology: 10-year retrospective study

Archana Pandita, Michael Merriman

Abstract

Aims This study is performed to determine the epidemiology and incidence of ocular trauma in Waikato, New Zealand.

Methods The data was analysed on age, sex, ethnicity and type of trauma. Visual acuity (VA) at presentation and discharge was recorded. Details of slit lamp examination were noted.

Results There were a total of 821 injuries. Men had higher rate of ocular trauma than women (74% vs 26%, p<0.001). Mean age was 31 years for males and 37 years for females respectively. Highest number of ocular trauma was seen in age group 15–20 (11.5%). There were 253 open globe injuries (OGI) and 568 closed globe injuries (CGI) (p<0.001). The most frequent causes of eye injuries in men were related to outdoor activities (25.9%) and work (20.7%). In women, outdoor activity was also the highest cause (10%).

The annual rate of ocular trauma was 20.5 per 100,000 populations. Final VA of ≥6/12 was found in 590 eyes, 6/12–6/60 in 143 eyes and ≤6/60 in 88 eyes. Primary or secondary vitreoretinal procedures were performed in 54 eyes. There were three cases (0.3%) of endophthalmitis (inflammation of the internal coats of the eye).

Conclusion This study provides insight into epidemiology of ocular trauma in Waikato, New Zealand.

Ocular trauma is a major public health issue. Ocular trauma mostly commonly occurs at work, at home, during sport activities, motor vehicle crashes or interpersonal trauma. Reported risk factors are male gender, workplace, road accidents, alcoholism and lower socioeconomic class.[1–3] It is a significant but preventable cause of blindness worldwide.

Ocular trauma has an impact on the healthcare system and also the wider economy due to time off work. Negrel and Thylefors reported that worldwide 1.6 million people are blind secondary to ocular injuries, 2.3 million with low visual acuity bilaterally and 19 million with unilateral blindness or low vision.[4]

Around 29,000 eye injuries occur in Australia annually.[1] Hospital admissions are not a complete record of prevalence and risk factors for ocular trauma because mild to moderate injuries such as corneal foreign bodies and corneal abrasions are not included as they are treated as an out patient. However nearly all severe and blinding injuries can be captured by using hospital admission data. Not only is the trauma often preventable but appropriate management of injuries can have a significant reduction on the burden of the visual impairment.

Waikato is the fourth largest region in New Zealand and has a population of just over 400,000. It includes Hamilton, a large urban centre (41% of population), but mainly

©NZMA

comprises rural areas and small towns (59% of population). The purpose of this retrospective study is to determine the incidence and risk factors associated with ocular trauma in Waikato.

Waikato Hospital provides secondary and tertiary care to the region and serves as a major referral centre for a geographical area of 25,000 km^2. The department of Ophthalmology at Waikato Hospital offers both emergency and specialised care for ocular diseases and conditions for patients of all age groups.

A better understanding of the risk factors associated with it can help to design targeted campaigns to reduce the incidence of ocular trauma in community and develop effective plans for disseminating eye injury prevention material to the public.

Methods

For this study case notes were reviewed with ocular trauma who presented to Waikato Hospital from January1999 to December 2008. Patient records were identified by computer search using Waikato Hospital's RUS codes (Resource Utilization System, equivalent to ICD codes) for all patients admitted.

Ocular injury was defined as any injury affecting eye or adnexa identified as principal discharge diagnosis. RUS codes for ocular trauma included contusion, penetrating wounds of orbit with and without foreign body, perforation, rupture, ocular laceration with and without prolapse or loss of intraocular tissue, injury of conjunctiva and corneal abrasion.

Patient data extracted included age, sex, ethnicity, type of trauma (sharp/blunt), location and nature of trauma, chemical injuries and burns. Visual acuity at the time of presentation and discharge was recorded using the Snellen's visual acuity chart. Details of slit lamp examination including fundus examination were noted.

Any computed tomography and ultrasound findings were recorded. Primary and secondary repair including adjuvant treatment was noted. Medical and surgical history was recorded. Any alcohol consumption at the time of trauma was noted. Injuries were classified by the standardized international classification of ocular trauma, Birmingham Eye Trauma Terminology system (BETTS).[5]

Statistical analysis was performed in conjunction with a professional biomedical statistician. Frequency distributions were created for injury type and cause. The eye injury rate was calculated using denominator obtained from NZ institute of statistics. Statistical analysis of quantitative data was performed for all variables. Frequency analysis was performed by the Chi-squared test. One way analysis of variance (ANOVA) was used to evaluate difference in parametric variables. Chi-squared test or Fischer exact test was used as appropriate. All p values were two tailed and p-value less than 0.05 was considered statistically significant.

Results

There were total of 821 patients who were admitted to Waikato Hospital with ocular injuries between January 1999 and December 2008. Among these 52 % were New Zealand European, 35% were Maori and 13% were from other ethnicity (mainly Asian, Pacific, or Middle East). NZ Europeans are 80% of total Waikato population and Maori are the 15% of population.

Adjusting for age and gender, men had higher rate of ocular trauma than women (74% vs 26%, $p<0.001$, Pearson's Chi-squared test). The mean age for all patients in this study was 35.5 years (range 0–98 years). Mean age for males was 31.0 (±20.8) and for females was 37.0 (±24.7; $p=0.005$ ANOVA test). Median age was 42 years. No significant difference in frequency of right vs left eye injuries was noted ($p=0.522$).

Figure 1. Eye trauma incidence in various age groups over 10 years period

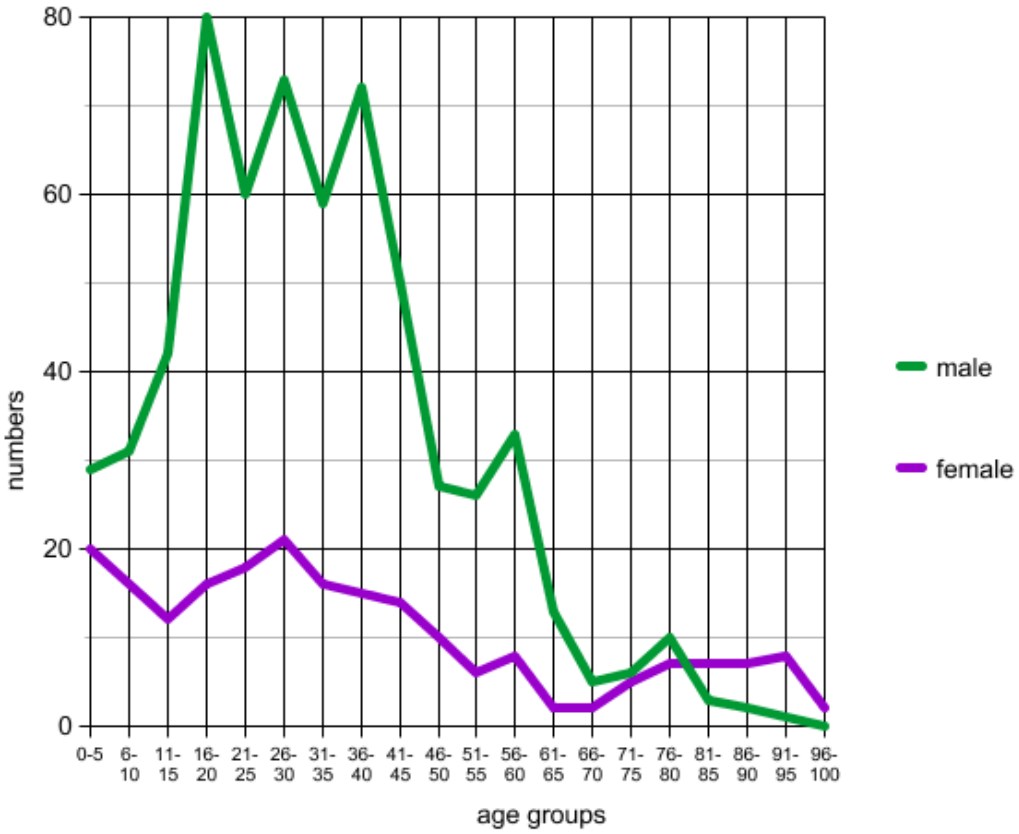


Table 1. Activity when eye injury occurred

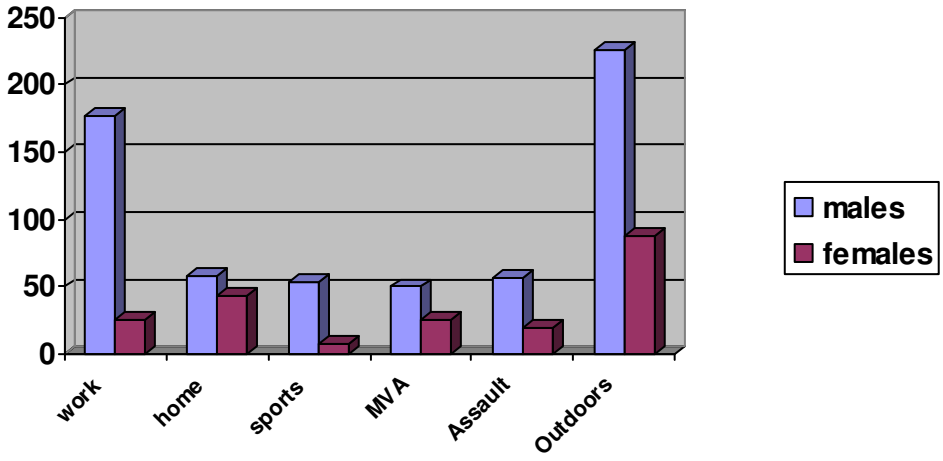
Activity	No. of eyes	Percentage	SE Asia[20]	Australia[1]
Assault	81	9.8	8.8	3.0
Motor Vehicle Accident	65	7.9	13.1	1.9
Sports	62	7.6	3.1	3.3
Falls at home	31	3.7		
Work (professional & DIY)	203	24.7	48.1	60
Hammering/chiselling/chainsawing	71			
Fencing/farm related	89			
Others	44			
Chemical	61	7.5	4.7	
Fireworks	5	0.7	1.8	
Others	313	38.1	20	

DIY=do it yourself work.

The incidence of eye injury was seen to be decreasing with increasing age. The maximum number of injuries was seen in the age group 16-20 years and 26-30 years (11.5% and 11.3% respectively, Fig 1). 21.5% of the New Zealand population is less than 15 years and 12.3% is above 65 years age. The younger age group had assault and metal work as a main cause of ocular injuries.

Elderly people had ocular injuries mainly from falls. Using the Birmingham Eye Trauma Terminology System (BETTS), contusion affecting the anterior segment occurred most frequently among different forms of ocular trauma (Table 2).

Figure 2. Frequency of injury by gender and activity



There was a correlation between activity when injured and gender ($p<0.001$; Pearson Chi-squared test) (Figure 2). Outdoor activity related injuries accounted for 34.8% of injuries in men followed by work related injuries (29%). The most frequent cause of ocular trauma in women was outdoor activity related (43%) followed by home related work (20%). Assaults accounted for 9.2% of all injuries and among these alcohol use was documented in 73.6%.

Table 2. Type of eye injury

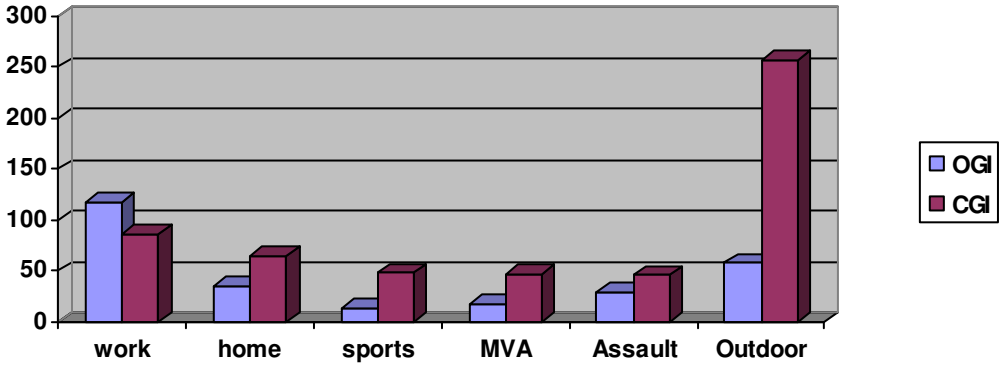
BETTS	No. of eyes	Percentage
Contusion	461	56.1
Lamellar laceration	107(corneal 102, conjunctival 5)	13.0
Penetrating injury	170	20.7
Perforating injury	5	0.6
Intraocular foreign body	19	2.3
Rupture	59	7.2

BETTS=Birmingham Eye Trauma Terminology System.

There were 253 open globe injuries and 568 closed globe injuries ($p<0.001$; Pearson's Chi-squared test). There was a significant difference in the frequency of open and closed globe injuries in work related injuries (58% open vs 42% closed, $p=0.044$; Fisher's exact test), sports-related injuries (23% open vs 77% closed, $p<0.005$;Fisher's exact test), outdoor related activities (17% open vs 83% closed, $p<0.005$; Fisher's

exact test) and in MVA-related injuries (28% open vs 72% closed, p=0.001; Fisher's exact test) respectively (Figure 3).

Figure 3. Frequency of injury by open globe/closed globe



A vitreoretinal procedure was performed in 54 eyes and three among these had repeat vitrectomy to improve vision. Nineteen eyes had vitrectomy for intraocular foreign bodies, 15 metal and 4 glass. Seventeen eyes had vitreoretinal procedures for retinal detachment repair. Another 17 eyes had reasons such as retinal haemorrhages, lens dislocation, decreased visual acuity after primary repair. One had vitrectomy for dislocated intraocular lens after blunt trauma.

There were 82 ocular injuries presenting to Waikato Hospital on average per year with an incidence rate of 20.5 (CI 19.3–21.5) per 100000 population (Fig 4). Incidence rate for CGI was 14.2/100,000 and for OGI was 6.3/100,000 population. Overall 590 eyes had BCVA(Best corrected visual activity)≥ 6/12 (71.8%), 143 had VA between 6/12 (17.4%) and 6/60 and 88 eyes had VA≤ 6/60 (10.7%) at final follow-up visits.

Generally it was seen that eyes injured with blunt objects had final BCVA of 6/12 or better compared to those injured by sharp objects. The majority of chemical injuries (82%) happened at work with sodium hydroxide and sodium hypochlorite being the dominant agents. Chemical injuries occurring at home (18%) were usually due to cleaning agents. All the chemical and firework injuries had full recovery of VA except one firework injury in a corneal graft patient whose VA was reduced from 6/9 to hand movements.

Figure 4. Incidence of ocular injuries per year

Table 3. Source of trauma for Visual acuity less than or equal to 6/60

Causes	No. of eyes (88)	Percentage
Assault (9 enucleations, 3 pthisis)	24	27.3
Farm related/fencing/wiring (5 enucleations, 2 evisceration)	18	20.5
Falls (1 enucleation, 2 evisceration)	9	10.2
MVA (6 enucleations,1evisceration, 1 pthisis)	8	9.1
Hammering/chiselling/chainsawing (2 enucleations,1 evisceration)	8	9.1
Sports (3 enucleations)	7	7.9
Gunshots (1 enucleation)	2	2.3
Fireworks	1	1.1
Others	11	12.5

The most common primary surgery was reconstitution of the globe integrity with repositioning or excision of extruded ocular contents and suturing of the wound. There were a total of 27 (3.2%) enucleations performed during this period that included 12(44.4%) primary and 15(55.6%) secondary enucleations.

Six (0.7%) eviscerations were performed, three for penetrating eye injuries, one for endophthalmitis resulting from IOFB (intraocular foreign body) and one each for complications from motor vehicle accident and scleral rupture.

Of the 19 cases of IOFB three developed endophthalmitis (two metallic and one organic).Two had bacillus species identified, the other had negative cultures. Two of these were treated with intravitreal antibiotics and vitreoretinal procedures and third one underwent evisceration.

Four eyes (0.5%) developed pthisis. No case of sympathetic ophthalmia (inflammation to both eyes following trauma to one eye) was seen in this study. Angle recession was noted in 1.5% (n=13) eyes.

Discussion

Ocular trauma is an important cause of visual loss and is frequently preventable. This study documents the nature of the ocular trauma over a 10-year period. We must acknowledge that only inpatients are included. However most patients with sight-threatening injuries are admitted.

Some closed globe injuries are treated as outpatients and will not be included in this study (e.g. Commotio retinae). Data was collected based on discharge coding, so some injuries would have been left out for example multisystem trauma with relatively mild eye injuries. As a retrospective study there will be recording bias. The vision at presentation and final follow-up was not recorded for every injury. Not all patients had complete treatment at Waikato Hospital so their final outcome may not be known.

Estimation of ocular trauma rates depends on the data source. Hospital data does not represent the total number of patients with eye trauma as not all the less severe injuries will present to hospital, but it will provide useful information regarding sight-threatening injuries which are of greatest concern.

This study provides insight into epidemiology of ocular trauma in New Zealand. It also supports the previous reports that ocular trauma may represent a significant cause of visual loss in the population.

The rates of eye injuries requiring hospital admission range from 8-57/100,000 population.[1,6-10] This study showed an incidence rate of 20.5/100,000 which is more than other reports from United States but comparable to Australia (21/100,000).[1]This could be related to factors such as increased outdoor activities in this region and comparatively easier access to public health system.

As a large geographic area, Waikato has an extensive road network that could contribute to a greater number of road traffic accidents compared to other regions. Some of our patients identified and included were from outside our region but treated at Waikato Hospital due to their location at time of injury e.g. MVA, or transferred to our centre for specialised treatment (e.g. vitreoretinal surgery).

Higher frequency of ocular injury in men was seen in our study population and occurred in all age groups. A higher male preponderance may be related to occupational exposure, participation in dangerous sports and hobbies, alcohol use and risk taking behaviour.[11] Other studies also reported higher rate in men compared to women.[1,3,15]

This study showed that sports and motor vehicle accidents contribute to about 15% of ocular injuries. Rugby was found to the commonest cause of sports injury followed by tennis and squash. Other less common sports eye injuries were from fishing, soccer, boating, golf, shooting and paint ball.

Work-related equipment was found to be the other major contributory risk factor for ocular injuries. Among these, lawn mowing caused highest eye injuries and others included fencing, hammering, tree pruning and grinding.

Excess alcohol consumption was identified as a contributing factor in approx 13.8% of injuries in our cohort, predominantly in assault and MVA activities. Of the 88 eyes with severe visual loss, assault and MVA caused 36%. Three quarters of eye injuries due to assault involved alcohol consumption.

Closed globe injuries have better prognosis compared to open globe injuries.[12] Pieramici et al described that good presenting visual acuity of 6/60 or better is associated with less incidence of enucleation.[13] This is consistent with other studies and is an important prognostic factor when counselling these patients. However vitreoretinal procedures in eyes with vision of hand movements resulted in measurable vision improvement in subsequent follow-up in some of our patients.

This study detected three cases of post traumatic endophthalmitis. This was 1.1% of the open globe injuries. No post operative endophthalmitis was seen. Post-traumatic endophthalmitis is reported in 2–12% of eyes with open globe injuries in other studies.[14-19]

Risk factors include delayed presentation, delayed commencement of antibiotics and presence of intraocular foreign body. This study has a comparatively low rate of endophthalmitis which is probably a consequence of prompt presentation, early antibiotic treatment and surgery.

There was a single gunshot perforating wound in the ten years of our study. This eye had pars plana vitrectomy, lensectomy and laser vision improved to 6/5 BCVA.

Ocular trauma is a significant cause of visual disability. Typically it impacts younger people and may dramatically affect their future, independence and work. Health education and appropriate preventive measures should therefore be directed at these high risks.

Our study shows that educating workplaces and people doing high risk tasks such as drilling, grinding, chain sawing and farm fencing would be a good target to reduce ocular injuries. Adequate eye protection is often a simple step. Education of the community regarding the high association of alcohol and eye injuries leading to blindness from MVA and assaults could be a useful in changing society's attitude to alcohol use.

Competing interests: None declared.

Author information: Archana Pandita, Registrar; Michael Merriman, Consultant; Department of Ophthalmology, Waikato Hospital, Hamilton

Correspondence: Archana Pandita, 26 Kentwood Drive, Wellington 6037, New Zealand. Email: panditaarchana@yahoo.com

References:

1. McCarty CA, Fu CL, et al. Epidemiology of Ocular Trauma in Australia. Ophthalmology 1999; 106:1847-52.
2. Thylefors B. Epidemiological patterns of ocular trauma. Aust NZ J Ophthalmol 1992; 20:95-8.
3. Cillino S, Casuccio A, et al. A five-year retrospective study of the epidemiological characteristics and visual outcomes of patients hospitalized for ocular trauma in Mediterranean area. BMC Ophthalmol 2008, 8: 6.
4. Negral AD, Thylefors B. The global impact of eye injuries. Ophthalmic Epidemiology 1998;5:43-69.
5. Kuhn F, Morris F, et al. The Birmingham Eye Trauma Terminology System (BETTS). J Fr Ophthalmol 2004; 27;206-10.
6. McGwin G, Xie A, Owsley C. The rate of eye injuries in the United States. Arch Ophthalmol 2005; 123:970-76.
7. Desai P, MacEwen CJ, et al. Incidence of cases of ocular trauma admitted to hospital and incidence of blinding outcome. Br J Ophthalmol 1996;80:592-96.
8. Wong TY, Tiellsch JM. A population based study on the incidence of severe ocular trauma in Singapore. Am J Ophthalmol 1999;128:345-51.
9. Wong TY, Klein BE, et al. The prevalence and 5-year incidence of Ocular trauma-The Beaver Dam Eye Study. Ophthalmology 2000;107:2196-202.
10. Loon SC, Tay WT, et al. Prevalence and risk factors of ocular trauma in an urban south-east Asian population: the Singapore Malay Eye Study. Clin and Exp Ophthalmology 2009;37:362-67.
11. Koo L, Kapadia MK, et al. Gender differences in etiology and outcome of open globe injuries. J Trauma 2005; 59:175-78.
12. Knyazer B, Levy J, et al. Prognostic factors in posterior open globe injuries. Clin and Exp Ophthalmology 2008; 36:836-41.
13. Pieramici DJ, MacCumber MW, et al. Open globe injuries. Update on types of injuries and visual results. Ophthalmology 1996;103:1798-803.
14. Smith ARE, O'Hagan SB, Gole GA. Epidemiology of open and closed globe trauma presenting to Cairns Base Hospital, Queensland. Clin Experiment Ophthalmol 2006;34:252-9.
15. Soliman MM, Macky TA. Pattern of ocular trauma in Egypt. Graefs Arch Clin Exp Ophthalmol 2008;246:205-12.
16. Peyman GA, Caroll CP, Raichand M. Prevention and management of traumatic endophthalmitis. Ophthalmology 1980;87:320-4.
17. Fan JC, Neiderer RL, et al. Infectious endophthalmitis : clinical features, management and visual outcomes. Clin and Exp Ophthalmol 2008;36:631-36.
18. Zhang Y, Zhang MN et al, Jiang CH, et al. Endophthalmitis following open globe injury.Br J Ophthalmol 2010; 94:111-14.
19. Essex RW,Yi Q, Charles PG, et al. Post traumatic endophthalmitis. Ophthalmology 2004;111:2015-22.
20. Chang CH, Chen CL, et al. Hospitalized eye injury in a large industrial city of South-Eastern Asia. Graefs Arch Clin Exp Ophthalmol 2008; 246:223-228.