Original article

Visual outcome in open globe injuries

Thevi T [1], Mimiwati Z [2], Reddy SC [2]
[1] Department of Ophthalmology, Tengku Ampuan Rahimah Hospital, Klang, Malaysia
[2] Department of Ophthalmology, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia

Abstract

Objective: To determine the factors affecting the visual outcome in patients with open globe injuries of eye.

Materials and methods: In a prospective interventional study of consecutive patients with open globe injuries, the age, gender, place of injury, object causing injury and safety precautions taken were recorded. A detailed examination of the eye was done with a slit-lamp. X-rays of the orbits were taken in order to determine the presence of a foreign body. The injuries were classified as simple or complicated depending on the involvement of the pupil/iris, lens and retina. Finally, post operative best-corrected visual acuity at last follow up was noted.

Results: Fifty-two patients (52 eyes) were included in the study. The mean age of patients was 27.25±12.62 years (range 9-73 years). The majority of injuries occurred in the workplace (36.5%); nail (15.4%) and glass (15.4%) were the most common objects causing injury. Of those with good initial visual acuity, 90% maintained good visual outcome. Patients with corneal lacerations of less than 5 mm had significant good visual outcome. The number of corneal lacerations and visual axis involvement did not affect the visual outcome. Those with corneo-scleral lacerations had significantly poor visual outcomes compared to those with corneal or scleral lacerations alone.

Conclusion: Predictors of good visual outcome are good initial visual acuity, a corneal laceration wound of less than 5mm, a deep anterior chamber, and simple lacerations. Age, gender, place of injury, object causing injury, presence of hyphema or intraocular foreign body, and the use of safety precautions did not affect the visual outcome.

Key-words: Penetrating eye injury, corneal laceration, sclera laceration, corneoscleral laceration, visual outcome.

Introduction

Penetrating eye injuries potentially sight threatening injuries that are defined by laceration of tissues in the eye (cornea/sclera/both), usually caused by sharp objects. They are the most frequent cause of emergency admission to an eye ward. Motor vehicle accidents are one of the major causes of eye injury, in addition to accidents at home and in the workplace. They are also called "perforating injuries of eye"; or "open globe injuries" (Dannenberg et al 1988; Wykes 1988; Dunn et al 1992; Desai et al 1996; MacEwen 1989). Though there are

Received on: 20.12.2011 Accepted on: 17.05.2012
Address for correspondence: Dr S Chandrasekhara Reddy
Professor & Head, Department of Ophthalmology, UCSI School of Medicine, Bukit Khor, 21600 Marang, Terengganu, Malaysia
Tel: +6013-6244532
Email: profscreddy@gmail.com

mandatory regulations designed to reduce the incidence of eye trauma, such as protective glasses in the workplace, many people do not take these precautions. Ocular trauma due to accidents cannot be prevented. However, with increased public awareness about eye injuries, measures can be taken to prevent and avoid eye trauma.

The Pubmed literature search revealed only two published reports on perforating injuries of eye from Malaysia (Lai and Moussa 1992; Zainal and Goh 1997). Therefore, this study was undertaken to determine the visual outcome and factors which may affect the visual outcome after surgery in patients with penetrating eye injuries. It is expected that this study will inspire healthcare workers to develop strategies to educate the public about prevention of such injuries.

Materials and methods

A three-year prospective observational study of consecutive patients with penetrating injuries admitted to Tengku Ampuan Rahimah Hospital, Klang, Malaysia, was conducted. The age, gender of the patients, place of injury, object causing injury and safety precautions taken were recorded. After recording visual acuity, detailed examination of both anterior and posterior segments of the eye was done with a slit lamp. The ocular findings noted were initial visual acuity, length of corneal/sclera/corneoscleral laceration, anterior chamber depth, presence or absence of hyphaema, pupil shape and other irregularities such as iris prolapse, iridodialysis, sphincter tears, cataract and subluxation or dislocation of the lens. The fundus was examined for vitreous haemorrhage, commotio retinae or retinal detachment. An X-ray of the orbits was taken for all patients to determine the presence of intraocular foreign bodies. The injuries were classified as simple or complicated depending on the involvement of the pupil/iris, lens and retina. Extracapsular cataract extraction was done in the same sitting after repair of the laceration wound; and secondary posterior chamber intraocular lens implantation was done six weeks later. Following the primary repair of the laceration in the eye, the intraocular foreign body was localized using CT scan imaging as early as possible and then removed successfully. Patients were followed up for at least 3 months. Post-operatively, all patients were given broad spectrum antibiotic eye drops (ciprofloxacin) and corticosteroid eye drops (dexamethasone) for six weeks in tapering frequency. The corneal sutures were removed after six weeks. At eight weeks postoperatively, the best corrected visual acuity was noted. Taking into account the WHO criteria for vision categorization (WHO 1992), the visual outcome was classified into 3 categories: good vision (6/6-6/12), impaired vision (6/18-6/36) and poor vision (6/60-NPL).

Statistics: The data was analyzed with Statistical Package for Social Sciences (SPSS) program. The global chi-square test and Fisher's exact test were used to determine the possible relation between two categorical variables. The Mc Nemar chi-square test was performed to determine change in vision between pre- and post-treatment. The independent t-test or the Mann-Whitney test was performed to determine difference of quantitative variables between two groups of categorical variables. A P value of < 0.05 was considered statistically significant.

Results

A total of 67 patients were admitted with penetrating eye injuries during the study period, of which 15 were excluded due to insufficient data in the case records; thus, the data from 52 patients were analyzed. Males (46, 88.5%) were more predominant than females (6, 11.5%), the male to female ratio being 7.6:1. The mean age of the patients was 27.25±12.62 years (range 9-73 years). Corneal laceration (32, 61.5%) was the most common clinical finding seen in our study (Table 1). Retinal detachment was not found in any patient. A single eye could present with more than one finding, hence, the number of clinical findings was greater than the number of eyes studied.

Table 1

Clinical findings in 52 patients with penetrating eye injuries

Clinical finding	Number	Percentage
Corneal laceration	32	61.5 %
Scleral laceration	6	11.5 %
Corneoscleral laceration	14	26.9 %
Flat anterior chamber	15	28.8 %
Hyphema	15	28.8 %
Pupillary sphincter tears	4	7.7 %
Iridodialysis	4	7.7 %
Iris prolapsed	5	9.6 %
Cataract	11	21.1 %
Intraocular foreign body	8	15.4 %
Vitreous hemorrhage	2	3.8 %

At the time of admission the initial vision was good in 11 (21.1%) patients, impaired in 15 (28.8%) and was poor in 26 (50%). Following surgery, many patients had an improvement in visual acuity, which was good in 36 (69.2%), impaired in 3 (5.8%) and poor in 13 (25%) patients (Table 2). There was a significant (p<0.0001) difference between initial visual acuity and visual outcome after surgery.

Table 2

Initial visual acuity and visual outcome after surgery

Initial vision	Visual outcome after surgery		
	Good vision	Impaired vision	Poor vision
Good Vision	10	0	1
Impaired vision	13	2	0
Poor Vision	13	1	12
Total	36 (69.2%)	3 (5.8%)	13 (25.0%)

(Mc Nemar test p<0.0001)

The individual association between each of the following factors and visual outcome was analyzed: time interval from accident, place of injury, objects causing injury, safety precautions taken, type/ location of laceration (corneal/ scleral/ sclerocorneal), depth of anterior chamber, presence of hyphema, and presence of intraocular foreign body. The results are shown in the following tables.

The time interval from the accident to the surgery was less than 6 hours in 39 (75%) patients. The time interval from trauma to surgery did not affect significantly (p=0.720) the visual outcome after surgery (Table3).

Table 3

Time interval from the accident to surgery and visual outcome after surgery

Time interval (hours)	Good vision	Impaired vision	Poor vision	Total
0-3	12	0	7	19 (36.5%)
3-6	14	2	4	20 (38.5%)
6-12	1	0	0	1 (1.9%)
12-24	6	1	2	9 (17.3%)
>24	3	0	0	3 (5.8%)
Total	36	3	13	52 (100.0%)

(Chai square=5.345, df=8, p=0.720)

The most common place of injury was found to be the workplace (n=19, 36.5%), followed by road accidents (n=17, 32.7%). The place of accident did not significantly affect (p=0.592) the visual outcome after surgery (Table 4).

Table 4

Place of injury and visual outcome after surgery

Place of injury	Good vision	Impaired vision	Poor vision	Total (%)
Home	13	0	2	15 (28.8%)
Road	10	1	6	17 (32.7%)
Work	12	2	5	19 (36.5%)
School	1	0	0	1 (1.9%)
Total	36	3	13	52 (100.0%)

(Chi-square=4.632, df=63, p=0.592)

The object causing injury was only known in 75% of the cases, which are summarized in the table below (Table 5). There was no significant association (p=0.730) between the object causing injury and visual outcome after surgery.

Table 5

Objects causing injury and visual outcome after surgery

Object causing injury	Good vision	Impaired vision	Poor vision	Total
Pencils/toys/ decorations	15	0	4	19 (36.5%)
Glass	5	1	2	8 (15.4%)
Nail	6	1	1	8 (15.4%)
Wood	1	0	2	3 (5.8%)
Knife	1	0	0	1 (1.9%)
Unkown	8	1	4	13 (25.0%)
Total	36	3	13	52 (100.0%)

(Chi-square=6.948, df=10,p=0.730)

Safety precautions were taken in only 6 cases (11.5%), of which 5 (9.6%) used seatbelts and 1 (1.9%) had used goggles. The rest of the patients did not take any safety precautions (Table 6). The use of safety precautions did not significantly affect (p=0.395) postoperative visual outcome.

Table 6

Safety precaution taken and visual outcome after surgery

Safety precaution taken	Good vision	Impaired vision	Poor Vision	Total
Seatbelt	2	0	3	5 (9.6%)
Goggles	1	0	0	1 (1.9%)
Nil	33	3	10	46 (88.5%)
Total	36	3	13	52 (100.0%)

(Chi-square=4.083, df=4, p=0.395)

Corneal lacerations were present in 32 (61.5%) patients. After surgery, 27 (84.4%) had good vision (Table 7). Corneal lacerations were significantly (p<0.001) associated with good postoperative visual outcome.

Table 7

Corneal laceration wound and visual outcome after surgery

Cornea laceration	Good vision	Impaired vision	Poor vision	Total
Absent	9	1	10	20 (38.4%)
Present	27	2	3	32 (61.5%)
Total	36	3	13	52 (100.0%)

(Chi-square=10.83, df=1,p<0.001)

There was visual axis involvement in only 7 of 32 (21.9%) patients with corneal lacerations, and 5 of them had good vision post-operatively. Multiple lacerations were seen in 3 (9.3%) of the 32 patients and in all cases the post-operative improvement of vision was good (6/6-6/12). Of 32 patients with corneal lacerations, 27 had good visual outcome with a mean corneal laceration length of 4.48±2.47 mm (range 1-12 mm); 2 had impaired visual outcome with a mean corneal laceration length of 6.00±2.83 mm (range 4-8 mm); and 3 had poor visual outcome with a mean corneal laceration length of 8.67±1.53 mm (range 7-10 mm). The visual outcome was significantly (p=0.037) associated with corneal laceration length of less than 5 mm.

Scleral laceration alone was present in 6 (11.5%) of 52 patients. After surgery, 3 (50.0%) had good vision (Table 8). Scleral lacerations were not significantly (p=0.378) associated with visual outcome after surgery.

Table 8

Scleral laceration wound and visual outcome after surgery.

Sclera laceration	Good vision	Impaired vision	Poor vision	Total
Absent	33	2	11	46 (88.4%)
Present	3	1	2	6 (11.5%)
Total	36	3	13	52 (99.9%)

(Chi-square=1.92, df=2, p=0.378).

Only 1 patient had multiple scleral lacerations. The remaining 5 had lacerations of 7.3± 4.65mm with a range of 3.5 to 15mm. In our study, mean scleral laceration length was not significantly associated with post-operative vision improvement (p=0.089).

Corneo-scleral lacerations were seen in 14 (26.9%) of the 52 patients of whom 6 (42.8%) had good vision after surgery (Table 9). Corneo-scleral lacerations were significantly (p=0.003) associated with poor visual outcome in our study.

Table 9

Corneo-scleral laceration wound and visual outcome after surgery

Corneoscleral laceration	Good vision	Impaired vision	Poor vision	Total
Absent	30	3	5	38 (73.1%)
Present	6	0	8	14 (26.9%)
Total	36	3	13	52 (100.0%)

(Fisher Exact Test: p=0.003)

A deep anterior chamber was noted in 21 (40.4%) patients (Table 10); and was significantly associated with good postoperative visual outcome (p=0.012).

Table 10

Anterior chamber depth and visual outcome after surgery

Anterior chamber	Good Vision	Impaired Vision	Poor Vision	Total
Flat	6	0	9	15 (28.8%)
Shallow	12	1	3	16 (30.8%)
Deep	18	2	1	21 (40.4%)
Total	36	3	13	52 (100.0%)

(Chi-square=16.331, df=6, p=0.012)

Hyphema was present in 15 (28.8%) of patients (Table 11) and its presence did not significantly affect the visual outcome after surgery (p=0.051).

Table 11

Hyphema and visual outcome after surgery

Hyphaema	Good vision	Impaired vision	Poor vision	Total
Absent	28	3	6	37 (71.2%)
Present	8	0	7	15 (28.8%)
Total	36	3	13	52 (100.0%)

(Chi-square=5.994, df=2, p=0.051)

Intraocular foreign body (IOFB) was present in 8 (15.4%) patients (Table 12), of which 1 was glass and the rest were metallic. Presence of IOFB did not significantly affect the postoperative visual outcome (p=0.549).

Table 12

Intraocular foreign body and visual outcome after surgery

Intraocular foreign body	Good vision	Impaired vision	Poor vision	Total
Absent	31	3	10	44 (84.6%)
Present	5	0	3	8 (15.4%)
Total	36	3	13	52 (100.0%)

(Chi-square=1.198, df=2, p=0.549)

Penetrating injuries with irregular pupils, sphincter tears, iris prolapse, anterior synechiae, iridodialysis, cataract, commotio retinae, retinal detachment, vitreous haemorrhage and macular scar were considered to be complicated injuries. Lacerations without the above findings were considered simple lacerations. Thirty-five out of 52 cases (67.3%) had complicated lacerations in our study (Table 13); and they were significantly (p=0.014) associated with poor vision.

Table 13

Simple vs complicated lacerations and visual outcome after surgery

Type laceration	Good vision	Impaired vision	Poor vision	Total
Simple	16	1	0	17 (32.7%)
Complicated	20	2	13	35 (67.3%)
Total	36	3	13	52 (100.0%)

Discussion

Tengku Ampuan Rahimah Hospital, Klang is located 25 km from Kuala Lumpur, the capital city of Malaysia. It is a referral center for the state of Selangor, which has a population of 4.2 million. There are three more government tertiary medical centers, one private eye hospital and many private eye specialists in Kuala Lumpur. Therefore, all patients with ocular injuries might not have come exclusively to the Klang hospital, which could be the reason for the small number of patients in our study.

Penetrating eye injuries are one of the important causes of severe visual impairment. In spite of new microsurgical techniques, the visual prognosis following surgery depends on the severity of the primary injury. Work-related penetrating eye injuries are an important cause of visual disability and blindness. The loss of a skilled worker is expensive for the employer, because they must not only pay compensation, but also train another person or acquire another equally skilled person to replace the injured person. When the person cannot earn regular wages following an eye injury due to blindness, he/she becomes dependent on family. Therefore, the prevention of ocular injuries is a worthwhile investment for both employees and the company.

In our study of open globe injuries, accidents in the workplace were the most common (36.5%). The US National Eye Trauma Registry investigated the characteristics of various types of eye injuries in the workplace and found that 22% of all penetrating injuries between 1985 and 1991 were work-related (Dannenberg 1992). A 10-year study in Gwent from 1976 to 1985 reported that in adults, industrial accidents (53%) were the most common cause of penetrating eye injuries (Wykes 1988).

Glass (15.4%) and nails (15.4%) were the most common objects responsible for ocular injury in our study (Table 5). Broken glass pieces, knives and hammering or drilling nails were the most common objects causing ocular injury in the USA (Dunn et al 1992).

Ocular trauma remains an important cause of avoidable and predominantly monocular visual morbidity; and the majority of patients did not take proper safety precautions (Desai et al 1996) . Even though the use of safety precautions did not affect the final visual acuity, for all practical purposes safety precautions are advised to prevent injuries, be it ocular or otherwise.

It is well known that although provided, protective eye goggles are not widely used in the industrial setting (Macewen 1989). However, there has been a change in attitudes of employees working in manufacturing industries towards the use of protective measures as reported by Parvinen (1984).

Victims of road traffic accidents are susceptible to eye damage as their heads move downwards onto the jagged, lower remnants of a shattered windshield. Australia led the way in countering road traffic accidents by introducing seat belt legislation in 1971 (Keightley 1983). Hall et al (1985) showed that an abrupt drop in eye perforations coincided with the introduction of seatbelt legislation in Wessex. The importance of laminated rather than toughened windshield in the prevention of eye injuries in road traffic accidents was emphasized by Mackay et al (1980). The use of improper spectacles can potentially convert blunt trauma into penetrating ocular trauma. Feigelman et al (1983) found that polycarbonate or plastic lenses never break into small pieces, therefore, the use of polycarbonate protective glasses can prevent ocular injuries. Desai et al (1996) found that home was the most frequent place for blinding injuries to occur; and they recommend that health education and safety strategies should target the home.

The majority of patients were treated within 24 hours in our study. Timing of surgical intervention did not significantly affect the visual outcome in our study, and the same was reported by Zainal et al (1997).

Initial visual acuity has been reported as an important indicator of visual outcome in ocular trauma (Punnonen and Laatikainen 1989) and penetrating eye injuries (Hunt 1996). The same was found to be true in our study (Table 2).

We found that the patients with corneal lacerations, regardless of the number or visual axis involvement tended to have good visual outcomes, when compared to those with scleral lacerations. Thompson et al (1997) and Zainal et al (1997) had similar findings.

In our study, visual outcome was good in patients with corneal lacerations of less than 5mm. Hunt (1996) found good visual outcome with corneal lacerations of less than 10 mm, while Snell (1943) did not observe such a correlation between corneal laceration length and visual outcome.

The presence of hyphema did not affect the visual outcome in our study. Barr (1983) has reported the absence of hyphema as a prognostic factor in corneo-scleral lacerations.

The presence of IOFB did not affect the visual outcome in our study. Canavan(1980), Punnonen (1989), Hunt(1996) and Brinton (1982) share the same opinion that IOFB does not affect the visual outcome. Chisholm (1964) concluded that sterile IOFBs had a better prognosis when the presence compared to contaminated ones.

In our study, 13 out of 35 patients with complicated laceration had poor visual outcome while 2 had impaired visual outcome (Table 13). Hunt (1996), Snell (1943) and Patel (1991) have reported that injuries without prolapse of intraocular tissues have the best prognosis. Punonen et al (1989) found that 64% of eyes with uveal and/or vitreous prolapse remained blind as compared to 19% of eyes without vitreous prolapse.

Conclusions

Penetrating eye injuries are potentially dangerous to vision, but with modern surgical techniques, patients are likely to achieve reasonably good visual outcomes. Predictors of good visual outcome are good initial visual acuity, corneal lacerations of less than 5mm, deep anterior chamber, and simple lacerations. Age, gender, place of injury, object causing injury, number of corneal lacerations, visual axis involvement, presence of hyphema or intraocular foreign body and the use of safety precautions did not affect the visual outcome in our study. Knowing the predictors of visual outcome will aid in counseling eye trauma patients and their families. The number of patients was small in our study. Therefore, we recommend a multi center study with a large number of patients to confirm the above predictors for good visual outcome in cases of penetrating ocular injuries.

References

Barr CC (1983). Prognostic factors in corneoslceral lacerations. Arch Ophthalmol; 101:919-924.

Brinton GS, Aberg TM, Reeser FH, Topping TM, Abrams G (1982). Surgical results in ocular trauma involving the posterior segment. Am J Ophthal; 93:271-278.

Canavan YM , O'Flaherty MJ, Archer DB (1980). A 10 year surveyof eye injuries in Northern Ireland 1967-76. Br J Ophthalmol; 64:618-625.

Chisholm IA (1964). Introcular metallic foreign bodies. Br J Ophthalmol; 48:364-372

Dannenberg AL, Parver LM, Brechner RJ, Khoo L (1992). Penetrating eye injuries in the workplace-The National Eye Trauma Registry. Arch Ophthalmol; 110:849-852.

Desai P, MacEwen CJ, Baines P, Minassain DC (1996). Incidence of cases of ocular trauma admitted to hospital and incidence of blinding outcome. Br J Ophthalmol; 80:592-596.

Dunn ES, Jaegar EA, Jeffers JB, Freitag SK (1992). The epidemiology of ruptured globes. Ann Ophthalmol; 24:405-410.

Fiegelman MJ, Sugar J, Jednock N, Read JS, JohnsonPL (1983). Assessment of ocular protection for racquetball. JAMA; 250(24):3305-3309.

Hall F, Denning AM, Elkington AR, Cooper PJ (1985). The eye and the seatbelt in Wessex. Br J Ophthalmol; 69:317-319.

Hunt L (1966). Penetrating ocular trauma and visual outcome. Journ of Am Soc of Ophthal Reg Nurses; XXI(4):133-134.

Keightley SJ (1983). Serious eye injury from windscreen contact. JR Soc Med; 76:911-916.

Lai YK, Moussa M (1992). Perforating eye injuries due to intraocular foreign bodies. Med J Malaysia; 47(3):212-219.

Macewen CJ (1989). Eye injuries:a prospective survey of 5671 cases. Br J Ophthalmol; 73:888-894.

Mackay GM, Gloyns PF, Hayes HRM (1980). Some aspects of facial injuries in present day cars. Proceedings of the VIIIth international technical conference of experimental safety vehicles. Wolfsberg.

Parvinen A (1984). The role of occupational health physicians in protection of the eyes and vision. Acta Ophthalmol; 161:29-33.

Patel BCK, Morgan LH (1991). Work-related penetrating eye injuries. Acta Ophthal; 69:377-381.

Punnonen E, Laatikainen L (1989). Prognosis of perforating eye injuries with intraocular foreign bodies. Acta Ophthalmol; 66:483-491.

Snell CA (1943). Perforating ocular injuries. Presented in part before the New York Academy of Medicine, section of Ophthalmology; pp: 263-281.

Thompson CG, Griffits RKS, Nardi W, Tester MP (1997). Penetrating eye injuries in rural New South Wales. Aust NZ Journ of Ophthal; 25:37-41.

World Health Organization (WHO) (1992). International statistical classification of diseases and health related problems. Tenth revision, Geneva; pp: 456-457.

Wykes WN (1988). A 10 year survey of penetrating eye injuries in Gwent, 1976-1985. Br J Ophthalmol; 72:607-611.

Zainal M, Goh PP (1997). A study of perforating eye injuries at the ophthalmology department, National University of Malaysia. Med J Malaysia; 52:12-16.

Source of support: nil. Conflict of interest: none