Clinical Characteristics and Treatment Outcome of Surgically Treated Open Globe Injuries in a Tertiary Eye Hospital

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ABSTRACT

BACKGROUND

Open globe injuries are ocular emergencies which require appropriate surgical treatment. We analyzed the presenting clinical characteristics, factors affecting the final visual outcome of open globe injuries over a 12 months period in a tertiary eye care center.

METHODS

This is a prospective observational non comparative interventional study, analysing 112 eyes of 111 patients admitted with open globe injuries at Regional Institute of Ophthalmology, South Kerala, India, from March 2018 to February 2019. Detailed history of trauma, eye examination, and visual assessment were done at the time of admission. Major outcome measure was final best corrected visual acuity (BCVA) at the end of follow up period of 6 months and important factors affecting final visual outcome. Role of additional clinical signs like presence of hyphaema, traumatic cataract, vitreous haemorrhage, retinal detachment, and prolapse of intraocular contents at the time of presentation were noted and these factors were separately analysed with final BCVA.

RESULTS

Mean age of presentation was 39.8 ± 20.5 years. 79.5 % patients (89 eyes) were males and 20.5 % (23 eyes) were females. 38.4 % patients (43 eyes) had injuries at work place, and 61.6 % (69 eyes) were non-work related but happened outdoor. Remaining 38.4 % of the injuries (43 eyes) occurred at home. Most common agent causing injury was metal piece in 34.8 % (39 eyes). 57.1 % of the patients (64 eyes) had BCVA of more than 6 / 18 Snellen's vision, 12.5 % had (14 eyes) BCVA ranging 6 / 18 - 6 / 60, 19 patients (17 %) had final vision between 6 / 60 - 3 / 60. Fifteen eyes (13.4 %) had vision less than 3 / 60 which is equivalent to legal blindness as per WHO (World Health Organization) classification. Among them, 10 eyes lost vision completely and ended up with no perception of light (NO PL).

CONCLUSIONS

Majority of the patients with open globe injuries were young males in productive age group and open globe injuries are a major cause for morbidity in these groups. As per our observations in this study injuries happen equally at home and work place. Major poor prognostic factors deciding final visual outcome were presence of additional clinical features including hyphaema, vitreous haemorrhage, retinal detachment and prolapse of intraocular contents at the time of presentation. Based on our observations in this study, we recommend better implementation of health education and awareness campaigns, appropriate preventive and prophylactic measures with regular monitoring of adequate use of protective goggles and shields at work place for high risk group.

KEYWORDS

Open Globe Injury, Work Related Injury, Visual Outcome, Prognostic Factors

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BACKGROUND

Open globe injuries remain one of the major causes of permanent monocular visual impairment in all age groups worldwide,[1] in spite of advanced technique and surgical skills in ophthalmology. Open globe injuries are defined as full thickness wound of the walls of the eye, which can be due to laceration or rupture of cornea and or sclera due to sudden impact on eye which increases intraocular pressure.[2]

Most of the patients with open globe injuries need admission in the hospital and emergency surgical repair of the wound. In general, the severity of visual impairment depends on the factors include the mechanism of injury, site of injury and extent of involvement of various intraocular structures. In most of the cases open globe injuries result in complications which may lead to some extent of permanent visual impairment. In some people significant degree of visual impairment may lead to reduced quality of vision[3] and decreased social functioning. Open globe injuries due to work related injuries and road traffic accidents affect mostly young males which in turn lead to decreased labour and it also has other socioeconomic implications like cost of medical care, loss of income and long term visual disability.[4] Most of these work related injuries are preventable by using protective eye wears.

This study analyses various causes of open globe injuries, its clinical characteristics at the time of presentation including work related and non-work related open globe injuries and the final visual outcome.

METHODS

This was a prospective observational study of 112 eyes of 111 patients who presented with open globe injuries and underwent surgical repair in a tertiary referral teaching center, Regional Institute of Ophthalmology, in Kerala, Trivandrum, South India, between March 2018 to February 2019. This study was conducted in accordance with the tenets of Declaration of Helsinki and received approval from Institutional Research Ethics Committee (No: 005 / HEC / 2018) of Regional Institute of Ophthalmology.

A detailed history was taken to determine demographic data, cause or mechanism of injury, place of injury, occupation of the patient and use of protective eye wear. A thorough clinical and slit lamp examinations was done to assess the zone of injury, extent of the wound and the involvement of other anterior segment structures like iris, lens and presence of hyphaema.

Zone of the injury was classified according to Ocular Trauma Classification Group: Zone I (wound limited to cornea including corneoscleral limbus), zone II (corneoscleral limbus to a point 5 mm posterior into the sclera), and zone III (posterior to the anterior 5 mm of the sclera which may involve retina, vitreous, choroid and optic nerve). Zone III injuries have been reported to be associated with poorer outcome.

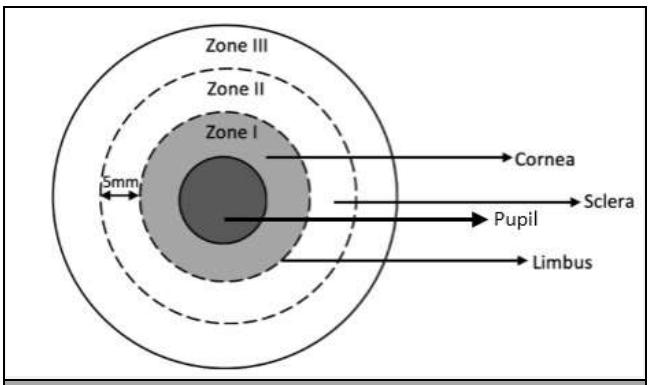

Figure 1. Diagrammatic Representation of Classification of Zone of Injury According to Ocular Trauma Classification Group[5]

Imaging techniques were used whenever necessary to determine the posterior segment involvement and to determine the presence of intraocular foreign body. Initial and final visual acuity was measured using Snellen's Visual acuity chart and converted to logarithm of the minimal angle of resolution (logMAR) before analysis. Snellen's Visual acuity of counting fingers, hand motion, light perception and no light perception were converted to logMAR values of 1.85, 2.3, 2.8 and 2.9 respectively.[6-8] In addition to this, the surgeries other than primary wound repair and the duration between the time of injury and hospital admissions, were documented.

Patients who were not willing to participate in the study, history of vision loss due to preexisting ocular diseases, patients who were not able to follow up for 6 months and patients with head trauma and multi organ trauma were excluded from the study. Frequencies and proportions were used to calculate binary and categorical variables like presence or absence of various clinical features like hyphaema or traumatic cataract. Mean and standard deviation were used to summarize continuous variables like age and visual acuity. Comparison of visual acuity at different time interval was carried out using McNemar test. Chi-square test was used to find association of visual acuity with selected categorical variables. For all statistical interpretations, $p < 0.05$ was considered the threshold for statistical significance. Statistical analyses were performed by using a statistical software package SPSS, version 20.0

RESULTS

This study included 112 eyes of 111 patients over one-year period. 89 (79.5 %) were males and 23 (20.5) patients were females. Mean age of presentation was 39.8 ± 20.5 years. 58 (51.8 %) of the patients are within the age group 21 - 50 years. Most common age group affected was 31 - 40 years. This shows the susceptibility of young males to open globe injuries because they must have more exposure to the underlying causes. 46 (41.1 %) patients were industrial workers, 10 (8.9 %) were agricultural workers by occupation. 102 (91.1 %) patients were from Kerala and 10 (8.9 %) were migrant workers from other states of the country. Among these 10 migrant workers, 7 had injury at their work place.

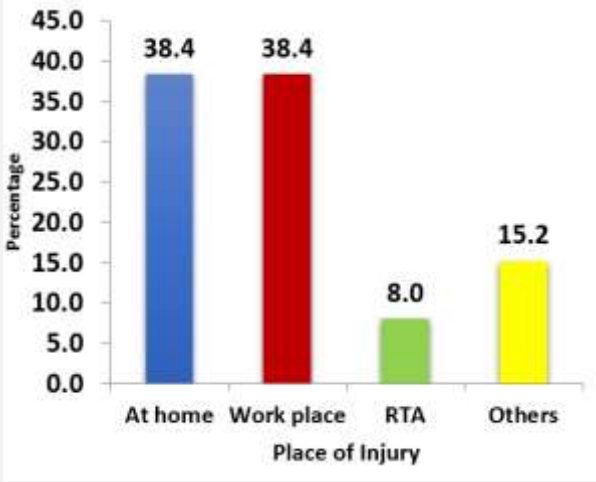

Figure 2. Percentage Distribution of the Sample According to the Place of Injury

43 (38.4 %) injuries were work related, and 69 (61.6 %) non-work related. All work related injuries have occurred at their work places and 43 (38.4 %) occurred at home. Equal number of injuries happened at home and work place. 9 (8.0 %) cases were due to Road Traffic Accidents (RTA). Others include assault, injuries at school and injuries other than above mentioned places. Left eye involved in 66 (58.8 %) cases right eye involved in 45 (40.2 %). Only one patient had bilateral penetrating wound, due to injury with glass pieces during RTA.

Regarding the time of presentation at the hospital, 81 (72.3 %) of the patients came to the hospital within 5 hours of injury, 12 (10.7 %) presented after 10 hours, among this only 2 patients presented after 1 day (24 hours). The time lapse between the time of injury and presentation at the hospital or surgery was not significant in their final visual outcome (p value = 0.258).

Cause of Injury	Count	Percent
Wood / Stick	19	17.0
Glass	8	7.1
Pen / Pencil	8	7.1
Stone	10	8.9
Knife	3	2.7
RTA	5	4.5
Metal	39	34.8
Others	20	17.9

Table 1. Percentage Distribution of the Sample According to Cause of Injury

Most common cause for the injury was metal piece (in 39 patients), especially flying metal pieces. Other causes were stick or wood piece, stone, glass, pen or pencil, RTA

With unknown materials and the remaining ones included injury due to fall, assault, etc. 27 (24.1 %) of the injuries were due to rupture and 85 (75.9 %) were due to lacerations. Among the laceration group 76 (67.86 %) were penetrating, 8 (7.14 %) intraocular foreign bodies and one case of perforation.

Work Related Injuries

Among the 112 open globe injuries, 43 cases were work related injuries. All the patients with work related injuries were males and most common eye involved was left eye, n = 30 (69.77 %). Among these 43 patients 36 (83.72 %) were industrial workers. The most common cause of injury was flying metal piece 28 (65.12 %). Most common type of injury was penetrating 35 (81.4 %), followed by intraocular foreign bodies (n = 6) and globe rupture (n = 2). Among 43 patients 39 (90.7 %) did not use protective eye wear, this shows that most of the work related injuries are preventable by the use of protective eye equipment.

Place of Injury	0.00 -0.50 (LogMAR)	0.52 - 1.0 (LogMAR)	1.02 - 1.30 (LogMAR)	> 1.30 (LogMAR)	P Value*
Work Place	31 (72.1 %)	3 (7 %)	6 (14 %)	3 (7 %)	0.073
Non Work Place	33 (47.8 %)	11 (15.9 %)	13 (18.8 %)	12 (17.4 %)	

Table 2. Comparison of Final Visual Acuity (LogMAR) Based on Place of Injury

*Pearson Chi-square test

Clinical Factors	Present /Absent	0.00 - 0.50 (LogMAR)	0.52 - 1.0 (LogMAR)	1.02 - 1.30 (LogMAR)	> 1.30 (LogMAR)	P Value*
Scleral Involvement	Present	18 (32.7 %)	9 (16.4 %)	15 (27.3 %)	13 (23.6 %)	p < 0.01
	Absent	46 (80.7 %)	5 (8.8 %)	4 (7 %)	2 (3.5 %)	
Iris or Uveal Prolapse	Present	30 (44.8 %)	10 (14.9 %)	14 (20.9 %)	13 (19.4 %)	p = 0.010
	Absent	34 (75.6 %)	4 (8.9 %)	5 (11.1 %)	2 (4.4 %)	
Hyphema	Present	13 (29.5 %)	7 (15.9 %)	12 (27.3 %)	12 (27.3 %)	p < 0.01
	Absent	51 (75 %)	7 (10.3 %)	7 (10.3 %)	3 (4.4 %)	
Vitreous Haemorrhage	Present	2 (7.4 %)	3 (11.1 %)	9 (33.3 %)	13 (48.1 %)	p < 0.01
	Absent	62 (72.9 %)	11 (12.9 %)	10 (11.8 %)	2 (2.4 %)	
Traumatic Cataract	Present	7 (38.9 %)	3 (16.7 %)	6 (33.3 %)	2 (11.1 %)	p = 0.170
	Absent	57 (60.6 %)	11 (11.7 %)	13 (13.8 %)	13 (13.8 %)	
Extrusion of intraocular contents	Iris / uvea	1 (12.5 %)	1 (12.5 %)	5 (62.5 %)	1 (12.5 %)	p < 0.01
	Lens / IOL	4 (20 %)	2 (10 %)	4 (20 %)	10 (50 %)	
Duration between onset of injury and hospital admission	Less than 10 hours	56 (56 %)	13 (13 %)	19 (19 %)	12 (12 %)	p = 0.258
	More than 10 hours	8 (66.7 %)	1 (8.3 %)	0 (0)	3 (25 %)	
Number of surgical procedure	Only primary wound repair	56 (68.3 %)	9 (11 %)	7 (8.5 %)	10 (12.2 %)	p < 0.01
	More than one surgeries	8 (26.7 %)	5 (16.7 %)	12 (40 %)	5 (16.7 %)	

Table 3. Analysis of Various Factors Which Affect the Final Visual Acuity in LogMAR

*Pearson Chi-square test

The final visual acuity of work-related, and non-work-related groups were compared (Table no: 2). There was no statistically significant difference in final visual acuity between the two groups.

61 (54.46 %) had zone I injuries, 19 (16.96 %) had injuries limited to zone II, 23 (20.54 %) had injuries involving both zone I and zone II, and 9 (8.04 %) had injuries involving zone III.

Limbal involvement was present in 44 (39.3 %). In 55 (49.1 %) of cases, sclera was also involved. Iris or uveal prolapse was present in 67 (59.8 %) and hyphaema in 44 (39.3 %). vitreous prolapse was present in 43 (38.4 %), vitreous haemorrhage in 27 (24.1 %) and traumatic cataract in 18 (16.1 %). The proportion of those with scleral involvement, hyphaema, vitreous haemorrhage, extruded intraocular contents like uvea, iris, lens or IOL (Intra Ocular Lens) and surgeries other than primary repair of wound were significantly higher in high LogMAR score or low final visual outcome (Table no: 3). 13 (11.61 %) patients had posterior segment involvement, like retinal detachment and choroidal rupture. Extruded lens or IOL were present in 20 (17.9 %), among this 3 had extrusion of IOL (n = 3).

Endophthalmitis

Endophthalmitis was present in 3 (2.7 %), among these 2 patients presented in the hospital less than 10 hours of injury and 1 patient presented after 24 hours. Causes of these injuries were injury with nail in one patient, stick injury in second and the last one a fish hitting on the eye while fishing. Two patients had NO PL vision at the end and one patient had final vision of 4 / 60.

30 (26.8 %) of the patients underwent surgeries other than primary surgical repair of corneal or scleral wound which include, traumatic cataract surgery, retinal detachment surgery and surgery for vitreous haemorrhage. Repeat surgeries had a worse prognosis in final visual outcome (p = < 0.01). The patients underwent second surgery either during the primary repair itself or during the follow up period as required in each case.

19 (17.0 %) cases had no significant complications as most of these patients had small wounds affecting peripheral cornea or small wounds at sclera alone. 26 (23.2 %) had decreased vision due to retinal involvement. In 10 (18.9 %) of cases, the eyes went into phthisis bulbi.

	Initial Visual Acuity		Final Visual Acuity		P
	Count	Percent	Count	Percent	Value
0.00 - 0.50	4	3.6	64	57.1	p < 0.01
0.52 - 1.0	29	25.9	14	12.5	
1.02 - 1.30	18	16.1	19	17.0	
> 1.30	61	54.5	15	13.4	

Table 4. Comparison of Initial and Final Visual acuities (Log MAR) and Categories of Visual Impairment According to World Health Organisation Criteria (WHO)[9] by McNemar Test

The final BCVA improved after the treatment in 102 (91.1 %) eyes, vision decreased in 2 (1.8 %) and 8 (7.1 %) maintained the same vision. 79 (70.6 %) of the patients had initial vision less than 6 / 60 (LogMAR more than 1) Snellen's vision, 61 (54.46 %) had less than 3 / 60 (LogMAR more than 1.3) and 8 patients had No PL vision at presentation. 64 (57.1 %) of the patients had final visual acuity more than 6 / 18 (LogMAR less than 0.50), 14 (12.5 %) had final vision 6 / 18 - 6 / 60 (LogMAR 0.52 - 1.0), 19 (17.0 %) patients had final vision between 6 / 60 - 3 / 60 (LogMAR 1.02 - 1.30) and 15 (13.4 %) had vision less than 3 / 60 (LogMAR more than 1.3) which is considered as blind according to WHO classification. Among these 10 patients had final vision of NO PL.

DISCUSSION

Open globe injuries are one of the leading causes of preventable monocular visual impairment, which are work related and non-work related, predominantly affecting young males. The severity of open globe injuries can vary from minor wounds which do not cause any visual disturbance or complications post operatively, to major injuries causing permanent visual impairment to total loss of vision.

In our study males were affected more and most common age group was 31 - 40 years. Most of the injuries happened between 21 - 50 years, which has been recorded in some other studies [10-12] This is comparable to reports from Turkey[13] in which the mean age was 28.1 + - 6.5 years and another report from China[14] in which it was 45.46 ± 17.48 years. Reasons for the male predominance could be due to the fact that they are more exposed to the activities involving industrial and other works, where these injuries are prone to happen, especially if they work without any eye protection equipment.

Regarding the place of injury, unlike previous studies, our study showed equal number of injuries at home and work place. Others include injuries at school, assault and RTA. Most of the previous studies showed, the workplace is the commonest site which accounts for more than half.[15-22] In this study no reported injuries due to war or any conflicts. Work place injuries happened exclusively in males[23,24] and in females, injury occurred mostly at home.[16,22] People engaged in certain occupations are more prone for ocular injuries like agricultural workers,[25,26] construction workers and carpenters.[27] Certain activities are also identified as high risk for ocular injuries like hammering, grinding, welding[28] and cutting metals or hard materials.

This study was conducted in southern part of Kerala, India, where we have only construction works, small scale industries and some extent of agricultural works as major occupations. In our study 90.7 % cases of the work place injuries did not wear protective eye equipment during their work, even if they were aware of it and was easily available. Studies have shown that more than 90 % of work related injuries are preventable[29] by the use of proper eye protective equipment.[30-32] Special care is needed in case of migrant workers because most of them return to their native place just after their surgical treatment. As they are from poor socioeconomic status, care should be taken for proper use of eye protective equipment to prevent the injury, and if injury happens, timely treatment and regular follow-up after the surgery is essential. Open globe injuries in younger age group have social and economic implications in terms of loss of income, absence from work and disability adjusted life years. Most of the injuries happened at home were due to negligence, like knife injury of paediatric patients. Another reason is fall at home especially in elderly people. Proper care of elders and control of their systemic diseases are needed to prevent this.

Most of the patients came to the hospital without much delay, because they were referred from primary health care centers and other hospitals. This study did not show any relationship between the time period between injury and surgery, and the final visual outcome of the patient. Like some of the previous studies, the most common cause of injury was metal piece, like iron nail and broken pieces of metal, happened during hammering, grinding or while cutting hard materials.

Involvement of limbus, sclera,[21] rupture of eye and presence of hypheama[18,19] had a worse final visual outcome in this study. Zone III injuries, extruded lens, vitreous haemorrhage and retinal involvement had a poor outcome [33-37] but traumatic cataract was not significantly influencing final visual outcome. Reason for this was, in most of the cases after cataract extraction and IOL implantation patients regain vision if the injury is confined to zone I. According to many studies before, factors affecting final BCVA include mechanism of injury, location of injury, initial visual acuity, presence of relative afferent pupillary defect (RAPD), hyphema, endophthalmitis, vitreous haemorrhage, and retinal detachment.[38-40] Presence of endophthalmitis always carry a poor prognosis in open globe injuries and the same showed in our series too. In this study 3 patients had endophthalmitis at presentation. Two of them had final visual acuity of NO PL, and one patient could achieve 4 / 60 final vision in spite of our best efforts.

About fifty percent of patients in this study group achieved BCVA of 6 / 18 or above. Most of them had less severe injuries and confined to zone one. About one third of our patients (30.4 %) ended up with final BCVA of less than 6 / 60 with severe visual impairment and remaining 13.4 % (n = 15) of the patients had a final BCVA less than 3 / 60, which is legally blind as per WHO classification.

More than half of the patients had more than 6 / 18 final visual acuity which indicate that most of these injuries were less severe, particularly injuries involving zone I. In this study 15 (13.4 %) of the patients have < 3 / 60 vision, according to WHO consider it as blindness, 34 patients (30.4 %) had final vision of < 6 / 60, severe visual impairment.

The most important limiting factor in this study is the small sample size. Also involvement of eye lid, adnexal, orbital injuries and multisystem trauma were not taken into consideration in this study. Further research is needed to evaluate the predisposing causes for increased incidence of domestic injuries especially among young adults and about the degree of awareness about eye protective equipment among high risk group.

CONCLUSIONS

This study demonstrated that there have been equal chances of open globe injuries at home and at workplace. Preventive measures like careful handling of things like knife, pencil, pen and stick at home are the need of the hour, in case of both adults and children. Employers should ensure the proper use of protective eye equipment by the workers throughout their work. In patients presenting with scleral involvement, hyphaema, rupture, vitreous haemorrhage, retinal detachment and extruded intraocular contents like lens or IOL have poor prognosis. Therefore, appropriate and careful management measures should be taken to get best possible final visual outcome.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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