Characteristics of Open Globe Injury in a Tertiary Hospital of Thailand and Predictive Factors for Visual Outcomes.

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Abstract

Background: Eye injuries are among the leading causes of visual impairment globally. This study investigated the characteristics of patients with open globe injuries and identified factors that may influence poor visual outcomes.

Methods: Retrospective review of 96 patients with open globe injury (OGI) between 2018 and 2023, presenting at Thammasat University Hospital. Demographic data and prognostic factors that influence the final visual outcome were examined. Statistical analysis was conducted using univariate and multiple logistic regression analysis.

Results: Of 96 patients, 85.4% were male, and the mean age was 44.64 ± 19.52 years. The outdoors was the leading place of open globe injury (OGI) (38.5%), followed by the workplace (31.3%). Construction was the most common culprit activity (37.5%). High-velocity metallic objects were the most common cause (42.7%). Penetrating injury is the most common type of injury (51.0%), followed by globe rupture (31.3%) and IOFB (17.7%). In a univariate analysis, factors that statistically affected visual outcome are older age, poor initial VA (2.12 ± 0.41 logMAR), globe rupture as a type of open globe injury, positive RAPD, present of retinal detachment, vitreous hemorrhage, eyelid laceration, and Low Ocular Trauma Score (OTS). In multivariate logistic regression analysis, poor initial VA, presence of retinal detachment, and Low OTS were found to be statistically significant.

Conclusion: In this retrospective study, the majority of patients with open globe injury were male. The mean age of the patients was 44.6 ± 19.5 years. The most important factors influencing final visual outcome were poor initial VA, presence of retinal detachment, and low OTS. This can be used to inform patient prognosis and identify strategies to prevent OGI.

Conflicts of Interest: This study has no conflicts of interest.

Keywords: Open globe injury, Ocular trauma score, Prognostic factors, Visual outcome

EyeSEA 2025;20(1):30-41

Background

Eye injuries are a significant cause of vision loss worldwide and are a leading cause of unilateral blindness in low- and middle-income countries.[1] Open globe injuries (OGI) represent a spectrum of trauma to the eye, including globe rupture from blunt trauma, penetrating globe injuries, perforating globe injuries, and intraocular foreign bodies. These injuries are considered ophthalmic emergencies, often requiring surgical intervention. The treatment process is resource-intensive and has high costs, which can significantly affect the financial well-being of patients, particularly in developing countries. Furthermore, these injuries place considerable strain on healthcare systems.

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Received : January 27th, 2025
Accepted : June 6th, 2025
Published : June 27th, 2025

Risk factors for open globe injuries (OGI) include male gender,[2,3] extremes of age (bimodal age distribution), and low socioeconomic status. Studies have shown that factors associated with poor visual outcomes or unfavorable prognosis include a low Ocular Trauma Score (OTS), poor initial visual acuity, the zone of injury in the eye, and the presence of associated ocular conditions such as abnormal pupillary response, uveal prolapse, hyphema, retinal detachment, lens injury, vitreous hemorrhage, and ocular infection.[3-8]

This study aims to examine the demographic data of the patients with open globe injuries, characteristics of open globe injury, and determine factors that lead to poor visual outcomes or treatment failures at Thammasat University Hospital, Thai Central Tertiary Referral Center. The results will enhance patient counseling, support informed treatment planning, and aid in creating preventive strategies for open globe injuries.

Method

Study design

This study is retrospective and descriptive. Patient records were reviewed from both paper medical files and electronic medical records, covering the period from January 1, 2018, to December 31, 2023. Relevant data were recorded in the case record form, without including any personal identifiers such as the patient's name, hospital number (HN), address, phone number, or other identification details that could potentially identify individual participants.

The data include gender, age, occupation, date of injury, time of injury, time to surgery, setting/place, activity, and causative object; initial and final best-corrected visual acuity (BCVA) in Snellen and Log MAR, mechanism of injury, wound size, wound location, the presence of a relative afferent pupillary defect (RAPD), associated findings including lens injury, retinal detachment, vitreous hemorrhage, endophthalmitis, and eyelid laceration, number of surgeries, operation, and actual cost of treatment before the deduction by the health system were collected. This study was conducted according to the Declaration of Helsinki and approval was obtained from the Ethics Committee for Research in Human Subjects of the Thai Ministry of Public Health.

The following definitions were used.

- Poor initial visual acuity (Poor initial VA): best-corrected visual acuity that is less than 20/200 at the first visit.
- Good initial visual acuity (Good initial VA): best-corrected visual acuity that is more than or equal to 20/200 at the first visit.
- Poor visual outcome: best-corrected visual acuity that is less than 20/200 at least six months after the end of treatment. (severe visual impairment or blindness from International Statistical Classification of Diseases and Related Health Problems 10th Revision's definition)[9]
- Good visual outcome: best-corrected visual acuity that is more than or equal to 20/200 at least six months after the end of treatment. (No or mild or moderate visual impairment from International Statistical Classification of Diseases and Related Health Problems 10th Revision's definition)

Subject

Inclusion criteria

- All patients diagnosed with open globe injury (OGI) and treated surgically at Thammasat University Hospital were included in the study, covering the period from January 1, 2018, to December 31, 2023.

Exclusion criteria

- All patients who had incomplete or missing recorded data.
- All patients who did not follow up for post-discharge care at least 6 months follow-up period.

Statistical analysis

The statistical analysis was conducted using the SPSS software version 25.0 (SPSS Inc, Chicago, USA). Descriptive statistics included numbers, percentages, mean, standard deviation, median, percentile, and minimum and maximum values, which were used to describe the general baseline data. Analysis Statistics (The level of statistical significance was set at $p < 0.05$) establishing relationships/comparative ratios among categorical data and associated findings between the poor and good final visual acuity (VA) Outcome Groups are using Chi-square test statistics or Fisher's Exact test. Comparing means of quantitative data between the poor final visual acuity (VA) outcome group and the good final visual acuity (VA) outcome group using independent t-test statistics in cases with normal distribution. If the data are not normally distributed, the Mann-Whitney U-test will be used. Analyzing factors associated with the occurrence of poor final visual acuity (VA) outcome group using Multiple Logistic Regression Analysis and reporting the risks with Odds Ratios (OR) and 95% Confidence Intervals (95% CI).

Log MAR was calculated using Schulze-Bonsel et al. 2006, Count finger (CF) as 1.85 Log MAR, Hand motion (HM) as 2.30 Log MAR. Light perception (LP) and no light perception (NLP) were not included in only the Log MAR calculation because these are detection, rather than discrimination tasks, they do not assess vision on a comparable scale in the reference study.[1] All the data included patients with light perception (LP) and no light perception (NLP), which were used to calculate demographic and clinical characteristics of participants, and the association between these characteristics and Final Visual Outcome.

Results

A total of 114 patients diagnosed with open globe injury (OGI) and treated surgically at Thammasat University Hospital from January 1, 2018, to December 31, 2023, were included in the study. Among these, 18 patients had incomplete or insufficient data for analysis, leaving 96 patients for further investigation.

The majority of patients with open globe injury were male, accounting for 85.4% (N = 82), while females comprised 14.6% (N = 14). The mean age of the patients was 44.6 ± 19.5 years, with an age range from 4 to 85 years. The majority of accidents occurred in outdoor settings at 38.5% (N = 37), followed by workplace settings at 31.3% (N = 30) and home settings at 24.0% (N = 23). Other less common settings included accidents on the road, at educational institutions, or as a result of physical assault. The most common activities that caused open globe injuries (OGI) were construction/chiseling/repairing, accounting for approximately 37.5% (N = 36). This was followed by gardening (19.8%), being struck by a blunt object (16.7%), being struck by a sharp object (13.5%), and falling (6.3%), in that order. The most common cause of injury was associated with high-velocity metallic objects (42.7%), followed by high-velocity objects (11.5%), glass (9.4%), wood branches (11.5%), and wood sticks (5.2%). The most common mechanism of injury were penetrating injuries (51.0%), followed by ruptured globes (31.3%) and intraorbital foreign bodies (IOFB) (17.7%). There were no perforating globe injuries in our study. The mean initial visual acuity (Initial VA) is 1.57 ± 0.83 logMAR calculating from the patient who has visual acuity better than light perception (LP) (N = 73). We categorized both initial visual acuity (Initial VA) and final visual acuity (Final VA) in to 5 group bases on The Ocular Trauma Score (OTS).[14] 9.4% of the patients (N = 9) had initial visual acuity (Initial VA) of 20/40 or better, 14.6% (N = 14) had initial visual acuity (Initial VA) between 20/50 and 20/200, 19.8% (N = 19) had initial visual acuity (Initial VA) between 20/400 and the ability to count fingers, 52.1% (N = 37) had hand motion vision to light perception, and 4.2% (N = 4) had no light perception shown in Table 1.

Table 1: Demographic and clinical characteristics of participants, and the association between these characteristics and Final Visual Outcome (n = 96)

Characteristics	Final Visual Outcome*						p-value
	Total	(n = 96)	Poor	(n = 48)	Good	(n = 48)	
	n	%	n	%	n	%	
Sex							0.247
Female	14	14.6%	5	10.4%	9	18.8%	
Male	82	85.4%	43	89.6%	39	81.3%	
Age (years)							0.007*
< 60	68	70.8%	28	58.3%	40	83.3%	
≥ 60	28	29.2%	20	41.7%	8	16.7%	
Mean ± SD.	44.64 ± 19.52		50.10 ± 20.56		39.17 ± 16.93		0.006*
Setting/Place							
Workplace setting	30	31.3%	12	25.0%	18	37.5%	0.186
Outdoor setting	37	38.5%	19	39.6%	18	37.5%	0.834
Traffic/Transportation setting	4	4.2%	3	6.3%	1	2.1%	0.617
Home setting	23	24.0%	13	27.1%	10	20.8%	0.473
Assault	1	1.0%	1	2.1%	0	0%	1.000
Educational setting	1	1.0%	0	0%	1	2.1%	1.000
Activity							
Mowing/bystander	3	3.1%	1	2.1%	2	4.2%	1.000
Gardening/farming/ cutting wood	19	19.8%	8	16.7%	11	22.9%	0.442
Constructing/Chiseling/ repairing	36	37.5%	14	29.2%	22	45.8%	0.092
Stuck by blunt object	16	16.7%	10	20.8%	6	12.5%	0.273
Struck by sharp object	13	13.5%	8	16.7%	5	10.4%	0.371
Fall	6	6.3%	6	12.5%	0	0%	0.027*
Other	3	3.1%	1	2.1%	2	4.2%	1.000
Causative object							
Floor	4	4.2%	3	6.3%	1	2.1%	0.617
High velocity metallic object	41	42.7%	20	41.7%	21	43.8%	0.837
High velocity object	11	11.5%	5	10.4%	6	12.5%	0.749
Wood stick	5	5.2%	3	6.3%	2	4.2%	1.000
Wood/Wood branch	11	11.5%	6	12.5%	5	10.4%	0.749
Glass	9	9.4%	5	10.4%	4	8.3%	1.000
Elastic objects	1	1.0%	1	2.1%	0	0%	1.000
Metallic object	5	5.2%	2	4.2%	3	6.3%	1.000
Stone	6	6.3%	2	4.2%	4	8.3%	0.677
Other	3	3.1%	1	2.1%	2	4.2%	1.000

Table 1: Demographic and clinical characteristics of participants, and the association between these characteristics and Final Visual Outcome (n = 96) (Cont.)

Characteristics	Final Visual Outcome*						p-value
	Total	(n = 96)	Poor	(n = 48)	Good	(n = 48)	
	n	%	n	%	n	%	
Initial VA**							< 0.001*
NLP	4	4.2%	4	8.3%	0	0%	
LP-HM	50	52.1%	37	77.1%	13	27.1%	
CF	19	19.8%	6	12.5%	13	27.1%	
20/200-20/50	14	14.6%	1	2.1%	13	27.1%	
≥ 20/40	9	9.4%	0	0%	9	18.8%	
Initial Visual acuity (Initial VA)***							< 0.001*
Poor initial VA	73	76.0%	47	97.9%	26	54.2%	
Good initial VA	23	24.0%	1	2.1%	22	45.8%	
Initial VA(LogMAR) Mean ± SD. (n = 73)	1.57 ± 0.83		2.12 ± 0.41		1.26 ± 0.85		< 0.001*
Mechanism of injury							0.026*
IOFB	17	17.7%	8	16.7%	9	18.8%	0.789
Rupture globe	30	31.3%	21	43.8%	9	18.8%	0.008*
Penetration	49	51.0%	19	39.6%	30	62.5%	0.025*
Wound location****							0.184
Zone 1	62	64.6%	27	56.3%	35	72.9%	
Zone 2	21	21.9%	12	25.0%	9	18.8%	
Zone 3	13	13.5%	9	18.8%	4	8.3%	
Associate finding							
Relative afferent pupillary defect (RAPD)	11	11.5%	9	18.8%	2	4.2%	0.025*
Lens injury	17	17.7%	30	62.5%	23	47.9%	0.151
Retinal detachment (RD)	18	18.8%	16	33.3%	2	4.2%	< 0.001*
Vitreous hemorrhage	26	27.1%	19	39.6%	7	14.6%	0.006*
Endophthalmitis	10	10.4%	8	16.7%	2	4.2%	0.045*
Eyelid laceration	13	13.5%	12	25.0%	1	2.1%	0.001*
Choroidal rupture	4	4.2%	3	6.3%	1	2.1%	0.307
Number of surgery							
1	48	50.0%	25	52.1%	23	47.9%	
2	29	30.2%	13	27.1%	16	33.3%	
3	9	9.4%	2	4.2%	7	14.6%	
4	8	8.3%	7	14.6%	1	2.1%	
5	1	1.0%	0	0%	1	2.1%	
8	1	1.0%	1	2.1%	0	0%	

Table 1: Demographic and clinical characteristics of participants, and the association between these characteristics and Final Visual Outcome (n = 96) (Cont.)

Characteristics	Final Visual Outcome*						p-value
	Total	(n = 96)	Poor	(n = 48)	Good	(n = 48)	
	n	%	n	%	n	%	
Number of surgery							0.800
1	48	50.0%	25	52.1%	23	47.9%	
2	29	30.2%	13	27.1%	16	33.3%	
3-8	19	19.8%	10	20.8%	9	18.8%	
Time to surgery							0.214
< 1day	56	58.3%	25	52.1%	31	64.6%	
> 1day	40	41.7%	23	47.9%	17	35.4%	
OTS category* **							< 0.001*
1	14	14.6%	14	29.2%	0	0%	< 0.001*
2	31	32.3%	21	43.8%	10	20.8%	0.016*
3	33	34.4%	12	25.0%	21	43.8%	0.053
4	11	11.5%	1	2.1%	10	20.8%	0.008*
5	7	7.3%	0	0%	7	14.6%	0.012*
OTS Mean ± SD.	64.40 ± 21.33		51.98 ± 18.41		76.81 ± 16.32		< 0.001*
Total cost of treatment							
Mean ± SD.	65,213.29 ± 45,147.66		76,691.74 ± 49,782.63		53,973.97 ± 37,286.43		0.019*
Median (IQR)	47866.25 (33,729.0 - 91,835.0)		56,699.25 (39,316.75 - 109,011.25)		40,918.38 (28,438.0 - 65,186.88)		

p values for mean data were calculated with the use of Mann-Whitney U-test, for percentages with the use of Chi-square test or Fishers' exact test, * Significant at p-value < 0.05

*Poor visual outcome: best-corrected visual acuity that is less than 20/200

Good visual outcome: best-corrected visual acuity that is more than or equal to 20/200

**HM, hand motion; LP, light perception; NLP, no light perception; CF, counting fingers

***Poor initial visual acuity (Poor initial VA): best-corrected visual acuity that is less than 20/200 at the first visit.

Good initial visual acuity (Good initial VA): best-corrected visual acuity that is more than or equal to 20/200 at the first visit.

****wound location: zone 1: cornea and limbus

zone 2: extending within 5 mm posterior to the limbus on the sclera

zone 3: full thickness injury more than 5 mm posterior to limbus

*****Ocular trauma score (OTS) category[14]

Category 1: score 0-44

Category 2: score 45-65

Category 3: score 66-80

Category 4: score 81-91

Category 5: score 92-100

In the outcome of treatment, we found that the mean final visual acuity (Final VA) is 0.90 ± 0.85 logMAR. 31.3% (N = 30) of the patients had Final VA of 20/40 or better, 18.8% (N = 18) had Final VA between 20/50 and 20/200, 14.6% (N = 14) had Final VA between 20/400 and the ability to count fingers, 15.6% (N = 15) had hand motion vision to light perception, and 19.8% (N = 19) had no light perception shown in Table 2.

Table 2: Show final visual acuity (Final VA) outcome.

	n	%
Final visual acuity (Final VA)		
NLP	19	19.8
LP-HM	15	15.6
CF	14	14.6
20/200-20/50	18	18.8
≥20/40	30	31.3
Final visual acuity (Final VA)		
Poor visual outcome	48	50.0
Good visual outcome	48	50.0
Final visual acuity (LogMAR) Mean ± SD. (n = 75)	0.90 ± 0.85	

HM, hand motion; LP, light perception; NLP, no light perception; CF, count finger

Poor visual outcome: best-corrected visual acuity that is less than 20/200 (severe visual impairment or blindness from International Statistical Classification of Diseases and Related Health Problems 10th Revision's definition)

Good visual outcome: best-corrected visual acuity that is more than or equal to 20/200

We recorded seven significant associated findings that need to be considered in the calculation of the ocular trauma score (OTS), which included vitreous hemorrhage 27.1% (N = 26), retinal detachment (RD) 18.8% (N = 18), lens injury 17.7% (N = 17), eyelid laceration 13.5% (N = 13), relative afferent pupillary defect (RAPD) 11.5% (N = 11), endophthalmitis 10.4% (N = 10), choroidal rupture 4.2% (N = 4), and 26 patients had no associated aforementioned findings. The patients were categorized based on the Ocular Trauma Score (OTS) into five groups, from the most severe (OTS 1) to the least severe (OTS 5). The mean ocular trauma score (OTS) is 64.40 ± 21.33. Of the patients, 14.6% (N = 14) were classified as OTS 1, 32.3% (N = 31) as OTS 2, 34.4% (N = 33) as OTS 3, 11.5% (N = 11) as OTS 4, and 7.3% (N = 7) as OTS 5. The prognosis was generally better for patients classified in the OTS 5 group and poorer for those in the OTS 1 group. Among OTS 1 patients, 57.1% (N = 8) had no light perception, 28.6% (N = 4) could perceive light or hand motion, and 14.3% (N = 2) were able to count fingers. These outcomes were assessed at least after 6 months of follow-up care. Surgical intervention within 24 hours of OGI was performed in 58.3% of the cases. The period between injury and repair time was unrelated to the final visual acuity (Final VA) outcome in our study (p = 0.214). The mean total cost of treatment is 65,213.29 ± 45,147.66 baht. Additionally, the poor visual outcome group incurred a higher average cost of 76,691.74 ± 49,782.63 baht, compared to the good visual outcome group.

We categorized the final visual acuity (Final VA) outcome at the end of treatment into two groups as defined before, according to the definition from International Statistical Classification of Diseases and Related Health Problems 10^{th} Revision. The first one is a good visual outcome (no or mild or moderate visual impairment), and the second one is a poor visual outcome (severe visual impairment or blindness).[10] The mean age of a good visual outcome group is 39.17 ± 16.93 years, while the mean age of a poor visual outcome is 50.10 ± 20.56 years ($p < 0.05$). The mean initial visual acuity of a good visual outcome group is 1.26 ± 0.85 logMAR ($p < 0.001$), while the mean initial visual acuity of a poor visual outcome is 2.12 ± 0.41 logMAR ($p < 0.001$). The mean ocular trauma scores (OTS) of the good visual outcome group are 76.81 ± 16.32 points, and 51.98 ± 18.41 points in the poor visual outcome group ($p < 0.001$). A good visual outcome was achieved in 100%, 90.9%, 63.6%, 32.3%, and 0% of OTS 5, 4, 3, 2, and 1, respectively. Demographic and clinical characteristics of participants and the association between these characteristics and the final visual outcome are shown in Table 1. Older age (p = 0.007), higher initial logMAR BCVA ($p < 0.001$), mechanism of injury (p = 0.026), associated findings such as relative afferent pupillary defect (RAPD) (p = 0.025), retinal detachment (RD) ($p < 0.001$), vitreous hemorrhage (p = 0.006), endophthalmitis (p = 0.045), and eyelid laceration (p = 0.001), and lower ocular trauma score ($p < 0.001$) were found to be related with poor visual outcomes.

After performing a univariate logistic regression analysis, factors that were found to be related to poor visual outcomes, defined as a final best corrected visual acuity (BCVA) less than 20/200 at least six months after the end of treatment, were included in a multivariate logistic regression analysis for further evaluation. Older age (≥ 60 years) ($p < 0.001$, OR 3.572, 95% CI 1.379 - 9.249), initial poor visual acuity (p = 0.009, OR 39.769, 95% CI 5.066–312.176), rupture globe as a mechanism of injury VA (p = 0.008, OR 3.684, 95% CI 1.397–9.714), the presence of relative afferent pupillary defect (RAPD) (p = 0.040, OR 5.308, 95% CI 1.082–26.040), retinal detachment (p = 0.002, OR 11.500, 95% CI 2.471–53.517), vitreous hemorrhage (p = 0.008, OR 3.837, 95% CI 1.428–10.312), eyelid laceration (p = 0.01, OR 15.667, 95% CI 1.946–126.116), and low ocular trauma score (OTS) ($p < 0.001$, OR 0.921, 95% CI 0.891–0.953) were found to be the most significant parameters related to poor visual outcome shown in Table 3**.**

Table 3: Factors associated with Poor Final Visual Outcome (n = 96) Univariate and multivariate logistic regression analysis

Factor	Univariate			Multivariate		
	Crude OR	**(95%CI)**	**p-value**	**Adj OR**	**(95%CI)**	**p-value**
Age (years)				-		
< 60	ref					
≥ 60	3.571	(1.379, 9.249)	0.009*			
Initial visual acuity*				-		
Poor	39.769	(5.066, 312.176)	< 0.001*	9.788	(1.037, 92.368)	0.046*
Good	ref			ref		
Mechanism of injury				-		
IOFB	1.404	(0.461, 4.269)	0.550			
Rupture globe	3.684	(1.397, 9.714)	0.008*			
Penetration	ref					
Relative afferent pupillary defect (RAPD) (present)	5.308	(1.082, 26.040)	0.040*	-		
Retinal detachment (RD) (present)	11.500	(2.471, 53.517)	0.002*	6.333	(0.988, 40.576)	0.0499*
Vitreous hemorrhage (present)	3.837	(1.428, 10.312)	0.008*	-		

Table 3: Factors associated with Poor Final Visual Outcome (n = 96) Univariate and multivariate logistic regression analysis (Cont.)

Factor	Univariate			Multivariate		
	Crude OR	(95%CI)	p-value	Adj OR	(95%CI)	p-value
Endophthalmitis (present)	4.600	(0.923, 22.930)	0.063	-		
Eyelid laceration (present)	15.667	(1.946, 126.116)	0.010*	-		
OTS score	0.921	(0.891, 0.953)	< 0.001*	0.943	(0.906, 0.980)	0.003*

Significant at p-value < 0.05

*Poor initial visual acuity (Poor initial VA): best-corrected visual acuity that is less than 20/200 at the first visit.

Good initial visual acuity (Good initial VA): best-corrected visual acuity that is more than or equal to 20/200 at the first visit.

Discussion

Eye injuries are one of the leading causes of vision loss worldwide and a major cause of unilateral blindness in countries with low- to middle-income populations.[1] The incidence of open globe injury (OGI) in adults was found to be 3.1-3.9/100,000 and has been defined as a preventable cause of permanent visual impairment.[2,11-12] The study found that the majority of patients were male, with 82 individuals (85.4%), which is similar to other reports both domestically and internationally. A male preponderance is a universal characteristic and is thought to be related to occupational exposure.[2,3]

In terms of age, the average age of patients was 44.6 ± 19.5 years, with an age range from 4 to 85 years. The majority of cases were in the 20-29 age group (20.8%), followed by the 30-39 age group (18.75%). These age groups are typically in the working age range, which increases the likelihood of work-related accidents.[4-6,11,13,14] Data collected from these two age groups showed that workplace injuries accounted for 40% and 44%, respectively. Regarding causes of injuries, the most common cause was high-velocity metal (42.7%), primarily related to construction/repairing activities (86.11% of the cases), which is in accordance with recent literature.[3,13,15] The second most common cause was wood/wood sticks/wood branches (16.67%), which resulted from gardening, farming, or woodcutting activities (47.4% of the cases). One-third of open globe injury (OGI) patients sustain injuries from work-related activities, particularly from constructing/chiseling/repairing tasks. Therefore, jobs with a high risk of eye injury should mandate eye protection as a strict regulation, and safety standards should be regularly monitored and enforced by government policy. Several studies have identified factors that influence poor treatment outcomes, including a low Ocular Trauma Score (OTS), poor visual acuity at the initial presentation, the zone of injury, and coexisting conditions associated with the open globe injury. These conditions include the presence of relative afferent pupillary defect (RAPD), retinal detachment, lens injury, vitreous hemorrhage, and ocular infections.[3-8]

In many studies, initial visual acuity is a key factor in predicting visual outcomes.[15-17] Our study compared initial visual acuity with visual outcomes by categorizing initial visual acuity into two forms: 1. Initial visual acuity (Snellen) 2. Initial visual acuity (logMAR) that was calculated using Schulze-Bonsel et al. 2006,[18] Count finger (CF) as 1.85 Log MAR, Hand motion (HM) as 2.30 Log MAR. Light perception (LP) and no light perception (NLP) were not included in the calculation. It was found that good initial visual acuity was associated with good visual outcomes, and poor initial visual acuity was associated with poor visual outcomes ($p < 0.001$). The study found that the group with poor final visual outcomes had an initial logMAR visual acuity of 2.12 ± 0.41, while the group with good final visual outcomes had an initial logMAR visual acuity of 1.26 ± 0.85 ($p < 0.001$). From multivariate logistic regression analysis, it can be inferred that patients with poor initial visual acuity were 9.79 times more likely to experience a poor final visual outcome compared to those with good initial visual acuity (p = 0.046). Four patients had initial visual acuity of no light perception (NLP); only one patient had improved visual outcome to light perception (LP), while the other still had no light perception (NLP). Nineteen patients had initial visual acuity of light perception (LP): only one eye regained useful ambulatory vision at VA 20/70.

Table 4: Final visual acuities and Ocular Trauma Score (OTS) categorical distributions in the OTS study and our study

		NLP		LP-HM		CF-20/400		20/200-20/50		> 20/40	
raw points	OTS category	OTS study (%)	Our study (%)	OTS study (%)	Our study (%)	OTS study (%)	Our study (%)	OTS study (%)	Our study (%)	OTS study (%)	Our study (%)
0-44	1	74	57	15	29	7	14	3	0	1	0
45-65	2	27	29	26	19	18	19	15	19	15	13
66-80	3	2	6	11	15	15	15	31	27	41	36
81-91	4	1	0	2	0	3	9	22	27	73	64
92-100	5	0	0	1	0	1	0	5	0	94	100

Percentages in each column may not be equal to 100% due to rounding.
CF, count finger; HM, hand motion; LP, light perception; NLP, no light perception; OTS, Ocular Trauma Score

The ocular trauma score (OTS) was calculated according to the patient's presenting findings following the ocular trauma score study (OTS study).[8] Table 4 shows the comparison of our study data and OTS study data. The table shows that our study closely aligns with the OTS study. Therefore, we can use the OTS as a preliminary guide for prognosis assessment in patients. The variables used to calculate the score, such as initial visual acuity, globe rupture, endophthalmitis, retinal detachment (RD), and relative afferent pupillary defect (RAPD), were found to be significantly correlated with the final visual outcome in this study. And from multivariate logistic regression analysis, we can imply that the patient with an increase of 1 point in the OTS score has a 0.943 times (5.7% reduction) lower risk of poor final visual outcome (p = 0.003).

An analysis of zones of injury revealed that more than half of our patients had zone 1 injury (64.6%). Numerous studies found similar rates for zone 1, which was the most common location of the injury.[3,11,15] Several studies found that wounds involving zone 3 had significantly poorer presenting and final visual acuity versus those involving zones 1 or 2,[10,15] however, in our study, there is no statistically significant difference between zone of injury and the final visual outcome, which may be due to an insufficient number of cases. Regarding the mechanism of injury, ruptured globes and penetrating injuries are significantly associated with poor final visual outcome. This result is consistent with other previous studies.[19]

The univariate analysis of our study demonstrated that the presence of relative afferent pupillary defect (RAPD), retinal detachment (RD), vitreous hemorrhage, or eyelid laceration as the associated finding was significantly associated with poor final visual outcome. Pieramici et al.[20] found that if an RAPD was presented, the final visual outcome was significantly worse. Furthermore, RAPD was present in 11 patients, and 9 of 11 patients had poor visual outcomes (p = 0.025). Using univariate logistic regression analysis, the presence of RAPD had a statistically significant influence on the final visual outcome (p = 0.040, OR 5.308, 95% CI 1.082–26.040). Therefore, assessing the RAPD is an important part of the initial eye examination that can provide insight into prognosis. However, in practice, this may not always be assessed because the injured eye often cannot be evaluated for pupil response. In such cases, performing the reverse RAPD test becomes crucial and should be considered and practiced. Retinal detachment was found to be a significant prognostic factor of poor final visual outcome.[21] In our study, retinal detachment was detected in a total of 18 patients with open globe injury (OGI). After they underwent surgical treatment, it was found that 16 patients had a poor final visual outcome. Upon performing a multivariate logistic regression analysis, the adjusted odds ratio (Adj OR) was 6.333 (p-value = 0.0499, 95% CI 0.988–40.576). This indicates that patients with retinal detachment (RD) are 6.33 times more likely to experience a poor final visual outcome compared to those without retinal detachment (RD). Retinal detachment (RD) after open globe injury usually requires multiple surgeries leading to poor visual outcomes. Vitreous hemorrhage may indicate the severity of ocular injury, making it a significant factor in determining visual prognosis. 16 of the 18 patients in our study with vitreous hemorrhage had poor final visual outcomes ($p = 0.006$), similar to previous studies.[16,21] In our study, lens injury does not indicate a poor visual outcome. Tök et al.[17] stated that lens injury is often associated with zone 1 injury, which increases the likelihood of performing lens surgery promptly after open globe injury (OGI). This, combined with advancements in modern cataract surgery tools, has improved surgical outcomes.

Study limitations

Firstly, this study was conducted retrospectively which resulted in insufficient medical records, such as the size of the wound and occupation, so the data could not be calculated in the statistical analyses. Secondly, a small number of cases contained data that was zero in certain fields that could not be included in the analysis.

Conclusion

The study found that open globe injuries occurred most frequently in the male population, predominantly among individuals of working age. The majority of these injuries took place in the workplace and were primarily associated with construction or repair activities. To reduce the incidence of open globe injuries, stronger workplace safety policies should be implemented. This study showed preoperative factors such as poor initial visual acuity, the presence of retinal detachment, and low ocular trauma score (OTS) that can be adversely affecting the final vision outcome. Recognizing these factors can help the surgeon in evidence-based counseling. In addition to these factors, there may be other factors that could affect the visual outcome, such as surgical techniques and surgical instruments, which should be further studied and updated.

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