Journal of Chitwan Medical College 2021;11(37):80-87
Available online at: www.jcmc.com.np

ORIGINAL RESEARCH ARTICLE

PATTERN OF OCULAR TRAUMA AND VISUAL OUTCOME IN PATIENTS ATTENDING NATIONAL REFERRAL EYE HOSPITAL OF ERITREA

Pradeep Bastola[1,*], Amir Ibrahim[2], Danait Michael[2], Hermela Misghna[2], Rut Russom[2], Polina Dahal[1], Femi Ibrahim[2]
[1]Department of Ophthalmology, Chitwan Medical College, Chitwan, Nepal
[2]Department of Ophthalmology, Asmara College of Health Sciences, Eritrea

Received: 26 Aug, 2021

Accepted: 15 Sep, 2021

Published: 30 Sep, 2021

Key words: BETTS; Ocular trauma; Ocular trauma score; Visual outcome.

***Correspondence to:** Pradeep Bastola, Department of Ophthalmology, Chitwan Medical College, Chitwan, Nepal.
Email:* bastola.pradeep@cmc.edu.np

Citation

Bastola P, Ibrahim A, Michael D, Misghna H, Russom R, Dahal P, Ibrahim F. Pattern of ocular trauma and visual outcome in patients attending national referral eye hospital of Eritrea. Journal of Chitwan Medical College.2021;11(37):80-87.

Peer Reviewed

ABSTRACT

Background: Ocular trauma has been a significant disabling health problem and a leading cause of visual loss in lower-middle-income countries. These injuries have many diverse costs including human suffering, long-term disabilities, loss of productivity, and economic hardship. This study was aimed to describe the pattern of ocular trauma, its visual outcome, and the overall epidemiology of ocular trauma in all patients presenting to Berhan Eye Hospital, Asmara, Eritrea.

Methods: A prospective observational study was conducted on ocular trauma patients who presented to Berhan Eye Hospital for the open globe, closed globe, and peri-orbital trauma from September – November 2018 after ethical approval from the Ministry of Health, Eritrea. Data on demography, initial and final visual acuity, type of injury as well as its outcome were collected using U.S Eye Injury Registry checklist. The types of injuries were classified according to Birmingham Eye Trauma Terminology System (BETTS), SPSS Version 22 was used.

Results: Ocular trauma accounted for 1.94% of the total patients attending the outpatient department (OPD) and emergency during the studied period. Of the studied 280 participants, 218 (77.9%) patients were below 40 years of age. The male to female ratio was 2.4:1. Closed globe injuries accounted the highest 205 (73.21%) followed by the open globe injuries 75 (26.79%). Home and industrial premises were the main places where ocular injuries occurred in the participants.

Conclusions: Ocular trauma affects mainly the younger age group. Blunt objects trauma in the eye are more common in low resource settings. Ocular trauma is an important cause of monocular blindness which can be prevented with early intervention and health promotion.

INTRODUCTION

Ocular trauma is the leading cause of uniocular visual disability and non-congenital uniocular blindness.[1,2] It has been estimated that 90% of all ocular injuries are avoidable.[3,4] Worldwide there are approximately 6 million people blind from eye injuries, 2.3 million bilaterally visually defected, and 1.9 million with unilateral visual loss; these facts make ocular trauma one of the most common causes of unilateral blindness.[5]

The prevalence of monocular blindness due to trauma ranges from 20%–50%, and of bilateral blindness from 3.2%–5.5%.[6] Hospital-based studies of eye trauma indicate that about two-thirds of those affected are males, predominantly children, and young adults, these numbers vary during conflicts.[7,8] Each year, there are 55 million eye injuries globally that result in restrictive activities for more than a day.[9] Males, lower socioeconomic status, children and younger age, occupation, sports, and road traffic accidents are some of the known risk factors associated with ocular trauma.[10,11] In addition to the impact on the affected individual, there are profound social implications regarding the lost productivity by young men and the requirement of caring facilities and rehabilitation for the elderly.[12] Therefore, knowledge of the causes of ocular trauma is essential for the proper management of patients and future prevention of the injury.[13] In most developing countries, farmers are highly at risk of ocular trauma.[14] Ocular trauma is a major public health concern, especially a barrier to achieve the goal of vision 2020 since 90% of ocular injuries are avoidable.[15]

The goal of this study was to describe the pattern of ocular trauma seen in BEH, analyze visual outcomes after ocular trauma, and finally make recommendations for public health and research of ocular trauma in the future.

METHODS

This was a prospective observational hospital-based study carried out in ocular trauma patients presenting to Berhan National Referral Eye Hospital, Asmara, Eritrea from September – November 2018. The study sample size was 280 subjects, convenience sampling was done as the sampling method.

The patients with ocular trauma were checked in the outpatient department (OPD), emergency unit, minor operating theatre

(OT), and major OT to ensure no subjects were missed. All ocular trauma patients presenting to OPD and the emergency unit of BEH during the study period were included in the study. The study subjects who were non-consenting, patients who were unable to adequately communicate with the data collection due to language barrier, children below the age of five, and psychologically unstable patients were excluded from the study.

The study was commenced after approval from the institutional review committee of the Ministry of Health, Eritrea. The aims and objectives of the study were explained to the patients during data collection. Written consent was taken from all participants. The participants benefited from the researchers in a way that thorough full health education was given depending on the type of ocular trauma.

The following computational method was used to derive the Ocular trauma score (OTS) and predict the visual acuity post intervention (Table 1).

The data collection was designed as a structured basic Ophthalmic examination. Primary data was collected from the patients presenting BEH due to trauma. The data was collected by the investigators. The tools used were the U.S. Eye Registry Injury checklist for trauma, Snellen chart for visual acuity, pen torch, slit lamp for an eye examination, direct and indirect ophthalmoscopes, non-contact tonometer, and B-scan where necessary.

The information sheets used for data collection were kept in safely locked draws while data entered in the computer was kept in encrypted folders in password computers (for safety data protection).

A pre-test was conducted for the first two weeks of August in the same hospital for pre-testing the checklist prepared. This was aimed to highlight the weakness (if any), since the checklist was adapted from U.S Eye Injury Registry. During this period 25 patients presented with ocular trauma. The checklist was modified according to the needs and had some weakness (Some tissues were missed, visual acuity on discharge for those who were admitted and diagnosed were not included). From the experience gained in the pretest, the technique of data collection was improved, and a more appropriate plan was developed

The relevant data for the study was entered in the statistician package for social service (SPSS) version 22 software and analyzed. A statistician was consulted when and where necessary.

Table 1: Ocular trauma score (OTS) and Initial visual factor

Initial Visual Factor		OTS Raw points
A. Initial Raw score (based on initial visual acuity)	NPL	60
	PL or HM	70
	1/60-5/60	80
	6/60-6/15	90
	Greater or equal to 6/12	100
B. Globe Rupture		-23
C. Endophthalmitis		-17
D. Perforating Injury		-14
E. Retinal Detachment		-11
F. Relative Afferent Pupillary Defect (RAPD)		-10
Raw Score = sum of raw points		

RESULTS

A total of two hundred and eighty people was enrolled in the study. Ocular trauma accounted for 1.94% of all patients (14,446) seen in BEH during the study period. The response rate from the patients was 100%. The mean age of study participants was 27.3 (5 – 93, ± 17.9) years. One hundred and ninety-eight (70.7%) were males and 82 (29.3%) were females giving a male to female ratio of 2.4:1. Twenty-five percent (n=70) of the ocular injuries were work-related while 75% (n = 210) were not work-related. Medical co-morbidity was seen in only 13 (4.6%) of the patients. The vision on the injured eyes was normal in 126 (45%), moderate to severe visual impairment (MSVI) in 63 (22.5%), and a blinding outcome i.e <3/60 constituted 82 (29.3%) of the study subjects. 251 (89.7%) study participants had a normal vision prior to the injury (Table 2).

Seventy-two patients required repair especially those who presented with open globe injuries and 78 (27.9%) patients were admitted. Time and place of trauma, place of injury in ocular trauma patients, presentation time to the hospital type of injury, cause of injury, type of injury according to BETT, ocular trauma score, post ocular trauma complications and OTS, sociodemographic characteristics, and presenting visual acuity and visual acuity at discharge are shown in (Tables 3-6).

Table 2: Clinical characteristics of patients

Category	Frequency (%)
Medical co-morbidity#	
Yes	13 (4.6%)
No	267 (95.4%)
Eye involved	
Right	131 (46.8%)
Left	140 (50.0%)
Both	9 (3.2%)
Vision of injured eye	
Normal (6/18 or better)	126 (45%)
MVI (<6/18-6/60)	49 (17.5%)
SVI (<6/60-3/60)	14 (5.0%)
Blind(<3/60-NPL)	82 (29.3%)
Bilateral injury	9 (3.2%)
Eye normal prior to injury	
Yes	251 (89.7%)
No	23 (8.2%)
Unknown	6 (2.1%)
Any repair due to trauma	
Yes	72 (25.7%)
No	208 (74.3%)
Hospitalization	
Yes	78 (27.9%)
No	202 (72.1%)
Arrival time post injury to BEH	
Greater than 24 hours	180 (64.3%)
Less than 24 hours	100 (35.7%)

Place of injury	Time of presentation at BEH		Total (n, %)
	Greater than 24 hrs (n, %)	Less than 24 hrs (n, %)	
Home	51 (57.3)	38 (42.7)	89 (100)
Street and highway	62 (70.5)	26 (29.5)	88 (100)
Work	57 (70.4)	24 (29.6)	81 (100)
School	8 (40.0)	12 (60.0)	20 (100)
Unknown	2 (100.0)	0 (0)	2 (100)

#: Hypertension, Diabetes, Cardiac Problems, Asthma

Table 3: Summary of pattern of the ocular injury

Characteristics	Frequency (%)
Etiology	
Blunt objects	105 (37.5%)
Sharp objects	87 (31.1%)
Fall	35 (12.5%)
Burn	24 (8.6%)
Road traffic accidents	11 (3.9%)
Others	18 (6.4%)
Intent	
Unintentional	197 (70.3%)
Assault	80 (28.6%)
Self-inflicted	1 (0.4%)
Unknown	2 (0.7%)
Alcohol use	
Yes	13 (4.6%)
No	267 (95.4%)
Type of ocular injury	

Closed	205 (73.2%)
Open	75 (26.8%)
Work related	
Yes	70 (25.0%)
No	210 (75%)
Eye protection	
Yes	30 (10.7%)
No	250 (89.3%)

Table 4: Sociodemographic characteristics and etiology of trauma

Category	Etiology of trauma				
	Frequency (n, %)				
Age	Blunt	Sharp	Burn	RTA	Fall
≤17	43	32	4	2	13
18-40	44	33	8	8	15
41-60	14	18	9	0	2
≥61	4	4	3	1	5
Gender					
Male	76	63	20	8	20
Female	29	24	4	3	15
Occupation					
Student	10	7	1	0	1
Agriculture/farmer	3	11	4	0	0
Metal and work related	2	16	1	0	0
No work related	85	51	14	11	34
Others	5	2	4	0	0

Table 5: Demographics of the study subjects and clinical presentation of patients with Ocular trauma score (OTS)

Category	Ocular trauma score	
	Good visual prognosis n (%)	Poor visual prognosis n (%)
Age		
≤17	65 (64.4%)	36 (35.6%)
18-40	75 (64.1%)	42 (35.9%)
41-60	32 (71.1%)	13 (28.9%)
≥61	10 (58.8%)	7 (41.2%)
Gender		
Male	127 (64.1%)	71 (35.9%)
Female	55 (67.1%)	27
Type of injury		
Open globe	41 (54.7%)	34 (45.3%)
Closed globe	141 (68.8%)	64 (31.2%)
Time of arrival		
Greater than 24 hours	105 (58.3%)	75 (41.7%)
Less than 24 hours	77 (77.0%)	23 (23.0%)
Vision of injured eye		
Normal (6/18 or better)	125 (96.9%)	4 (3.1%)
MVI (<6/18-6/60)	44 (88.0%)	6 (12.0%)
SVI (<6/60-3/60)	3 (21.4%)	11 (78.6%)
Blind(<3/60-NPL)	7 (8.4%)	76 (91.6%)
Bilateral injury	6 (75.0%)	3 (25.0%)
Eye normal prior to injury		
Yes	168 (66.9%)	83 (33.1%)

No	12 (52.2%)	11 (47.8%)
Unknown	2 (33.3%)	4 (66.7%)
Repair due to trauma		
Yes	27 (37.5%)	45 (62.5%)
No	155 (74.5%)	53 (25.5%)
Hospitalization		
Yes	21 (26.9%)	57 (73.1%)
No	161 (79.7%)	41 (20.3%)
Source		
Blunt	66 (62.9%)	39 (37.1%)
Sharp	54 (62.1%)	33 (37.9%)
Burn	17 (70.8%)	7 (29.2%)
Road traffic accidents	10 (90.9%)	1 (9.1%)
Fall	22 (62.9%)	13 (37.1%)
Others	13 (72.2%)	5 (27.8%)

Table 6: Age range, gender, and source of injury with the type of injury

Category	Type of trauma (BETT)	
	Open globe injury (OGI)	Closed globe injury (CGI)
Age		
≤17	32	69
18-40	26	91
41-60	15	30
≥61	2	15
Gender		
Male	56	142
Female	19	63
Source		
Blunt	15	90
Sharp	47	40
Burn	5	19
Road traffic accidents	0	11
Fall	5	30
Others	3	15

The probability of final visual acuity was estimated based on presenting visual acuity and clinical presentation using ocular trauma score (OTS) (Table 7).

Table 7: Ocular trauma score (OTS) and type of Injury

Type of injury	Ocular trauma score (OTS)					Total (n=280)
	0-44	45-65	66-88	81-91	92-100	
Open globe	4	14	16	20	21	75
Closed globe	2	6	56	47	94	205
Sub total	6	20	72	67	115	280

Probability of final visual acuity (VA) was estimated based on presenting visual acuity and clinical presentation using Ocular Trauma Score (OTS) 129 (46.1%) patients presented with normal VA, 65(23.2%) patients with moderate to severe visual impairment and 82(29.3%) patients were documented to have a blinding outcome i.e., visual acuity of <3/60.

DISCUSSION

Because of the delicacy and the peculiarities of ocular tissues, an injury that would be insignificant elsewhere in the body is a serious one in the eye. Direct trauma invariably results in severe damage and often loss of the eye, and ocular injuries are an important cause of visual loss worldwide.[16,17] The epidemiological data varies from one part of the world to another.

Studies on the role of age and gender are two important factors on the incidence of ocular trauma which have demonstrated higher incidences in people under 30 years of age and in the male gender.[18,19] Our findings also indicated that men were 2.4 times more likely to have ocular trauma, this finding in our

study is understandable as such people are likely to engage in risky behaviors and activities which may lead to ocular injuries; this figure in our study is comparable to studies done elsewhere where they found 2.2 higher chances of trauma in men and stated that men have 2.5 folds more risk of ocular trauma.[20,21]

In a systematic review of global eye injuries by Negral and Thylefors, the male to female ratio for ocular trauma was stated as low as two in Senegal, and as high as 8.5 in Iceland.[5,8] In any event, all reports indicate that men are at higher risk of ocular injuries, and this can be mainly attributed to occupational differences and men's involvement with more risky tasks than women. The greater tendency for men to sustain eye injury is multifactor which includes aggressive behavior, work-related, assault-related, alcohol abuse, and unwillingness to use protective devices at work.[22]

The mean age of presentation in our study was 27.28 years (SD±17.99) in the current study. The finding correlated with many studies.[23-25] These studies conducted elsewhere reported that the young and active age group between 18-40 years of age were more prone to ocular trauma as they are exposed to more hazardous activities and this could be because of the more active nature of boys than girls and because of the aggressive and adventurous nature of boys to girls.[23-25]

Laterality in ocular injuries also tends to vary in different studies. In our study right eye was involved in 131 (46.8%) patients, the left eye was involved in 140 (50%) patients rest study participants had a bilateral ocular injury. The slight predominance of the left eye injuries may be explained by the fact that most people are right-handed, and the left eye of the victim is the one that is more vulnerable to an attack from a right-handed person. Nine (3.2%) patients had a bilateral injury which correlated well with the study done in Uttarakhand, India.[26]

In this study, work-related injuries occurred in 25% of the study subjects. The common occupations among these groups were students, farmers, metalwork (hammering, grinding, and welding), and woodwork. Of these patients, only 9 (12.9%) patients gave a history of wearing protective devices while working. This finding of our study differed from a study done in Pakistan,[27] which showed that none of those patients gave a history of wearing protective devices while working.

In this study the most common place in which injury occurred were home 31.8%, followed by street and highway 31.4% and workplace 28.9%. This finding was comparable to studies from Ethiopia and Nepal where injuries occurring at home constituted 33% of study subjects and 32% respectively.[14,28] In contrast in a study by Zagelbuam et al,[29] the street was the place where most traumas occurred. Streets in our study included bus accidents, sidewalk injuries (perhaps by stone, or a fight), and recreational areas. The occurrence of injury at home was probably exaggerated by the fact people of age group less than 17 years of age, face domestic injuries at home due to various reasons.

Accidents are preventable and they occur because of ignorance, haste, negligence, carelessness, and lack of knowledge.[30] This study showed more accidental injuries than assault injuries that is 70.4% and 28.6 % respectively, which is comparable to the findings from a study done in elsewhere, where 92% of ocular injuries were accidental and 7.7 % were due to assault.[30]

We found that most cases of trauma (48.92%) were blunt, compared to 19.64% and 12.5% for trauma with sharp objects and falls, respectively. There are studies in the literature that found sharp trauma had a higher incidence.[7,13] Nonetheless, blunt trauma was more frequent in most studies done in various parts of the world in addition to ours.[31-33] This type of trauma was mainly caused by sticks and thrown stones. Less frequent were fistfights and injuries during sports. Blunt trauma has been reported to cause posterior segment complications such as retinal edema retinal hemorrhage, fundus changes, and peripheral retinal changes.[34] Although blunt traumas are more prevalent than sharp injuries, the management of sharp trauma is more challenging and their complications include endophthalmitis, in addition to immediate consequences such as severe corneal perforation and retinal tears.[35] In our study the main cause for sharp object injury was during hammering, where a small piece of metal penetrates the globe at very high speed from the metal being hit. This intraocular foreign body (IOFB) contributed a great deal to poor visual outcomes after such injury in the affected workers. Although gunshots were not a major cause (only 1.8%), they still represent a serious problem resulting in the severe visual loss.

In this study, closed globe injuries were found to be twice as common as open globe injuries. This correlated well with a study done in southwest Ethiopia, which had closed globe injuries accounting for 45.4% study subjects than 22.7% of OGI.[36]
However, the findings of our study differed from the results of a study from China,[9] which reported a higher incidence of open globe injuries. This discrepancy could likely be attributed to a higher proportion of occupational injuries from sharp penetrating injuries and the involvement of young persons in many plastic industries in China.

Our study showed an association between the duration of presentation at the hospital after the injury and the presence of complications at presentation using the OTS. In this study, 45% had the visual outcome of 6/6 – 6/18, but 29.3% had a blinding outcome i.e., visual acuity of <3/6. This finding from our study correlated very well with a study done at JUDO, which reported 21.1% of the study subjects with a blinding outcome i.e., visual acuity < 3/60.[36]

As this was a hospital-based study, the study subjects were not representative of the population at risk. Hence it is difficult to determine the prevalence of ocular injury accurately. The study covered patients only from Ophthalmology departments

and hence patients who had eye injuries along with other life-threatening injuries may have been missed. The short study period that may not reflect the trends of the ocular injury in the whole year.

Preventive educational measures be instigated at home environment for women and children and at workplaces for men to reduce the incidence of ocular traumatic emergency, especially Open Globe Injury (OGI). The poor outcome of OGI, associated with late presentation, may be addressed by improving access to eye health care services among the rural communities. Efforts to prevent ocular injuries should particularly be directed toward improving established domestic habits and taking care during farming and harvesting activities. The necessity of seeking professional medical help immediately after injury and the danger of delaying treatment should also be stressed

It is further recommended that our hospitals or vision centers should design an urgent referral system for emergency care services for ocular trauma patients to achieve a better outcome. Also, an appropriate tool should be adopted for documenting and reporting ocular injuries when seen in the hospital for detailed documentations and comparison over time. The US eye trauma registry format (used in this study) may be adopted.
It is recommended that if the injury is work related there should be a way to compensate the subject as the eye is one's soul and nothing can replace it.

CONCLUSION

Ocular injuries are still a common and preventable cause of monocular blindness mainly affecting 18-40 years, males and is predominantly work-related. It accounts for 1.94% of patients seen in the National Eye Referral Hospital in Eritrea. Blunt and sharp injuries were the most common causes of ocular injury in this study. Home and industrial premises were the main places where ocular injuries occurred. Ocular trauma score and Birmingham Eye Trauma Terminology (BETT) for grading ocular trauma can help predicting the prognosis for visual outcome in subjects with ocular injury.

ACKNOWLEDGEMENT

We would like to pass our sincere debt to the patients and their families without them the study would have been never possible. We would like to thank Dr. Kahsay F. the hospital director of Berhan Eye Hospital for continuous support during the study period. We would like to take an opportunity to acknowledge the staffs of Berhan Eye Hospital and the Ministry of Health, Eritrea for the support during the study.

CONFLICT OF INTEREST: None

FINANCIAL DISCLOSURE: None

REFERENCES:

1. Nordberg E. Injuries as a Public Health Problem in Sub-Saharan Africa: Epidemiology and Prospects for Control. East Afr Med J. 2000 Dec;77(12):S1-43. [PMID]
2. MacEwen CJ, Baines PS, P Desai P. Eye injuries in Children: the current picture. Br J Ophthalmol 1999; 83(8):933-6. [DOI]
3. Thompson CK, Kumar N, Billson FA, Martin F. The Aetiology of Perforating Ocular Injuries in Children. Br J Ophthalmol. 2002; 86(8):920-2. [DOI]
4. Omolase CO, Omolade EO, Ogunleye OT, Omolase BO, Ihemedu CO, Adeosun OA. Pattern of ocular injuries in Owo, Nigeria. J Ophthalmic Vis Res 2011 Apr;6(2):114-8. [PMID]
5. Négrel AD, Thylefors B. The global impact of eye injury. Ophthalmic Epidemiol. 1998 Sep;5(3):143-69. [DOI]
6. Toride AH, Toshida H, Matsui A, Matsuzaki Y, Honda R, Ohta T et al. Visual Outcome after Emergency Surgery for Open Globe Eye Injury in Japan. Clinical Ophthalmology. 2016;10:1731-6. [DOI]
7. Wong TY, Klein EKB, Klein R. The Prevalence and Incidence of Ocular Trauma. The Beaver Dam Eye Study. Ophthalmology 2000 Dec;107(12):2196-202. [DOI]
8. Theylefors B. Epidemiological patterns of ocular trauma. Aust N Z J Ophthalmol.1992 May; 20(2):95-8. [DOI]
9. Cao H, Zhang M. Epidemiology of patients hospitalized for ocular trauma in the Chaoshan region of China. PLoS One 2012;7(10):e48377. Epub 2012 Oct 31. [DOI]
10. Desai P, MacEwen CJ, Baines P, Minassian DC. Epidemiology and implications of ocular trauma admitted to hospital in Scotland. J Epidemol Community Health. 1996 Aug;50(4):436-41. [DOI]
11. Oluyemi F. Epidemiology of penetrating eye injury in Ibadan: a 10-year hospital-based review. Middle East Afr J Ophthalmol. 2001;18:159-63. [DOI]
12. Nelson LW, Wilson TW, Jeffers JB. Eye injuries in childhood: demography, etiology, and prevention. Pediatrics. 1989;438-41. [PMID]
13. Soliman MM. Pattern of ocular trauma in Egypt. Graefes Arch Clin Exp Ophthalmol. 2008 Feb;246(2):205-12. Epub 2007 Dec 11. [DOI]
14. Khatry SK, Lewis AE, Schein OD, Thapa MD, Pradhan EK, Katz J. Epidemiology of ocular trauma in rural Nepal. Br J Ophthalmol 2004 Apr;88(4):456-60. [DOI]
15. Gebril MM. Pattern of ocular trauma in Benghazi eye hospital, Benghazi, Libya. 2017;2(1):40-6. [LINK]
16. Esmaeli B, Elner SG, Schork MA, Elner VM. Visual outcome and ocular survival after penetrating trauma: a clinicopathologic study. Ophthalmology. 1995 Mar 1;102(3):393-400. [DOI]
17. de Juan Jr E, Sternberg Jr P, Michels RG. Penetrating ocular injuries: types of injuries and visual results. Ophthalmology. 1983 Nov 1;90(11):1318-22. [DOI]
18. Kuhn F, Morris R, Witherspoon CD, Heimann K, Jeffers JB, Treister G. A standardized classification of ocular trauma. Graefes Arch Clin Exp Ophthalmol. 1996 Jun;234(6):399-403. [DOI]
19. Tielsch JM, Parver L, Shankar B. Time trends in the incidence of hospitalized ocular trauma. Arch Ophthalmol. 1989 Apr 1;107(4):519-23. [DOI]
20. Dandona R, Dandona L, Srinivas M, Giridhar P, Prasad MN, Vilas K, McCarty CA, Rao GN. Moderate visual impairment in India: The Andhra Pradesh eye disease study. Br J Ophthalmol . 2002 Apr 1;86(4):373-7. [DOI]
21. Nirmalan PK, Katz J, Tielsch JM, Robin AL, Thulasiraj RD, Krishnadas R, Ramakrishnan R. Ocular trauma in a rural south Indian population:

the Aravind Comprehensive Eye Survey. Ophthalmology. 2004 Sep 1;111(9):1778-81. [DOI]

22. Katz JT, Tielsch JM. Life Time Prevalence of Ocular Injuries. Baltimore: Arch Ophthalmol.1993 Nov; 111(11):1564-8. [DOI]
23. Chiapella AR, Rosenthal AR. One Year in an Eye Casualty Clinic. Journal of Ophthalmology. 1985 69(11);865-70. [DOI]
24. Strahlman EE, Elman M, Daub E. Causes of Pediatric Eye Injuries: A population Based Study. Archives of Ophthalmology 1990:108(4):603-06. [DOI]
25. Papadakis MM. Current Medical Diagnosis and Treatment. New York: McGraw-Hill Medical 54th Edition 2015;P 63.
26. Dhasmana R, Bahadur H, Jain K. Profile of ocular trauma in Uttarakhand, A hospital based study. Indian journal of community health. 2012 Dec 31;24(4):297-303. [DOI]
27. Babar TF, Khan MT, Marwat MZ, Shah SA, Murad Y, Khan MD. Patterns of ocular trauma. J Coll Physicians Surg Pak. 2007 Mar;17(3):148-53. [PMID]
28. Alemayehu WT, Shahin S. Epidemiology of ocular injuries in Addis Ababa Ethiopia. The Journal of Ophthalmology of Eastern, Central and Southern Africa. 2014;18(1).
29. Zagelbuam BT, Tostanoski JR, Kerner DJ, Hershet PS. Urban Eye Trauma. Ophthalmology. 1993;100(6): 851-56. [DOI]
30. Mallika PS, Tan AK, Asok T, Faisal HA, Aziz S, Intan G. Pattern of ocular trauma in Kuching, Malaysia. Malays Fam Physician 2008;3(3):140-5. [PMID]
31. McCarty CA, Fu CL, Taylor HR. Epidemiology of ocular trauma in Australia. Ophthalmology. 1999 Sep 1;106(9):1847-52. [DOI]
32. Rahman IM, Maino A, Devadason D, Leatherbarrow B. Open Globe Injuries: Factors Predictive of Poor Outcome. Eye. 2005;20 (12):1336-41. [DOI]
33. Smith AR, O'Hagan SB, Gole GA. Epidemiology of open-and closed-globe trauma presenting to Cairns Base Hospital, Queensland. Clin Exp Ophthalmol. 2006 Apr;34(3):252-9. [DOI]
34. Pahor DP. Changes in Retinal Light Sensitivity Following Blunt Ocular Trauma. London: Eye (Lond) 200; 14(Pt 4):583-9. [DOI]
35. Jackson HJ. Bilateral Blindness Due to Ocular Trauma. London: Eye (Lond) 1996;10(Pt4):517-20. [DOI]
36. Asaminew TG, Gelaw Y, Alemseged F. Review of Ocular Trauma. Ethiopia: Ethiop J Health Sciences 2009;19(2):67-74. [DOI]