Clinical and Epidemiological Insights into Blunt Ocular Trauma: Prognostic Indicators and Visual Recovery

Christian Piedrahita Ochoo[1], Gildardo Gallego Noreñr[2]

Abstract Introduction: *Ocular trauma is a leading cause of avoidable monocular blindness and visual impairment worldwide. The incidence and prevalence of ocular trauma vary based on geographical location, climate and societal factors. Approximately 1.6 million people worldwide are blind due to ocular trauma, 2.3 million being bilaterally visually impaired and 19 million have unilateral loss of vision. The reported incidence of ocular trauma in India varies from 1% to 5%. 5% of all ophthalmic hospitalisation in the developed countries are due to ocular trauma and this figure is much higher in developing countries.* ***MATERIALS AND METHODS:****The study included all patients with ocular and orbital trauma at the Department of Ophthalmology. In this study, ocular injury was defined as any injury affecting the eye or adnexa requiring hospital admission and having a principal discharge diagnosis from the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-AM). Moreover, the Ocular Trauma Classification System (OTCS) classified the ocular trauma on the basis of visual acuity, anatomical location of wound, mechanism of injury, and presence of an afferent pupillary defect.* ***RESULTS*** *:Out of 290 patients, 215 (74.14%) were males and 75 (25.86%) were females. The mean age of the male participants was 31.84±13.92, and female participants was 41.56±15.28 (p<0.001). Out of 290 patients, 172 (59.3%) had closed globe injuries, whereas 95 (32.8%) had open globe injuries. 12 patients had chemical injuries, 8 had burn injuries, while 3 patients had combined chemical and burn injuries, accounting for 8.97% of the total injuries. Mode of treatment- 55.17% (160 eyes) of the cases were treated surgically. This included corneal or conjunctival tear suturing, scleral tear suturing, lid tear suturing, evisceration, cataract extraction with or without intraocular lens implantation, and trabeculectomy. 44.83% (130 eyes) of the cases received medical treatment.****Conclusion****:Ocular trauma is a grave cause of ocular morbidity and mortality. Prevention is always better than cure, so appropriate preventive measures should be used at potentially hazardous places. Prompt transfer to a good eye facility, early investigations, and management are key features to prevent permanent visual loss. The results of this study suggest the need to explore strategies to minimize ocular trauma as a priority.*

Keywords*: Blunt ocular trauma, Lid edema, Sub conjunctival hemorrhage, Eye protection.*

[1] Bacterióloga y Laboratorista Clínica. Magíster en Virología. Coordinadora Científica, Editora Médica Colombiana S.A. Carrera 43C No. 5-33. Medellín, Colombia

[2] Microbiólogo y Bioanalista, Estudiante de Maestría. Grupo Reproducción, Grupo Centauro, Grupo Nacer-SSR, Sede de Investigación Universitaria, Universidad de Antioquia. Medellín, Colombi

Medicina & Laboratorio 2023;27:297-313. https://doi.org/10.36384/01232576.708.
Received January 9, 2025; accepted March 11, 2025

INTRODUCTION

Ocular trauma is a leading cause of avoidable monocular blindness and visual impairment worldwide. The incidence and prevalence of ocular trauma vary based on geographical location, climate and societal factors. Approximately 1.6 million people worldwide are blind due to ocular trauma, 2.3 million being bilaterally visually impaired and 19 million have unilateral loss of vision. [1] the reported incidence of ocular trauma in India varies from 1% to 5%. 5% of all ophthalmic hospitalisation in the developed countries are due to ocular trauma and this figure is much higher in developing countries. Despite its public health importance, ocular trauma is most neglected and underreported disorder.[2]

Severity and extent of ocular injury is determined by the amount of energy transferred to the globe & orbit, characteristic of traumatic agent and location of impact area. Blunt trauma is the commonest form (54.9%) of ocular injury. Blunt trauma can occur in almost any setting and circumstances including workplace / domestic accidents, road traffic accidents, sports & recreational activities and physical assaults etc. [3]

The most common traumatic agent causing blunt ocular trauma are cricket ball, squash ball, fist, bamboo /wooden stick, airbag, cow horn and other projectile objects like stone, brick & Gulli etc.[4] The spectrum of blunt ocular injuries ranges from mild non-sight threatening injuries like ecchymosis of eye lid, corneal abrasion, subconjunctival haemorrhage to extremely serious blinding consequences such as globe rupture, retinal detachment, intraocular haemorrhage, traumatic optic neuropathy and orbital haemorrhage etc.[5]

Blunt ocular trauma can cause damage of ocular tissue by the coup and countercoup mechanism and anteroposterior compression or horizontal tissue expansion. Coup injury occur at the site of impact (e.g. ecchymosis of lid, sub-conjunctival haemorrhage and corneal abrasion etc). Counter-coup refers to injuries at the opposite side of site of impact like commotio retinae.[6]

Blunt trauma causes various effects in anterior and posterior segment of the eyeball and its adnexa [eyelid, orbit, conjunctiva].[7] In this hospital based, observational study we analyze the demographic profile, injury pattern, clinical presentation, visual outcome and prognostic factors of blunt ocular trauma. [8]

MATERIALS AND METHODS

The study included all patients with ocular and orbital trauma at the Department of Ophthalmology of hospital over a 1 year period from January 2001 through December 2005. This ophthalmic unit is the major adult eye trauma centre which serves as a major referral center for a large geographic area.

As a centre of excellence in eye care, the Department of Ophthalmology offers both emergency eye care and specialized care for patients of all ages with specific and complicated ocular or orbital diseases and conditions with a 24-hour Ophthalmic Emergency Department. This offers the opportunity to analyze ocular traumatic injuries in an well-defined study area.

In this study, ocular injury was defined as any injury affecting the eye or adnexa requiring hospital admission and having a principal discharge diagnosis from the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-AM). Patient records were identified by computer search using codes from the ICD-10-AM and the diagnostic codes were chosen to be identical to those used by Tielsch et al. and Klopfer et al.

Records from 290 patients were reviewed for open or closed globe injury, and classified by the Standardized international classification of ocular trauma (Birmingham Eye Trauma Terminology, BETT) as those involving blunt force, resulting in contusion (closed globe injury) or rupture (open globe injury), and those involving sharp forces, resulting in lamellar laceration (closed globe injury) or penetrating, perforating, and intraocular foreign body laceration (open globe injury). Moreover, the Ocular Trauma Classification System (OTCS) classified the ocular trauma on the basis of visual acuity, anatomical location of wound, mechanism of injury, and presence of an afferent pupillary defect.Records of the initial visit were assessed for visual acuity, mechanism of injury and the zone of injury. Zone I, II, and III were, respectively, from the anterior to the posterior pole of the globe.

Statistical Analysis

Data were analyzed with Epi Info version 6.0 (CDC, Atlanta, GA, US) and SPSS version 14.0

Statistical analysis of quantitative data, including descriptive statistics, parametric and non-parametric comparisons, was performed for all variables. Frequency analysis was performed by the chi-square test. Correlation analysis for initial and final visual acuity was performed with Spearman's test. Categorical evaluations were done for the numeric scores representing the likelihood of the final visual acuity in the OTS study and this study group. Chi square test or Fischer exact test were used as appropriate. All P-values were two-sided and P-values less than 0.05 were considered statistically significant

RESULTS

Out of 290 patients, 215 (74.14%) were males and 75 (25.86%) were females. The mean age at presentation was 34.21±14.76 years, while the median age was 34 years. The mean age of the male participants was 31.84±13.92, and female participants was 41.56±15.28 ($p<0.001$). Table 1 shows the age and gender distribution of the participants. Most of the patients, 170 (58.62%), belonged to rural areas, and 120 (41.38%) were from urban areas.

Table 1- Age and gender distribution

Age Group (Years)	Female Patients (%)	Male Patients (%)	Total Patients (%)
1-15	4 (5.33%)	35 (16.28%)	39 (13.45%)
16-30	11 (14.67%)	68 (31.63%)	79 (27.24%)
31-45	40 (53.33%)	90 (41.86%)	130 (44.83%)
46-60	10 (13.33%)	12 (5.58%)	22 (7.59%)
≥61	10 (13.33%)	10 (4.65%)	20 (6.90%)
Total	**75 (100%)**	**215 (100%)**	**290 (100%)**

In our study, we found that the majority of the patients, i.e., 160 (55.17%), presented between 6 to 24 hours, 95 (32.76%) presented to the hospital within <6 hours after the injury, and 35 (12.07%) presented after 24 hours. The most common place of injury was roadside in 125 (43.10%) of patients, followed by occupation/work-related injuries in 65 (22.41%), play-related injuries in 35 (12.07%), and assault in 25 (8.62%). Table 2 provides a breakdown of the place of injury.

Table 2- Place of Injury

Cause of Injury	Patients	Percentage
RTA	125	43.10%
Work-related	65	22.41%
Play-related	35	12.07%
Assault	25	8.62%
Fall	20	6.90%
Wood/tree branch	10	3.45%
Ball injury	8	2.76%
Nail chip	7	2.41%
Metal wire	5	1.72%
Total	**290**	**100%**

Table 3- Mode of Injury)

Cause of Injury	Patients	Percentage
RTA	125	43.10%
Assault	25	8.62%
Fall	20	6.90%
Tree Branch/Twig	10	3.45%
Ball	8	2.76%
Metal/Nail Chip	7	2.41%
Metal Wire	5	1.72%
Chemical	7	2.41%
Firecracker	6	2.07%
Metallic Foreign Body	5	1.72%
Cattle Tail	4	1.38%
Buffalo Horn	4	1.38%
Fingernail	4	1.38%
Sharp Plastic	3	1.03%
Needle	3	1.03%
Pen	3	1.03%
Stone	3	1.03%
Welding	3	1.03%
Burst Tire	2	0.69%
Foreign Body	2	0.69%
Iron Wire	2	0.69%
Pencil Tip	2	0.69%
Plastic Bat	2	0.69%
Fevi Quick	2	0.69%
Dog Bite	2	0.69%
Total	**290**	**100%**

Out of 290 patients, 172 (59.3%) had closed globe injuries, whereas 95 (32.8%) had open globe injuries. Out of 172 (59.3%) eyes having closed globe injuries, 152 (52.4%) cases had contusion, 12 (4.14%) cases had lamellar laceration, and 8 (2.76%) cases had superficial foreign bodies. In cases of open globe injuries, penetrating injury was the most common type as it was seen in 80 (27.59%) cases, 9 (3.10%) cases had IOFB, and globe rupture was seen in 6 (2.07%) cases. 12 patients had chemical injuries, 8 had burn injuries, while 3 patients had combined chemical and burn injuries, accounting for 8.97% of the total injuries.

11 patients (3.79%) were using eye protection at the time of injury, while 96.21% (279) of the cases were not using any eye protection devices such as PPE/goggles, etc. Among 85 patients of RSA traveling by 2-wheelers, 70 patients (82.35%) did not wear a helmet, while only 15 cases (17.65%) wore a helmet.

Table 4- Type of Injury

Type of Injury	Eyes (N=290)	Percentage
Mechanical Injury		
Closed Globe (N=172)		
Contusion	152	52.41%
Lamellar Laceration	12	4.14%
Superficial Foreign Body	8	2.76%
Open Globe (N=95)		
Penetrating	80	27.59%
IOFB	9	3.10%
Globe Rupture	6	2.07%
Chemical/Burn Injury	23	8.97%

Out of 290 patients, 172 (59.3%) had closed globe injuries, whereas 95 (32.8%) had open globe injuries. 12 patients had chemical injuries, 8 had burn injuries, while 3 patients had combined chemical and burn injuries, accounting for 8.97% of the total injuries.

Table 5- Trauma to Ocular Structures

Ocular Structures	**Injuries (N=590)**	**Percentage**
Lid	220	37.29%
Conjunctiva	160	27.12%
Cornea	105	17.80%
Sclera	15	2.54%
AC	30	5.08%
Iris	25	4.24%
Pupil	10	1.69%
Lens	15	2.54%
Vitreous	6	1.02%
Choroid	5	0.85%
Optic Nerve	12	2.03%
Retina	7	1.19%
Total	**590**	**100%**

Mode of treatment- 55.17% (160 eyes) of the cases were treated surgically. This included corneal or conjunctival tear suturing, scleral tear suturing, lid tear suturing, evisceration, cataract extraction with or without intraocular lens implantation, and trabeculectomy. 44.83% (130 eyes) of the cases received medical treatment..

Table 6- Comparison of VA at Presentation and on Final Visit

VA	At Presentation (Eyes)	Percentage	Final Visit (Eyes)	Percentage	X^2	p-value
6/6-6/18	160	55.17%	210	72.41%	40.765	0.001 *(HS)
6/24-6/60	40	13.79%	30	10.34%		
5/60 to PL	75	25.86%	38	13.10%		
No PL	15	5.17%	12	4.14%		
Total	**290**	**100%**	**290**	**100%**		

*p-value <0.05 is taken as significant

DISCUSSION

This prospective observational study involved 290 patients who sought treatment at a tertiary care hospital's ED due to OT. The young, productive male population in their 3rd–4th decades of life involved in RTAs becomes the common victims. Most injuries occurred in public places with blunt objects as the source of injury. [9]The majority sustained a unilateral eye injury. CGIs were the most common injury pattern, with the involvement of the lids and conjunctiva. The vision was unaffected in most of the victims, with the majority having an OTS score of grade 4, indicating a good visual prognosis.[10]

The current study revealed a higher prevalence of OT among males, with a male to female ratio of 4.5:1. These findings are consistent with previous research conducted in India and other regions, which also reported a significant gender bias toward males in ocular injury cases.[2 5] The male gender typically assumes the role of breadwinner within their families and often engages in more outdoor activities and occupational settings compared to their female counterparts, thereby increasing their susceptibility to various injuries, including OT. A study from northern India by Mohanty et al. [10] reported that the 21–30 year old age group was the most affected by OT, which aligns with our study population. Earlier epidemiological studies have documented age as an important predictive factor for ocular injuries, with the younger population having higher odds of injury than old age.

In contrast, Belmonte Grau et al., in their study on the Spanish population, reported a mean age of 54 years among the victims of OT. Another study by Choovuthayakorn et al. [11] on the Asian population revealed age differences between genders in ocular injuries and observed a mean age of 39.8 (22.9) years for females and 43.8 (17.8) years for males. Notably, studies by Belmonte Grau et al. and Choovuthayakorn et al. had domestic accidents and workplace injuries, respectively, as the major cause of OT in contrast to RTAs in the present study, which may partially explain the mean age difference between these studies.[12] The higher incidence of ocular injuries among the young and productive age group has long lasting effects on their productivity and imposes a significant economic burden on both the affected individuals' families and society at large.

The study noted RTAs as the most common cause of OT, followed by accidental self injury. The findings contrast with epidemiological studies from most Western countries such as Spain, the USA, and Korea, where occupational injuries and domestic accidents are the major causes of ocular injury.[13] The study done on the Singapore population by Voon et al. [14]

also reported occupational injuries as the most common mode of injury among OT victims. India is a developing country with an enormous burden of mortality and morbidity from RTAs and unintentional injuries where adherence to safety guidelines, protective wear, and conducive environmental factors such as road infrastructure are suboptimal. However, earlier studies in northern and southern India also reported that RTAs are the major cause of ocular injuries in their injury victims. The study center was also a tertiary care center located near national highways, with a high load of RTA cases, ferried to the ED as the first treatment center. The high incidence of RTAs could be partially attributed to this fact. Earlier studies showed occupational injury is the most common mode, with differences in work types between countries. Kinderan et al. [15] reported the pattern of ocular injuries among the western Nepal population and found injuries by sticks as the common mechanism of ocular injuries, followed by injuries from human body parts such as hands and fists. Choovuthayakorn et al., in their study from Taiwan, reported occupational injury as the most common mode, particularly with wooden objects or flying objects from an electrical grass trimmer. In our study, only 15 (8%) had OT in an occupational setting. The difference could be due to the center being a tertiary care setup located in an urban setting.

The study observed that the specific mechanism of ocular injury was that eye injuries predominantly occurred by falling from a moving vehicle (118, 66%), followed by blunt injury (27, 15%) and sharp objects (14, 8%), respectively. Out of 122 RTA victims, 112 patients were drivers or pillion riders of two wheelers and 110 of them did not have helmets at the time of the accident. Similarly, out of the 15 patients with occupational injuries, none had any protective eyewear at the time of the accident. The study findings corroborate the Voon et al. [16] study from Singapore, which reported that only 21.4% of occupational eye injury victims used eye protective devices at the time of injury.

Wearing protective gear such as a helmet can substantially reduce OT during RTAs, and compulsory protective eyewear such as goggles can reduce the incidence of ocular injuries in occupational settings. The study observed that evening time (4–8 pm) was the most common time of OT. This could be attributed to the fact that most OT victims sustained injuries following RTAs, and there is a high incidence of RTAs during this evening time, as reported by earlier epidemiological studies from eastern India. The study observed that 22 (12%) victims were intoxicated with psychoactive substances at the time of OT. These factors can alter the attention and judgmental capacity of road users and workers and predispose them to various kinds of trauma, including OTs. Apopulation based study from South India by Krishnaiah et al. [17] reported unilateral blindness in 39 out of 824 subjects who sustained ocular injuries. The findings corroborate a study by Kinderan et al. that reported that 74.8% of subjects regained normal vision following the OT, as per the World Health Organization criteria.[18]

CONCLUSION

The results of this study suggest the need to explore strategies to minimize ocular trauma as a priority. The target population which includes young, illiterate, and those working in mechanical jobs should be focused upon and given preventive measures and timely visit to ophthalmologists. Resources should be mobilized to provide quality ocular emergency care. Certain legislative directives for the protection of laborers and factory workers should be implemented. A joint effort by the

industry and agricultural experts with the health professional is the need of the hour to determine the region and work-specific eye protection.

REFERENCES

1. Shukla B. Epidemiology of ocular trauma. In Shukla B, Natarajan S, editors. Management of Ocular Trauma. 1st ed. Delhi: Meenakshi Printers; 2005. p. 3 4.
2. Krishnaiah S, Nirmalan PK, Shamanna BR, Srinivas M, Rao GN and Thomas R. Ocular Trauma in a Rural Population of Southern India. Ophthalmology. 2006; 113(7):1159-1164.
3. Sen E, Celik S, Inanc M, Elgin U, Ozyurt B, Yılmazbas P. Seasonal distribution of ocular conditions treated at the emergency room: a 1-year prospective study. Arq Bras Oftalmol. 2018 Apr;81(2):116-119. \
4. Puodžiuvienė E, Jokūbauskienė G, Vieversytė M, Asselineau K. A five-year retrospective study of the epidemiological characteristics and visual outcomes of pediatric ocular trauma. BMC Ophthalmol. 2018 Jan 18;18(1):10
5. Pai SG, Kamath SJ, D'Souza S, Dudeja L. A Clinical Study of Blunt Ocular Trauma in a Tertiary Care Centre. Online J Health Allied Scs. 2013;12(2):10.
6. Sharma, Yog Raj and Dinesh K Talwar. “Profile of Ocular Trauma at Tertiary Eye Centre.” JK Science, Vol. 7 No. 1, January-March 2005.
7. S.Padmanaban "Original Research Article A Clinical Study Of Visual Outcome In Ocular Blunt Trauma "IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 17, no. 5, 2018, pp 11-18
8. Kuhn F. Epidemiology of ocular trauma. In: Kuhn F, Morris R, Mester V, Witherspoon D, editors. Ocular Traumatology. Berlin, Heidelberg: Springer-Verlag; 2005. p. 47-77.
9. Mulrooney BC. Traumatic cataract. E Med J 2002;3(7):21–5.
10. Greven CM, Collins AS, Slusher MM, Grey WR. Visual results, prognostic [4] indicators, and posterior segment findings following surgery for cataract/ lens subluxation-dislocation secondary to ocular contusion injuries. Retina. 2002;22:575-80.
11. Ganesh A, Al-Zuhaibi S, Mitra S, Sabt BI, Ganguli SS, Bialasiewicz AA. Visual rehabilitation by scleral fixation of posterior chamber intraocular lenses in Omani children with aphakia. Ophthalmic Surg Lasers Imaging. 2009;40:354-60.
12. Misra S, Nandwani R, Gogri P, Misra N. Clinical profile and visual outcome of ocular injuries in a rural area of western India. AMJ 2013, 6, 11,
13. Shailaja Karve, Ankush Kolte, Ansari Alfia, Hemangi Rathi. Study of clinical profile of ocular trauma at a tertiary eye care centre. International Journal of Contemporary Medical Research 2017;4(12):4-7.
14. Rahul Dagwar, Sandeep Jawade, Ravi Chauhan, Clinical Profile and Visual Outcome of Blunt Ocular Trauma in a Tertiary Care Centre of Central India: A Prospective Study, International Journal of Medical Science and Clinical Invention 7(11): 5063-5069 2020
15. Maiya AS, Dharmesh AM, Jayaram R. Clinical profile of ocular blunt trauma in a rural hospital. Journal of Clinical Ophthalmology and Research, 2018; 6(1): 3-7.
16. Maurya RP, Singh VP, Gautam S, Asha, Kumar A, Mishra CP, et al. Study of epidemiology, clinical profile, visual outcome and prognostic factors of blunt ocular trauma in a teaching hospital. Indian J Clin Exp Ophthalmol. 2022;8(4):546-552.
17. Singh S, Sharma B, Kumar K, Dubey A, Ahirwar K. Epidemiology, clinical profile and factors predicting final

visual outcome of pediatric ocular trauma in a tertiary eye care center of Central India. Indian J Ophthalmol. 2017;65(11):1192-1197.
18. Sharat S, Pani S, Raj PB, Sohail MJ. Eye on impact: An analysis of blunt ocular trauma cases at a tertiary eye care centre in South India. Indian J Ocul Oncol Oculoplasty. 2024;10(3):145-150.