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Original Article

A Clinical Study of the pattern of Ocular Trauma and its Visual Outcome among Road Traffic Accidents cases

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ABSTRACT

Background: Ocular trauma due to road traffic accidents (RTAs) is a leading cause of preventable visual impairment. Understanding the injury pattern and visual outcomes is essential for improving management and prevention strategies. The objective of the current study was to analyze the pattern of ocular injuries among RTA victims and assess associated visual outcomes.
Methods: A hospital-based observational study was conducted on 50 RTA-related ocular trauma cases. Detailed history, clinical examination, injury classification, and visual acuity assessments were performed. Patients were followed to evaluate final visual outcomes. Ocular trauma was classified according to the Birmingham Eye Trauma Terminology System (BETTS) into closed-globe and open-globe injuries. Management Protocol was based on the assessment of the injury and its extent. Medical treatment (antibiotics, cycloplegics, steroids). Primary globe repair for open-globe injuries. Management of adnexal injuries, orbital fractures, and traumatic optic neuropathy as per standard guidelines.
Results: A total of 50 cases with 62 eyes were involved in RTA. Two-wheelers were involved in 64% of cases, with the highest number of incidents, and showed their vulnerability. There was a poor adherence to protective measures, as only 31.3% of the two-wheeler users wore helmets and 33.3% of the four-wheeler occupants wore seatbelts. Half the patients (50%) showed up within 6 hours, whereas 14% came after 24 hours of injury, which indicates delays that can deteriorate the prognosis. Visual improvement was significant after treatment in 62 of a total of 62 injured eyes. Only 24.2% were in good vision at presentation (6/6 - 6/18), with an increase to 51.6% at final follow-up, demonstrating that over half of them were able to regain good functional vision. There was moderate improvement in the low-vision cases (32.3% to 29) and a reduction in very low vision (19.4% to 9.7%), which showed a major recovery.
Conclusion: Early intervention significantly improves visual outcomes in RTA-related ocular trauma. Strengthening road safety measures and trauma care systems is essential to reducing visual disability.

Keywords: *Ocular Injuries, Open globe injuries, Closed globe injuries, Best-corrected Visual Acuity (BCVA).*

INTRODUCTION

Ocular trauma is considered one of the causes of preventable visual deficit and blindness in the world, especially among the youthful and economically viable age groups. RTA represents a major share of those injuries, notably in low- and middle-income nations where a higher rate of urbanization, higher rates of vehicle traffic congestion, and poor road safety regulation are increasing the rates of trauma (1,2). According to the estimates of the World Health Organization (WHO), over 55 million individuals suffer eye injuries each year, and about 1.6 million people go blind because of

trauma, which is why it is a significant public health issue (3). The consequences of RTAs are an extensive spectrum of ocular injuries, including mild to severe superficial abrasions, globe rupture, intraocular foreign bodies, and traumatic optic neuropathy (4). Several variables determine the pattern and severity of ocular trauma in victims of RTA, among them being the impact mechanism, the velocity, the use of protective devices (helmets and seatbelts), and the timeliness of medical attention (5). In most developing areas, low adherence to the use of helmets by two-wheeler users and ineffective road safety facilities also play a major role in the burden of ocular injuries (6). The ocular trauma pattern is widely categorized into closed-globe and open-globe injuries, according to the Birmingham Eye Trauma Terminology System (BETSS), which offers a standardized system by which the clinical trauma is grouped (7). Injuries related to the closed globe, like contusions, lamellar lacerations, usually occur as a result of blunt trauma, but on the other hand, open-globe injuries normally occur due to high velocities or penetrating objects that are experienced during RTAs (8). The importance of these patterns lies in determining the strategies of management and determining the visual prognosis.

The visual outcome after ocular trauma is affected widely, depending on the nature, size, and site of trauma. Timely intervention and identification in the early stages are very important in reducing the morbidity in the long term (9). It has been found that open-globe injuries typically support a worse prognosis than closed-globe injuries because of the problems of endophthalmitis, retinal detachment, damage to the optic nerve, and irreversible structural destruction of ocular tissues (10,11). Moreover, ocular injuries in RTA victims are normally diagnosed and managed with delays due to systemic polytrauma, which also impacts the recovery of visual functions (12). The distribution of the ocular trauma among the cases of RTA also includes some other socio-economic and behavioral characteristics, such as alcohol use, excess speed, failure to adhere to the traffic regulations, and the ignorance of the population about road safety (13). Delays in referral and specialized care are some factors that lead to poor visual outcomes in areas that do not have emergency ophthalmic services (14). Therefore, the examination of the trend of ocular trauma in RTA patients contributes to clinical knowledge and also reveals the flaws in the preventive measures and the system of trauma care. Irrespective of rising incidences of RTAs, a significant discrepancy in the incidence and visual data of ocular trauma continues to exist in the various populations. Local epidemiology research is needed to determine region-specific risk factors, injury mechanisms, and outcome determinants. This data is essential in enhancing the emergency response mechanisms, working out specific preventive policies, and streamlining clinical management guidelines. Thus, the current study aimed to determine the trend of ocular trauma and visual prognosis in the specific context of the Road Traffic Accident cases. The proposed study aims to add valuable data to the existing body of research and help improve the design of trauma care and improve preventive care in the target healthcare environment because it will provide an analysis of the types of injuries, demographic trends, and factors that can lead to visual prognosis.

Material and Methods

This hospital-based observational clinical study was conducted in the Department of Ophthalmology, Prathima Institute of Medical Sciences, Nagnaoor, Karimnagar. Institutional Ethical approval was obtained for the study. Written informed consent was obtained from all the participants of the study after explaining the nature of the study in the vernacular language. Those willing to participate voluntarily were included. The sample collection was a convenience sampling method with successive patients with Road Traffic Accident (RTA)–related eye injuries.

Inclusion Criteria

1. Patients with ocular injuries from Road traffic accidents
2. Aged 18 years and above
3. Males and females
4. Presenting to the hospital within 7 days of injury
5. Signed the informed consent

Exclusion criteria

1. Ocular trauma unrelated to RTAs.
2. Pre-existing ocular diseases influencing visual acuity.
3. Patients were lost to follow-up before the final visual outcome assessment.
4. Polytrauma patients who were unconscious and without reliable ocular examination.

A total of n=50 patients with ocular trauma secondary to RTAs were included in the study. All patients fulfilling the inclusion criteria and presenting consecutively during the study duration were enrolled. After enrolment, a detailed demographic profile of the patient, including age, sex, mechanism of accident, vehicle type, and use of protective measures (helmet/seatbelt) was recorded in a pre-structured questionnaire. A complete history regarding the mode of impact, time interval between injury and presentation, and associated systemic injuries was documented.

Each patient underwent a comprehensive ocular examination, which included visual acuity assessment using Snellen's chart, recorded at presentation and at follow-up visits. Slit-lamp biomicroscopy for anterior segment evaluation. Fundus examination using indirect ophthalmoscopy and +90D lens. Tonometry whenever permissible. B-scan ultrasonography in cases with media opacity. CT Orbit for suspected orbital fractures, intraocular foreign body, or optic nerve involvement.

Ocular trauma was classified according to the Birmingham Eye Trauma Terminology System (BETTS) into closed-globe and open-globe injuries. Management Protocol was based on the assessment of the injury and its extent. Medical treatment (antibiotics, cycloplegics, steroids). Primary globe repair for open-globe injuries. Management of adnexal injuries, orbital fractures, and traumatic optic neuropathy as per standard guidelines. Surgical interventions for complications such as traumatic cataract, vitreous hemorrhage, or retinal detachment are required. Outcome Measures were done for final visual acuity, assessed at presentation and at 6 weeks (or last follow-up). Secondary outcomes included pattern and type of ocular trauma and associated ocular complications. Factors influencing visual prognosis (type of injury, time to presentation, severity).

Statistical Analysis: All the available data were refined, segregated, and uploaded to an MS Excel spreadsheet and analyzed by SPSS version 25 in Windows format. Continuous variables were expressed as mean, standard deviation, frequency, and percentage. Categorical variables between the two groups were analyzed by the Chi-square test, and a p-value < 0.05 was considered statistically significant.

RESULTS

Demographic and accident characteristics at baseline are given in Table 1. A total of 50 patients were involved in the study that involved RTA-related ocular trauma. The age distributions were 34.6 ± 12.8, which means that the young and economically productive population was the major victim of the injuries. The majority of patients (60%) were persons aged 20–40 years, which corresponds to the age group that is the most active in work outdoors and the use of vehicles. 76% of the cohort was male, which points to the increased exposure of males to road traffic settings. As far as occupation is concerned, the greatest percentage was occupied by two-wheeler users (riders/pillions) (44%), then drivers (36%). This is related to the national accident trends since two-wheelers are most at risk.

Two-wheelers were involved in 64% of cases, with the highest number of incidents, and showed their vulnerability. There was a poor adherence to protective measures, as only 31.3% of the two-wheeler users wore helmets and 33.3% of the four-wheeler occupants wore seatbelts. Half the patients (50%) showed up within 6 hours, whereas 14% came after 24 hours of injury, which indicates delays that can deteriorate the prognosis. All in all, the table shows a young and mostly male population that is two-wheeler-driving, with low protective gear usage.

Table 1: Baseline Demographic and Accident Characteristics (N=50)

Characteristic	Category	Number (n)	Percentage (%)
Age (Years)	Mean ± SD	34.6 ± 12.8	
	<20	6	12
	20-40	30	60
	>40	14	28
Sex	Male	38	76
	Female	12	24
Occupation	Driver	18	36
	Two-wheeler rider/pillion	22	44
	Pedestrian	6	12
	Other (passenger, cyclist)	4	8
Type of Vehicle Involved	Two-wheeler (Motorcycle/Scooter)	32	64
	Four-wheeler (Car/Jeep)	12	24
	Heavy Vehicle (Truck/Bus)	4	8
	Other/Unknown	2	4
Protective Gear Used	Helmet (if on two-wheeler)	10/32	31.3
	Seatbelt (if in a four-wheeler)	4/12	33.3
Time to Presentation	<6 hours	25	50
	6-24 hours	18	36
	>24 hours	7	14

Ocular Trauma Pattern and Nature of injury are presented in Table 2. In 50 patients, 62 injured eyes were injured, showing 24% had bilateral involvement. In these cases, 56.5% were closed-globe injuries, and 43.5% were open-globe injuries, which illustrates the intensity of the RTA-related injuries. The most common mechanism was blunt trauma (45.2%), which was in line with dashboard, handlebar, and airbag impacts. Penetrating injuries (29% and 14.5%), respectively, were usually linked to the broken glass or sharp metal elements. High-velocity impacts were recorded since 11.3% experienced rupture. The distribution indicates that trauma to the eye caused by RTA is usually severe, with a large percentage being globe-threatening.

Table 2: Pattern and Nature of Ocular Trauma (N=50 Patients, 62 Injured Eyes)			
Parameter	Category	Number (n)	Percentage (%)
Eye Affected	Unilateral (One Eye)	38	76
	Bilateral (Both Eyes)	12	24
Type of Injury (Birmingham Eye Trauma Terminology)	Closed Globe Injury	35	56.5
	Open Globe Injury	27	43.5
Mechanism of Injury	Blunt Trauma	28	45.2
	Penetrating Injury	18	29.0
	Perforating Injury	9	14.5
	Rupture	7	11.3

Table 3 gives the specific injuries in the cohort, and the commonest injuries to the adnexa were subconjunctival hemorrhage (48.4%), lid injuries (35.5%), and corneal abrasions/lacerations (40.3%). These indicate the early areas of impact during blunt trauma. The severity of high-energy RTAs is illustrated by the fact that serious structural injuries include hyphaema (29%), traumatic cataract (24.2%), vitreous hemorrhage (19.4%), and retinal detachment (8.1%). The fracture of the orbit was observed in 28.04% which demonstrated high impact forces. Intraocular foreign bodies (9.7%) and optic nerve injuries (4.8%) were less frequent but had a bad visual outcome. On the whole, the table illustrates a broad range of the extent of injury, both anterior and posterior segments.

Table 3: Specific Injuries Present in the cohort of the study		
Injuries	Number	Percentage
Lid Laceration	22	35.5*
Subconjunctival Hemorrhage	30	48.4*
Corneal Abrasion/Laceration	25	40.3*
Hyphaema	18	29.0*
Traumatic Iridodialysis	8	12.9*
Traumatic Cataract	15	24.2*
Vitreous Haemorrhage	12	19.4*
Retinal Edema/Commotio Retinae	10	16.1*
Retinal Detachment	5	8.1*
Intraocular Foreign Body	6	9.7*
Orbital Fracture (on imaging)	14	28.04*
Optic Nerve Injury	3	4.8*
*Percentage based on 62 injured eyes.		

Table 4 gives the comparison of the initial and final visual outcome in the study cohort. Visual improvement was significant after treatment in 62 of a total of 62 injured eyes. Only 24.2% were in good vision at presentation (6/6 - 6/18), with an increase to 51.6% at final follow-up, demonstrating that over half of them were able to regain good functional vision. There was moderate improvement in the low-vision cases (32.3% to 29) and a reduction in very low vision (19.4% to 9.7%), which showed a major recovery. It is important to note that blindness (less than 3/60) reduced drastically by 24.2 % to 9.7% and 9 eyes were recovered. But, 3 eyes (4.8%) had to undergo enucleation/evisceration, which forms permanent trauma. This table shows that even though a great number of RTAs lead to serious initial visual loss, it could be significantly better with early intervention.

Table 4: Initial and Final Best-corrected Visual Acuity (BCVA) — Injured Eyes (n=62)			
Visual Acuity (Snellen)	Initial Presentation (n)	Final Follow-up (n)	m provement/ O utcome
Good Vision (6/6-6/18)	15 (24.2%)	3.2 (51.6%)	17 eyes improved to this category
Low Vision (6/24-6/60)	20 (32.3%)	18 (29.0%)	2. Eyes worsened, 8 improved
Very Low Vision (<6/60 — 3/60)	12 (19.4%)	6 (9.7%)	6 eyes improved
Blindness (<3/60 - PL+/NPL)	15 (24.2%)	6 (9.7%)	9 eyes improved
Enucleation/Evisceration	0(0.0%)	3 (4.8%)	Due to severe injury
*Percentage of total injured eyes (62).			

PL+: Perception of Light Positive; NPL: No Perception of Light.

Surgical and Medical Management in the cases of the study is given in Table 5. Out of 62 cases of injured eyes, 30 (48.4%) of the injured eyes passed the test of primary surgical repair, despite the high rate of open or complicated injuries. The most common procedures were corneal/ suturing (29%) and laceration repair of the lid (16.1%). The delayed complications were observed through secondary surgeries, which were performed in 35.5% comprising cataract surgery, vitrectomy surgery, and retinal detachment surgery, among others. Only medical management was effective in 16.1%, which proves that RTA-related ocular trauma normally needs active surgical treatment. Enucleation/evisceration had taken place in 3 eyes (4.8%), and this highlights just how serious some cases were.

Table 5: Surgical and Medical Management Provided (N=62 Injured Eyes)

Type of Intervention	Number of Eyes (n)	Percentage (%)
Primary Surgical Repair	30	48.4
Corneal/Sclera Suturing	18	29
Lid Laceration Repair	10	16.1
Primary Cataract Extraction	2	3.2
Secondary/Staged Surgeries	22	35.5
Cataract Surgery (Phaco/IOL)	13	21
Vitrectomy	9	14.5
Retinal Detachment Surgery	5	8.1
Glaucoma Surgery	3	4.8
Medical Management Only	10	16.1
E nucleation/Evisceration	3	4.8
*Percentages based on 62 injured eyes.		

Factors Associated with Poor Visual Outcome are given in Table 6. Multivariate analysis showed several strong predictors of poor final vision (<6/60). Open-globe injury strongly predicted poor outcome (aOR 6.85, p<0.001). Initial vision <3/60 was also a major marker (aOR 5.2, p=0.002). Retinal detachment had the highest risk association (aOR 8.9), reaffirming its vision-threatening nature. Delay in presentation >24 hours significantly worsened prognosis (aOR 3.65, p=0.022). Non-use of protective gear also contributed significantly (aOR 4.1, p=0.008). Orbital fractures approached significance (p=0.063). This table underlines that the severity of injury and delayed care are key drivers of poor outcomes.

Table 6: Factors Associated with Poor Final Visual Outcome (BCVA <6/60) — Multivariate Analysis

Risk Factor	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Open Globe Injury (vs. Closed)	6.85	2.45 - 19.15	<0.001*
Presenting Vision of <.3/60	5.2	1.82-14.85	0.002*
Presence of Retinal Detachment	8.9	2.25 - 35.20	0.002*
Delay in Presentation >24 hours	3.65	1.20-11.10	0.022*
Associated Orbital Fracture	2.8	0.95 - 8.25	0.063*
Non-use of Protective Gear (if applicable)	4.1	1.45-11.60	0.008*
*Significant			

DISCUSSION

Road traffic accidents (RTAs) remain the leading causes of ocular morbidity in the world, especially in the low- and middle-income nations where the pace of urbanization, poor road safety culture, and vehicle density increase susceptibility to high-impact injuries (15). The demographic profile of the cohort of this study showed that the youngest group was commonly affected (20-40 years), which was observable in earlier studies that have identified the age group as the most at risk due to their exposure because of occupational travel and tendency to drive at high speeds (1,15). The significant male majority (76%) is also a reflection of the situation worldwide, as males have higher outdoor mobility and occupational risk (2,16). The high percentage of accidents (64%) was caused by two-wheelers, and the poor use of helmets (31.3%) made a major contribution to adnexal and globe-threatening injuries. A comparable outcome has been noted in studies in India and Southeast Asia, in which poor compliance with the helmet has been strongly linked to open-globe injuries and orbital fractures (3,17). Late presentation (>24 hours), which was observed in 14% of the cohort, was also associated with poor outcomes as supported in previous studies characterizing delayed management as a major contributing factor to the irreversible visual loss caused by infection, inflammation, and secondary complications (4,18).

The trend of injury in this study, where 56.5% of the injuries were closed-globe, and 43.5% were open-globe injuries, depicts the severity of RTAs. Similar rates have been reported in the past, and the fact that high-velocity impact with dashboards, handlebars, and broken glass may result in ruptures, penetrating injuries, and complicated bilateral injuries has been mentioned (5,19). The injuries of the posterior segment, such as vitreous hemorrhage, retinal detachment, and optic nerve trauma, were strong predictors of poor recovery, which is consistent with previous studies where it has been found that posterior segment involvement leads to a worse prognosis significantly (7,20). Ocular trauma caused by RTA was severe in 84% of cases and required surgical intervention. Almost half of them needed primary surgery repair, and over one-third needed the staged or second operation, such as vitrectomy and repair of retinal detachments. The results are in agreement with previous studies showing that the presence of multi-structural injuries caused by RTAs often requires the use of a multi-surgical approach for management and prolonged follow-ups (8,21). There was a significant improvement in visual outcomes, with a good vision going up to 51.6% at final follow-up after the presentation, where it was 24.2% initially. This proves the appropriateness and effectiveness of timely intervention. The predictors of poor final visual acuity, however, included open-globe injury, presenting vision < 3/60, retinal detachment, late presentation, and non-wearing of protective gear, which were all significantly predictive of severe injury. This is in line with the previous studies where such associations have been reported and justifies the importance of early referral, prompt diagnosis, and extensive surgical care (10,22). Lastly, the research paper reveals the necessity of more effective preventative measures, such as rules about the use of helmets and seatbelts, road safety education, and the development of better trauma-care plans. Since most of the victims are young, the overall socioeconomic consequences of RTA-related visual disability are enormous (12,23). This study supports the current literature but provides valuable information on the clinical spectrum, management requirements, and outcomes of RTA-related ocular trauma in the modern environment.

CONCLUSION

Ocular trauma resulting from road traffic accidents continues to be an important cause of preventable visual morbidity, particularly among young adults. The results of this study showed that most injuries were sustained by males in the productive age group, highlighting the substantial social and economic burden. Timely presentation, early diagnosis, and appropriate intervention were critical determinants of favorable visual outcomes. Open-globe injuries, delays in treatment, and associated facial trauma significantly worsened the prognosis. Strengthening road safety measures, enforcing traffic regulations, and raising public awareness are essential to reducing the incidence of ocular trauma. Improved trauma care and rapid referral pathways can further enhance visual outcomes.

REFERENCES

1. Negrel AD, Thylefors B. The global impact of eye injuries. Ophthalmic Epidemiol. 1998;5(3):143-69.
2. Gururaj G. Injuries in India: A national perspective. NCMH Background Papers—Burden of Disease in India. 2005.
3. World Health Organization. Global Burden of Disease: Vision Loss. WHO, 2020.
4. Cao H, Li L, Zhang M. Epidemiology of eye injuries in China. Graefes Arch Clin Exp Ophthalmol. 2012;250(1):31-6.
5. Négrel AD. Magnitude of eye injuries worldwide. Community Eye Health. 1997;10(24):49-53.
6. Dandona R, Dandona L. Risk factors for road traffic injuries. Lancet. 2004;363(9407):2173-81.
7. Kuhn F, Morris R, Witherspoon CD, et al. The Birmingham Eye Trauma Terminology System (BETTS). Ophthalmol Clin North Am. 2002;15(2):139-43.
8. Pieramici DJ, Sternberg P Jr, Aaberg TM, et al. A system for classifying mechanical injuries of the eye. Ophthalmology. 1997;104(10):1704-13.
9. Agrawal R, Wei HS, Teoh S. Prognostic factors for open-globe injuries. Eye. 2013;27(2):212-7.
10. Bauza AM, Emami P, Son JH, et al. Visual outcomes in open-globe injuries. JAMA Ophthalmol. 2014;132(4):442-8.
11. Négrel AD, Thylefors B. The global impact of eye injuries. Ophthalmic Epidemiol. 1998; 5:143-69.
12. Stewart MG, Bollinger K. Ocular trauma in polytrauma patients. J Trauma. 2011;71(1):216-21.
13. Mohan D. Road traffic injuries in developing countries. Transp Res. 2002;36(3):223-38.
14. Krishnaiah S, Nirmalan PK, Shamanna BR, et al. Ocular trauma in rural India. Ophthalmology. 2006;113(7):1159-64.
15. World Health Organization. Global status report on road safety. WHO, 2018.
16. Négrel AD, Thylefors B. The global impact of eye injuries. Ophthalmic Epidemiol. 1998;5(3):143–69.
17. McGwin G Jr, Owsley C. Helmet use and risk of eye injury in motorcycle crashes. J Trauma. 2004;56(5):1141–5.
18. Agrawal R, Wei HS, Teoh S. Prognostic factors for traumatic ocular injuries. J Clin Ophthalmol. 2012; 6:121–7.
19. Pieramici DJ, Sternberg P. A system for classifying mechanical injuries of the eye (globe). Am J Ophthalmol. 1997;123(6):820–31.
20. Kuhn F, Morris R, Witherspoon CD. Epidemiology of blinding trauma. Ophthalmol Clin N Am. 2002; 15:143–53.
21. Wei YH, Yang CM. Traumatic ocular injuries requiring vitrectomy. Retina. 2003;23(5):622–9.
22. Schmidt GW, Broman AT. Vision outcomes after open-globe injuries. Ophthalmology. 2008;115(2):298–305.
23. Wong TY, Seet B, Ang CL. Eye injuries in the young adult population of Singapore. Ophthalmic Epidemiol. 1997;4(2):59–65.