Original Article

Patterns of Ocular Injuries Following Road Traffic Accidents: A Hospital-Based Study

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Abstract

Background: The objective is to evaluate the epidemiology, type of ocular injury, clinical presentation and visual outcome of the cases who presented for ocular trauma after road traffic accident. **Material and Methods:** A prospective observational study was undertaken in the department of Ophthalmology at Vijayanagar Institute of Medical Sciences, Ballari, with a study period of 18 months (from January 2021 till June 2022). All 85 patients by all age groups and gender with accident-related eye injuries were included. Detailed demographic and injury-related data were collected such as age, sex, type of protection used, alcohol consumption and when the patient attended. Full ophthalmological examination included Ophthalmoscopy, IOP measurement, anterior segment examination, and visual acuity assessment. When necessary, other tests including ultrasound (B-scan) and computed tomography of the orbit were carried out. Patients were followed up for clinical and visual outcomes. **Results:** All 85 patients were assessed of which 67% were within the age range of 21-40 years. The male-to-female ratio was 13:1 with males making up 92.9% of the cases. The majority lived in urban areas (57.6%) and only positive measures (8.2%) used were helmets or seat belts. 56% reported drinking alcohol at the time of their injury. injuries to the adnexa of the eyes (58%), followed by anterior segment injuries (29%) and combined anterior and posterior segment (13%) lesions were the most frequently recorded injuries. All patients had injuries of the eyelids, and 42.3% had conjunctival involvement. Closed globe injury was seen in 97.6% while open glob injury was seen in 2.4% of cases. Involvement of the right eye was 52% compared to 41% of the left eye, 7% had both eyes involved. The majority of patients were reported within 24 hours of the injury, and were able to have favourable visual outcomes after proper management. **Conclusion:** The incidence of road traffic accidents has great impact on ocular morbidity with a high percentage of young adult males. Nearly all injuries are linked with risk factors that can be modified, including the lack of use of protective measures and drinking of alcohol or drugs. The most common patterns of trauma are ocular adnexal or closed globe injuries. Often, the results of a better visual outcome are a combined result of early presentation, prompt diagnosis and timely intervention. Improvement of the road safety infrastructure, compelling the use of helmets and seat belts, and raising awareness of road users are important to decrease the burden of ocular injury due to road traffic accidents.

Keywords: Ocular trauma, Road traffic accidents, Ocular injuries, Closed globe injury, Visual outcome, Eye trauma, Ocular morbidity, Ophthalmology.

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Introduction

Any injury to the eye or its surrounding areas is referred to as ocular trauma and is a serious public health problem and a common source of morbidity at all ages, affecting more often children and young adults. It continues to be the most significant cause of preventable monocular blindness in the world and can cause a wide range of injuries to the globe, neuro-ophthalmic tubes (optic nerves) and ocular adnexa, from minor superficial injuries to vision threatening injuries.[1-3,21] It is particularly affecting the productive population age group, particularly males, which has a substantial impact on the social and economic development. Traumatic complication of the eye is multifactorial which includes the low socio-economic status and illiteracy and lack of awareness, which can be different in various geographical locations and population characteristics.[8,9] Mechanical injuries are common injuries to the eyes and are usually caused by road traffic accidents (RTAs), work related, home accidents, homicide/assault and sporting injuries. As the number of vehicles on the road increases, poorly designed roads combined with irresponsible driving, and the failure to wear protective equipment are major causes of these injuries, especially in developing countries where ocular injuries have become one of the leading causes of injured people seeking care from hospital eye departments because of road traffic accidents.[10-12,19]

World over, an ocular trauma is an important contributor to visual impairment. Over 55 million eye injuries per year are estimated with an estimated 1.6 million cases being blind, 2.3 million being

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bilaterally impaired, and 19 million being monocular blind or impaired.[4-6,18] Moreover, almost 90% of eye injuries are deemed preventable with relatively easy safety precautions.[7,23] Trauma remains a significant socio-economic and psychological burden in developing countries affecting the lives of those who are affected and their families. Road traffic accidents were found to be one of the most common causes of ocular trauma in a number of studies in hospital. A variety of extra-ocular manifestations have been reported in association with motor vehicle accidents, such as subconjunctival hemorrhage, eyelid lacerations, periorbital ecchymosis, corneal injuries, traumatic optic neuropathy and globe rupture.[3,22] Despite the significant advances in the diagnosis and treatment of severe ocular injuries over the last few years, the impact on the eye with its subsequent visual disability and blindness is still a significant number of patients.[2,20]

Kuhn et al. have established the Birmingham Eye Trauma Terminology System (BETTS) to classify ocular trauma, and the Ocular Trauma Score (OTS) can be used to predict visual outcome after eye trauma. They have helped to improve the assessment and management of injuries affecting the eyes in clinical practice. Despite these advances, however, there is an absence of comprehensive information available to support effective injury prevention strategies on the burden, pattern, risk factors and outcomes of ocular injuries.[13-17] Thus, the current hospital-based study was conducted to analyse the pattern of ocular injuries secondary to road traffic accidents, clinical presentations, associated risk factors and visual outcomes. It is crucial to have knowledge regarding the epidemiology and clinical profile of patients with eye trauma following road traffic accidents (RTA) as this forms the baseline for the development of eye trauma prevention strategies, enhancement of patient care and reduction of avoidable sight loss.

Aim of the Study: To assess the nature, characteristics and visual effects of ocular injuries in road traffic accidents (RTA).

Objective of the Study: To evaluate the demographic data, types of ocular trauma sustained, clinical manifestation and vision outcome in road traffic accident investigators who have suffered ocular trauma.

Materials and Methods

Prospective study utilizing data from hospitals. The study was done in Department of Ophthalmology of a tertiary care teaching hospital. Subject to study was conducted for 18 months starting from January 2021 to June 2022. Patients presenting to the eye bank on road traffic accidents were included for the study period provided they had an eye injury. A total of 85 patients with eye injuries after road traffic accidents (ATRA) were included in the study.

Inclusion Criteria

This study covered all age groups and both genders of patients with eye trauma caused by road traffic accidents (RTAs) during the study period, who attended the department of Ophthalmology. Persons who were drivers, passengers, pedestrians or occupants of cars involved in road traffic accident and suffered eye and/or orbital trauma as a result were included. Inclusion criteria were that the patient needed to have a full eye examination, and have given informed consent.

Exclusion Criteria

- Patients who were injured in an accident, but their injury involved trauma to the eyes that was not related to road traffic accidents.
- Patients that have already developed a disease which affects the eyes which effects there visual learning, as this will have an impact on the eye.
- Patients who do not want to be included in the study or consent to it.

Data Collection: A detailed history was obtained from all patients -- including history of alcohol consumption, time lapse, type of vehicle involved, seat belt (or helmet) use, and mechanism of injury were recorded.

Clinical Evaluation

All patients were carefully examined ophthalmically and the following procedures were performed:

- Visual acuity assessment (best corrected).
- External ocular examination.
- Slit-lamp biomicroscope.
- Measurement of intraocular pressure (IOP) whenever required.
- Thorough examination of the anterior and posterior segment of eyes.

Further examination of the orbit by B-scan ultrasonography and computed tomography (CT) was done when clinically necessary

Outcome Measures: The main study outcome was the type of eye injury sustained in road traffic crashes. The other outcome measures analyzed were: visual acuity presentation and follow-up, anatomic involvement and factors of visual prognosis.

Statistical Analysis: A structured proforma was used to data input and the relevant statistical tools were used to analyse the data. Demographic data, patterns of injuries and visual outcomes were summarized using descriptive statistics. Association between selected clinical parameters and visual outcome was evaluated via appropriate statistics and a value of $p < 0.05$ was deemed to be statistically significant.

Results

There were 85 patients who presented with eye injury post road traffic collision. Majority of the patients were in the age group between 21 years and 40 years (54 cases (67.0%)) Twenty-four patients (27.0%) were between 41 and 60 years of age and 5 (3.5%) were under the age of 20. The age group affected the least (2.5%) was above 60 years. This suggests that the majority of people that suffer eye injuries from road traffic accidents have been the economically productive population.

Table 1: Age Distribution of Patients (n = 85)

Age Group (Years)	Number of Patients	Percentage (%)
<20	5	3.5
21–40	54	67.0
41–60	24	27.0
>60	2	2.5
Total	85	100

Table 2: Gender Distribution

Gender	Number of Patients	Percentage (%)
Male	79	92.9
Female	6	7.1
Total	85	100

The 85 students who were included in the study were 79 males (92.9%) and 6 females (7.1%). Male predominance was evident with a male/female ratio close to 13:1 in the case of ocular injuries in road traffic accident cases.

Table 3: Occupation of Patients

Occupation	Number of Patients
Students	28
Farmers	20
Manual workers	18
Others	19
Total	85

Students were the most numerous in the group that suffered from ocular trauma (28 cases). 20 cases were from farmers and 18 were from the manual labor employees. There were 19 other occupations for the rest of the cases. This distribution shows that there are more young people and working age people exposed to injuries from road traffic among students.

Table 4: Residence of Patients

Residence	Number of Patients	Percentage (%)
Urban	49	57.6
Rural	36	42.4
Total	85	100

Among the total of patients in the study, 49 (57.6%) lived in urban areas, and 36 (42.4%) lived in rural areas. The higher percentages of urban patients could represent higher traffic levels and more vehicle exposure in urban areas.

Table 5: Use of Protective Measures

Protective Measure	Number of Patients	Percentage (%)
Used	7	8.2
Not Used	78	91.8
Total	85	100

Only 7 patients (8.2%) said they wore protective gear (helmet or seat belt) at the time of the accident. By contrast, 78 (91.8%) patients were not utilising any form of protective equipment. The results highlight inadequate use of safety measures among people concerned in road traffic collision.

Table 6: Alcohol Consumption at the Time of Accident

Alcohol Intake	Percentage (%)
Present	56
Absent	44
Total	100

Of all the patients, 44% reported no alcohol and 56% reported that they were drinking alcohol when they got into the accident. Alcohol use was a significant risk of road traffic accidents ocular injury incidents, as suggested by the high proportion of these types of incidents.

Table 7: Time of Accident

Time of Accident	Percentage (%)
6:00 PM – 11:59 PM	51
12:00 PM – 5:59 PM	31

6:00 AM – 11:59 AM	16
12:00 AM – 5:59 AM	2
Total	100

The greatest number of road traffic accidents with ocular injuries was from 6:00 PM to 11:59 PM, representing 51%. 31% of accidents took place between 12 PM and 5.59 PM and 16% took place between 6.00 AM and 11.59 AM. Only 2% of cases occurred from 12:00AM to 5:59AM, with that being the lowest frequency of the time of day.

Table 8: Time of Presentation to Hospital

Time of Presentation	Percentage (%)
<1 hour	5
1–6 hours	50
6–24 hours	41
>24 hours	4
Total	100

50% of the patients were admitted to the hospital between 1 to 6 hours after their injury. About 41% of the patients presented within 6–24 hours and 5% within one hour. 4% presented after a period of 24 hours. The results of this survey reflect the fact that the majority of patients were examined in the ophthalmic treatment units within a day of injury.

Table 9: Structures Involved

Structure Involved	Percentage (%)
Ocular adnexa	58
Anterior segment	29
Anterior + Posterior segment	13
Total	100

The most common ocular adnexal injury made up 58% of all injuries. The anterior segment, when present, accounted for 29% of the injuries and anterior posterior segment injuries were seen in 13% of the injured. Considerable periocular and adnexal lacerations are observed, indicating superiority of road traffic accidents.

Table 10: Laterality of Eye Involvement

Eye Involved	Percentage (%)
Right eye	52
Left eye	41
Both eyes	7
Total	100

There was a greater prevalence in the right eye (52%), than in the left eye. Ocular involvement was found to occur in 41% of patient in the left eye while 7% had bilateral involvement. Therefore, there were more cases of unilateral ocular injures among the study population.

Table 11: Type of Globe Injury

Type of Injury	Number of Patients	Percentage (%)
Closed globe injury	83	97.6
Open globe injury	2	2.4
Total	85	100

Closed globe injuries were far more common, in 83 patients (97.6%). Only 2 patients (2.4%) had injuries in the area of the cornea. This result suggests that for most RTA-associated ocular injuries that occurred those were non-penetrating eye injuries.

Table 12: Distribution of Closed Globe Injuries by Zone (n = 83)

Zone	Number of Patients	Percentage (%)
Zone I	73	88.0
Zone II	3	3.6
Zone III	7	8.4
Total	83	100

Of the 83 patients having closed globe injuries, Zone I injuries were the most common (73 cases, 88.0%). Zone is an injury that occurs within three zone boundaries, and 7 cases (8.4%) were observed in zone III, the least common injuries were zone II, which was reported in 3 cases (3.6%). A significant number of mutations were seen in the anterior

structures of the eye, based on the high percentage of Zone I collisions.

Table 13: Common Ocular Structures Injured

Structure Injured	Percentage (%)
Eyelids	100
Conjunctiva	42.3
Optic nerve	7.0
Orbital fracture	4.7
Traumatic mydriasis	4.7
Vitreous hemorrhage	2.3
Traumatic palsy	2.3

The eyelid was the most commonly injured structure of the eye, and was present in all cases (100%). Injuries to the conjunctiva were detected in 42.3% of the cases. Optic nerve was involved in 7.0% of the patients, whereas, 4.7% each had orbital fracture and traumatic mydriasis. Vitreous hemorrhage and traumatic palsy were the rarest seen in 2.3% each. These findings suggest that the disease affects mainly the anterior part of the eye and posterior segment involvement is not common.

Discussion

Road traffic accidents (RTAs) are one of the major etiological causes of ocular trauma, which continues to be a major preventable cause of vision impairment in the world today. The aim of the present hospital-based study was to assess the socio-demographic profile, injury type, and visual outcomes after ocular trauma secondary to road traffic accidents. The present hospital-based study aimed at determining socio-demographic characteristics, type of injury and visual outcome following road traffic accident (RTA) associated ocular injuries. The results offer informative information about the epidemiology of eye trauma and its prevention and early management. 67% of the patients in the present study were of age 21–40 whereas the remaining 27% were in the age group of 41–60 years. This discovery shows that people with working age dominance the side of the ones that result as victims of eye injury. The surge in young adults also could be due to more of the outside world, increased exposure at work, risk taking behavior, and more motor vehicle-exposure, reported by Gahlot et al. (mean age 30.57 ± 10.53 years) and Kumaraswamy et al. (from 21 until 30 years) reported the highest number of cases.[12]

Preponderance of males was noticed in the present study such that 92.9% of the patients were male and the male-to-female ratio was 13:1. The results agree with other previous studies which reported 84.4% and 75% male involvement, respectively.[19-21] The higher male rate of occurrence could be attributed to their higher involvement in driving and outdoor work and high-risk activities, while females stay out of these activities. In this study, the occupational group most affected by ocular trauma were students followed by farmers/manual labours. Some similar results have been reported in studies conducted in developing countries where there is a higher prevalence of exposure to road traffic hazards among young adults and working population. The high percentage (57.6%) of urban residents in the present study might be due to increased traffic congestion, heavy vehicle population, and excessive exposure of road traffic accidents in an urban environment.

The very low adoption rates of protective measures was one of the most significant findings of this study. At time of injury, only 8.2% of patients were in some form of protective device (helmet or belt) and 91.8% of patients were not wearing any protective equipment. None of these patients involved in the RTAs were wearing helmet in this study while Kushwaha et al. (2016) reported similar findings, there is an urgent need to strengthen enforcement of traffic regulations as well as awareness programs.[16] Another significant risk factor for injuries was alcohol use; 56% of patients were drunk upon the time of injury. Similarly, alcohol results in poor judgment, slower reaction times, more high-speed collisions and is an important factor in the cause of severe injuries seen in the setting of an RTA, as reported by Kushwaha et al.[16]

In the current study, most of the accidents happened at the evening time (6:00 PM – 11:59 PM), and 51% did. It is possible this is due to more cars passing thought, reduced overall visibility, driver fatigue, and the increased alcohol consumption at night times. A cluster of similar temporal trends has been found in other road traffic injury assessments. The majority of patients (50%) would be seen at the hospital within 1-6 hours of their injury, and 41% within 6-24 hours. Prompt presentation is key to prompt diagnosis and treatment of the acute eye injury. Early intervention has been proven to enhance both eye function and anatomical results and avoid permanent impairment of eye function. This observation corroborates that by Raiturcar et al., in which they found that most of the patients presented within six hours of the injury and were able to obtain favourable visual results.[11]

The present study revealed that injuries to the eyes were most frequent which comprised 58% of all the injuries. Anterior segment involvement only was present in 29% and combined anterior and posterior segment involvement was present in 13% of the injuries. Involvement of eyelid was seen in all the patients, while conjunctival injuries were seen in 42.3% of patients. Similarly, Raiturcar et al., found subconjunctival hemorrhage, eyelid lacerations, and eyelid ecchymosis to be the most common signs of ocular trauma with 44.6%, 6.6%, and 86.6% of patients having each, respectively.[11] Gahlot et al. reported the same clinical manifestations of ocular trauma with subconjunctival hemorrhage, eyelid lacerations, and eyelid ecchymosis accounting for almost all of the cases tested (86.6%, 6.6%, and 86.6%, respectively).[12]

Laterality was performed and showed that only in 7% the patients had both eyes involved; in 52% it was the right eye and in 41%

the left eye. The literature includes several previous studies with unilateral injuries being predominant, which might be understood by the way injuries occur and by the shelter that the eyes receive during the attack. In the current study the majority of injuries were of the closed globe type (97.6%) and only 2.4% were of the open globe type. Closed globe injuries were found in around 87% of ocular trauma cases, similar to the findings reported by Kushwaha et al, who found that the majority of ocular trauma cases were caused by closed globe injuries.[16] This may be attributed to the fact that closed globe injuries were likely to be caused by collisions, by impact with the interior of the vehicles, or by impact on roads. Anterior ocular structures were found to affect more frequently (Zone I make up the greatest proportion) than posterior structures.

Severe injuries (such as optic nerve damage, vitreous hemorrhage, traumatic palsy, and orbital fractures) occurred relatively rarely, but were correlated with poor visual prognosis. This has been reported by Raiturcar et al., in which, patients with retinal and optic nerve injuries and open globe injuries had significantly poorer visual outcomes, than those with anterior segment injuries only.[11] The results of this study highlight the importance of the fact that most cases of ocular injury depending on road traffic accidents can be avoided at all. Injuries rates are high over a large portion of the young male population, usage of protective clothing is low, and alcohol drinking consumption is highly associated with injury; road safety education, mandatory road safety clothing for road users, strict control and enforcement of traffic laws and public awareness campaigns are the areas on which preventive measures should be implemented. Early recognition and timely prophylaxis of the ophthalmologist are also essential in eradicating visual morbidity and for good prognosis.

Conclusion

Road traffic accidents are an important cause of ocular morbidity, especially in young adult males in the economically productive age group. In the present study, it was revealed that motor vehicle accident victims with ocular injuries were predominantly males and the age group 21-40 years old, with the majority victims admitting that they did not wear protective equipment like helmets or seat belts and a large number victims also reported having been intoxicated at the time of the accident. The most frequent presentations were ocular adnexal injuries, particularly eyelid injuries, and there were a large number of closed globe injuries. The results show that the majority of eye injuries related to road crashes are preventable. Poor protective device use and the high rates of alcohol use are risk factors that are amenable to change. Most patients had relatively less severe injuries to the anterior segment and the ocular adnexa, but severe injuries to the optic nerve, orbital fractures, vitreous hemorrhage, and open globe injuries have been found which resulted in loss of vision initially. In most patients' visual outcome was improved by timely presentation to the hospital and early assessment by an ophthalmologist. Increase in the strengthening of measures to prevent road traffic accidents and improve the use of helmets, seat belts, control of traffic with stricter measures, prevent operation of motorized vehicles by individuals under the influence of alcohol and improve public awareness of ocular trauma is essential to reduce burden caused by road traffic accidents related injuries to the eye. Timely recognition and management are important to avoid permanent visual impairment and search quality of affected lives.

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Conflicts of interest

There are no conflicts of interest.

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