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Original Article

Ophthalmology Section

# Epidemiology and Predictors of Visual Outcome in Patients with Occupational Eye Injuries- A Prospective Observational Study

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## ABSTRACT

**Introduction:** Work Related Eye Injuries (WREI) constitute majority of eye injuries affecting younger age group. Trauma mainly affects people from lower socioeconomic background. People having workplace related eye injuries have an added financial burden. Challenges with respect to workplace related eye injuries include lack of occupational safety and health cover, lack of related information about pattern and exact incidence and management protocols.

**Aim:** To study epidemiological profile, risk factors and predictors of visual outcome in occupational eye injury patients.

**Materials and Methods:** This prospective observational/cohort study was conducted in Department of Ophthalmology, at Rajiv Gandhi Medical college and CSM Hospital, Kalva, Thane between October 2020 to February 2022. Study population included 42 patients having occupational eye injuries. After obtaining written informed consent, detailed history regarding their occupation, mode of injury and awareness and history of use of any Protective Eye Device (PED) at the time of injury was noted. Best Corrected Visual Acuity (BCVA), detailed anterior segment examination and fundus examination was done. Ocular injury was classified as Open Globe Injury (OGI) or Closed Globe Injury (CGI) and ocular trauma scale was calculated. Patients were treated medically or surgically as indicated and followed-up next day and subsequently BCVA was noted and progress at each follow-up till six months was recorded. Factors related to good visual outcome (better or equal to 6/24) and bad visual outcome (visual acuity worse than 6/24) were identified. Continuous variables were described as the mean and variation of each observation from the mean value (Standard deviation) represented as mean±SD (analysed using independent t-test). Univariate analysis was done for identifying factors associated with bad visual outcome and p-value of <0.05 was considered significant.

**Results:** Forty-two patients were included in study (40 males and 2 females). There were 21 patients each in OGI and CGI. Most commonly affected were construction workers- 15 (35.72%). A total of 45% workers had access to PED at workplace but none of them used them. Univariate analysis showed open-globe injury, Zone-1 injury, presence of iris prolapse, traumatic cataract, vitreous prolapse/RD were related to bad visual outcome (<6/24). At six months, the median logMAR BCVA improved significantly from logMAR 0.8 to 0.18 (0-1.3) (p=0.0002).

**Conclusion:** Occupational ocular trauma is commonly seen in younger males. Poorer visual outcomes are associated with OGI and Zone-1 injuries, presence of iris prolapse, traumatic cataract, vitreous prolapse/retinal detachment. Lack of use of protective eye gear was universally noted along with its unavailability in many places. Conducting regular educational programs on ocular safety at workplaces, sensitising the workers and their employees regarding the hazards of ocular trauma and strict implementation of mandatory use of eye protective devices is recommended.

**Keywords:** Closed globe injury, Open globe injury, Ocular trauma, Incidence

## INTRODUCTION

Workplace related eye injuries are eye injuries which take place while working in various occupations like agriculture, industries, construction works etc. It constitutes majority of eye injuries affecting younger age group [1]. Though the data for workplace related eye injuries is sparse in India, The Andhra Pradesh Eye disease study (APEDS) showed that they contribute to 55.9% eye injuries [2]. Ocular trauma mainly affects people from lower socioeconomic background as shown by a study conducted in Northern India [3]. People having workplace related eye injuries not only have an added financial burden but also cause emotional disturbance when it happens in most productive years of life [1]. Challenges with respect to workplace related eye injuries include lack of occupational safety and health cover, lack of related information about pattern and exact incidence, management protocols and its impact on peoples' lives [1]. Previous similar studies have described their findings about visual outcome in penetrating ocular injuries and those related to retained Intraocular Foreign Body (IOFB) [4,5]. A study by Ratnapakorn T et al., described predictors of visual outcome in penetrating ocular injuries with IOFB and concluded that most of these injuries have a poor visual outcome [4]. Another study by Esmaeli B et al., gave insight about predictive factors of final visual acuity in penetrating ocular injury patients [5]. However, to the best of our knowledge, study describing epidemiology and predictors of visual outcome in occupational or workplace eye injuries has not been discussed. Thus, the aim of the current study was to analyse the epidemiology and predictors risk factors of visual outcome in occupational or workplace related ocular injuries.

## MATERIALS AND METHODS

This was a prospective study, conducted in Department of Ophthalmology at Rajiv Gandhi Medical College and CSM Hospital, Kalva between October 2020 to February 2022 which included 42 patients of any occupational ocular trauma attending the hospital. Clearance for the study was obtained from Institutional Review Board and Ethical Committee of the institute prior to commencement of study (IEC no: RGMC/CSMH/IEC/A/391/2020). This study adhered to the declaration of Tenets of Helsinki and well-informed consent was obtained from all patients included in the study.

**Inclusion criteria:**

1. All types of workers (industry/agricultural/any other) above 18 years of age with occupational eye injuries;
2. Domestic workers with eye injuries involving household works like cleaning, cooking, washing etc.,

**Exclusion criteria:**

1. Patients not willing to be a part of study;
2. Patients with minor ocular trauma with visual acuity 6/6 in affected eye and not requiring admission;
3. Patients with any pre-existing ocular diseases;
4. Patients with history of any intraocular surgeries.

## Procedure

The patients were subjected to detailed history taking regarding mode of injury, their occupation, duration between onset of injury and presentation to the hospital, any training received for their job before injury, awareness of PED while working (awareness was determined by asking leading questions) and history of use of any such devices at the time of injury was noted. Examination was done by noting Best Corrected Visual Acuity (BCVA), detailed anterior segment examination and fundus examination. Grading of injury done as Open Globe Injuries (OGI) or Closed Globe Injuries (CGI) and zones of injury were noted. The injury was categorised as per Ocular Trauma Classification Score [6]. Patients were treated medically or surgically as indicated. Patients were followed on day 1, day 7, 1st month and 6th month. Final visual acuity was evaluated at six months. Factors related to good and bad visual outcome were analysed.

**Zones of injury [7,8]:**

**OGI:** Zone-1- Cornea and limbus; Zone-2- from limbus to 5 mm posterior into sclera; Zone-3- posterior to 5 mm from limbus.

**CGI:** Zone-1- external anterior segment, conjunctiva, cornea, and sclera; Zone-2- internal anterior segment including lens, zonules and pars plicata; Zone-3- posterior segment including vitreous, retina, optic nerve, choroid and ciliary body.

## STATISTICAL ANALYSIS

The statistical analysis was performed by SPSS 23.0 version. Continuous variables were described as the mean and variation of each observation from the mean value (Standard deviation), represented as mean±SD. Categorical variables were described by taking percentages and were analysed using the chi-square test or Fisher-exact test when appropriate. Variables with a p-value <0.05 was considered statistically significant. Univariate analysis was done for identifying factors associated with bad visual outcome and p-value of <0.05 was considered significant.

## RESULTS

Forty-two eyes of 42 patients with a history of occupational ocular trauma were included in the study. All patients in the study had uniocular injury. The mean age of the study population was 36.95±13.45 years. Majority of the patients were in the 18-30 years age group (45.23%) followed by 31-40 years (30.95%). [Table/Fig-1] lists the age distribution of the study patients/population. [Table/Fig-2] shows the epidemiological profile of the subjects included in the study. Among the 42 patients, 31 were temporary workers and 11 were permanent workers. Most of the patients with injuries were construction workers and machinery and equipment workers [Table/Fig-3].

| Age of patients | No. of the patients (N=42) | Percentage |
|---|---|---|
| 18-30 | 19 | 45.23 |
| 31-40 | 13 | 30.95 |
| 41-50 | 1 | 2.38 |
| 51-60 | 7 | 16.67 |
| >60 | 2 | 4.76 |

**[Table/Fig-1]:** Age distribution of the study population.

**Training status and job experience in study participants:**

A total of 26 patients (62%) had history of training in their respective occupations, of which 23 (88.5%) patients had >six months experience and 3 (11.5%) patients had <six months experience in their occupations. Sixteen patients (32%) were untrained in their occupations, of which 15 (94%) had >six months experience and 1 (6%) patient had <six months experience in their work.

[Table/Fig-4] shows that almost 45% of workers sustained ocular injury in initial five hours of their work and 45% of workers presented to tertiary centre within first five hours of injury.

Among 42 subjects, 32 were aware about the use of protective eye wear, however 24 were not aware about the protective-eye devices. The protective-eye devices were available to 19 patients, but were not used [Table/Fig-5]. Injury from sharp objects was observed in 22 patients [Table/Fig-6].

A bad visual outcome was defined as a BCVA of 6/24 or worse. 42.86% of the study population had a final BCVA of ≤6/24. On univariate analysis, factors associated with bad visual outcomes at the six month were the presence of open-globe injury, Zone-1 injury, presence of iris prolapse, traumatic cataract, vitreous prolapse/RD, and an Ocular Trauma Score (OTS) of three [Table/Fig-7].

[Table/Fig-8,9] show the type of injuries and OTS score among OGI and CGI.

The median logMAR BCVA of the study eyes at baseline was 0.8 (IQR 0.2-1.5).

**Types of injuries:**

OGI=21 patients (50%), CGI=21 patients (50%)

On detailed evaluation, the size of the corneal tear was also measured. The mean size of the tear was 4.09±2.66 mm. A majority of the patients had a corneal tear of <5 mm (71.4%). The surgical and medical management of the patients has been tabulated in [Table/Fig-10]. Most common OGI management

| Gender | | Rural vs Urban | | Migrant status | | Job status | |
|---|---|---|---|---|---|---|---|
| Males=40 (95%) | Females=2 (5%) | Urban=41 (98%) | Rural=1 (2%) | Migrant workers=16 (38%) | Non migrant workers=26 (62%) | Temporary workers=31 (74%) | Permanent workers=11 (26%) |

**[Table/Fig-2]:** Epidemiology of study population.

| Occupation | No. of the patients (N=42) | Percentage |
|---|---|---|
| Agriculture | 2 | 4.76 |
| Construction worker | 15 | 35.72 |
| Electrician | 5 | 11.9 |
| Food industry worker | 2 | 4.76 |
| Household worker | 3 | 7.15 |
| Machinery and equipment | 9 | 21.43 |
| Wood and furniture | 6 | 14.28 |

**[Table/Fig-3]:** List of occupations of the study participants.

| | <5 hour | 5-10 hour | 10-20 hour | >20 hour |
|---|---|---|---|---|
| Time of injury from starting of work | 19 (45.2%) | 19 (45.2%) | 4 (9.5%) | Nil |
| Time of presentation at tertiary centre after injury | 19 (45.2%) | 9 (21.4%) | 8 (19%) | 6 (14.2%) |

**[Table/Fig-4]:** Time of injury after starting work and time of presentation after injury.

| Availability of eye-protective devices | 19 (45.28%) | Used=0 (0%) / Not used=19 (100%) |
|---|---|---|
| Non availability of eye-protective devices | 23 (54.27%) | - |
| Awareness of protective-eye devices | Aware=32 (76%) | Not aware=10 (24%) |

**[Table/Fig-5]:** Availability and awareness about eye-protective devices in study participants.

| Objects caused injury | No of the patients (N=42) | Percentage |
|---|---|---|
| Metal foreign body | 7 | 16.67 |
| Grinding stone | 3 | 7.14 |
| Chemical/corrosive agent | 4 | 9.53 |
| Sharp metal | 22 | 52.38 |
| Stick/thorn/tree/ vegetative matter | 3 | 7.14 |
| Thermal | 3 | 7.14 |

**[Table/Fig-6]:** Objects causing the injury in the study population.

| Factors | | Bad outcome (N=18) | Good outcome (N=24) | p-value |
|---|---|---|---|---|
| Zone | 1 | 11 (61.1) | 24 (100) | **0.005** |
| | 2 | 6 (33.3) | 0 (0) | |
| | 3 | 1 (5.6) | 0 (0) | |
| Corneal tear | | 14 (77.8) | 4 (16.7) | **<0.001** |
| Scleral tear | | 6 (33.3) | 1 (4.2) | **0.031** |
| Iris prolapse | | 9 (50) | 1 (4.2) | **0.001** |
| Traumatic cataract | | 14 (82.4) | 2 (8.3) | **<0.001** |
| Vitreous prolapse/retinal detachment | | 6 (33.3) | 1 (4.2) | **0.031** |
| Ocular trauma category | 2 | 2 (11.1) | 0 (0) | **<0.001** |
| | 3 | 14 (77.4) | 1 (4.2) | |
| | 4 | 0 (0) | 3 (12.5) | |
| | 5 | 2 (11.1) | 20 (83.3) | |
| Globe | Open Globe | 17 (94.4) | 4 (16.7) | **<0.001** |
| | Closed Globe | 1 (5.6) | 20 (83.3) | |
| Experience | ≤12 h | 11 (61.1) | 15 (62.5) | **0.927** |
| | <six months | 3 (16.7) | 0 (0) | **0.071** |
| Size of tear | <5 mm | 10 (55.6) | 20 (83.3) | **0.084** |

**[Table/Fig-7]:** Univariate analysis for factors leading to bad visual outcomes.

| Zones | Types of injuries | OTS category |
|---|---|---|
| Zone-1=13 (61.9%) | Intra-ocular foreign body=5 (24%) | OTS 1=0% |
| Zone-2=7 (33.33%) | Globe rupture=2 (9%) | OTS 2=2 (9.5%) |
| Zone-3=1 (4.76%) | Penetrating injury=14 (67%) | OTS 3=14 (66.66%) |
| - | - | OTS 4=2 (9.5%) |
| - | - | OTS 5=3 (14.3%) |
| Total | 21 (100%) | |

**[Table/Fig-8]:** Open Globe injuries (OGI).

| Types of injuries | OTS category |
|---|---|
| Lid laceration=9 (42%) | OTS 1=0% |
| Conjunctival tear=8 (38%) | OTS 2=0% |
| Subconjunctival foreign body=4 (20%) | OTS 3=1 (5%) |
| Total patients=21 | OTS 4=1 (5%) |
| | OTS 5=19 (90%) |

**[Table/Fig-9]:** Closed Globe Injuries (CGI).

required was corneal tear repair. Most CGI cases escaped severe injury with lid tear suturing being most commonly performed procedure for CGI.

Final BCVA

| Open Globe Injuries (OGI) | Closed Globe Injuries (CGI) |
|---|---|
| K-tear repair only=7 (33%) | Lid tear suturing=9 (42%) |
| K-tear repair+iris abscission=2 (9%) | Conjunctival tear suturing=8 (38%) |
| K-tear repair+IOFB removal=3 (14%) | Subconjunctival foreign body removal=4 (20%) |
| K-tear repair+lens aspiration=3 (14%) | |
| K-tear repair+lens aspiration+anterior vitrectomy=1 (5%) | |
| Scleral tear repair=1 (5%) | |
| Scleral tear repair+subconjunctival FB removal=3 (15%) | |
| Evisceration=1 (5%) | |

**[Table/Fig-10]:** Surgical management in open and Closed Globe Injuries (CGI).

At six months, the median logMAR BCVA improved significantly to 0.18 (0-1.3) from baseline 0.8 (0.2-1.5) (p=0.0002) . More than half (57.14%) of the patients had a final BCVA > 6/24 [Table/Fig-11].

| Snellen acuity | LogMAR acuity | No. of patients at presentation | No. of patients at six months |
|---|---|---|---|
| 6/6-6/18 | 0-0.5 | 16 | 24 |
| 6/24-6/60 | 0.6-1 | 9 | 5 |
| <6/60-3/60 | 1.02-1.3 | Nil | 3 |
| <3/60-1/60 | 1.32-1.68 | 8 | 5 |
| <1/60-FCCF | 1.69-2 | 4 | 2 |
| PL PR | <2 | 5 | 2 |
| No PL | <2 | Nil | 1 |
| | | Total=42 | Total=42 |

**[Table/Fig-11]:** Visual acuity at presentation and at final follow-up.

## DISCUSSION

WREI are a major cause of vision loss due to trauma therefore the knowledge about epidemiological and sociodemographic aspects, causative factors and visual outcome are necessary in occupational ocular trauma [6]. In this prospective study, more than two-thirds of the study population (76.18%) was under 40-year-old, with a mean age of 36.95 (±13.45) years [Table/Fig-2] and most of them were temporary non-migrant workers. This is consistent with previous researches, which demonstrates that WREI is more common in the younger population [9-12]. This implies that younger age-group is exposed to potentially hazardous environment at workplace and such injuries are quite common in local temporary working population. The major disadvantages associated with temporary workers are the lower wages, short-term nature of the job making the workers less involved in the task, and lack of team-spirit [13,14]. This subset of population should be made more aware of such injuries and they should be trained well before undertaking the job.

In this study, majority of injuries (57.16%) took place in laborious jobs like including construction, and machinery and equipment. In a similar study from Singapore, grinding, cutting metal, and drilling were the specific tasks at the time of injury in 90% of the cases [12]. This implies that most occupational ocular injuries take place in construction professions.

[Table/Fig-5] shows that almost 45% of workers sustained ocular injury in initial five hours of their work and 45% of workers presented to tertiary centre within first five hours of injury. This shows that occupational ocular injuries are common even during early hours of work when workers are more alert than later hours of day's work. It also indicates that though fairly high percentage of such workers are able to get treatment at tertiary centre, more awareness about such injuries and their sequalae should be imparted in such workers so that 100% workers sustaining work-related ocular injury reach tertiary centre for treatment. Also, availability of trained medical

professionals in vicinity of such work-places should be emphasised for administering first aid treatment and making arrangements for referral of patients requiring early intervention.

Awareness regarding health and safety forms the crux of preventing occupational injuries. In current study, the knowledge regarding PED (was present in more than 2/3rd (76%) of the study population [Table/Fig-6]. Although this was very encouraging, the availability of any form of PED was in less than half of the population (45.28%) at their workplace. None of the patients were using these devices at the time of injury or regularly. This is in line with a majority of the other studies which have shown a greater risk of injury associated with poor usage of eye-protective devices [15-18]. In a study by Ezisi CN et al., barely (1.3%) of the participants wore eye goggles infrequently, which is very similar to the present study [16]. Precautionary measures are not applied as often as they should be in a significant majority of workplaces. Adequate training and policies on workplace safety and the use of PED are of paramount importance.

Injury by sharp metal occurred in more than half (52.38%) of the present study population [Table/Fig-7]. Also, injury related to the metallic foreign body was seen in a further 16.67% of patients. Injuries with metallic objects are commonly encountered in an Indian scenario since they are abundantly used in construction and other industries.

The patients with open-globe injury had significantly worse visual outcomes as compared to closed-globe injury patients and the presence of Zone-1 injury was significantly associated with poorer visual outcomes.

In this study, 43% patients with corneal tear had mean size of 4.09±2.66 mm with almost 3/4th of them (71.4%) measuring <5 mm. Singh S et al., similarly evaluated corneal tear dimensions in 220 cases of paediatric ocular trauma [19]. In their study, a marginally higher proportion of patients (81.48%) had a tear of <5 mm. Of these patients, 42.04% had a final visual acuity of <0.6 logMAR. Although the size of the corneal tear did not have an impact on the final visual outcomes in the present study, the presence of a corneal tear was significantly associated with poorer visual outcomes at six months. Additional clinical features including the presence of traumatic cataract, iris prolapse, scleral tear, vitreous prolapse/retinal detachment, and an OTS of three and less were also significantly associated with a BCVA of <6/24.

In OGI, Zone-1 injury affected nearly two-thirds of the population (61.9%), followed by a Zone-2 injury (33.33%), and a Zone-3 injury (4.76%). Since a Zone-1 injury involves the cornea, it directly damages the visual axis. Thus, it can have a broader impact on the final visual outcome when compared to Zone-2 or Zone-3 injuries.

For open-globe injuries, a primary repair was done immediately. Additional procedures including IOFB removal, cortical aspiration, iris abscission, and vitrectomy were performed as indicated. Six of the 21 patients with OGI required a secondary intervention, which was performed anywhere from five days to six months following the first surgery. At six months, a significant improvement was noted in the BCVA. The occurrence of open-globe injury, Zone-1 injury, iris prolapse, traumatic cataract, vitreous prolapse/RD, and an OTS of three and less were all related to poor visual outcomes (BCVA <6/24) at six months. Results of this study are comparable to a similar study done by Men Y and Yan H which showed that Hyphema, vitreous haemorrhage, lens injury, retinal detachment and poor initial visual acuity were related to worse final visual outcome [7]. A better knowledge and understanding of these poor prognostic factors may help inform realistic visual prognosis to patients and their relatives. They may also assist diagnostic decision-making and planning for prompt intervention strategies to improve final anatomical and functional outcome.

Occupational ocular injuries can significantly impact the quality of life and source of income for the patients. These injuries can be greatly prevented by using a well-fitted and sturdy PED during the entire period of work. This will drastically minimise the number of days lost due to unproductive time. Furthermore, training programs for both employers and employees on workplace safety measures and effective preventive tactics must be addressed. Educational programs at the workplace pertaining to ocular safety education and training programs should be part of occupational safety efforts to raise workers' knowledge of this public health issue.

### Limitation(s)

Limitations of the study were short follow-up period and recall/information bias in multiple parameters pertaining to history of injury.

## CONCLUSION(S)

Based on the study, we conclude that occupational eye injuries are common in younger age-group (18-30 years group). Factors associated with poor visual outcome in occupational injuries were: open globe and Zone-1 injuries, iris or vitreous prolapse, traumatic cataract, retinal detachment. Increasing availability and awareness of protective eye gear in different occupations should be top priority in workplaces to prevent such injuries. Conducting regular educational programs on ocular safety at workplaces, sensitising the workers and their employees regarding the hazards of ocular trauma and strict implementation of mandatory use of eye protective devices should be emphasised.

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