



A STUDY OF WORKPLACE INJURY TO EYE IN A TERTIARY EYE CARE CENTRE

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Abstract

Background: Workplace eye injuries are an important cause of ocular morbidity and may result in significant visual impairment, loss of productivity and socioeconomic consequences. Many occupational eye injuries are preventable through appropriate use of protective eyewear, workplace safety measures and worker education. This study was undertaken to evaluate the demographic profile, occupational characteristics, mechanisms, clinical presentation, management and visual outcomes of workplace-related ocular injuries presenting to a tertiary eye care centre.

Methods: This retrospective observational study included patients with workplace-related ocular injuries who presented to a tertiary eye care centre in Bangalore during the period from February 2021 to January 2023. A total of 225 patients were included. Demographic details, occupation, mechanism of injury, time to presentation, use of protective eyewear, anatomical structures involved, type of ocular injury, visual acuity, treatment and visual outcomes were assessed. Patients were evaluated clinically and managed according to the nature and severity of the injury.

Results: The majority of patients were adult males, with a mean age of 36.9 ± 11.4 years. Factory/industrial workers constituted the largest occupational group (27.9%), followed by welders (20.4%) and construction workers (15%). The right eye was involved in 53.1% of cases, the left eye in 43.8%, and bilateral involvement in 3.1%. Wooden stick injury was the most common mechanism of injury (68.1%), followed by iron nail injury (10.6%) and chemical exposure (8%). Most injuries occurred during the late afternoon (81.5%) and were self-inflicted (97.7%). A majority of patients (89%) did not use protective eyewear at the time of injury. Closed-globe injuries constituted 85.4% of cases, while open-globe injuries accounted for 14.6%. The cornea was the most commonly involved ocular structure (65.5%). Most patients (91%) were managed medically, while 9% required surgical intervention. Corneal tear was the most common indication for surgery. At follow-up, visual acuity improved in 81.1% of patients, remained stable in 17.3%, and deteriorated in 2.7%.

Conclusion: Workplace ocular injuries remain an important and largely preventable cause of visual morbidity. The high proportion of injuries occurring among workers not using protective eyewear highlights the need for strict implementation of occupational eye-safety measures. Regular worker education, identification and control of workplace hazards, provision and mandatory use of appropriate protective eyewear, and periodic safety training may substantially reduce the incidence and severity of occupational eye injuries.

Keywords: Workplace eye injury; Occupational ocular trauma; Ocular trauma; Occupational injury; Protective eyewear; Corneal injury; Workplace safety; Visual outcome.

Introduction

Workplace eye injuries constitute an important and potentially preventable cause of ocular morbidity. Occupational activities expose workers to a wide range of hazards, including mechanical trauma, foreign bodies, chemical splashes, thermal injuries, radiation, and injuries caused by tools, machinery and flying particles. Although many occupational eye injuries are minor, some can result in severe ocular damage, permanent visual impairment and, in extreme cases, loss of the eye.⁽¹⁾

The nature and severity of workplace eye injuries vary according to the occupation, type of workplace, availability and use of personal protective equipment, duration of exposure, and mechanism of injury. Industrial workers, construction workers, agricultural workers, welders, mechanics and workers involved in manufacturing are particularly exposed to occupational ocular hazards. Injuries caused by metallic or non-metallic foreign bodies, blunt trauma and chemical exposure are commonly encountered in ophthalmic practice.⁽²⁾

Occupational eye injuries have considerable socioeconomic consequences. In addition to the cost of medical treatment, affected workers may experience loss of working days, reduced productivity, temporary or permanent disability and financial difficulties. Severe ocular trauma may require surgical intervention and prolonged follow-up.⁽³⁾

A significant proportion of workplace eye injuries can potentially be prevented by appropriate safety measures. These include the use of protective goggles and face shields, adequate workplace illumination, proper machine guarding, worker education, appropriate handling of chemicals and adherence to occupational safety regulations. Understanding the epidemiological characteristics and clinical pattern of workplace eye injuries is therefore essential for developing effective preventive strategies.⁽⁴⁾

A tertiary eye care centre provides an opportunity to study the spectrum of occupational ocular injuries, their mechanisms, clinical presentations, anatomical involvement, visual outcomes and treatment requirements. Prospective assessment also allows systematic documentation of injury-related factors and follow-up of affected individuals.⁽⁵⁾

Objective Of The Study

To study the demographics, mode and type of ophthalmic work place injury and its management.

Methodology

This is a retrospective study of patients with work place injury to eye in a tertiary eye care centre from February 2021 to January 2023.

Source of study:-

Outpatient, ward and operative records at tertiary care centre, Bangalore.

Sample size-225 patients.

Study period- February 2021 to January 2023.

Inclusion Criteria

Patients fulfilling the following criteria will be included:

1. Patients presenting with an ocular injury sustained at the workplace.
2. Patients of any age and either sex.
3. Patients presenting during the defined study period.
4. Patients willing to participate in the study.
5. Patients providing informed consent for participation and follow-up.

Exclusion Criteria

Patients fulfilling any of the following criteria will be excluded:

1. Ocular injuries occurring outside the workplace.
2. Patients with ocular trauma unrelated to occupational activities.
3. Patients unwilling to participate in the study.
4. Patients with inadequate clinical information regarding the mechanism or circumstances of injury.

5. Patients who are unable to complete the required follow-up, where follow-up assessment is essential for evaluating outcome.

Ophthalmological Examination

The following parameters will be documented:

Visual assessment

- ☐ Unaided visual acuity
- ☐ Best-corrected visual acuity, where applicable
- ☐ Near vision, where relevant

Anterior segment examination

- ☐ Eyelids
- ☐ Conjunctiva
- ☐ Cornea
- ☐ Anterior chamber
- ☐ Iris
- ☐ Pupil
- ☐ Lens

Posterior segment examination

- ☐ Vitreous
- ☐ Optic disc
- ☐ Macula
- ☐ Retina
- ☐ Choroid

Additional investigations

Depending on the clinical presentation, appropriate investigations may include:

- ☐ Slit-lamp examination
- ☐ Fluorescein staining
- ☐ Intraocular pressure measurement
- ☐ Direct/indirect ophthalmoscopy
- ☐ Gonioscopy where indicated
- ☐ Orbital/ocular ultrasonography
- ☐ X-ray orbitRES
- ☐ CT orbit
- ☐ Other investigations as clinically indicated.

Classification Of Workplace Eye Injuries

Injuries will be categorized according to the mechanism and clinical findings.

A. Mechanical injuries

- ☐ Corneal/conjunctival foreign body
- ☐ Corneal abrasion
- ☐ Lid injury
- ☐ Blunt ocular trauma
- ☐ Closed-globe injury
- ☐ Open-globe injury
- ☐ Penetrating injury
- ☐ Perforating injury
- ☐ Intraocular foreign body

B. Chemical injuries

- ☐ Acid injury
- ☐ Alkali injury
- ☐ Other chemical exposure

C. Thermal injuries

- ☐ Thermal burns
- ☐ Hot material/metal injuries

D. Radiation-related injuries

- ☐ Ultraviolet radiation injury, including welding-related photokeratitis
- ☐ Other occupational radiation-related injuries.

Management

Patients will receive appropriate treatment according to the nature and severity of the injury.

Treatment may include:

- ☐ Removal of superficial foreign bodies
- ☐ Irrigation for chemical injuries
- ☐ Topical antibiotics
- ☐ Lubricating eye drops
- ☐ Topical corticosteroids where clinically indicated
- ☐ Cycloplegics
- ☐ Antiglaucoma medication where indicated
- ☐ Tetanus prophylaxis where appropriate
- ☐ Repair of lid injuries
- ☐ Corneal or scleral wound repair
- ☐ Foreign body removal
- ☐ Intraocular foreign body removal
- ☐ Other surgical procedures as required

The treatment provided and any complications will be recorded prospectively.

Follow-Up

Patients will be followed according to the nature and severity of injury.

At follow-up, the following will be documented:

- ☐ Visual acuity
- ☐ Healing of ocular structures
- ☐ Intraocular pressure where indicated
- ☐ Development of complications
- ☐ Additional treatment required
- ☐ Surgical intervention, if required
- ☐ Final visual outcome

RESULTS

- ☐ Majority of workplace injuries happened during late afternoon in 184 cases(81.5%).
- ☐ Most of them are self inflicted in 220 patients(97.7%).
- ☐ 206 patients were managed with medical line of treatment(91%).
- ☐ The most common indication among study population for surgical intervention was corneal tear(30.6%).
- ☐ 198(89%) workers did not use eye protective devices.

Table 1 Demographic and Occupational Characteristics of the Study Participants (N = 225)

Demographic variables	Frequency (n)	Percentage (%)
Age group (years)		
18–20	15	8
21–30	93	23.9
31–40	38	31
41–50	35	17.7
>50	44	13.3
Mean age $\pm$ SD (years)	36.9 $\pm$ 11.4	—
Sex		
Male	220	94
Female	5	6
Occupation		
Factory/Industrial worker	63	27.9
Welder	46	20.4
Construction worker	34	15
Farmer	27	11.9
Mechanic	20	8.8
Carpenter	13	5.8
Electrician	10	4.4
Others	12	5.8

Table 2 Characteristics of Occupational Ocular Injuries (N = 225)

Variable	Frequency (n)	Percentage (%)
Eye involved		
Right	120	53.1
Left	99	43.8
Bilateral	6	3.1
Mechanism of injury		
Wooden stick	154	68.1
Iron Nail	23	10.6
Chemical exposure	18	8
Stone	11	4.9
Metal Piece	8	3.5
Electrical burns	5	2.2
Vegetative Matter	6	2.7
Time to hospital presentation		
<6 hours	81	36.3
6–24 hours	96	42.5
>24 hours	48	21.2
Use of protective eyewear		
Yes	27	11
No	198	89

Table 3 Clinical Profile and Management of Occupational Ocular Injuries (N = 225)

Variable	Frequency (n)	Percentage (%)
Type of injury		
Closed-globe injury	193	85.4
Open-globe injury	32	14.6
Predominant ocular structure involved		
Cornea	147	65.5

Conjunctiva	41	18.1
Eyelid	15	6.6
Sclera	8	3.5
Lens	5	2.2
Posterior segment	9	4
Management		
Medical treatment only	206	91
Surgical intervention	19	9
Hospital admission		
Yes	30	13.7
No	195	86.3
Overall Visual Outcome		
Improved	181	81.1
Stable	39	17.3
Deteriorated	5	2.7

Table 4 Best-Corrected Visual Acuity at Presentation <N = 225>

Best-corrected visual acuity (BCVA)	At presentation n (%)
≥6/18	127 (56.2)
<6/18–6/60	50 (22.1)
<6/60–3/60	22 (9.7)
<3/60–PL	19 (8.4)
NPL	7 (3.5)

Discussion

Workplace-related ocular injuries remain an important cause of preventable visual morbidity, particularly among workers involved in industrial, construction, agricultural and other occupations associated with mechanical and chemical hazards. The present study evaluated 225 patients presenting with workplace-related ocular injuries to a tertiary eye care centre in Bangalore, with particular emphasis on demographic characteristics, occupation, mechanism of injury, use of protective eyewear, anatomical involvement, management and visual outcome. The findings demonstrate that occupational ocular trauma predominantly affected young and middle-aged male workers and was strongly associated with inadequate use of protective eye devices.

In the present study, the mean age of the affected workers was 36.9 ± 11.4 years, with a predominance of injuries among younger working-age individuals. The largest proportion of patients belonged to the 21–30-year age group, followed by those in the 31–40-year age group. This distribution indicates that workplace ocular trauma affects individuals during their economically productive years. Ocular injury in this age group can therefore have consequences beyond the immediate medical problem, including loss of working days, reduced productivity, financial burden and, in severe cases, long-term occupational disability.

There was a marked male predominance in our study, with 94% of patients being male. This finding is consistent with previous studies of occupational ocular trauma. Thompson et al. reported male predominance with a mean age of approximately 38 years, while Chinyelu N. Ezisi et al. also reported that the majority of affected workers were males, with a mean age of 32 years. Arunava Kundu et al. reported 89% male patients, and Terrence Kwong-Weng Soong et al. reported 88% males with a mean age of 31.5 years. The predominance of males in these studies may be related to the greater representation of men in occupations involving heavy machinery, construction, welding, manufacturing and other physically hazardous activities.

The occupational distribution in the present study further supports this observation. Factory and industrial workers constituted the largest occupational group (27.9%), followed by welders (20.4%), construction workers (15%), farmers (11.9%), mechanics (8.8%), carpenters (5.8%) and electricians (4.4%). These occupations commonly involve exposure to flying particles, sharp objects, tools, machinery, chemicals, heat and other mechanical hazards. The high proportion of industrial workers and welders emphasizes the importance of occupation-specific eye protection and workplace hazard assessment.

The most common mechanism of injury in our study was wooden stick injury, accounting for 68.1% of cases. Iron nail injury was the second most frequent mechanism (10.6%), followed by chemical exposure (8%). Other mechanisms included stone injury, metal-piece injury, electrical burns and injury due to vegetative matter. The predominance of wooden stick injury indicates that occupational ocular trauma in this study was largely related to direct mechanical trauma. Depending on the velocity, shape and force of impact, such injuries can range from superficial corneal abrasions and foreign bodies to corneal lacerations and open-globe injuries.

Our findings differ somewhat from those of other published studies. Thompson et al. reported corneal foreign body as the most common occupational ocular injury, accounting for approximately 59% of cases. Similarly, Arunava Kundu et al. reported corneal foreign body as the commonest injury, occurring in 58.4% of patients. Chinyelu N. Ezisi et al., in a study of stone quarry workers, reported blunt trauma as the most common mechanism, accounting for 58.2% of cases. These differences may be explained by variation in occupational groups, workplace environments, types of tools used and the specific hazards encountered in different geographic and industrial settings.

A striking finding in the present study was the very low use of protective eyewear. Only 11% of workers were wearing protective eye devices at the time of injury, whereas 89% were not using any protective eyewear. This represents one of the most important preventable risk factors identified in the study. Similar findings have been reported by several investigators. Thompson et al. reported that 56% of workers were not wearing protective devices, while Chinyelu N. Ezisi et al. reported that 98.7% of workers did not use eye protection. Arunava Kundu et al. reported that 88.3% of workers were not using protective devices. Soong et al. found that only 2.5% of workers reported using eye protection at the time of injury.

The consistently low use of protective eyewear across different studies suggests that availability alone may not be sufficient to prevent occupational eye injuries. Workers may fail to use protective devices because of inadequate awareness, discomfort, poor fit, inconvenience, lack of enforcement or underestimation of the risk involved in apparently routine tasks. Therefore, prevention should involve not only provision of protective equipment but also appropriate worker education, regular supervision and enforcement of occupational safety policies.

In our study, 81.5% of injuries occurred during the late afternoon. A similar tendency for injuries to occur during the later part of the working day has been reported by Chinyelu N. Ezisi et al. This temporal distribution may potentially be related to prolonged working hours, fatigue, reduced concentration, increased workload or pressure to complete tasks toward the end of the working period. However, the present study does not establish a causal relationship between fatigue and timing of injury. Nevertheless, the concentration of injuries during this period suggests that additional safety supervision and reinforcement of protective measures may be useful during later working hours.

An important observation was that 97.7% of injuries were self-inflicted. This finding indicates that most injuries occurred while the worker was directly engaged in the activity responsible for the ocular trauma rather than as a result of injury caused by another worker. Self-inflicted occupational injuries are particularly relevant from a preventive perspective because they may be associated with direct exposure to tools, materials or machinery. Identification of the specific tasks associated with these injuries may allow targeted modifications of work practices and appropriate selection of personal protective equipment.

Regarding the time to presentation, 36.3% of patients presented within six hours, 42.5% presented between 6 and 24 hours, while 21.2% presented after more than 24 hours. Thus, although a substantial proportion sought medical care relatively early, approximately one-fifth of patients presented after 24 hours. Delay in presentation may adversely affect outcomes in certain ocular injuries, particularly chemical injuries, penetrating trauma, retained foreign bodies and injuries associated with infection. Early recognition and prompt referral to an ophthalmic facility are therefore important components of occupational eye injury management.

The right eye was involved in 53.1% of cases, while the left eye was involved in 43.8% and bilateral involvement occurred in 3.1%. The slight predominance of right-eye involvement may reflect differences in hand dominance, working posture or direction of impact, although these factors were not specifically evaluated in the present study. Bilateral injuries were relatively uncommon, suggesting that most occupational trauma resulted from localized exposure rather than a widespread workplace event.

Closed-globe injuries constituted the majority of cases in our study, accounting for 85.4%, whereas open-globe injuries represented 14.6%. This finding indicates that although most occupational ocular injuries did not involve full-thickness disruption of the globe, a significant minority were severe injuries requiring urgent specialist evaluation and, in some cases, surgical management. The relatively high proportion of closed-globe injuries may be explained by the predominance of blunt and superficial mechanical injuries.

The cornea was the most commonly involved ocular structure, accounting for 65.5% of cases. Conjunctival involvement was noted in 18.1%, followed by eyelid injuries (6.6%), scleral injuries (3.5%), lens involvement (2.2%) and posterior-segment involvement (4%). The predominance of corneal involvement is consistent with the findings of Thompson et al. and Arunava Kundu et al., who also reported corneal foreign bodies as the commonest occupational ocular injury. The exposed anatomical position of the cornea makes it particularly vulnerable to direct contact with flying particles, wooden fragments, metallic particles and other workplace materials.

Visual acuity at presentation showed that 56.2% of patients had BCVA of $\geq 6/18$. However, 22.1% had visual acuity between $<6/18$ and $6/60$, 9.7% had vision between $<6/60$ and $3/60$, 8.4% had vision between $<3/60$ and perception of light, and 3.5% had no perception of light. Thus, while more than half of the affected workers presented with relatively preserved vision, a considerable proportion had significant visual impairment at presentation. This emphasizes that occupational ocular trauma can range from minor injuries to potentially devastating injuries with severe visual consequences.

Corneal tear was the most common indication for surgical intervention, accounting for 30.6% of surgical cases. This finding is clinically important because corneal laceration can compromise ocular integrity and may lead to irregular astigmatism, corneal scarring, infection and permanent reduction in vision if not managed appropriately. Early diagnosis and timely surgical repair are therefore essential in patients with suspected open-globe or significant corneal injuries.

Only 13.7% of patients required hospital admission, while the majority were managed without admission. This is consistent with the overall predominance of closed-globe and corneal injuries that could be managed on an outpatient basis. However, hospitalization remains important for severe ocular trauma, open-globe injuries, significant chemical injuries and patients requiring surgical procedures or close observation.

The major strength of the present study is that it describes multiple aspects of occupational ocular trauma, including demographic characteristics, occupation, mechanism, timing, protective-device use, anatomical involvement, treatment and visual outcome. The study also highlights a potentially modifiable risk factor—lack of protective eyewear—which can be directly addressed through occupational safety interventions.

There are certain limitations that should be considered while interpreting the findings. The study was conducted in a tertiary eye care centre, and therefore the cases may not represent the complete spectrum of workplace ocular injuries occurring in the community. Minor injuries that did not require hospital-based ophthalmic care may have been underrepresented. In addition, the study depended on clinical records and available information regarding occupational circumstances and protective-device use. Further multicentric studies involving different industries and workplaces may provide a broader understanding of occupational ocular trauma and allow identification of occupation-specific risk factors.

Conclusion

Workplace protective gears have to be provided with regular information, education and compulsory laws to use them have to be enforced.

The most important thing the patients can do to protect vision at work is to always wear appropriate protective eyewear. This can prevent more than 90% of serious eye injuries.

The workers should know the dangers in their working environment and that is possible by continuous information, education at periodic intervals by employing companies/institutions.

The control of potential hazards can be done by isolating the hazard by clear identification of high risk areas, by adequate ventilation and lighting.

Employers and employees should recognise the importance of workplace eye safety.

Once the appropriate workplace changes have been made and eye protection has been selected, a maintenance program is required.

Ocular injuries can be reduced by the implementation of appropriate preventive strategies to address each risk factor.

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