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Original Article

Occupational Ocular hazards in Ahmedabad's Industrial Workforce: A Descriptive Outpatient-Based Study

Dr. Vaishali Gohil[1], Dr. Vijay Damor[2], Dr. Aman Damor[3]

[1] Senior Resident in Department of Ophthalmology M.P Shah Medical College Jamnagar, Gujarat, India
[2] Assistant Professor in Department of Ophthalmology Narendra Modi Medical College Ahmedabad, Gujarat, India
[3] Assistant Professor, Department of Community Medicine, Zydus Medical College and Hospital, Dahod, Gujarat, India

Corresponding Author:

Dr. Vaishali Gohil
Senior Resident in Department of Ophthalmology M.P Shah Medical College Jamnagar, Gujarat, India.

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ABSTRACT

Background: Occupational ocular injuries are a major yet preventable cause of visual impairment among industrial workers, particularly in developing countries. This study aimed to describe the demographic profile, pattern of occupational ocular injuries, management, and visual outcomes among patients attending a tertiary care hospital in Ahmedabad.

Methods: A hospital-based observational study was conducted in the Department of Ophthalmology, Narendra Modi Medical College and L.G. sheth General Hospital, Ahmedabad, from August 2020 to August 2022. A total of 226 adult patients with occupational ocular injuries were enrolled. Demographic characteristics, occupation, mechanism of injury, use of personal protective equipment (PPE), clinical findings, management, and visual outcomes were recorded. Patients were followed for one month after treatment.

Results: The mean age of participants was 36.9 ± 11.4 years, with the highest proportion in the 31–40 years age group (31.0%). Males constituted 88.1% of cases. Factory workers (27.9%) and welders (20.4%) were the most affected occupations. Metallic foreign bodies were the leading cause of injury (68.1%), while the cornea was the most commonly involved ocular structure (65.5%). Closed-globe injuries accounted for 85.4% of cases. Only 27.4% of workers used protective eyewear. Visual improvement was observed in 80.1% of patients after treatment.

Conclusion: Occupational ocular injuries predominantly affected young male industrial workers and were largely preventable. Improved workplace safety, mandatory PPE use, worker education, and early ophthalmic care are essential to reduce occupational ocular morbidity and prevent avoidable visual impairment.

Keywords: *Occupational ocular injury; occupational eye trauma; industrial workers; personal protective equipment; visual outcome.*

INTRODUCTION

Occupational hazards are defined as sources or situations with the potential to cause injury, illness, property damage, workplace environmental damage, or a combination of these outcomes. Occupational hazards encompass physical, chemical, biological, and psychosocial risks encountered during work. The World Health Organization (WHO) promotes occupational health as an essential component of workplace safety, emphasizing the primary prevention of occupational hazards through safe working environments, health promotion, and appropriate protective measures. (1)

Occupational ocular trauma is a major yet preventable cause of visual impairment and monocular blindness worldwide. Eye injuries sustained at the workplace constitute a significant public health problem because they predominantly affect individuals in their economically productive years, resulting in substantial personal, social, and economic consequences. Although many occupational eye injuries can be prevented through the appropriate use of personal protective equipment (PPE), inadequate compliance with safety practices continues to contribute to their high incidence. Workers from lower socioeconomic and educational backgrounds often bear a disproportionate burden because of limited awareness, delayed healthcare seeking, and restricted access to ophthalmic services. (2)

According to the World Health Organization, an estimated 36 million people were blind and 216.6 million were visually impaired globally in 2015. Ocular trauma accounts for approximately 55 million eye injuries annually, with nearly 1.6 million cases of blindness, many of which are potentially preventable. Men are affected more frequently than women, with an estimated male-to-female ratio of approximately 3:1 globally as well as in India. (3,4)

Beyond the immediate visual consequences, occupational ocular injuries adversely affect quality of life, emotional well-being, and employment. Previous studies have demonstrated that patients with severe ocular trauma experience significantly poorer health-related quality of life and may develop psychological disorders requiring further evaluation. Visual disability can impair work productivity, necessitate occupational changes, or even result in permanent disability and loss of employment. (5–7)

Evidence from India indicates that occupational eye injuries constitute a substantial proportion of all ocular trauma. A study from North India reported that 22% of ocular injuries were work-related, with the majority occurring among males aged 21–40 years. Manufacturing, construction, and agricultural workers were the most commonly affected occupational groups. Metallic foreign bodies accounted for nearly 70% of occupational eye injuries, followed by chemical injuries, while inadequate use of protective eyewear and insufficient workplace safety practices were identified as major contributing factors. (8)

Similar observations have been reported from Gujarat. A study conducted at Baroda Medical College demonstrated a high frequency of occupational eye injuries among industrial workers, labourers, and welders. These injuries were associated with significant visual morbidity, loss of productivity, and avoidable blindness, highlighting the importance of workplace safety education and appropriate use of eye protection. (9)

Industrial workers, construction workers, farmers, and manual labourers remain particularly vulnerable because of frequent exposure to high-velocity projectiles, metallic particles, chemicals, agricultural materials, and mechanical hazards. Ocular trauma is also strongly associated with lower socioeconomic status, delayed presentation to healthcare facilities, poor awareness regarding eye protection, and inappropriate self-medication, all of which contribute to poorer visual outcomes. (2)

Ahmedabad is one of the major industrial cities in western India, with numerous manufacturing industries, engineering units, construction sites, refineries, and allied industrial establishments employing a large workforce exposed to occupational eye hazards. Despite this high-risk environment, data describing the epidemiological and clinical profile of occupational ocular injuries from this region remain limited. Therefore, the present study was undertaken to describe the demographic and occupational profile of affected workers, identify the mechanisms and patterns of occupational ocular injuries, assess awareness and use of personal protective equipment, and evaluate the visual outcomes following management. The findings are expected to provide evidence for developing targeted preventive strategies and strengthening workplace eye safety programmes aimed at reducing the burden of preventable occupational visual impairment.

MATERIALS AND METHODS

Study Design

A hospital-based observational study was conducted over a period of two years from August 2020 to August 2022**.**

Study Setting

The study was carried out in the Department of Ophthalmology, Narendra Modi Medical College and L.G. sheth General Hospital, Maninagar, Ahmedabad, Gujarat, India. The hospital is a tertiary care teaching centre catering to a large urban population, with an average daily ophthalmology outpatient attendance of approximately 150–200 patients.

Study Population

The study included consecutive adult patients presenting with occupational ocular injuries to the ophthalmology outpatient department or emergency/casualty services during the study period.

Eligibility Criteria

Inclusion Criteria

- Patients aged ≥18 years.
- Patients presenting with ocular trauma directly related to their occupation.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Ocular trauma unrelated to occupational exposure.
- Ocular trauma occurring more than one month before presentation.
- Patients who declined to participate in the study.
- Sports-related ocular injuries and occupational ocular injuries among healthcare professionals.

Sample Size

The sample size was calculated using the single population proportion formula: $n=Z^2PQ/d^2$

Based on a previous study reporting that 70% of occupational ocular injuries were caused by metallic foreign bodies, assuming a prevalence (P) of 70%, precision (d) of 5%, and a 90% confidence interval (Z = 1.64), the minimum required sample size was calculated to be 226 participants**.** (8)

Sampling Technique
A consecutive sampling technique was adopted. All eligible patients presenting during the study period who fulfilled the inclusion criteria were enrolled until the desired sample size was achieved.

Data Collection
After obtaining written informed consent, participants were interviewed using a pretested structured questionnaire. Information regarding demographic characteristics, socioeconomic status, occupation, workplace characteristics, mechanism of injury, use of personal protective equipment, and time elapsed between injury and hospital presentation was collected.

Clinical Evaluation
A comprehensive ophthalmic examination was performed for all participants. Presenting visual acuity was assessed using the Snellen visual acuity chart. Detailed anterior segment examination was carried out using slit-lamp biomicroscopy. Intraocular pressure was measured by Goldmann applanation tonometry whenever indicated.
Posterior segment evaluation was performed by dilated fundus examination using slit-lamp biomicroscopy with a fundus lens and indirect ophthalmoscopy. In patients in whom posterior segment visualization was not possible because of media opacity or severe ocular injury, B-scan ultrasonography was performed. Additional investigations, including optical coherence tomography (OCT) and fundus photography, were carried out whenever clinically indicated.

Management and Follow-up
Patients were managed according to the standard treatment protocol of the department. Depending on the severity of injury, patients received either outpatient management or hospital admission. Medical and surgical interventions were provided whenever indicated. Patients were followed up on the second day, at one week, and at one month after presentation. During each follow-up visit, visual acuity and clinical findings were reassessed, and additional investigations were performed whenever required.

Outcome Measures
The primary outcomes included the pattern and type of occupational ocular injuries, causative agents, use of personal protective equipment, and visual outcome following treatment. Secondary outcomes included the requirement for surgical intervention and complications associated with ocular trauma.

Ethical Considerations
The study was conducted after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrolment. For patients unable to provide consent because of the severity of injury, consent was obtained from the legally authorized representative. Participant information sheets and consent forms were provided in Gujarati, Hindi, and English.

Statistical Analysis
Data were entered into Microsoft Excel after appropriate coding and validation. Descriptive statistical analysis was performed using Microsoft Excel. Continuous variables were summarized as mean ± SD, whereas categorical variables were presented as frequencies and percentages.

RESULT
A total of 226 patients with occupational ocular injuries were enrolled during the study period and included in the final analysis. The mean age of the study participants was 36.9 ± 11.4 years**.** The majority of patients belonged to the 31–40 years age group (31.0%), followed by the 21–30 years age group (23.9%). Males constituted 88.1% of the study population, resulting in a male-to-female ratio of approximately 7.4:1**.** Factory and industrial workers formed the largest occupational group (27.9%), followed by welders (20.4%) and construction workers (15.0%) (Table 1).

Most ocular injuries involved the right eye (53.1%)**,** while 43.8% involved the left eye and 3.1% were bilateral. Metallic foreign bodies were the most common mechanism of injury (68.1%), followed by chemical exposure (10.6%) and welding arc injuries (8.0%). Nearly half of the participants (42.5%) presented to the hospital within 6–24 hours of injury, whereas 36.3% presented within the first six hours. Only 27.4% of workers reported using protective eyewear at the time of injury, while the majority **(**72.6%**)** were not using any eye protection (Table 2).

Closed-globe injuries accounted for 85.4% of all occupational ocular injuries, whereas 14.6% were open-globe injuries. The cornea was the most frequently affected ocular structure (65.5%), followed by the conjunctiva (18.1%). Most patients **(**69.5%**)** were managed conservatively with medical treatment alone, while foreign body removal was performed in 20.4% and surgical intervention was required in 10.2% of cases. Hospital admission was necessary for 13.7% of

patients. Overall, visual improvement was observed in 181 (80.1%) patients, while visual acuity remained stable in 39 (17.3%) patients and deteriorated in **6 (2.7%)** patients following treatment (Table 3).

At presentation, 56.2% of patients had a best-corrected visual acuity (BCVA) of ≥6/18, which increased to 84.5% at the one-month follow-up. The proportion of patients with moderate and severe visual impairment progressively decreased during follow-up. Only one patient **(**0.4%**)** had no perception of light at the one-month follow-up (Table 4).

Table 1 Demographic and Occupational Characteristics of the Study Participants (N = 226)

Demographic variables	**Frequency (n)**	**Percentage (%)**
Age group (years)		
18–20	18	8
21–30	54	23.9
31–40	70	31
41–50	40	17.7
51–60	30	13.3
>60	14	6.2
Mean age ± SD (years)	**36.9 ± 11.4**	—
Sex		
Male	199	88.1
Female	27	11.9
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	13	5.8

Table 2 Characteristics of Occupational Ocular Injuries (N = 226)

Variable	**Frequency (n)**	**Percentage (%)**
Eye involved		
Right	120	53.1
Left	99	43.8
Bilateral	7	3.1
Mechanism of injury		
Metallic foreign body	154	68.1
Chemical exposure	24	10.6
Welding arc injury	18	8
Wooden foreign body	11	4.9
Cement/Lime	8	3.5
Glass injury	5	2.2
Others	6	2.7
Time to hospital presentation		
<6 hours	82	36.3
6–24 hours	96	42.5
>24 hours	48	21.2
Use of protective eyewear		
Yes	62	27.4
No	164	72.6

Table 3 Clinical Profile and Management of Occupational Ocular Injuries (N = 226)

Variable	**Frequency (n)**	**Percentage (%)**
Type of injury		
Closed-globe injury	193	85.4
Open-globe injury	33	14.6
Predominant ocular structure involved		

Cornea	148	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	157	69.5
Foreign body removal	46	20.4
Surgical intervention	23	10.2
Hospital admission		
Yes	31	13.7
No	195	86.3
Overall Visual Outcome		
Improved	181	81.1
Stable	39	17.3
Deteriorated	6	2.7

Table 4 Best-Corrected Visual Acuity at Presentation and One-Month Follow-up (N = 226)

Best-corrected visual acuity (BCVA)	At presentation n (%)	One-month follow-up n (%)
≥6/18	127 (56.2)	191 (84.5)
<6/18–6/60	50 (22.1)	22 (9.7)
<6/60–3/60	22 (9.7)	7 (3.1)
<3/60–PL	19 (8.4)	5 (2.2)
NPL	8 (3.5)	1 (0.4)

***Abbreviations: BCVA - Best-corrected visual acuity; PL - Perception of light; NPL - No perception of light.**

DISCUSSION

Occupational ocular trauma is a primary, yet largely preventable, cause of visual morbidity and monocular blindness in rapidly developing industrial economies (10). This study highlights critical clinical patterns, epidemiological characteristics, and defensive loopholes within Ahmedabad's industrial workforce.

The heavy concentration of injuries within the highly active 31–40 years cohort (31.0%) and 21–30 years cohort (23.9%)—with a mean age of 36.9 ± 11.4 years—mirrors regional trends across India (11, 12). This distribution underscores the extreme vulnerability of young and middle-aged manual laborers. The pronounced male-to-female ratio of 7.4:1 is strongly corroborated by industrial ophthalmic registries, which report overwhelming male majorities (exceeding 80% to 85%) in work-related trauma (11, 13). This disparity is driven by labor dynamics where high-risk roles like metalwork, welding, and construction are heavily male-dominated (10). Industrial workers (27.9%) and welders (20.4%) constituted nearly half of the cohort, facing front-line dangers from high-velocity tools, grinding, and optical radiation (11, 13).

Mechanistically, metallic foreign bodies were the most frequent cause of trauma (68.1%), aligning with the high prevalence of isolated corneal involvement (65.5%) (11,14). Mechanical actions like grinding and lathe machining release high-speed micro-projectiles that directly embed into the corneal epithelium (14, 15). Closed-globe injuries predominated (85.4%) over complex open-globe disruptions (14.6%). While closed-globe events present less risk of sudden, total vision loss, they impose a massive cumulative economic burden due to lost working hours and secondary microbial keratitis (10, 11). Conversely, open-globe presentations underscore severe incidents, such as high-velocity intraocular foreign bodies, carrying high risks of lifelong visual impairment (14). The right eye lateralization preference (53.1%) matches established patterns linked to right-handed tool usage (11).

A major clinical impediment was delayed emergency presentation; only 36.3% of workers accessed care within the 6-hour "golden window," while 21.2% delayed care past 24 hours. This latency stems from absent factory floor first-aid infrastructure (10), dangerous reliance on untrained peers using unsterile tools for foreign body removal (11), and structural anxieties regarding immediate wage loss (16). Delayed removal introduces severe complications like rust rings and stromal melting (14, 15).

Crucially, protective eyewear utilization was abysmally low at 27.4%, leaving 72.6% completely exposed, despite evidence that safety goggles mitigate up to 90% of injuries (10, 13, 16). This points to an institutional safety culture vacuum, compounded by poorly fitting, easily fogged PPE, lack of regulatory labor oversight, and low safety literacy among workers who view protective lenses as hindrances (13, 16).

Nevertheless, final therapeutic success was high: 69.5% were managed conservatively with topical medications, and 20.4% required minor outpatient interventions (14, 15). Visual acuity (≥ 6/18) rose from 56.2% at presentation to 84.5%

at one month, showing that 80.1% achieved objective improvement. However, the 2.7% permanent deterioration rate and one case of irreversible loss of light perception (NPL) remind us that severe industrial trauma still leads to permanent blindness (10, 11).

CONCLUSION

Occupational ocular injuries constitute a significant and largely preventable cause of ocular morbidity among the industrial workforce. The present study demonstrated that occupational eye injuries predominantly affected young and middle-aged males engaged in industrial and manual occupations. Metallic foreign bodies were the most common cause of injury, and the cornea was the most frequently involved ocular structure. Closed-globe injuries accounted for the majority of cases, with most patients responding favourably to timely medical or surgical management. However, the low utilization of protective eyewear observed in this study highlights an important gap in workplace safety practices. The findings emphasize that appropriate preventive measures, early diagnosis, and prompt ophthalmic intervention can substantially reduce visual morbidity and improve clinical outcomes following occupational ocular trauma.

Recommendations

- Based on the findings of the present study, the following recommendations are proposed:
- The use of appropriate eye protective devices should be made mandatory for workers employed in occupations with a high risk of ocular injury, particularly in industrial, welding, construction, and manufacturing sectors.
- Regular occupational eye safety education and training programmes should be conducted to improve workers' awareness regarding workplace hazards, the correct use of personal protective equipment (PPE), and the importance of immediate medical attention following ocular trauma.
- Employers should ensure the availability, accessibility, and compliance with certified protective eyewear through regular workplace supervision and safety audits.
- Periodic occupational ophthalmic screening should be incorporated into workplace health programmes for early identification and management of ocular disorders among high-risk workers.
- Collaboration between industries, occupational health services, ophthalmologists, and regulatory authorities should be strengthened to develop and implement comprehensive workplace eye safety policies.
- Further multi centric prospective studies with larger sample sizes and longer follow-up are recommended to evaluate long-term visual outcomes, determinants of occupational ocular injuries, and the effectiveness of preventive interventions.

REFERENCES

1. World Health Organization. Occupational health [Internet]. Geneva: WHO; [cited 2026 Jul 15]. Available from: https://www.who.int/india/health-topics/occupational-health
2. Chaudhuri Z, Vanathi M, editors. *Postgraduate Ophthalmology*. 2nd ed. Vol. 2. New Delhi: Jaypee Brothers Medical Publishers; 2020. p. 2553.
3. Négrel AD, Thylefors B. The global impact of eye injuries. *Ophthalmic Epidemiol*. 1998;5(3):143-169. doi:10.1076/opep.5.3.143.8364.
4. May DR, Kuhn FP, Morris RE, Witherspoon CD, Danis RP, Matthews GP, et al. The epidemiology of serious eye injuries from the United States Eye Injury Registry. *Graefes Arch Clin Exp Ophthalmol*. 2000;238(2):153-157.
5. Yüksel H, Türkcü FM, Şahin M, Cinar Y, Cingü AK, Ozkurt Z, et al. Vision-related quality of life in patients after ocular penetrating injuries. *Arq Bras Oftalmol*. 2014;77(2):95-98.
6. Mangione CM, Lee PP, Gutierrez PR, Spritzer K, Berry S, Hays RD. Development of the 25-item National Eye Institute Visual Function Questionnaire. *Arch Ophthalmol*. 2001;119(7):1050-1058.
7. Schrader WF. Open globe injuries: epidemiological study of two eye clinics in Germany, 1981-1999. *Croat Med J*. 2004;45(3):268-274.
8. Dahiya M, Dua M. Epidemiological profile of occupational ocular injury in a tertiary eye care centre of North India. Int J Community Med Public Health 2020;7:2164-8.
9. Patel A, Ganvit S. Workplace eye safety: a neglected essential. Int J Community Med Public Health. 2020;7(11):4518-4522. doi:10.18203/2394-6040.ijcmph20204754.
10. 10.Vanathi M. Vision wellness in occupational safety and health. *Indian J Ophthalmol*. 2023;71(10):3273-3274.
11. Sethi A, Agrawal C, Girgis S, Sethi V, Konale M, Lokwani P, et al. Etiological causes and epidemiological characteristics of patients with occupational corneal foreign bodies: A prospective study in a hospital-based setting in India. *Indian J Ophthalmol*. 2020;68(1):54-59.
12. Ta J, Manade VV, Kotecha MR, Chodvadiya SA. Incidents of Occupational Ocular Injuries in Industrial Settings: Highlighting the Critical Significance of Protective Eye Gear. *Indian J Public Health*. 2024;68(1):140-142
13. Mahesh M, Sharma R, Patel K. Clinical profile and aetiological factors in patients with occupational corneal foreign body. *Int J Acad Med Pharm*. 2024;6(1):903-906.
14. Camodeca AJ, Anderson EP. Corneal Foreign Body. In: *StatPearls [Internet]*. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK536977/
15. Allen R, Gupta S. Corneal Abrasions and Corneal Foreign Bodies. *MSD Manual Professional Edition*. Kenilworth (NJ): Merck & Co., Inc.; 2025.
16. WorkSafeBC. Ocular foreign body injuries. *BC Med J*. 2023;65(4):142-145.