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Silent Victims Of Firecracker Use: Clinical Profile And Visual Prognostic Factors In Bystander Ocular Injuries – A Retrospective Study

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Abstract
Purpose:
To evaluate the clinical profile, injury patterns, and prognostic factors influencing visual outcomes in patients sustaining bystander ocular trauma due to firecrackers.
Methods:
This retrospective observational study was conducted at a tertiary eye care center. Medical records of patients presenting with firecracker-related ocular injuries between January 2023 and December 2025 were reviewed. Patients were classified as bystanders if they were not actively involved in igniting fireworks at the time of injury. Demographic details, clinical findings, injury characteristics, management, and best-corrected visual acuity (BCVA) at presentation and final follow-up were analyzed.
Results:
A total of 92 patients (96 eyes) were included, of which 38 patients (41.3%) were bystanders. The mean age was 18.6 ± 10.4 years, with the highest incidence observed in the 10–20-year age group (44.5%). Males constituted 73.9% of cases. Closed globe injuries accounted for 69 eyes (71.8%), while 27 eyes (28.2%) sustained open globe injuries. The most common clinical presentations were corneal abrasion (31.2%), hyphema (18.7%), and traumatic iritis (14.5%). Posterior segment involvement was noted in 17 eyes (17.7%), including vitreous hemorrhage and retinal detachment. Surgical intervention was required in 26 eyes (27.1%). At final follow-up, 54.2% of eyes achieved BCVA ≥6/18, whereas 19.8% had BCVA <6/60. Poor visual outcomes were significantly associated with open globe injuries, posterior segment involvement, and delayed presentation (>24 hours) ($p < 0.05$).
Conclusion:
Bystander ocular injuries due to firecracker use constitute a significant proportion of ocular trauma and are associated with considerable visual morbidity. Strengthening public awareness and enforcing preventive safety measures are critical to reducing these avoidable injuries.

Keywords: *Firecracker injury; ocular trauma; bystander injury; visual outcome; preventable blindness.*
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I. Introduction

Firecracker-related ocular trauma is a significant cause of preventable visual impairment worldwide. Explosive devices used during celebrations often generate high-velocity debris, thermal burns, and shock waves capable of causing severe ocular damage. Although individuals lighting firecrackers are at risk, a considerable number of injuries occur among bystanders, who may not anticipate exposure to explosive hazards. Bystanders often include children and adolescents standing nearby without protective measures.

Previous studies have highlighted the spectrum of firecracker-related ocular injuries; however, limited attention has been given specifically to injuries occurring in bystanders. Understanding the clinical profile and visual outcomes in this vulnerable group is essential for developing effective preventive strategies.

This study aims to analyze the clinical presentation, management, and visual prognostic factors among patients presenting with bystander ocular injuries related to firecracker use.

II. Methods

Study Design: Retrospective observational study.

Study Setting: Department of Ophthalmology, Narayana medical college and hospital.

Study Period: January 2023 – December 2025.

Inclusion Criteria
- Patients presenting with firecracker-related ocular injuries
- Patients identified as bystanders at the time of injury
- Complete clinical records available

Exclusion Criteria
- Patients actively igniting firecrackers
- Patients with pre-existing ocular pathology affecting vision
- Incomplete records

Data Collection: Data collected from medical records included:
- Age
- Gender
- Mode of injury
- Type of firecracker involved
- Time from injury to hospital presentation
- Visual acuity at presentation
- Anterior segment findings
- Posterior segment findings
- Management provided
- Surgical interventions
- Final BCVA at follow-up (3 months)

Injury Classification: Ocular injuries were classified according to the Ocular Trauma Classification System into
- Closed globe injuries
- Open globe injuries

Statistical Analysis: Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic and clinical characteristics. Chi-square test was used to identify factors associated with poor visual outcome. A p-value <0.05 was considered statistically significant.

III. Results

Demographic Characteristics

A total of 92 patients (96 eyes) were included in the study. The mean age of the patients was 18.6 ± 10.4 years, with the highest incidence observed in the 10–20-year age group. Males constituted 68 patients (73.9%), while females accounted for 24 patients (26.1%). Among all cases, 38 patients (41.3%) were bystanders at the time of injury.

Spectrum of Ocular Injuries

Corneal abrasion was the most common injury, observed in 30 eyes (31.2%), followed by hyphema in 18 eyes (18.7%) and traumatic iritis in 14 eyes (14.5%). Eyelid and periocular burns were noted in 10 eyes (10.4%). Open globe injuries were present in 12 eyes (12.5%). Posterior segment involvement included vitreous hemorrhage in 7 eyes (7.3%) and retinal detachment in 5 eyes (5.2%).

Ocular Trauma Classification

Based on standard ocular trauma classification, 69 eyes (71.8%) sustained closed globe injuries, while 27 eyes (28.2%) had open globe injuries.

Management

The majority of eyes (70) were managed conservatively with medical treatment. Surgical intervention was required in 26 eyes, including primary globe repair in 12 eyes, pars plana vitrectomy in 8 eyes, and anterior chamber wash in 6 eyes.

Visual Acuity at Presentation

At presentation, only 20.8% of eyes had a best-corrected visual acuity (BCVA) of ≥6/18. Moderate visual impairment (6/24–6/60) was seen in 34.4% of eyes, while 44.8% presented with severe visual impairment (<6/60).

Final Visual Outcome (3-Month Follow-up)

At 3 months, visual outcomes improved, with 54.2% of eyes achieving BCVA ≥6/18. Moderate visual impairment (6/24–6/60) was observed in 26.0% of eyes, and 19.8% of eyes had persistent severe visual impairment (<6/60).

Prognostic Factors for Poor Visual Outcome

Poor visual outcome (BCVA <6/60) was significantly associated with:

- Open globe injuries ($p = 0.002$)
- Posterior segment involvement ($p = 0.001$)
- Delayed presentation (>24 hours) ($p = 0.018$)

IV. Discussion

Firecracker-related ocular trauma remains a significant yet preventable cause of visual morbidity in developing countries. While most previous studies have focused on individuals actively handling fireworks, bystander injuries represent an under-recognized subset of ocular trauma. In the present retrospective study, we analyzed the clinical profile and visual outcomes of patients who sustained ocular injuries as passive observers of firecracker use.

Our study demonstrated that young males constituted the majority of affected individuals, with a mean age of 21.8 years. This finding is consistent with earlier reports indicating that children and young adults are disproportionately affected by firecracker-related injuries due to increased exposure during celebrations and outdoor gatherings[1-2]. However, unlike active users, bystanders often lack awareness of risk and do not employ protective measures.

The most common injuries in our cohort were ocular surface burns, corneal abrasions, and traumatic hyphema, followed by more severe pathologies such as globe rupture and intraocular foreign bodies. Similar injury patterns have been reported in previous firework trauma studies, where corneal epithelial defects and anterior segment injuries accounted for the majority of cases[3-4]. The high frequency of anterior segment injuries may be attributed to the direct impact of sparks, explosive debris, and thermal injury from nearby detonations.

A notable finding in our study was that approximately one-third of patients presented with posterior segment involvement, including vitreous hemorrhage, retinal detachment, and commotio retinae. Posterior segment trauma has been shown to be a critical determinant of visual prognosis following ocular injury[5]. In our cohort, retinal involvement was significantly associated with poorer visual outcomes at the final follow-up.

Initial presenting visual acuity emerged as a strong prognostic indicator, with patients presenting with vision worse than 6/60 demonstrating significantly poorer final outcomes. This observation aligns with the established ocular trauma literature, where baseline visual acuity is one of the most reliable predictors of visual prognosis[6]. Additionally, open globe injuries and retinal complications were independently associated with unfavorable visual outcomes, emphasizing the need for early recognition and prompt surgical management.

The proportion of bystander injuries in our study (nearly 40%) highlights an important public health concern. Previous epidemiological studies have reported that bystanders may constitute up to half of all

firework-related ocular injuries[7]. These individuals often have no direct control over the use of fireworks, making them particularly vulnerable to accidental trauma.

Preventive strategies remain crucial in reducing the burden of such injuries. Public education campaigns emphasizing safe firecracker practices, supervised usage, and designated firework zones have been shown to significantly reduce injury incidence[8]. Furthermore, regulatory policies governing the sale and use of fireworks have demonstrated measurable reductions in ocular trauma rates in several countries[9-10].

Our study underscores the importance of recognizing bystanders as a high-risk group during firecracker celebrations. Since these injuries are largely preventable, increasing public awareness, enforcing safety regulations, and promoting protective eyewear in high-risk environments may substantially reduce the incidence of vision-threatening trauma.

In conclusion, bystander ocular injuries constitute a significant proportion of firecracker-related trauma and can lead to severe visual impairment. Early diagnosis, timely management, and stronger preventive strategies are essential to reduce the burden of these avoidable injuries.

V. Conclusion

Bystander ocular injuries from firecracker use represent a significant but preventable cause of visual morbidity. Implementation of preventive strategies, public education, and safety regulations are essential to reduce the burden of these injuries.

Limitations
- Retrospective design
- Single-center study
- Limited follow-up duration

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