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Clinical Evaluation and Visual Outcome of Paediatric Ocular Trauma Patients Presenting in a Tertiary Care Hospital

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Abstract

Background: Paediatric ocular trauma remains a major preventable cause of monocular blindness in children. Early recognition and timely management are crucial for optimizing visual outcomes.

Purpose: This study aimed to evaluate the clinical profile, types of injury, and visual outcomes in paediatric patients presenting with ocular trauma to a tertiary care hospital.

Methods: A retrospective observational study was conducted among paediatric patients (<18 years) presenting with ocular trauma to the ophthalmology outpatient department or casualty from November 2024 to April 2025. Data regarding age, gender, laterality, cause and type of injury, time of presentation, and visual outcomes were collected from medical records. Each patient underwent a detailed ocular examination, including anterior and posterior segment evaluation. Management was individualized according to the type and severity of injury. Visual outcomes were assessed on follow-up visits.

Results: A total of 24 patients (25 eyes) were included. The majority were males (87.5%), with the 7–12-year age group being most affected (45.8%). Blunt trauma (32%) was the most common cause, followed by firecracker injuries (28%) and sharp object injuries (20%). Most patients (58%) presented within 6 hours of injury. Closed-globe injuries (87.5%) predominated, while open-globe injuries were seen in 8.3%. Visual acuity improved in most cases at follow-up, with 16 eyes achieving visual acuity between 0.00–0.30 log MAR. Only two patients required surgical intervention.

Conclusion: Paediatric ocular trauma was more common in males, with blunt and firecracker-related injuries being the leading causes. Timely presentation and appropriate management led to favourable visual outcomes in most cases. Strengthening preventive measures, such as parental supervision and awareness regarding high-risk activities, can help reduce the incidence of paediatric ocular injuries.

Keywords: Paediatric ocular trauma, Childhood blindness, Ocular Trauma Score (OTS), Open-globe injuries, Visual outcomes

Introduction

Paediatric ocular trauma represents a significant global public health concern, contributing to a large proportion of acquired monocular blindness and visual disability among children. Children's visual systems are especially susceptible because, if left untreated, ocular injuries sustained during the crucial stage of visual development can result in amblyopia, irreversible vision impairment, or blindness. Long-term functional, cosmetic, educational, and psychological repercussions of eye damage in children

might potentially impact scholastic achievement and quality of life Shah SM et al. [1].

An estimated 1.6 million cases of blindness, 2.3 million cases of bilateral poor vision, and 19 million cases of unilateral blindness or visual impairment occur annually worldwide as a result of ocular trauma Négrel AD et al. [2]. Twenty to fifty percent of these instances include children, underscoring the necessity of age-appropriate preventative and rehabilitative measures. Depending on socioeconomic circumstances, cultural traditions, supervision, and access to ophthalmic treatment, the epidemiology of paediatric ocular trauma differs by area.

Paediatric ocular trauma is still an avoidable but little-known cause of childhood blindness in India. Ocular trauma is the fourth most common cause of unilateral blindness in children, accounting for 5–10% of avoidable childhood blindness, according to the National Programme for Control of Blindness and Visual Impairment (NPCBVI, MoHFW, Govt. of India) Verma R et al.[3]. Ocular trauma accounts for up to 15–20% of all ophthalmic emergency admissions in Indian tertiary care institutions, according to data from hospital-based registries and community-based surveys.

Most paediatric eye injuries happen in rural or semi-urban areas and are frequently related to outdoor play, farming, or household mishaps. Children are more likely to sustain injuries from twigs, stones, pens, metallic wires, toys, and household items because they are inherently interested and less risk-aware. Injuries from firecrackers continue to be a major source of open-globe injuries and corneal burns in India, especially during holidays like Diwali Venkatesh R et al. [4]. Furthermore, the risk is further increased by inadequate use of protective eyewear and a lack of adult supervision.

Ocular injuries are often divided into two categories: open-globe and closed-globe, according to the Birmingham Eye Trauma Terminology (BETT) categorisation Dogramaci M et al.[5]. A worse visual prognosis and an increased risk of sequelae including traumatic cataract, vitreous haemorrhage, retinal detachment, and secondary endophthalmitis are frequently linked to open-globe injuries, which include corneal or scleral lacerations, penetrating wounds, and globe ruptures. Conversely, contusions, lamellar lacerations, or superficial foreign bodies are examples of closed-globe injuries, which often have better results but can nonetheless cause serious side effects such hyphema, angle recession glaucoma, lens displacement, or posterior segment involvement Akça Bayar S et al. [6].

The type and mechanism of injury, initial visual acuity, and time between injury and medical intervention are among the many interrelated factors that have been shown in numerous studies to influence the visual prognosis in paediatric ocular trauma. In order to reduce secondary injury and enhance prognosis, early evaluation and surgical intervention are essential. In India, delayed presentation is still a significant problem, particularly for rural communities where access to, knowledge of, and price of specialised ophthalmic treatment are low.

Children also frequently arrive late because carers may not recognise their symptoms or may hide their injuries. The identification of sight-threatening interior injuries may occasionally be delayed if there are no obvious outward wounds.

There are differences in the pattern of paediatric ocular trauma across genders and age groups. Due to increased outdoor activity and risk-taking behaviour, boys are more likely than girls to be impacted. Children between the ages of 5 and 15 are most frequently implicated since this is when they are most active and exposed to environmental risks Parija S et al. [8]. Because children are more likely to be right-handed, exposure-related bias is probably the reason why the right eye is more frequently affected.

There may be major public health consequences from eye trauma. Preventing trauma-related vision loss is essential in developing nations like India, where juvenile blindness has a major socioeconomic impact. In order to lessen the burden, early detection, suitable treatment, and rehabilitation are crucial. The prevalence of such accidents can be significantly decreased by public health education initiatives that prioritise the use of protective eyewear, parental monitoring, and safety during play Shah SM et al. [1]. Furthermore, early diagnosis and referral can be enhanced by including ocular trauma therapy into rural health outreach services and school health programs.

The results of child ocular trauma have greatly improved because to recent developments in microsurgical procedures, paediatric anaesthesia, and

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postoperative visual rehabilitation. The prognosis for open-globe injuries is still uncertain, nevertheless, especially if endophthalmitis or posterior segment involvement are present Verma R et al.[3]. In light of this, the current study was created to examine the demographics, causes, types, and patterns of ocular damage, as well as the visual consequences of these injuries in children who are enrolled in tertiary care hospitals. The study intends to enhance clinical outcomes and boost preventative tactics in cases of childhood ocular damage by identifying common aetiologies and prognostic factors.

Materials And Methods

Study Design: Retrospective observational study.

Study Period: November 2024 – April 2025 (6 months)

Study Setting: Department of Ophthalmology, [MGM Medical College and Hospital, Chh Sambhajinagar].

Study Population: All paediatric patients (<18 years) presenting with ocular trauma to the ophthalmology outpatient department or casualty during the study period.

Sample Size: 24 patients (25 eyes).

Inclusion Criteria

- Patients below 18 years of age presenting with any form of ocular trauma.

Exclusion Criteria

- Patients whose parents or guardians did not provide consent for participation.

Data Collection and Parameters

Demographic and clinical details were recorded from patient case files, including:

1. **Age and gender**
2. **Laterality of injury** (right eye, left eye, or both eyes)
3. **Cause of injury** (firecracker, blunt object, sharp object, animal/plant-related, chemical injury, etc.)
4. **Type of injury** (open globe, closed globe, adnexal)
5. **Time interval between injury and hospital presentation**
6. **Presenting visual acuity and final visual outcome**

Comprehensive ocular examination was performed using slit-lamp biomicroscopy, fundus examination, and, where necessary Bscan ultrasonography. Injuries were classified according to the Birmingham Eye Trauma Terminology System (BETTS). Management included conservative medical therapy or surgical intervention, depending on the severity of the injury. Visual acuity was measured using the logMAR chart at presentation and follow-up.

Results

Table 1: Age-wise Distribution of Patients

Age Group (years)	Number of Patients	Percentage (%)
0–6	8	33.3
7–12	11	45.8
13–18	4	16.7
Total	**24**	**100.0**

The age distribution of the 24 paediatric patients showed that, with 45.8% of cases, ocular trauma was most common in the 7–12 age range. 33.3% belonged to the 0–6 year group, and 16.7% to the 13–18 year group. This trend suggests that school-age children are more susceptible to eye injuries, maybe as a result of more outside play and less supervision.

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Figure 1: Age Distribution

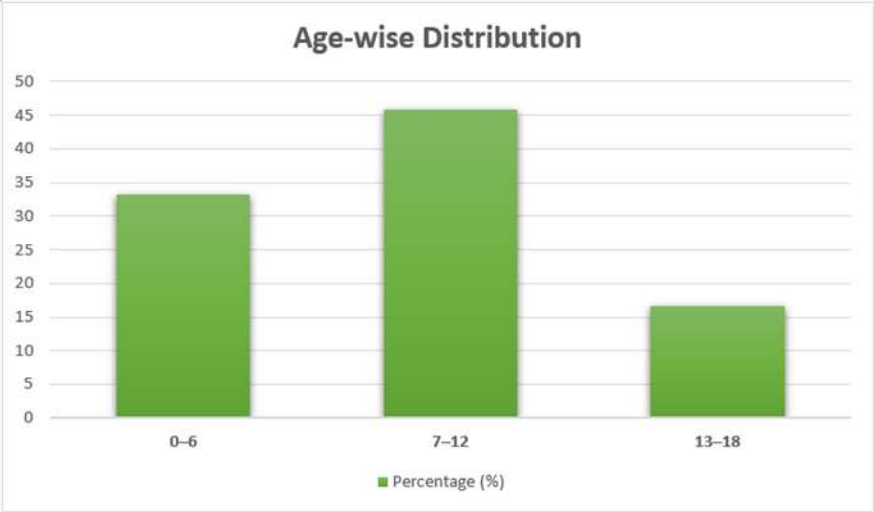

Table 2. Gender Distribution

Gender	Number	Percentage (%)
Male	21	87.5
Female	3	12.5
Total	**24**	**100.0**

Among the 24 patients, 21 (87.5%) were male and 3 (12.5%) were female, demonstrating a clear male preponderance. This male dominance aligns with existing literature, which attributes the higher incidence in boys to greater participation in outdoor play, sports, and risk-prone activities compared to girls.

Figure 1: Gender Distribution

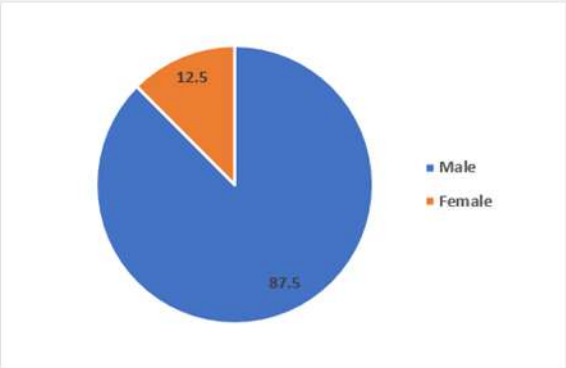

Table 3. Laterality of Involvement

Laterality	Number of Eyes	Percentage (%)
Right Eye (RE)	12	48.0
Left Eye (LE)	11	44.0

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Both Eyes (BE)	1	4.0
Total Eyes	**25**	**100.0**

Unilateral eyes were most commonly injured by ocular trauma. Of the instances, 48.0% impacted the right eye (RE) and 44.0% included the left eye (LE). There were 25 afflicted eyes overall, although only one patient (4.0%) had bilateral involvement. The nearly equal distribution between the left and right eyes raises the possibility that the mechanism of damage, rather than laterality preference, may be more closely linked to the side of involvement.

Table 4. Time of Presentation After Injury

Duration	Number of Patients	Percentage (%)
Up to 6 hours	14	58.3
6–24 hours	6	25.0
More than 1 day	4	16.7
Total	**24**	**100.0**

Most patients (**58.3%**) presented **within 6 hours** of sustaining the injury, indicating a relatively prompt response in seeking medical care. However, **25.0%** presented between **6–24 hours**, and **16.7%** had a **delay of more than one day**. Delayed presentation may be associated with poor awareness, limited accessibility to tertiary eye care, or initial underestimation of injury severity by caregivers.

Table 5. Cause of Injury

Cause of Injury	Number of Eyes	Percentage (%)
Firecracker	7	28.0
Sharp Objects	5	20.0
Animal/Plant Related	2	8.0
Blunt Trauma	8	32.0
Chemical Injury	3	12.0
Total	**25**	**100.0**

Blunt trauma was the most common cause of ocular damage (32.0%), with firecracker-related injuries coming in second (28.0%). Additionally, injuries from chemical exposure (12.0%), trauma from animals or plants (8.0%), and injuries from sharp objects (20.0%) were noted. The prevalence of firecracker and blunt injuries highlights the need for increased public awareness and safety precautions at outdoor events and festivals.

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Figure 2: Causes of Injury

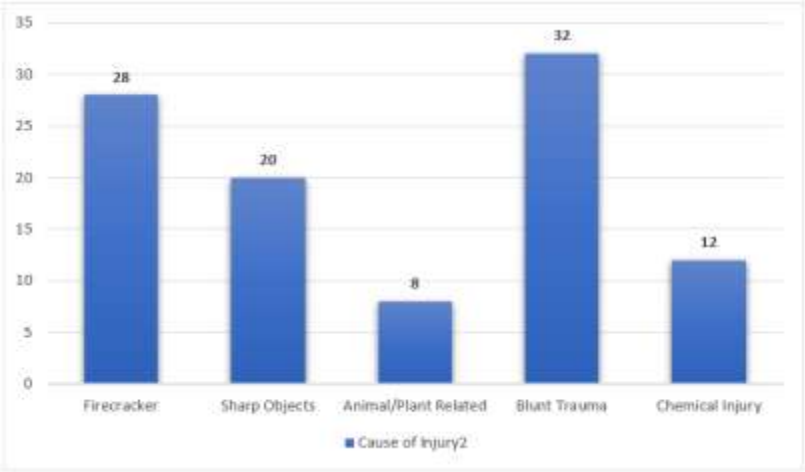

Table 6. Type of Ocular Injury

Type of Injury	Number	Percentage (%)
Open Globe	2	8.3
Closed Globe	21	87.5
Adnexal Injury	2	8.3
Total	**24**	**100.0**

The majority of the 24 patients (87.5%) had closed-globe injuries, whereas 8.3% of cases had open-globe injuries and 8.3% had adnexal injuries. In contrast to open-globe injuries, which frequently need surgical repair and have a worse visual prognosis, closed-globe injuries are more common in youngsters and are usually caused by physical trauma.

Table 7. Closed Globe Injury Profile

Type of Closed Globe Injury	Number	Percentage (%)
Corneal Abrasion	5	23.8
Corneal Epithelial Defect	4	19.0
Subconjunctival Hemorrhage	4	19.0
Conjunctival Tear	1	4.8
Hyphema	3	14.3
Total (Closed Globe)	**21**	**100.0**

Within the subset of 21 closed-globe injuries, corneal abrasions were the most common finding (23.8%), followed by corneal epithelial defects (19.0%), and subconjunctival hemorrhage (19.0%). Other presentations included hyphema (14.3%) and conjunctival tears (4.8%). These patterns suggest that anterior segment involvement predominates in paediatric closed-globe injuries and typically responds well to conservative management.

Table 8. Visual Outcome at Presentation and Follow-up (logMAR)

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Visual Acuity (logMAR)	At Presentation (n=25)	At Follow-up (n=25)
0.00 – 0.30	11	16
0.30 – 1.00	6	3
1.00 – PL+	4	2
Unable to Assess	4	4
Total Eyes	**25**	**25**

Four eyes had severe vision loss (>1.00 logMAR to PL+), six eyes had moderate impairment (0.30–1.00 logMAR), and eleven eyes had acceptable visual acuity (0.00–0.30 logMAR) at the time of presentation. Because of their age or lack of participation, four instances could not be evaluated. The number of eyes with moderate or severe impairment decreased, and 16 eyes achieved normal or near-normal vision (0.00–0.30 logMAR) at the follow-up, indicating a significant improvement in visual outcomes. This suggests that in cases of paediatric ocular injuries, prompt intervention and suitable therapy greatly enhance the visual prognosis.

Discussion

Ocular trauma in children remains a significant cause of preventable monocular blindness worldwide, with long-term functional and psychosocial implications. In this study of 24 paediatric patients presenting with ocular trauma, most injuries occurred among school-aged males, with blunt trauma and firecracker-related injuries being the most frequent causes. The results are in line with international and Indian research that highlights the prevalence of unintentional, activity-related trauma in this age range.

The age group that was most often impacted in our sample was 7–12 years old (45.8%), followed by 0–6 years old (33.3%). This distribution is consistent with findings by Shah A et al. [10] and Irawati Y et al. [7], who noted a comparable age pattern and attributed it to school-aged children's increasing outside activities, lack of supervision, and risk-taking behaviour. Younger children (less than six years old) are more at risk since they are less aware of the risks.

This study found a significant male preponderance (87.5%), which has been repeatedly shown in earlier Indian investigations by Qayum S et al. [11]. Males are more likely to engage in outdoor activities, energetic play, and the usage of potentially hazardous objects, all of which raise the risk of injury. The behavioural and social elements that contribute to this male bias emphasise the value of community-based education initiatives and parental watchfulness.

In terms of laterality, there was just one instance of bilateral damage, and trauma was split nearly evenly between the right and left eyes (48.0% vs. 44.0%). Al-Mahrouqi HH et al. [12] observed similar results, emphasising that the damaged eye is frequently determined by the mechanism of injury rather than laterality. In most cases, functional vision can be preserved if adequate and prompt treatment is given, as indicated by the prevalence of unilateral involvement.

One significant predictive factor was the time of presentation after the injury. While 16.7% of patients in our research sought medical attention more than a day later, 58.3% of patients showed up within six hours. In line with research by Parija S et al. [8], which shown that delayed referral and a lack of prompt ophthalmic care significantly contribute to poor visual prognosis, prompt presentation was linked to better visual results. Low awareness, living in a remote area, and having limited access to specialised eye care are the main causes of delayed presentation in underdeveloped nations.

The most frequent cause, in terms of causative agents, was blunt trauma (32.0%), which was followed by injuries due to firecrackers (28.0%), sharp objects (20.0%), and chemicals (12.0%). Ocular injuries from firecrackers are very common in India because of festivals like Diwali. Similar patterns were noted by Venkatesh R et al. [4], who underlined the necessity public education initiatives on firecracker safety. Children frequently experience blunt injuries from household items, sticks, or sports activities, highlighting the significance of safe play spaces.

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The majority of patients (87.5%) had closed-globe injuries, whereas 8.3% had both open-globe injuries and adnexal damage. This trend is consistent with research by Shah A et al. [10] which found that closed-globe injuries were more common but frequently linked to better results. Despite being less common, open-globe injuries have a poorer prognosis because they increase the likelihood of infection, retinal detachment, or endophthalmitis.

The most frequent closed-globe injuries were subconjunctival haemorrhage (19.0%), corneal abrasions (23.8%), and epithelial defects (19.0%). Conservative treatment typically results in a good recovery from these anterior segment injuries. 14.3% of patients had hyphema, which is in line with research by Rmili MF et al. [13], who pointed out that hyphema is a typical aftereffect of forceful trauma and needs careful observation to avoid corneal blood staining or subsequent glaucoma.

Regarding visual results, at presentation, 44% of eyes (11/25) had good visual acuity (0.00–0.30 logMAR), and at follow-up, that number rose to 64% (16/25). This enhancement demonstrates the value of prompt diagnosis and suitable treatment. Studies by Shah A et al. [10] showed similar patterns of visual recovery and showed that prompt therapy greatly lowers the likelihood of permanent eyesight loss. However, in certain cases, the existence of posterior segment involvement and delayed presentation led to poor results.

The study's conclusions highlight how paediatric ocular damage is avoidable. Unsupervised play or festival festivities accounted for a significant percentage of injuries. The incidence can be significantly decreased by educating the public about eye protection, safe play techniques, and avoiding high-risk activities. Additionally, early referral and results can be enhanced by the establishment of specialised paediatric eye trauma facilities and public awareness campaigns through media and schools.

Conclusion

One important but avoidable source of visual morbidity is paediatric ocular trauma. According to the current study, school-aged boys were the most afflicted group, and the most common causes were injuries from blunt objects and firecrackers. Compared to open-globe injuries, closed-globe injuries were more common and had a better prognosis. After receiving the right care, the majority of patients who arrived early (within six hours) had a significant improvement in their vision. To reduce the burden of visual impairment, early detection, timely treatment, and preventative education for parents and kids are crucial. Paediatric eye injuries can be significantly decreased by enforcing safety regulations at festivals, encouraging play supervision, and raising community awareness.

Limitations

1. **Small sample size (n=24)** limits the generalizability of results to the wider paediatric population.
2. **Retrospective study design** may introduce data bias and limits assessment of long-term outcomes.
3. **Short follow-up period** may not capture delayed complications such as amblyopia or traumatic cataract.
4. The study was **conducted at a single tertiary centre**, and findings may not represent community-level trauma patterns.

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