



Pattern of ocular injury in pediatric patients visiting a tertiary eye hospital in Eastern Nepal

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ABSTRACT

Background: Pediatric ocular trauma is a leading cause of preventable visual morbidity and monocular blindness worldwide. The epidemiology and clinical patterns of ocular injuries vary across regions due to differences in environmental exposure, socioeconomic factors, and supervision practices. Understanding local injury patterns is essential to informing targeted prevention strategies and optimizing clinical management.

Methods: A hospital-based cross-sectional observational study was conducted at Biratnagar Eye Hospital, a tertiary eye care center in Eastern Nepal, between April and September 2023. Pediatric patients younger than 16 years presenting for the first time with ocular trauma were consecutively enrolled. Data on demographic characteristics, educational status, causative agents, place and anatomical zone of injury, clinical diagnosis, and management approach were collected using a structured proforma. Injuries were categorized based on anatomical zones, and management was classified as medical, surgical, or observational. Results were summarized using descriptive statistics.

Results: A total of 260 children were included, 184 (70.8%) of whom were male. The highest incidence of ocular trauma was observed in children aged 6–10 years (n = 115, 44.2%). Stick- or wood-related injuries were the most common cause (n = 85, 32.7%), followed by injuries from iron or other sharp objects (n = 45, 17.3%). The majority of injuries occurred at home (n = 170, 65.4%). Open globe injuries constituted the most frequent diagnosis (n = 101, 38.8%), while Zone I injuries accounted for 96.9% (n = 252) of cases, indicating predominant anterior segment involvement. Medical management alone was sufficient in 58.0% (n = 150) of patients, whereas 40.0% (n = 104) required surgical intervention.

Conclusions: Pediatric ocular trauma in Eastern Nepal predominantly affects school-aged boys and frequently occurs in the home environment due to largely preventable causes. The substantial burden of open globe and anterior segment injuries highlights the need for strengthened injury prevention strategies, enhanced parental supervision, and timely access to specialized ophthalmic care. Targeted community education and coordinated trauma management approaches may help reduce the incidence and visual consequences of pediatric ocular injuries.

KEYWORDS

children, trauma, corneal trauma, prognoses, eyes, eye injury, home accidents, boys, girls

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INTRODUCTION

Ocular trauma constitutes a true ophthalmic emergency and represents a major contributor to the development of ocular morbidity in children [1]. It is a leading cause of non-congenital, preventable monocular blindness among pediatric populations [2, 3], encompassing injuries to the globe as well as the surrounding ocular adnexa. Pediatric ocular trauma is reported to account for approximately 8%–14% of all childhood injuries worldwide [4]. Multiple studies have demonstrated that ocular injuries are a significant cause of visual impairment in children, with considerable variation in incidence across countries and regions [5–7]. Ocular injuries were reported in 18.9% of children aged 15 years and younger in a tertiary eye care center in India [8], compared with 8.1% among pediatric patients in a tertiary eye hospital in Nepal [9].

The epidemiological profile of pediatric ocular trauma varies substantially between countries and even across regions within the same country. Comprehensive knowledge of the prevalence, mechanisms, timing, and settings of ocular injuries is essential for the development of effective, targeted prevention strategies aimed at high-risk populations and environments [4, 8, 10]. While the implementation of stringent safety regulations and preventive measures in developed countries has led to a decline in the incidence of ocular trauma, such reductions have not been consistently observed in developing nations [8, 11, 12].

Therefore, the aim of the present study was to investigate patterns of ocular injury among pediatric patients and to identify the associated risk factors contributing to these injuries.

METHODS

A hospital-based cross-sectional observational study was conducted at Biratnagar Eye Hospital (BEH), a tertiary eye care referral center in Eastern Nepal, over a six-month period from April to September 2023, to characterize the epidemiological profile, clinical presentation, anatomical distribution, and management patterns of pediatric ocular trauma presenting to the hospital during the study period.

The study protocol was reviewed and approved by the Institutional Review Committee of Biratnagar Eye Hospital (reference no. BEH-IRC-82/A). All study procedures adhered to the tenets of the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians of all participating children prior to data collection. In cases where participants were recruited through schools, consent was additionally obtained from the pertinent school authorities. Participation was entirely voluntary, and strict measures were implemented to ensure the privacy, confidentiality, and anonymity of all patient information.

Pediatric patients younger than 16 years who presented for the first time to the pediatric department of BEH with a history of ocular injury during the study period were eligible for inclusion. Patients with previous ocular trauma, repeat visits for the same injury, and follow-up cases were excluded to avoid duplication and recall bias. Children presenting with non-traumatic ocular conditions were also excluded.

A purposive sampling technique was employed to recruit eligible participants. The sample size was calculated using OpenEpi software based on an estimated prevalence of pediatric ocular trauma reported in previous studies, with a 95% confidence interval and a 10% allowance for non-response. A total of 260 pediatric patients who met the inclusion criteria were enrolled in the study.

Data were collected at the time of clinical evaluation using a structured and pretested proforma. The collected variables included demographic characteristics (age, sex, and educational status of patients and parents based on school grade), injury-related details (laterality, place of occurrence, causative agent or object of injury, anatomical involvement, and time interval between injury and hospital presentation) [9], and clinical parameters such as presenting visual acuity, anatomical diagnosis, and management approach.

Presenting visual acuity was assessed using age-appropriate methods; cooperative children were evaluated using standard visual acuity charts, while alternative pediatric visual assessment techniques were employed for younger or uncooperative children as clinically indicated [6, 8]. A comprehensive ophthalmic examination was performed for all patients, including a detailed slit-lamp examination (SLIT LAMP AIA 11–3SL, Appasamy Associates, India) of anterior segment evaluation and posterior segment assessment where feasible. Additional testing was performed based on clinical indications [6, 8].

All examinations and diagnoses were performed by trained ophthalmologists. In cases of diagnostic uncertainty, clinical findings were reviewed and confirmed by a senior consultant ophthalmologist to ensure diagnostic accuracy. Ocular injuries were categorized by anatomical zones based on standardized ocular trauma zoning criteria. Zone I injuries involved the cornea and limbus (cornea, corneoscleral limbus), Zone II injuries extended from the limbus up to 5 mm posterior to the sclerocorneal limbus, and Zone III injuries involved structures posterior to Zone II, including the posterior segment [13, 14].

Management strategies were categorized into three groups: medical management (pharmacological treatment without surgical intervention), surgical management (any operative intervention), and observation alone (no active medical or surgical treatment). The choice of management was determined based on type and severity of ocular injury.

Collected data were entered into Microsoft Excel spreadsheets (Microsoft Office 365; Microsoft Inc., Redmond, WA, USA) and verified for completeness and accuracy prior to analysis. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS version 20.0; IBM Corp., Armonk, NY, USA). As this was a descriptive study, inferential statistical

analyses were not performed. Continuous variables were summarized using means and standard deviations, while categorical variables were presented as frequencies and percentages.

RESULTS

A total of 260 pediatric patients with ocular trauma were included in the analysis. The study population displayed a marked male predominance, with 184 (70.8%) male and 76 (29.2%) female participants. The highest proportion of injuries occurred among children aged 6–10 years ($n = 115$, 44.2%), followed by those aged 11–15 years ($n = 73$, 28.1%) and 0–5 years ($n = 72$, 27.7%). With respect to educational status, more than half of the injured children were enrolled up to primary school level (grade ≤ 5 ; $n = 138$, 53.1%), while 17.3% ($n = 45$) had no formal education. Parental educational levels varied, with nearly one-third of parents ($n = 84$, 32.3%) reporting no formal education. The detailed sociodemographic characteristics of the study participants are summarized in Table 1.

Table 1. Sociodemographic characteristics of pediatric patients with ocular trauma (N = 260)

Characteristic	Category	n (%)
Sex	Male	184 (70.8)
	Female	76 (29.2)
Age group (years)	0–5	72 (27.7)
	6–10	115 (44.2)
	11–15	73 (28.1)
Educational status of patients (school grade)	\leq Grade 5	138 (53.1)
	Grades 6–8	62 (23.8)
	Grades 9–10	14 (5.4)
	> Grade 10	1 (0.4)
	No formal education	45 (17.3)
Educational status of parents (school grade)	\leq Grade 5	34 (13.1)
	Grades 6–8	47 (18.1)
	Grades 9–10	48 (18.5)
	> Grade 10	47 (18.1)
	No formal education	84 (32.3)

Note: Data are presented as number (percentage). Percentages may not total 100 due to rounding.

Table 2. Causes, clinical diagnoses, and places of occurrence of pediatric ocular injuries (N = 260)

Injury-related characteristics		n (%)
Cause	Stick/Wood pieces	85 (32.7)
	Iron/Sharp object/Sickle	45 (17.3)
	Dust/Sand/Leaf	27 (10.4)
	Finger/nail/head injury	24 (9.2)
	Ball/Blunt object	23 (8.8)
	Road traffic accident/Fall	12 (4.6)
	Miscellaneous	12 (4.6)
	Plastic/Rubber	11 (4.2)
	Soap/Lime/Super glue	9 (3.5)
	Firecracker	6 (2.3)
	Animal-related injury	6 (2.3)
Diagnosis	Open globe injury	101 (38.8)
	Subconjunctival hemorrhage	73 (28.1)
	Closed globe injury	46 (17.7)
	Conjunctival laceration	14 (5.4)
	Lid laceration	12 (4.6)
	Chemical burn	8 (3.1)
	Thermal burn	6 (2.3)
Place	Home	170 (65.4)
	Playground	60 (23.1)
	Road	21 (8.1)
	School	9 (3.5)

Note: Data are presented as number (percentage). Percentages may not total 100 due to rounding.

Table 2 presents the distribution of causes, clinical diagnoses, and places of occurrence of ocular injuries among the study participants. Stick- or wood-related injuries were the most common mechanism, accounting for 85 cases (32.7%), with a notably higher occurrence among children aged 6–10. Injuries caused by iron or other sharp objects, including sickles, constituted the second most frequent category, affecting 45 patients (17.3%) across all age groups. Particulate matter-related injuries, such as those caused by dust, sand, or leaves, were observed in 27 cases (10.4%), while injuries resulting from finger, nail, or head contact accounted for 24 cases (9.2%). Blunt trauma from balls or similar objects was reported in 23 children (8.8%). Less frequent causes included road traffic accidents or falls and miscellaneous mechanisms, each contributing to 12 cases (4.6%). Plastic or rubber objects were responsible for 11 injuries (4.2%), whereas chemical-related agents—including soap, lime, and super glue—accounted for 9 cases (3.5%). Injuries due to firecrackers and animal-related causes were comparatively rare, each representing 6 cases (2.3%) (**Table 2**).

Open globe injury was the most frequently observed diagnosis, affecting 101 children (38.8%). Subconjunctival hemorrhage was the next most common finding, identified in 73 cases (28.1%), followed by closed globe injury in 46 cases (17.7%). Less frequent diagnoses included conjunctival lacerations in 14 patients (5.4%) and lid lacerations in 12 patients (4.6%). Chemical burns were documented in 8 cases (3.1%), while thermal burns represented the least common diagnosis, occurring in 6 cases (2.3%) (**Table 2**).

Most ocular trauma cases occurred at home, accounting for 170 injuries (65.4%). Playgrounds represented the second most common setting, with 60 cases (23.1%). Injuries sustained on roads were less frequent, comprising 21 cases (8.1%), while school-related ocular injuries were the least common, reported in 9 children (3.5%) (**Table 2**).

The anatomical distribution of ocular injuries demonstrated a marked predominance of Zone I involvement, which accounted for 96.9% ($n = 252$) of cases. In contrast, injuries involving Zone II were uncommon ($n = 2$, 0.8%), while Zone III injuries were observed in 2.3% ($n = 6$) of patients, indicating relatively limited posterior segment involvement in the study population.

With respect to management strategies, the majority of patients were treated with medical management alone, comprising 58.0% ($n = 150$) of cases; this suggests that conservative therapy was sufficient for over half of the injuries. Surgical intervention was required for 40.0% ($n = 104$) of patients, reflecting the presence of severe or complex ocular trauma necessitating operative care. Observation without active medical or surgical treatment was done in a small proportion of cases ($n = 6$, 2.0%), indicating minor injuries with minimal clinical impact. Overall, these findings underscore the heterogeneous severity of pediatric ocular injuries encountered, with a substantial proportion requiring specialized surgical management.

DISCUSSION

This study describes the epidemiological and clinical profile of pediatric ocular trauma presenting to a tertiary eye care center in Eastern Nepal. Ocular injuries predominantly affected male children, with the highest incidence observed among those aged 6–10 years. Most injuries occurred at home and were commonly caused by sticks or wooden objects. Open globe injuries constituted a substantial proportion of cases, although the majority involved anterior segment structures. While over half of the patients were managed conservatively, a considerable proportion required surgical intervention, underscoring the substantial burden and variable severity of pediatric ocular trauma.

The prevalence and pattern of ophthalmic trauma vary widely by geographic location, socioeconomic status, age, occupation, and cultural practices [12, 15–17]. Ocular trauma is of particular public health importance, not only because of its contribution to visual morbidity but also because most cases are preventable [18, 19]. It has been estimated that nearly 90% of ocular injuries could be avoided through the implementation of simple and effective preventive measures [20–23].

In the present study, ocular injuries were more common among male children than female children, a finding consistent with previous reports [1, 2, 4, 6, 24–26]. This male predominance may be attributed to nature of their activities and higher exposure to risk-prone behaviors [26]. The highest proportion of injuries was observed in children aged 6–10 years (44.2%), whereas injuries were comparatively less frequent in children aged 0–5 years (27.7%). This may reflect closer parental supervision and greater protective measures among younger children [27]. Similar age-related trends have been reported in studies from India and other regions worldwide [1, 2, 6, 28]. Madan et al. [8] reported the highest frequency of ocular trauma in children aged 6–10 (39.3%), followed by those aged 11–15 (36.1%), and Saxena et al. [6] found that the majority of ocular injuries occurred in children aged 5 years and older (87.7%).

With regard to the causes of ocular injury, sticks or wooden objects were the most common etiological agents, accounting for 32.7% of cases, followed by iron or sharp objects, including sickles (17.3%). The widespread availability of wooden materials in and around the household environment may explain this [29, 30]. Consistently with this finding, the home was identified as the most common location of injury (65.4%)—a pattern also reported in several other studies [31, 32]. Injuries caused by firecrackers were relatively uncommon (2.3%), likely reflecting the seasonal nature of fireworks use and the impact of fireworks regulation policies [33–35]. Similarly, animal-related injuries accounted for 2.3% of cases, as children are particularly vulnerable to ocular trauma inflicted by domestic or stray animals [36, 37].

Regarding clinical diagnoses, Saxena et al. reported that among children aged 14 or younger presenting with ocular trauma in India, closed globe injuries accounted for 42.2% of cases, open globe injuries for 53.9%, and chemical injuries for 3.9% [6]. The present study evidenced a predominance of open globe injuries (38.8%) compared with closed globe injuries (17.7%). Open globe

injuries represent a severe form of ocular trauma and frequently occur in pediatric patients due to penetration by sharp objects within the home environment [38, 39]. Common etiological agents associated with open globe injuries in this study included needles, knives, glass, and arrows—findings that are consistent with previous reports [4, 40]. The relatively higher proportion of open globe injuries observed may be attributable to referral bias, as children with severe visual impairment are more likely to seek care at a tertiary center, whereas milder closed globe injuries may be underreported [25, 41]. Open globe injuries are known to carry a greater risk of poor visual outcomes compared with closed globe injuries [13, 42–45] and may occasionally necessitate enucleation [46].

Anatomically, Zone I injuries were the most common across all diagnostic categories, suggesting that the anterior segment of the eye is particularly vulnerable to trauma. This observation is consistent with findings from previous studies [13, 44]. Zone III injuries were relatively infrequent (2.3%), indicating limited posterior segment involvement in the study population. Nonetheless, posterior segment injuries are acknowledged as important predictors of poor visual prognosis [47]. In contrast to the present findings, some studies have reported a higher prevalence of closed globe injuries compared with open globe injuries [34, 48], highlighting regional and contextual variations in the pattern of pediatric ocular trauma.

To reduce blindness resulting from ocular injuries and to improve outcomes in pediatric ocular trauma, the establishment of a rapid-response, multidisciplinary ocular trauma team within ophthalmic departments has been recommended [8]. Such a team may include a casualty medical officer, an ophthalmology resident, a vitreoretinal specialist, an anesthetist, and a medical social worker [8]. This coordinated approach could facilitate timely diagnosis and management while also supporting community education and injury prevention initiatives [27, 49, 50]. Moreover, elucidating the epidemiological profile of ocular trauma is critical for designing and implementing effective preventive measures [51]. In the present study, medical management alone was sufficient in 58.0% of cases, indicating that conservative treatment can effectively manage a substantial proportion of pediatric ocular injuries. However, 40.0% of patients required surgical intervention, reflecting the presence of severe or complex injuries necessitating operative care. A small proportion of cases (2.0%) were managed by observation alone, suggesting minimal injury severity. Overall, these findings highlight the heterogeneous nature of pediatric ocular trauma and the need for both preventive strategies and access to specialized surgical services.

The present study provides valuable insight into the epidemiological and clinical patterns of pediatric ocular trauma in a tertiary care setting, supported by prospective data collection, standardized clinical evaluation, and a relatively large sample size for a single-center study. Still, several limitations should be acknowledged. The study did not assess injury-related complications or their management in detail, limiting comprehensive evaluation of treatment challenges and outcomes. The absence of follow-up data restricts interpretation of long-term visual and functional outcomes. The relatively short study duration may also have limited the ability to capture seasonal variations and longer-term trends in pediatric ocular trauma. Future multicenter studies with extended follow-up are warranted to evaluate visual outcomes, complication rates, and the effectiveness of targeted prevention strategies.

CONCLUSIONS

Pediatric ocular trauma represents an important and largely preventable cause of ocular morbidity in Eastern Nepal. In this tertiary care-based study, injuries were more frequent among school-aged boys and most commonly occurred in the home environment, often due to avoidable causes such as sticks and sharp objects. A substantial proportion of cases involved open globe and anterior segment injuries, reflecting the potential severity of the trauma encountered. These findings underscore the need for enhanced injury-prevention efforts, improved parental supervision, and timely access to appropriate ophthalmic care. Strengthening community awareness and reinforcing coordinated trauma management pathways may contribute to reducing the burden and visual consequences of pediatric ocular injuries.

ETHICAL DECLARATIONS

Ethical approval: The study protocol was reviewed and approved by the Institutional Review Committee of Biratnagar Eye Hospital (reference no. BEH-IRC-82/A). All study procedures adhered to the tenets of the Declaration of Helsinki. Written informed consent was obtained from the parents or legal guardians of all participating children prior to data collection. In cases where participants were recruited through schools, consent was additionally obtained from the pertinent school authorities. Participation was entirely voluntary, and strict measures were implemented to ensure the privacy, confidentiality, and anonymity of all patient information.

Conflict of interests: None.

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