A study on the clinical profile and visual outcome of pediatric ocular trauma in Eastern India

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Abstract:

PURPOSE: Ocular trauma in children is the leading cause of ocular morbidity and unilateral blindness. This study aims to analyze the clinical profile and predictors of final visual outcomes of ocular injuries in the pediatric age group presenting to a tertiary care institute in Eastern India.

METHODS: This is a retrospective, observational study conducted on 114 cases of pediatric ocular injuries over 4 years (between 2016 and 2020) at a tertiary care academic hospital in Eastern India. All the data were analyzed based on the demography, nature of the injury, location of the injury, ocular trauma score (OTS), the initial and final visual acuity, and management protocol. The ocular trauma classification was based on the Birmingham Eye Trauma Terminology and the Ocular Trauma Classification System.

RESULTS: Majority of the injuries (n = 51, 44.7%) occurred in children between 6 and 10 years and in males from the rural areas (60.75%). The mean age of children was 9 ± 3.47 years (range: 3–16 years). Most of the injuries occurred during outdoor activities (57.9%). Majority of ocular injuries were caused by sharp objects (34, 30%), followed by blunt objects (24, 21%). Open globe injuries (OGIs) were more common (85, 48.3%) as compared to closed globe injuries (CGIs) (71, 40.3%) and nonglobe injuries (20, 11.4%). Mean OTS was 2.8 in 11–16 years indicating a good final visual outcome. Final visual outcome on multivariate analysis showed that the odds of blindness in CGI were 82% less as compared to OGI (odds ratio [OR] 0.18 [confidence interval (CI) 0.03–0.88]; $P < 0.03$) and that in late presenting (>6 h) group was 47% more (OR 1.47 [0.13–16.47]; $P < 0.75$) compared to early reporting group.

CONCLUSION: Children with ocular trauma commonly present as emergency cases, especially during the festivals in India. Our study reported OGIs to be more common with high risk for blindness. OTS is a useful tool for predicting the visual outcome of OGIs in children. Hence, strategic planning is needed with a focus on the early detection and intervention and also on creating the awareness activities for its prevention. The primary treatment is the key to a successful visual outcome.

Keywords:

Blindness, closed globe injuries, firecracker, open globe injuries

Introduction

Ocular trauma is one of the leading causes of acquired unilateral blindness in children.[1,2] The study by Brophy *et al*. reported that ocular trauma in children accounts for 8%–14% of total injuries and is a major cause of emergency hospitalization in children.[1] Various studies have reported a wide variation in pediatric ocular injuries among developed and developing countries and also among the rural and urban populations of the same country.[3-9] The epidemiological pattern of ocular trauma in children varies based on the geographical region, age, and gender. According to several studies, children below 18 years account for 25.4% of ocular injuries.[4,5] The ocular injuries may be classified as open globe and closed globe injuries (CGIs) with different presentations such as, corneal perforation, traumatic cataracts, retinal detachment, and endophthalmitis. Immediate surgical intervention is required to prevent visual loss. Long-term visual rehabilitation for

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postoperative astigmatism and amblyopia is also essential for optimal visual outcome.[4-6,10,11]

Ocular injuries in children are preventable in the majority of cases.[12,13] Timely treatment is essential to prevent visual impairment and blindness. Ocular morbidity affects the social, emotional, and psychological state of the child, adversely affecting their overall development.[2-4,6,10,11] Hence, to predict the final visual outcome using OTS[12] plays a significant role for the ophthalmologist for triage, to counsel and manage the cases in the emergency casualty and also for parents regarding multiple surgeries, long-term rehabilitation and financial issues. Strategies need to be adapted for early intervention in open globe injuries (OGIs) to prevent endophthalmitis and vision loss. Further, awareness creation and proper supervision at home are also necessary to prevent these injuries in children. The purpose of this study was to identify the risk factors, demographic, clinical profile, and prognostic factors in the management of pediatric ocular injuries at a tertiary care hospital in Eastern India.

Methods

This was a retrospective, hospital-based study which was conducted by the authors on pediatric patients (<16 years) with ocular trauma, who presented to trauma and emergency services and to the department of ophthalmology at a tertiary care institute in Eastern India from July 2016 to March 2020. There were medical records of 122 pediatric ocular trauma (POT) cases, but after exclusion, 114 cases were enrolled for the study. Eight cases were excluded from the analysis due to the loss of follow-up and incomplete records. The study adhered to the guidelines of the Declaration of Helsinki and was conducted after the approval of the institutional review board. Protocols were used to record the information based on demographic details, nature, and cause of injury, the time interval between the occurrence of injury and time of presentation, and treatment received. Records were reviewed to look for information about visual acuity, anterior segment, fundus findings, intraocular pressure, and gonioscopy (in CGIs) where it was done and all findings were noted. Documentation of X-rays for intraocular foreign-body localization, B-scan ultrasonography for vitreous hemorrhage, retinal detachment or endophthalmitis, and computerized tomography (CT) scans for orbital fractures was also noted. Infection, if present, was also noted along with the number of eyes lost due to evisceration or enucleation. The entire study group was divided into three groups as per age: below 5 years; 6–10 years and 11–16 years. Ocular injuries were classified as per the Birmingham Eye Trauma Terminology and the Ocular Trauma Classification System.[11,12] OGIs were categorized into penetrating injury (injuries where there is no exit wound), perforating injury (have both entrance and exit wounds), intraocular foreign body, and globe rupture while CGIs as contusions.[12] The ocular trauma score (OTS) was used for predicting the final visual acuity.[14] Visual rehabilitation was undertaken in the form of spectacles, contact lenses, and intraocular lenses followed by occlusion therapy for amblyopia. The final visual outcome was assessed based on the visual acuity improvement after 3 months of follow-up.

Statistical analysis

All the data were entered into the Microsoft Excel sheet and analyzed using the STATA version 13 (StataCorp,Texas,USA). Descriptive analysis was used in the form of frequency, percentages, mean with standard deviation, or median with interquartile range. The categorical variables were analyzed using the Chi-square tests and continuous variables using the paired *t*-test. One-way ANOVA and Kruskal–Wallis test were applied for finding an association between groups, as applicable. $P < 0.05$ was considered statistically significant.

Results

Among 550 children, a total of 122 (22.18%) children presented with ocular injuries who were treated in the emergency department or admitted in ophthalmology during the study period. Eight children did not meet the inclusion criteria; hence, 114 children were analyzed. The prevalence rate of ocular trauma in our study was (122/550 = 22.18%) over 2 years period. The study reported a significant male dominance (85, 74.6%) and (29, 25.4%) were female ($P < 0.02$) with male-to-female ratio of 3:1. The study population was divided into three age groups: <5 years (18, 15.8%), 6–10 years (51, 44.7%), and 11–16 years (45, 39.5%). The mean age was 9 ± 3.47 years (range 3–16 years), and a majority (96, 84.2%) of injuries occurred in children above 5 years. About half (62, 54.4%) of the injuries were sustained in outdoor settings and occurred in monsoon and winter seasons (75, 65.8%). Almost all (111, 97.4%) injuries were unilateral with a predilection for the right eye (65, 57.0%) as shown in Table 1. The majority of children presented to the hospital after 24 h (60, 52.6%) while (47, 41.2%) reported within 6–24 h of sustaining ocular injuries. The mean follow-up duration was maximum (107.1 ± 29.4 days) for the 6–10 years age group. Although the median duration was slightly higher (96 days) in the 6–10 years category compared to that in the 1–5 years and 11–16 years categories (median 90 days), it was not statistically significant ($P = 0.12$) between the groups by Kruskal–Wallis test [Table 1].

The maximum number of injuries were caused by sharp objects (34, 30%) followed by blunt objects (24, 21%) and firecrackers (23, 20%). Among sharp objects, the majority of wounds were afflicted by multiple items notably stick (14, 41%) and stationery items (13, 38%) whereas the least were caused by needle (2, 6%), hook (2, 6%) and bite (3, 9%). The maximum percentage of blunt injuries was caused by stone (21, 88%) and least by fist injuries (3, 12%) [Figure 1].

Out of the total injuries, OGIs were encountered more (85, 48.3%) than CGIs (71, 40.3%) and nonglobe injuries (20, 11.4%). Corneal laceration with iris prolapse contributed to 38 (44.7%) of the OGIs followed by corneal tear with

Table 1: Distribution of sociodemographic profile among different age categories

	1–5 years (*n*=18), *n* (%)	6–10 years (*n*=51), *n* (%)	11–16 years (*n*=45), *n* (%)	*P*
Sex				
Male	14 (77.78)	32 (62.75)	39 (86.67)	0.02*
Female	4 (22.22)	19 (37.25)	6 (13.33)	
Residence				
Urban	6 (33.33)	20 (39.22)	22 (48.89)	0.45
Rural	12 (66.67)	31 (60.78)	23 (51.11)	
Socioeconomic status				
Upper	4 (22.22)	6 (11.76)	9 (20.00)	0.63
Middle	7 (38.89)	25 (49.02)	23 (51.11)	
Lower	7 (38.89)	20 (39.22)	13 (28.89)	
Education				
School	2 (11.11)	46 (90.20)	44 (97.78)	0.00*
Nonschool	16 (88.89)	5 (9.80)	1 (2.22)	
Location				
Indoor	17 (94.44)	23 (45.10)	12 (26.67)	0.00*
Outdoor	1 (5.56)	28 (54.90)	33 (73.33)	
Season				
Spring	0	2 (3.92)	0	0.002*
Summer	11 (61.11)	18 (35.29)	5 (11.11)	
Monsoon	2 (11.11)	17 (33.33)	18 (40.00)	
Autumn	0	0	3 (6.67)	
Winter	5 (27.78)	14 (27.45)	19 (42.22)	
Eye				
Right eye	12 (66.67)	27 (52.94)	26 (57.78)	0.19
Left eye	6 (33.33)	24 (47.06)	16 (35.56)	
Both eyes	0	0	3 (6.67)	
Follow-up (days), median	90 (90–90)	96 (90–120)	90 (90–98)	0.12

*Chi-square test

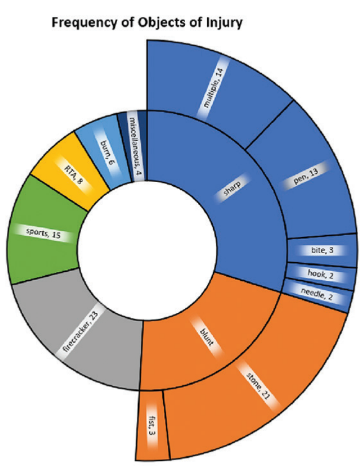

Figure 1: Chart showing causes and types of objects causing ocular injuries in children

traumatic cataract (18, 21.2%), sclerocorneal tear (12, 14.1%), and globe rupture (7, 8.2%). Among the CGI, the highest contribution was from corneal abrasion (15, 21.1%) followed by partial corneal laceration, traumatic cataract, and hyphema (14, 19.7% in each). Globe rupture was noted more among 6–10 years children, while corneal laceration ($n = 24$) and traumatic cataracts ($n = 15$) occurred more among the older children of 11–16 years category. The major injuries in the nonglobe group were lid lacerations (14, 70%) followed by lacrimal apparatus injuries (4, 20%) and orbital fracture (2, 10%) [Table 2].

Among the causative agents, burn injury had a better visual prognosis compared to road traffic accidents (0.25 vs. 1.0 logMAR) following treatment; ($P < 0.02$), as shown in Table 3. Out of a total of 117 eyes, the pre- and postoperative visual acuity were better (median 1.5 vs. 0.5 logMAR) in 11–16 years compared to the age group below 5 years (2.3 vs. 1.0 logMAR) respectively. The difference in postoperative visual acuity between the age categories was statistically significant ($P < 0.04$) [Figure 2].

The raw score (median 66) as well as the OTS score (mean 2.8 ± 0.79) was more among the older children (11–16 years) reflecting the impact of injury to be less severe and early intervention in this age group. The younger children (1–5 years) presented with the lowest raw score (median 56) and OTS score (mean 2.44 ± 0.7) indicating more serious types of injuries with a poor visual outcome. At the final postoperative visit, visual acuity of 6/9 or better corresponded to the highest raw score (median 76) and OTS score (mean 3.24 ± 0.93) whereas blind children showed lowest raw score (median 53) and OTS score (mean 1.94 ± 0.66), respectively. One patient had severe visual impairment with an initial OTS score of 3.0 and showed no improvement after treatment. Among

Table 2: Frequency of globe involvement among age groups

	1–5 years (*n*=18), *n* (%)	6–10 years (*n*=51), *n* (%)	11–16 years (*n*=45), *n* (%)	*P*
Open globe				
Globe rupture	1 (14.29)	6 (85.71)	0	0.05
Corneal laceration with iris prolapse	7 (18.42)	15 (39.47)	16 (42.11)	0.70
Corneal tear with traumatic cataract	3 (16.67)	7 (38.89)	8 (44.44)	0.86
Sclerocorneal tear	5 (41.67)	3 (25.00)	4 (33.33)	0.03*
Scleral tear	1 (33.33)	2 (66.67)	0	0.34
RD	0	1 (50.00)	1 (50.00)	0.82
IOFB and endophthalmitis	1 (25.00)	1 (25.00)	2 (50.00)	0.70
VH	0	0	1 (100.00)	0.46
Closed globe				
Traumatic cataract	0	7 (50.00)	7 (50.00)	0.22
Corneal abrasion	2 (13.33)	6 (40.00)	7 (46.67)	0.83
Corneal laceration	0	6 (42.86)	8 (57.14)	0.15
Hyphema	1 (7.14)	8 (57.14)	5 (35.71)	0.51
RD	0	1 (50.00)	1 (50.00)	0.82
VH	0	1 (20.00)	4 (80.00)	0.16
Traumatic iritis with raised IOP	1 (14.29)	2 (28.57)	4 (57.14)	0.59
Nonglobe				
Lid laceration	4 (28.57)	5 (35.71)	5 (35.71)	0.37
Lacrimal apparatus injury	0	3 (75.00)	1 (25.00)	0.42
Orbital fracture	0	2 (100.00)	0	0.28

*Chi-square test. RD: Retinal detachment, IOFB: Intraocular foreign body, VH: Vitreous hemorrhage, IOP: Intraocular pressure

Table 3: Association of visual acuity with age categories, globe involvement and objects of injury

	Pre-VA (median with IQR)	*P*	Post-VA (median with IQR)	*P*
Age group (years)				
1–5	2.3 (1.3–2.3)	0.13	1 (0.6–1.3)	0.04#
6–10	2.3 (1–2.3)		0.6 (0.3–1)	
11–16	1.5 (1–2.3)		0.5 (0.3–0.8)	
Globe involvement				
Open globe	2.3 (1.8–2.3)	0.0001#	0.6 (0.5–1.3)	0.0001#
CG	1.5 (1–2.3)		0.5 (0.2–0.8)	
Nonglobe	0.6 (0.5–0.8)		0.2 (0–0.35)	
Object of injury				
Sharp	2.3 (1.8–2.3)	0.04#	0.7 (0.5–1.3)	0.02#
Blunt	1.5 (1–2.3)		0.6 (0.3–1)	
Firecracker	2.3 (1–2.3)		0.6 (0.3–0.8)	
RTA	1.9 (1–2.55)		1 (0.7–1)	
Burn	0.7 (0.6–1.3)		0.25 (0.2–0.5)	
Sports	1.5 (1–2.3)		0.5 (0.2–0.6)	
Miscellaneous	1.55 (1.05–2.05)		0.45 (0.25–0.8)	

#Kruskal–Wallis test. RTA: Road traffic accidents, CG: Closed globe, IQR: Interquartile range, VA: Visual acuity

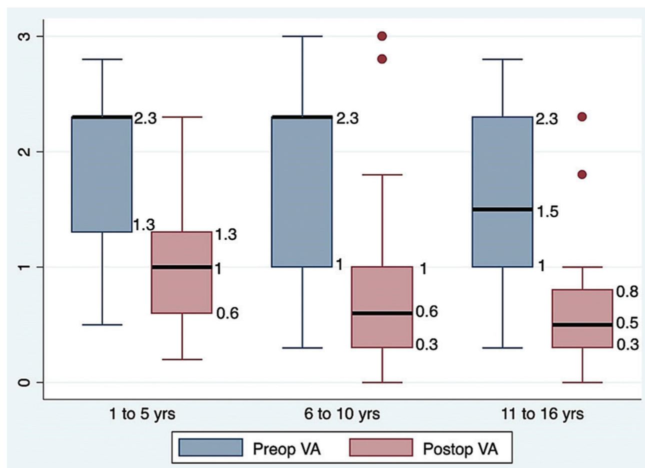

Figure 2: Box and Whiskers plot showing the distribution of preoperative and postoperative visual acuity among the age categories in pediatric ocular injuries

the groups with various degrees of visual impairment, both raw score and OTS score showed a statistically significant difference ($P < 0.001$) [Table 4].

The association between final vision and variables such as age, gender, residence, education, place of the injury, globe involvement, and time of reporting were analyzed. On univariate analysis, the chances of having blindness in outdoor injuries were 71% less compared to indoor injuries (odds ratio [OR] 0.29 [confidence interval (CI) 0.09–0.89]) and that in CGIs was 86% less compared to OGIs (OR 0.14 [CI 0.03–0.64]) with $P = 0.03$ and 0.01, respectively. On multivariate analysis, the chances of having blindness in CGIs were 82% less compared to OGIs (OR 0.18 [CI 0.03–0.88]) and that in late presenting (>6 h) group was 47% more compared to early presenting (<6 h) group (OR 1.47 [0.13–16.47]) with $P = 0.03$ and 0.75, respectively [Table 5].

The predictive factors for poor visual outcomes were younger age (<5 years), indoor injuries, OGIs, and late time of reporting to the hospital (>6 h). By log rank test, it was statistically significant ($P = 0.013$) in the globe involvement and place of injury categories, although clinical difference was observed in other categories as well [Figure 3].

Table 4: Association of ocular trauma score with age categories and visual outcome

	Raw score (median with IQR)	*P*	OTS score (mean±SD)	*P*
Age groups (years)				
1–5	56 (56–76)	0.13	2.44±0.7	0.15
6–10	56 (56–76)		2.51±0.9	
11–16	66 (56–76)		2.8±0.79	
Visual impairment (LogMAR) initial				
Normal (0–0.3)	100	0.0001#	5±0.0	<0.001*
Mild impairment (0.31–0.5)	90 (76–90)		3.6±0.55	
Moderate impairment (0.51–1.0)	80 (76–90)		3.42±0.50	
Severe impairment (1.1–1.3)	80 (66–80)		3±0.0	
Blind (1.31–3)	56 (56–59.5)		2.11±0.46	
Visual impairment (LogMAR) final				
Normal	76 (66–90)	0.0001#	3.24±0.93	0.000*
Mild impairment (0.31–0.5)	58 (56–66)		2.5±0.67	
Moderate impairment (0.51–1.0)	56 (56–70)		2.42±0.62	
Severe impairment	66		3	
Blind (1.31–3)	53 (47–56)		1.94±0.66	

*One-way ANOVA test, #Kruskal–Wallis test. IQR: Interquartile range, OTS: Ocular trauma score, SD: Standard deviation, LogMAR: Logarithm of the minimum angle of resolution

Table 5: Univariate and multivariate logistic regression of blindness with individual and injury parameters

Parameters	COR (95% CI)	*P*	AOR (95% CI)	*P*
Sex	2.39 (0.81–7.00)	0.11	1.71 (0.51–5.77)	0.38
Age groups (11–16 years)	0.25 (0.05–1.26)	0.09	0.43 (0.03–5.66)	0.52
Residence	1.91 (0.62–5.84)	0.26	1.77 (0.50–6.26)	0.37
Education	1.96 (0.61–6.30)	0.26	0.71 (0.08–6.12)	0.76
Place of injury	0.29 (0.09–0.89)	0.03*	0.45 (0.12–1.68)	0.23
Globe involvement (CG)	0.14 (0.03–0.64)	0.01*	0.18 (0.03–0.88)	0.03*
Time of reporting	1.05 (0.12–9.36)	0.96	1.47 (0.13–16.47)	0.75

*Logistic regression. CI: Confidence interval, COR: Crude odds ratio, AOR: Adjusted odds ratio, CG: Closed globe

Discussion

In this study, we have tried to analyze all aspects of ocular trauma in children presenting to a tertiary care institute in Eastern India and compared these findings with other studies available worldwide.[13,15-17] The rate of occurrence of POT from various studies ranged from 23.6% to 58.5%.[4-6,17,18] The prevalence of POT in our study was 22.18%.There were 550 children who were examined in the department during the 2 years period and hundred and twenty were cases with ocular injuries. The studies by Saxena *et al*. from North India reported an incidence of 20.8% while Madan *et al*. from Central India reported as 18.9%, respectively.[4,17] The wide variation observed in the incidence of POT might be due to differences in study designs, sociocultural practices, and type of institution (apex or referral center) where the study was conducted.

Children are at risk of ocular trauma because of their inability to avoid hazards, tendencies to experiment with new objects, and to imitate adult behavior, lacking awareness of the consequences.[7] The critical age of binocular vision development and high risk for amblyopia development is seen in the first 7 years of life. In this study, males (74.6%) were affected more than females which is similar to other studies.[7,8] The highest incidence of ocular injuries occurred among the age of 6–10 years (44.7%) which is similar to the studies from by Miratashi and Al-Bdour and Azab who reported maximum injuries occurred in 8–12 years (58.3%) and 6–10 years, respectively, but different from El-Sebaity *et al*. where 2–7 years children were affected.[2,9,10] The study by Oiticica-Barbosa and Kasahara reported an age-specific biphasic peak for ocular trauma, with an early affection among (0–2 years) and another at a later age (6–11 years).[8] Infants and preschool-going children are usually under adult supervision and hence less likely to sustain injuries. However, nail injuries, sewing needle and knitting injuries, or hooks are few injuries accidentally inflicted by the caretaker.[19] School-going children are more susceptible because of their independent and adventurous spirit that places them in various vision-threatening activities.

The majority of the children in our study were from the rural region (*n* = 66; 57.9%) which is comparable to the study of Madan *et al*. (54.1%);[17] Singh *et al*. (60%);[5] Katiyar *et al*. (78%)[20] but different from the studies of Miratashi[9] and Chakraborti *et al*. (70%)[21] who reported more children from the urban population. This shows that more advanced eye care facilities need to be integrated at all trauma centers in rural regions for optimal visual outcomes.

The children seeking immediate medical care (within 6 h) after sustaining ocular injury were 6.14%, while in 14.9% of cases there was a delay of more than 3 days in our study. Saxena *et al*. reported early hospital referral (within 6 h) in only 24.0% of cases and after 24 h of injury in 34.3%.[4] The study by Narang *et al*. found 45.4% of children were seen by medical officers within 24 h of trauma.[19] Cao *et al*. have reported that delay in seeking medical help had a detrimental impact on the final visual acuity.[18] Parents must be made aware of the visual complications and co-morbidities occurring

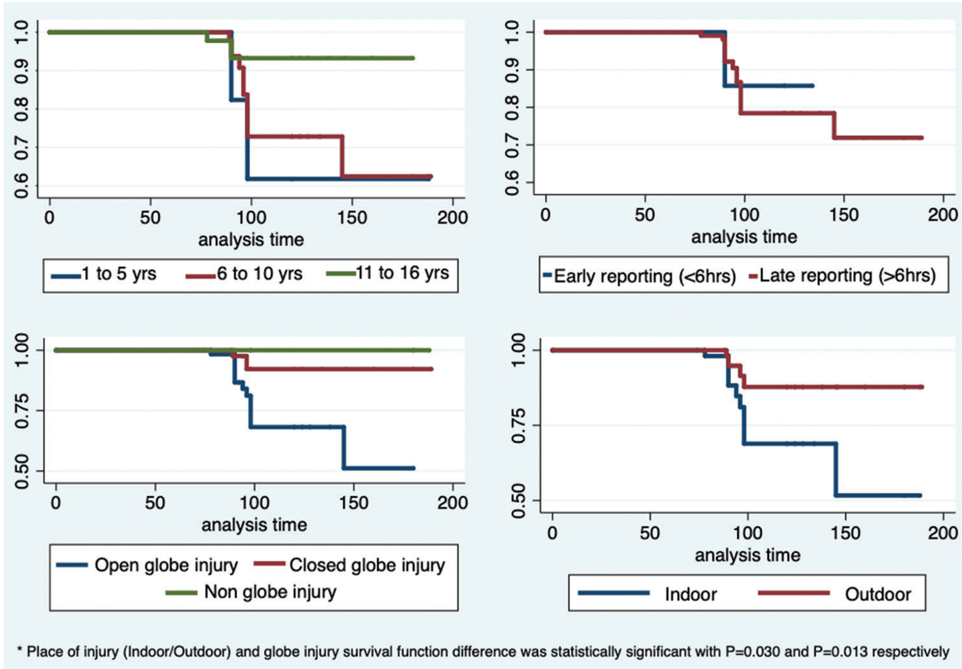

Figure 3: Kaplan–Meier survival graph showing predictive factors for the preservation of vision

due to delayed presentation and must be encouraged to seek timely medical care.

Ocular injuries occurred commonly at home, followed by outdoor activities as reported in several studies.[6,7,12,22-24] MacEwen *et al*.(51%) and Desai *et al*.(45.62%) reported that most of the injuries occurred at home.[22,25] Podbielski *et al*. and Aghadoost *et al*. also stated that the majority of ocular injuries occurred at home followed by schools.[26,27] Home is the commonplace of injuries, both for infants and preschool-going children which reflects the amount of time spent at home. Most of the younger age groups were injured by domestic utensils or toys. Hence, there is a need to educate the mothers and spread awareness on preventive measures for ocular injuries. According to Ilhan *et al*., accidents in the streets and school were second in terms of frequency.[28] Our study reported that the majority of eye injuries occurred during outdoor activities (57.9%) mainly while playing (bow and arrow and firecracker injuries), followed by indoor activities in (42.1%). The injuries sustained were mainly openglobe injuries and hence had a poor visual prognosis. This is consistent with the study done by Sofi *et al*.[29] and Miratashi.[9] Similar findings were reported by El-Sebity *et al*.[2] who also noted that road was a major place of injury in Egypt in (54.7%). The study conducted in Northern Jordan also showed that the maximum injuries were sports-related ocular injuries and occurred while playing outdoors games.[10]

In the current study, OGIs (48.3%) were more common compared to CGIs (40.3%) similar to other studies.[4,13,17] However, few studies are contradicting our findings which report CGI as more common than OGI, as shown in Table 6. For most of the OGIs, 58 eyes (49.6%) needed immediate surgical intervention. Poor visual outcome in the OGIs was related to multiple ocular structure involvement and severity of the damage. These were mainly caused by sharp objects and firecracker injuries leading to evisceration or enucleation in three cases. The surgical procedures performed in our study were primary repair in (n = 92, 78.6%), anterior chamber wash in (n = 7, 5.98%), and lens matter aspiration with secondary intraocular lens implantation in (n = 28, 23.9%) cases which suggested that most injuries occurred in the anterior segment. The posterior segment procedures such as pars plana vitrectomy for vitreous hemorrhage, intravitreal injections for endophthalmitis, and intraocular foreign body removal and retinal detachment surgeries were done in 18 (15.4%) eyes. This study has brought out the importance of emergency services which needs to be well-equipped to provide primary care treatment at the earliest to save sight.

In our study, the OGI group had initial visual acuity of 2.3 LogMAR at the time of presentation compared to CGI group of 1.5 LogMAR. The final vision was related to the type and severity of the injury. Other studies also concluded that OGI carries a poorer prognosis and children are more likely to suffer from long-term visual impairment.[4,13,17,23,24,30-32] The age of the patient and delay in presentation were the factors not found to be independently affecting the final visual outcome of the patients in our study. Several studies on pediatric trauma have reported that the accurate predictors of poor final visual outcome were OGIs and poor visual acuity at initial presentation.[19,24,33] The OTS has a prognostic value to predict the final visual outcome of ocular trauma in adults and this can also be used in children at the time of initial ocular examination in OGIs in the emergency department.[34]

Table 6: Literature review comparing different studies on paediatric ocular trauma

Author and year	Age	Total number of patients	Object of injury (%)	Place of injury (%)	Nature of injury		OTS score
					CGI (%)	OGI (%)	
MacEwen (1999)[22]	≤14 years	93	Sports (16) > assaults (14)	Home (51) > school (14)	65	24	N/A
Saxena *et al*., (2002)[4]	≤14 years	204	Bows and arrows (15.2) > household objects (14.3)	Outdoor (41.67) > indoor (23.53)	42.2	53.9	N/A
Al-Mahdi *et al*., (2011)[23]	Mean 6.6 years (7 months–14 years)	106	Wooden stick (16) > RTA (8.5)	Home (42.5) > street (35.8)	59.4	40.6	N/A
Maurya *et al*., (2019)[6]	2–16 years	82	Projectile objects (24.39) > sharp objects (19.51)	Home (34.15) > outdoor (66.85)	21.95	29.27	N/A
Katiyar *et al*., (2015)[20]	7.6±3.3 years (1–14 years)	191	N/A	Outdoor (43.5) > indoor (21.5)	30.9	60.8	N/A
Singh *et al*., (2017)[5]	Mean 8.74±3.93 years (0–16 years)	220	Wooden objects (29.54) > metallic objects (14.09)	N/A	32.72	53.63	Majority had score 3 in 81 (48.21%) cases
Puodžiuvienė *et al*., (2018)[7]	10.7±4.6 years (6 months–17.5 years)	268	Blunt (40.3) > sharp (29.9)	Home (60.4) >outdorrs (31.7)	53.4	28.7	N/A
Schneider *et al*., (2018)[30]	Median 6 years (1 month–17 years)	278	Superficial nonpenetrating trauma (33.09) > blunt trauma (26.98)	N/A	N/A	N/A	N/A
Qayum *et al*., (2018)[13]	≤16 years	357	Fall (35) in CGI and pen (22) in OGI	Home (47.8) > street (17.9)	67.8	32.2	N/A
Boret *et al*., (2020)[31]	8.4±4.1 years (6 months–14.9 years)	337	Blunt (22) > direct trauma (17)	Home (51) > public place (21)	22 had hyphaema (MC CGI)	23	5 in 211 and ≤3 in 39 children
Madan *et al*., (2020)[17]	8.33±4.03 years (0–15 years)	61	Sports injury (29.5) > wooden stick injury (22.9)	N/A	24.6	63.9	Majority had score 2 in 31 eyes of OGI and 15 eyes of CGI
Li *et al*., (2020)[32]	7.0±4.1 years (0–18 years)	1125 (739 for analysis)	Sharp (48.4) > blunt (19.6) objects	N/A	24.4	75.6	Majority (69.96%) had score 2 and 3

Author and year	Time of reporting and hospitalisation	Initial VA	Primary repair	Final visual outcome	Follow-up
MacEwen (1999)[22]	Admitted for a mean duration of 4.2 days (range 1–25 days)	None was bilaterally blind	48%	VA ≥6/12 in 88%	3 months
Saxena *et al*., (2002)[4]	24% presented within 6 h	VA <6/60 in 34.9% of CGI and 95.5% of OGI	46.5% in CGI and 95.45% in OGI	VA >6/12 in 91.86% of CGI and 15.45% of OGI	6 months
Al-Mahdi *et al*., (2011)[23]	All admitted with mean duration of stay of 4.87 days (range 1–10 days)	VA >6/18 in 6 of OGI and 19 of CGI patients	52.8% (56 patients)	VA >6/18 in 43 of OGI and 52 of CGI patients	6 months
Maurya *et al*., (2015)[6]	N/A	VA ≥6/18 in 36.59%	47.56%	VA ≥6/18 in 46.34%	1 week, 1 month, 2 months, 6 months
Katiyar *et al*., (2015)[20]	Mean reporting time 8.25±14.6 h (range 1 h–5 days)	26.5% had VA >6/18	62.3%	27.9% had VA >6/18	3 months
Singh *et al*., (2017)[5]	66 (30%) were treated within 12 h of injury	VA 6/60 - NPL in 124 (56.36%) cases	N/A	VA 6/60 - NPL in 81 (65.3%) cases	POD 1, 7, 1st month, 6th month
Puodžiuvienė *et al*., (2018)[7]	0.7±1.6 days (64.9% admitted in first 24 h)	29.5% eyes had grade 1 injury (VA ≥0.5)	42.13% (113 patients)	65.4% (85 eyes) regained VA ≥0.5	327±449 days (median 102 days)
Schneider *et al*., (2018)[30]	N/A	N/A	43 patients	N/A	10.79% had long-term sequelae and 0.36% had anophthalmia
Qayum *et al*., (2018)[13]	N/A	N/A	N/A	206 patients (57.7%) had VA 6/6–6/18 while 44 (12.3%) ended with blindness	2 weeks, 1 month, 2 months, 3 months
Boret *et al*., (2020)[31]	46% presented between 6 and 12 pm 62% admitted with mean duration of 4.7±4.1 days (range 1–39 days)	VA >4/10 in 36% and VA <1/10 in 25% children	47 patients	93% of CGI and 66% of OGI had VA >5/10	1 month, 6 months, 1 year after trauma

Contd...

Table 6: Contd...

Author and year	Time of reporting and hospitalisation	Initial VA	Primary repair	Final visual outcome	Follow-up
Madan *et al*., (2020)[17]	11.5% presented within 6 h	OGI - 6 patients had NPL CGI - 8 patients had VA 6/60 - PL+	N/A	OGI - 5 had NPL CGI - 10 improved to VA 6/6–6/12	N/A
Li *et al*., (2020)[32]	Penetrating injury (398) and rupture (66) mostly presented within 24 h, whereas contusion injury (78) presented >1 week	66 (8.9%) had VA ≥0.5	N/A	128 (17.3%) had VA ≥0.5. Overall, 43.2% showed improvement	Till discharge

N/A: Not available, OGI: Open globe injuries, CGI: Closed globe injuries, PL: Perception of light, NPL: No PL, VA: Visual acuity

The mean duration of hospitalization in our study was 6.03 ± 3.13 days that was longer compared to the studies of Cao *et al*.[18] and Zhang *et al*.[35,36] Severity of ocular trauma at presentation requiring multiple surgeries under anesthesia, rural background, and the cost factor for multiple follow-up reviews were some of the factors that accounted toward a longer hospital stay in our cases similar to that reported by Zhang *et al*.[35]

This study suggests the importance of adapting certain preventive measures for children during sports activities and firework displays. Since road traffic accidents usually present to trauma and emergency departments, it is essential to educate the duty doctors on the use of OTS tool during the initial ocular examination for visual prognosis and counseling. It is also important to train medical officers at the community centers about the type of ocular trauma, first-aid management of eye injuries, and timely referral of emergency cases.

The limitation of this study is it is a retrospective study, so there could have been an underestimation of the number of injured eyes and treatment bias. Hence, prospective, multicentric studies with long-term follow-up are warranted. OTS must be used in all cases of OGIs in children for gross prediction of final visual outcome. Further, the importance of a standardized reporting system as exists in other countries must also be adopted in our country to maintain uniformity. This will also help to provide epidemiological data and formulate longitudinal population-based studies as well as protocols for management of ocular injuries in children.

Conclusion

Ocular trauma in children leads to visual impairment, cosmetic blemish, ocular morbidity, and psychological impact. Initial visual acuity does play a significant role in the prediction of final visual acuity in ocular trauma in children and OGIs carry a poor visual prognosis requiring immediate intervention. Hence, all the children with ocular trauma must receive primary treatment at all levels of emergency trauma care units at initial presentation. Therefore, it is imperative to reinforce training of health-care workers, develop an effective referral system, and accessibility to healthcare for timely intervention and improve prognosis.

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Conflicts of interest

There are no conflicts of interest.

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