Original Article

Patterns and Outcomes of Pediatric Ocular Trauma: Experience from a Tertiary Eye Care Center in Karachi, Pakistan

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ABSTRACT

Purpose: To determine the epidemiological patterns, clinical presentations, and visual outcomes of pediatric ocular trauma in patients aged 15 years or younger presenting to a tertiary eye care center in Karachi.

Study Design: Descriptive observational study.

Place and Duration of Study: Al-Ibrahim Eye Hospital, Karachi, from July 2021 to March 2022.

Methods: A total of 237 eyes from 232 pediatric patients were included. Data were collected using structured questionnaires and comprehensive ophthalmologic examinations. Injuries were classified using the Birmingham Eye Trauma Terminology System (BETT) and the Ocular Trauma Classification System (OTCS). Treatment outcomes were analyzed using SPSS version 22 and a p-value of <0.05 was considered significant.

Results: The mean age at presentation was 8.28±3.52 years, with boys (M: F = 2.6:1) more frequently affected. Most injuries occurred outdoors (49.4%) and were commonly caused by wooden sticks (24.5%) and sharp objects (21.9%). Closed globe injuries (58.4%) were more prevalent than open globe injuries (32.1%). The most frequent diagnosis was traumatic cataract (28.9%). Medical management was provided in 32.9% of cases, while 67.1% underwent surgical intervention. Significant improvement in visual acuity was observed post-treatment (Wilcoxon Signed-Rank Test, p = 0.0001). Visual outcomes correlated with the Ocular Trauma Score, with poorer outcomes in lower score categories.

Conclusion: Pediatric ocular trauma remains a major cause of visual morbidity, predominantly affecting boys engaged in outdoor activities. Timely management significantly improves visual prognosis. Preventive strategies and public awareness are essential to mitigate these largely preventable injuries.

Keywords: Corneal perforation, Penetrating wounds, Eye foreign bodies.

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INTRODUCTION

Ocular trauma is a significant cause of ophthalmic morbidity and monocular blindness worldwide.[1,2] Pediatric ocular injuries account for approximately 8–14% of all trauma cases in children, with many of these injuries being preventable.[3] Despite this, an estimated 1.6 million individuals globally suffer blindness annually due to ocular trauma.[4] In the United States, the hospitalization rate for pediatric ocular injuries was 8.9 per 100,000 individuals aged ≤20 years as of 2000.[1] Children are particularly susceptible to ocular trauma due to underdeveloped motor skills and a general lack of caution.[5] Boys are

disproportionately affected, likely due to their increased engagement in outdoor and high-risk activities.[6] Diagnosing and managing ocular trauma in children is often complex.[7] Uncooperative behavior during clinical examination, heightened postoperative inflammation, risk of amblyopia, and low compliance with treatment are common challenges.[8] The prognosis largely depends on the nature, duration, and severity of the trauma.[9]

Ocular injuries can be broadly classified into open globe injuries (OGI), closed globe injuries (CGI), and adnexal or periocular injuries. OGIs, such as globe ruptures or penetrating injuries, represent ophthalmic emergencies requiring immediate surgical attention.[3,10]

Understanding the local epidemiological trends, common clinical presentations, and determinants of visual prognosis in pediatric ocular trauma is essential for developing targeted preventive strategies, optimizing acute care, and improving visual rehabilitation services. This study addresses this knowledge gap and aims to generate evidence that can inform both clinical practice and community-based injury prevention programs in the Pakistani context. This study aimed to assess the patterns, clinical characteristics, management, and visual outcomes in children (≤15 years) presenting with ocular trauma at a tertiary care center in Karachi, Pakistan.

METHODS

This descriptive observational study was conducted in the Al-Ibrahim Eye Hospital, Karachi from July 2021 to March 2022. Ethical approval was obtained from the institutional research committee **(REC/IPIO/2021/028A)**, and the study adhered to the principles of the Declaration of Helsinki.

All patients aged 15 years or younger presenting with unilateral or bilateral ocular trauma were included. Data were collected via a structured questionnaire, recording demographics, nature and timing of injury, causative agents, and previous consultations or interventions.

Visual acuity (VA) was assessed using age-appropriate methods: fixation-following techniques in children under 2 years, Cardiff/Kay/Sheridan-Gardner charts for ages 2–5, and Snellen or illiterate E charts for children older than 5 years. Comprehensive ocular examinations were performed using slit-lamp bio microscopy and direct ophthalmoscopy. Where media opacity was present, B-scan ultrasonography was employed. Ancillary tests such as OCT, CT scans, and MRI were conducted where indicated.

Minor injuries (e.g., subconjunctival hemorrhages, ecchymosis, conjunctivitis) were managed conservatively. Surgical management included repair of lid tears, corneal/scleral lacerations, Hyphema evacuation, cataract extraction with intraocular lens implantation (including CTR or scleral fixation as needed), pars plana vitrectomy for vitreous hemorrhage or retinal detachment, and other trauma-specific interventions. All surgeries were performed under general anesthesia using an operating microscope.

Injuries were classified based on the Birmingham Eye Trauma Terminology System (BETT)and the Ocular Trauma Classification System (OTCS).[11,12] BETT categorizes trauma into OGI, CGI, and periocular injuries.

Data was analyzed using IBM SPSS Statistics Version 22. Descriptive statistics summarized demographics, injury types, causes, and treatments. Categorical variables were presented as frequencies and percentages and continuous variables as means ± standard deviation (SD). The Wilcoxon Signed-Rank Test evaluated the significance of VA improvement. A p-value <0.05 was considered statistically significant. Cross-tabulation assessed the correlation between Ocular Trauma Score (OTS) and final visual outcome.

RESULTS

Our study encompassed 237 eyes from 232 patients. Of these, 232 patients presented with unilateral ocular injuries, while 5 patients sustained bilateral injuries. The mean age was 8.2 ± 3.53 years. Most injuries occurred in the 5 to 9 years age group (45.6%), followed by the 10 to 15 years group (37.1%), and the 0 to 4 years group (17.3%).

There was a statistically significant predominance of male patients, with a male-to-female ratio of 2.6:1 ($p < 0.001$). Regarding the location of injury, outdoor environments were the most common (49.4%), followed by home settings (40.9%). Injuries occurring at school accounted for 6.8%, while only 3.0% of cases were reported in other locations.

When stratified by age group, home was found to be the most frequent place of injury among children aged 0 to 4 years (58.5%). In contrast, children aged 5 years and above were more likely to sustain injuries in outdoor environments. Among children aged 5 to 9

years, 50.0% were injured outdoors and 42.6% were injured at home. Similarly, in the 10 to 15 years group, 54.5% of injuries occurred outdoors, compared to 30.7% at home. School-related injuries were more common in older age groups, with the highest frequency observed in children aged 10 to 15 years.

The primary causative agent for eye trauma in our cohort was wooden sticks (24.5%), followed by sharp objects (21.9%) (e.g., knives, needles, sharp toys, pencils, pens). Stone trauma accounted for 16.5% of injuries, with finger/nail/hand trauma (7.6%) and projectile injuries (5.5%) (e.g., pellets, flying metal fragments, wood chips, stone fragments) also being significant contributors (Table 1).

Table 1:

Causative Agents	Frequency	Percent
Wooden stick	58	24.5
Sharp objects	52	21.9
Stone	39	16.5
Hand/Finger	18	7.6
Projectiles	13	5.5
Fall	10	4.2
Ball	9	3.8
Vegetative material	7	3
Chemicals	4	1.7
Unknown	3	1.3
Firecrackers	3	1.3
Metal rod	3	1.3
RTA	2	0.8
Animal horn	2	0.8
Sand	2	0.8
cricket bat	2	0.8
Bike handle	2	0.8
Dog bite	2	0.8
Toys	2	0.8
Rope	1	0.4
Door	1	0.4
Belt	1	0.4
Swing	1	0.4
Total	237	100

The most prevalent clinical presentation of eye trauma at our institution was traumatic cataract (38.0%, n=90). This was followed by corneal laceration (13.9%, n=33), microbial keratitis (10.1%, n=24), and Hyphema (8.0%, n=19) (Table 2). It is important to note that the sum of these frequencies does not equal 100% due to the presence of multiple diagnoses in many patients.

CGI were found to be the most common type of eye injury (58.4%, n=140). OGI accounted for 32.1% (n=77) of all cases, followed by periocular injuries (9.6%, n=23). Table: 3 shows BETT classification. Out of OGI the most frequent type was penetrating injury (90.9%) followed by IOFB (5.19%), globe rupture (0.8%) and perforating injury (0.4%).

Table 2: *Clinical presentation after trauma at the tertiary care center.*

Diagnosis	Frequency	Percent
Traumatic Cataract	90	38.0
Corneal Laceration	33	13.9
Microbial Keratitis	24	10.1
Hyphema	19	8.0
Corneal Scarring	17	7.2
Retinal Detachment	13	5.5
Traumatic Mydriasis	11	4.6
Endophthalmitis	10	4.2
Corneal Foreign Body	9	3.8
Traumatic Conjunctivitis	9	3.8
Vitreous Hemorrhage	9	3.8
Preseptal Cellulitis	8	3.4
Subconjunctival Hemorrhage	8	3.4
Macular Scar	7	3.0
Corneoscleral Laceration	6	2.5
Eyelid Laceration	4	1.7
IOFB	4	1.7
Periorbital Ecchymosis	4	1.7
Commotio Retinae	3	1.3
Conjunctival Laceration	3	1.3
Corneal Abrasion	3	1.3
Chemical Injury	2	0.8
Globe Rupture	2	0.8
Iridodialysis	2	0.8
Lens Subluxation	2	0.8
Scleral Tear	2	0.8
Traumatic Iritis	2	0.8
Choroidal Detachment	1	0.4
Choroidal Rupture	1	0.4
Cicatricial Entropion	1	0.4
Conjunctival Foreign Body	1	0.4
Nasolacrimal Fistula	1	0.4
Total	311	131.2

Table3: *Frequency distribution of BETT Classification.*

Injury Type	No. of Patient	Percentage
Open Globe Injury		
Penetrating Injury	70	29.2
Perforating Injury	1	0.4
IOFB	4	1.7
Globe Rupture	2	0.8
Closed Globe Injury		
Contusion	99	41.3
Lamellar Laceration	41	17.1
Periocular Injuries		
Ocular surface foreign bodies	7	2.9
Eyelids injury	12	5.0
Lacrimal injury	1	0.4
Orbital injury	3	1.3
Total	240	100

Table 4: *Distribution of Ocular Injuries by Type and Age Group.*

Injury Type	Sub-Type	<5 years	5–9 years	10–15 years	Total
Open Globe Injuries	Penetrating Injury	13	41	16	70
	Perforating Injury	0	1	0	1
	Intraocular Foreign Body (IOFB)	1	2	1	4
	Globe Rupture	2	0	0	2
	Subtotal	**16**	**44**	**17**	**77**
Closed Globe Injuries	Contusion	7	43	49	99
	Lamellar Laceration	12	14	15	41
	Subtotal	**19**	**57**	**64**	**140**
Periocular Injuries	Ocular Surface Foreign Body	2	4	1	7
	Eyelid Injury	2	6	4	12
	Lacrimal Injury	0	0	1	1
	Orbital Injury	2	0	1	3
	Subtotal	**6**	**10**	**7**	**23**
Grand Total		**41**	**111**	**88**	**240**

Table 5:

OTS_Score	Open Globe Injury	Closed Globe Injury	Periocular Injuries
1. (0-44)	5	3	0
2. (45-65)	38	13	0
3. (66-80)	26	74	5
4. (81-91)	2	14	1
5. (92-100)	3	33	15
Total	**74**	**137**	**21**

CGI were noted to be higher in children aged 10-15 years and OGI in 5-9 years of age group. Tables: 4 shows comparison of age groups with the type of injury.

Out of 237 patients, the majority (30.8%) presented within 2–7 days of injury, followed by 27.0% who presented after 1 to 4 weeks, and 18.1% within 24 hours. Delayed presentations included 12.2% after 1–6 months, 8.0% after 1–5 years, 2.5% after 6 months to 1 year, and only 1.3% after more than 5 years.

Seventy-eight eyes (32.9%) received medical treatment, which included modalities such as observation, topical medications (eye drops and ointments), oral medications, hot fomentation, cold compresses, and bed rest. The remaining 159 eyes underwent surgical intervention. Final visual acuity data were obtained for 230 eyes, with 7 eyes lost to follow-up. Both medically and surgically treated patients demonstrated a statistically significant improvement in visual acuity compared to their pre-treatment vision. Specifically, 30 eyes in the medically treated group achieved normal visual acuity, while 48 eyes in the surgically treated group showed moderate visual impairment. A Wilcoxon Signed-Rank Test confirmed a statistically significant improvement in visual acuity post-treatment ($z = -10.668$, $p < 0.0001$), indicating that post-treatment visual acuity ranks were significantly higher than pre-treatment ranks.

Analysis of the Ocular Trauma Score (OTS) revealed that 38 eyes with open globe injuries fell into OTS category 2. Furthermore, 74 eyes with closed globe injuries achieved an OTS score of category-3, and 15 eyes with periocular injuries had an OTS score of category 5 (Table 5). These findings collectively suggest a poorer visual outcome in cases of open-globe injury.

DISCUSSION

This study aimed to elucidate the epidemiological and clinical patterns of pediatric ocular trauma in a tertiary care setting. The highest frequency was noted in the 5–9-year age group (45.6%), followed by children aged 10–15 years (37.1%), aligning with previous reports that associate increased mobility and outdoor exposure with greater injury risk. This finding correlates with other studies.[3,13,16] Differing from our results, a study conducted in Miami found that the majority of pediatric ocular trauma occurred in age group 0-6

years.[17] One study conducted in Egypt found that 2-7 years age group were most affected.[2] Some studies showed the common age group of ocular injuries were 7-12 years.[1,18,19]

Consistent with global literature, male children were disproportionately affected (M: F = 2.6:1), likely due to more frequent participation in outdoor activities and physical play.[3,7,13-16] While some studies report home as the most common place of trauma, our findings identified outdoor environments (49.4%) as the primary setting, especially among school-aged children.[1,7-10,20,21] This finding is consistent with some other studies.[2,18,19] Home-based injuries predominated in the 0–4 years' age group, reflecting their limited outdoor exposure. Some studies have similar results.[1,7,9]

Wooden sticks (24.5%) and sharp objects (21.9%) were the leading causes of trauma, followed by stones and blunt injuries. The high prevalence of stick-related injuries may relate to their availability in outdoor settings. Most of the studies demonstrate the wooden stick as a common cause of injury.[1,3,13,14,21] Sharp object injuries were more common in younger children (0–4 years), likely due to their access to household items like knives and needles. Studies conducted in Malaysia showed similar results.[22] Our findings differ from studies emphasizing sports-related trauma possibly due to socioeconomic and environmental differences.[3,23]

CGIs (58.4%) were the most prevalent injury type, followed by OGIs (32.1%) and periocular injuries (9.6%). Similar findings were reported in other studies.[1,7,16,24] In some studies, OGI was found to be higher than CGI.[3,13-15] Penetrating injuries accounted for the majority of OGIs (90.9%) which is consistent with previous research.[1] Globe ruptures and intraocular foreign bodies were relatively rare. Higher rate of globe rupture was noted by Kadappu et al.[25]

The OTS system proved effective in prognosticating visual outcomes. Most patients in OTS category 5 achieved favorable vision (6/6), while those in category 1 had poor outcomes. This finding correlates with Singh et al, who found that 96.2% of patients with OTS 5 could achieve good vision compared to 6.2% patients with OTS 1.[13] Our data confirmed that OGIs tend to have worse prognoses than CGIs, consistent with earlier studies.[3,13,24]

This study represents one of the largest prospective series on pediatric ocular trauma conducted in a tertiary care center in Karachi, providing valuable local epidemiological data. The use of standardized classification systems (BETT and OTCS) enhances the objectivity and comparability of injury types. The inclusion of the Ocular Trauma Score (OTS) adds prognostic value and helps correlate injury severity with visual outcomes. Comprehensive data collection and follow-up allowed for analysis of both initial and final visual acuity, giving insight into treatment effectiveness and prognosis. However, there were few limitations. Being a single-center study, the findings may not be generalizable to other regions or healthcare settings, particularly rural areas. The study did not assess long-term complications or visual outcomes beyond the study period, which may underestimate chronic sequelae. Some data were dependent on patient or caregiver recall (e.g., time since injury, causative agents), which may have introduced recall bias.

CONCLUSION

Pediatric ocular trauma is a significant public health concern, particularly among school-going boys. Outdoor activities and access to hazardous objects contribute notably to injury risk. Early diagnosis, timely intervention, and public awareness are crucial for prevention and improved visual outcomes. The OTS remains a reliable tool for predicting prognosis and guiding patient counseling.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(REC/IPIO/2021/028A)**.

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