

Epidemiology of Open Globe Injury in Children at a Tertiary Hospital in Jordan

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Purpose: To study the epidemiology of open globe injury (OGI) in children and highlight the risk factors associated with these injuries and suggest targeted protocols and strategies to minimise its occurrence.

Methods: A retrospective analysis of all paediatric OGI cases presenting to our unit between Jan 2014 and Jan 2018. Clinical records were reviewed, and demographic data was collected and analysed for age, gender, place of occurrence, mechanism of injury, type of trauma, and direct cause of injury. Clinical data including presenting visual acuity, type of injury, number of operations, complications, and final visual acuity were also recorded.

Results: A total of 67 cases were identified, but 8 cases were excluded due to lack of complete data. Fifty-nine eyes of 59 patients were included, of whom 31 (53%) involved the left eye and 46 patients were males (78%). The mean presenting vision was 1.7 ± 1.05 Log MAR (Median 1.8; IQR 2.2), and the mean vision at 12 months was 0.8 ± 1.13 Log MAR (Median 0.3; IQR 0.7) with the difference being statistically significant ($P < 0.001$). Mean age was 9.34 ± 4.35 (range 3–16) years and, in most cases (78%), the mechanism of injury was due to a sharp object. The most common places where injuries occurred were home settings (42%) and neighbourhood areas (36%), whereas schools were not found to be common places for injury.

Conclusion: We identified epidemiological features of OGI in children in our community that may help local authorities and health education teams reduce its incidence. Discouraging the use of sharp objects by young children, especially in home settings, requires more public awareness strategies. Community and healthcare services may consider these findings useful for implementing local strategies and protocols to prevent and reduce the occurrence of such devastating injuries.

Keywords: open globe injury, OGI, visual impairment in children

Introduction

Open Globe Injury (OGI), defined as full-thickness damage to the cornea, sclera, or both¹ is a major cause of permanent visual impairment worldwide² and is responsible for most cases of monocular blindness in children.³ The causes are usually (90%)⁴ preventable reasons^{5–7} and OGI accounts for 25 to 60% of ocular trauma in previous studies.^{2,5} It is also thought to be the main cause of ocular trauma hospitalisations.⁶ OGI has been studied thoroughly in developed countries^{7–16} but much less in developing countries.^{5,17} Its clinical and epidemiological features vary among communities¹⁸ and among different age groups.^{19–22} The management of ocular trauma in children is much more challenging as compared to adults and they also face higher risk of complications with lifelong consequences. The incidence of visual loss in children due to ocular trauma has been estimated to be 2–14% according to different publications which rises sharply in cases of OGI to 33%.²⁰ On one hand, children are more susceptible to eye injuries, but at the same time, simple preventive measures may help in significant reduction of such injuries. Our aim was to study the demographic and epidemiological features of these injuries in children in our community so that preventive strategies and protocols can be designed.

Materials and Methods

This was a retrospective analysis of consecutive cases of OGI in children aged <17 years managed in the eye department at Princess Hamzah Hospital, Jordan, between Jan 2014 and Jan 2018. Prince Hamzah Hospital is one of the major public tertiary referral centres in Amman, the capital of Jordan. These patients either presented to our emergency eye services or were referred to our department from nearby eye units where paediatric surgical ophthalmic services were not available. The collected demographic data from the hospital records included age, gender, eye involved, mechanism of injury, direct causative object, and place of injury. OGI cases were classified according to the Birmingham Eye Trauma Terminology, and clinical data such as presenting and final visit visual acuity (VA), significant ophthalmic history, type of injury, number of eye surgeries, and long-term complications were recorded and analysed. All patients with at least one year of follow-up were included in this study. The study protocol was approved by the Institutional Review Board (IRB) of Hashemite University. The study protocol ensured full confidentiality of the patient data and complied with the Declaration of Helsinki. Informed consent was not required by the IRB, as this was a retrospective study, and all statistical analyses were performed using GraphPad Prism software with a two-sided P values less than 0.05 being considered statistically significant. Statistical analysis was assessed using paired and unpaired t-tests while testing variables between groups were done using chi-square test.

Results

Sixty-seven patients aged 17 or less with an OGI were identified. Eight cases with insufficient data were excluded, and fifty-nine eyes of 59 patients were included in the study. Thirty-one cases (53%) involved the left eye, and 28 (47%) involved the right eye, with no bilateral cases. According to Birmingham Eye Trauma Terminology (BETT)¹ our case series can be divided into the following groups: Penetrating in 52 eyes (88%), Intra-Ocular Foreign Body (IOFB) in 3 (5%), perforating and globe rupture in 2 (3.5%) each.

The age and gender distribution of the patients are presented in Table 1. Forty-six patients (78%) were boys and 13 (22%) were girls; the difference was statistically significant ($p = 0.003$ Chi-Square test). The age ranged between 3 and 16 years with a mean age of $9.34 \text{ years} \pm 4.35$. The mean age was lower in girls ($7.38 \text{ years} \pm 4.13$) than in boys ($9.89 \text{ years} \pm 4.39$), as shown in Figure 1, but the difference was not statistically significant ($p = 0.665$ unpaired t test).

The mean presenting vision was 1.7 ± 1.05 Log MAR (Median 1.8; IQR 2.2), and the mean vision at 12 months' follow-up was 0.8 ± 1.13 Log MAR (Median 0.3; IQR 0.7). This difference was statistically significant ($p < 0.0001$ paired t -test) as shown in Figure 2.

For further epidemiological and demographic clarification, we categorised the patients into 3 age groups; first group: infants and preschool children aged 0–5 years, second group: primary school children aged 6–10 years and third group: secondary school children 11–16 years. Looking at the age group and gender together, we found a smaller number of girls (23% as compared to 38.5% each in the other two groups) in the older age group (3 female patients in the oldest group). Contrarily, the number of boys went up as the age group gets older, Figure 3. When identifying the place of injury, we found that home setting was the most common place in the first and second age groups, whereas in the older age group, injuries mostly occurred in the neighbourhood area. A total of 8 cases in the oldest age group had occurred at work. Fortunately, school injuries occurred least frequently (only three cases, 5%) and only in the second age group Figure 4.

The commonest cause of injury was sharp object in 46 patients (78%), unknown object in 5 (8%), blunt object in 3 (5%), bird beak in 3 (5%), and 2 patients (4%) had a gun shot injury. The sharp objects responsible for the injuries were

Table 1 Age and Gender Distribution

Age	Boys	Girls	Total	Percentage (%)
0–5	9	5	14	24
6–10	16	5	21	36
11–16	21	3	24	40
Total	46	13	59	100

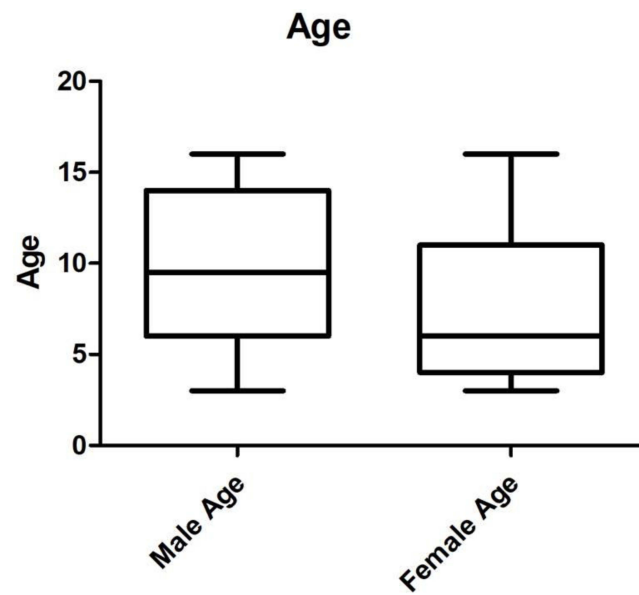


Figure 1 Range and mean age in male and female patients.

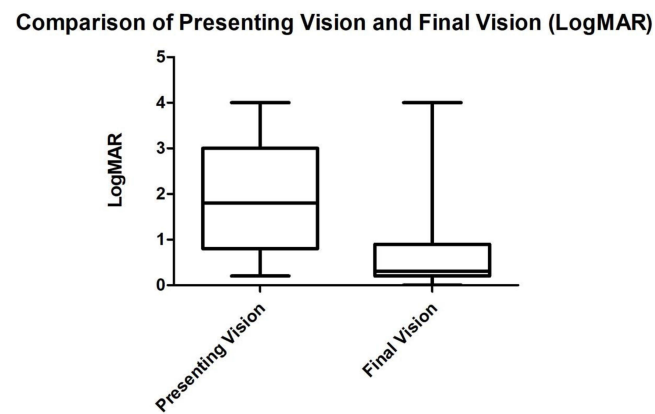


Figure 2 Showing the difference between presenting and final visual acuities.

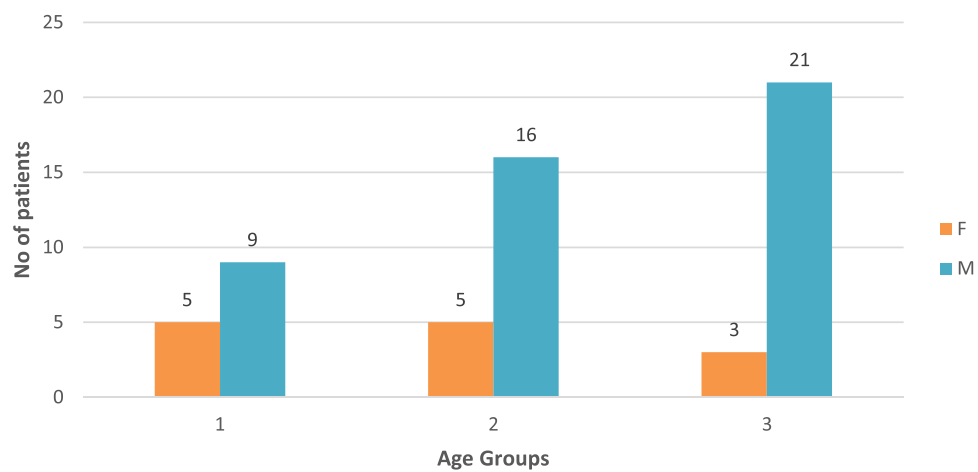


Figure 3 Gender distribution according to age category.

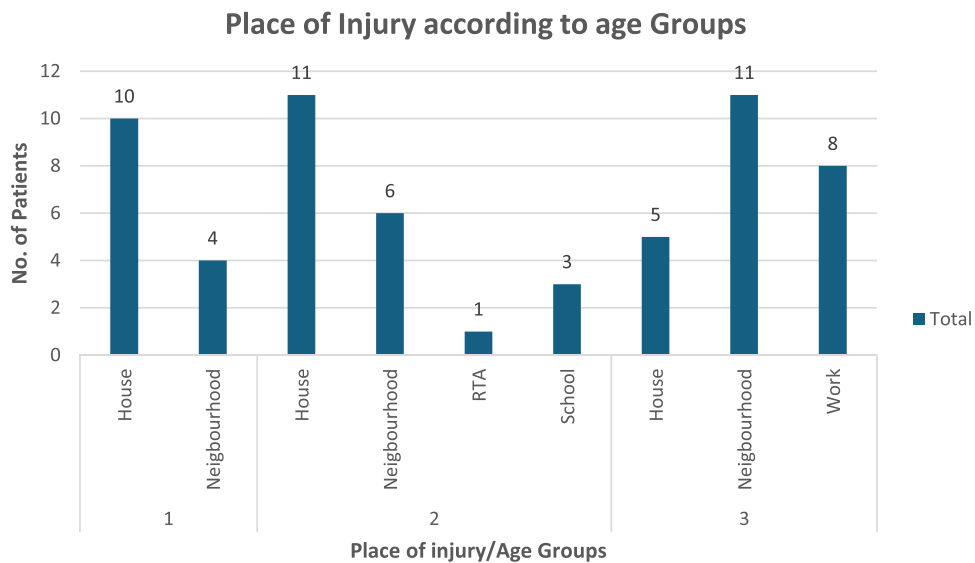


Figure 4 Place of injury according to age groups.

broken glass (nine patients), knife (five patients), scissors, pencil, and fork (three patients each). The workplace causative objects were cutting porcelain (two patients) and sharp metallic tools (three patients) [Figure 5](#). Most patients (83%) had no previous significant eye disease, and 17% had underlying pathology in the affected traumatised eye, [Figure 6](#).

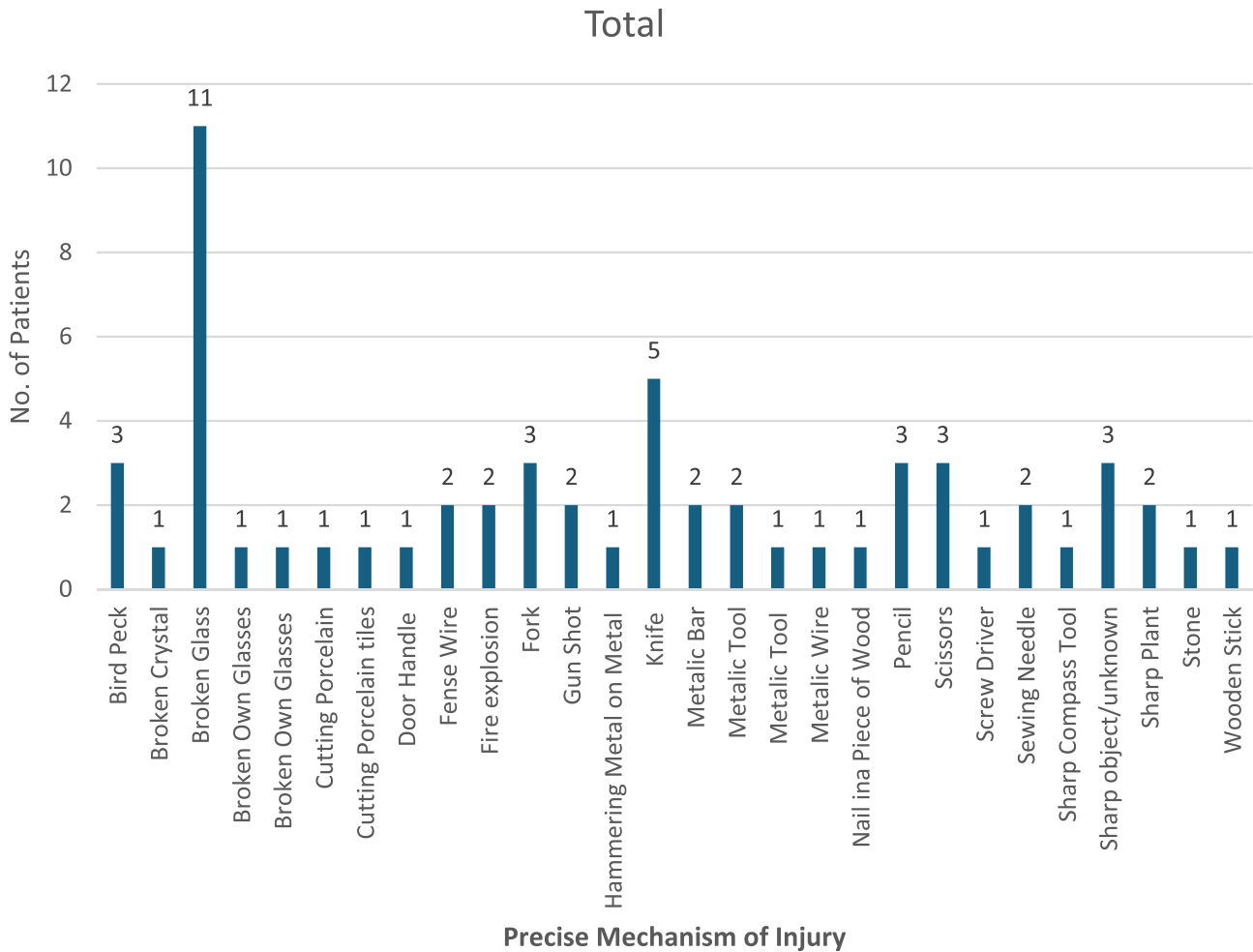


Figure 5 The direct and specific cause of injury.

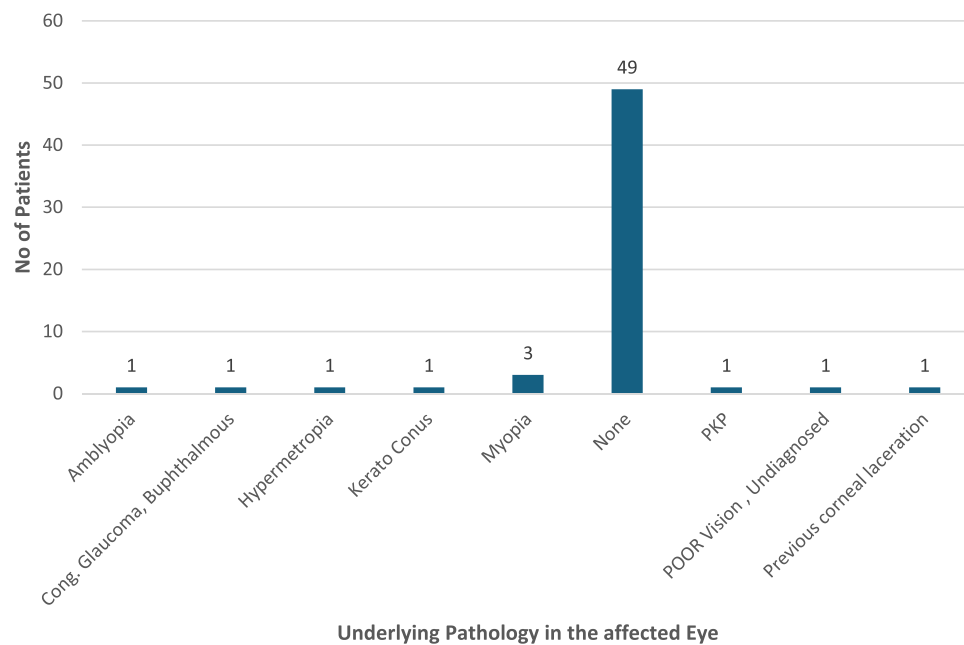


Figure 6 Underlying pathology in the affected, traumatised eye.

The location of the wounds was corneal in 53%, corneo-limbal in 25% and 8% involved the cornea, limbus, and sclera as shown in Figure 7. Limbus alone was involved in 5%, Limbo-scleral with sparing of cornea was seen in 2%, and scleral alone in 5%. One injury occurred in a previously grafted cornea and involved 180 degrees of the graft dehiscence.

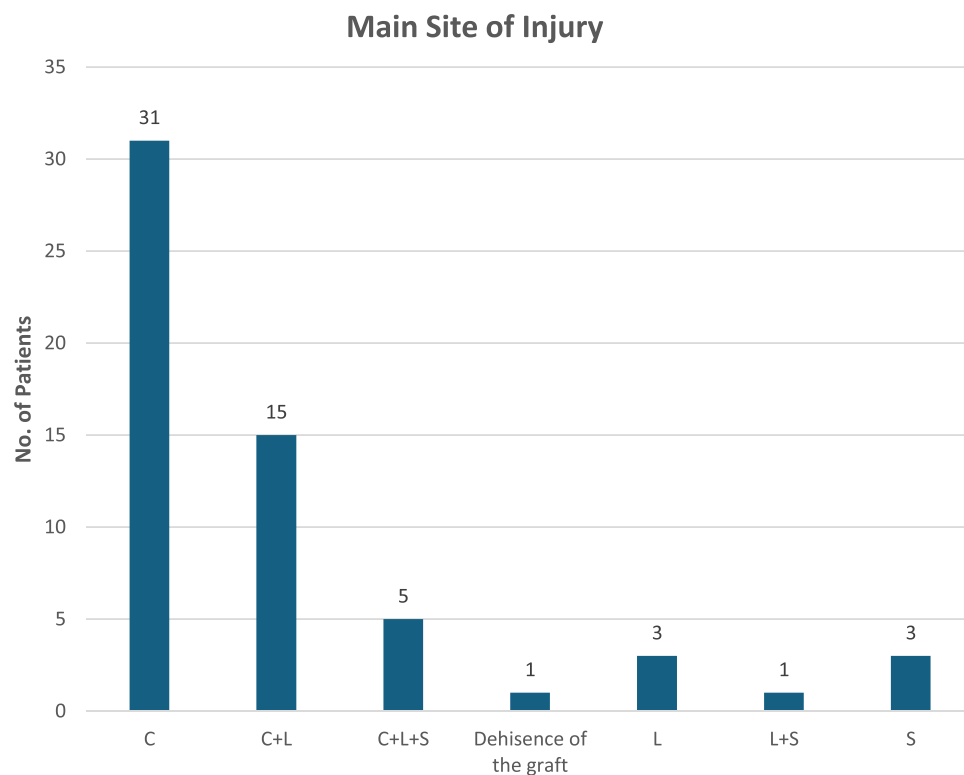


Figure 7 Main site of injury.

Abbreviations: C, corneal; L, limbal; S, scleral.

Discussion

The injuries were classified according to the Birmingham Eye Trauma Terminology (BETT) System. The BETT classifies globe injuries into two main categories: closed-globe injuries and open-globe injuries. Closed-globe injuries are further subdivided into contusion and partial laceration. Open globe injuries can be caused by blunt injuries leading to globe rupture or sharp injuries, which are further subdivided into three subgroups: penetrating eye injury (PEI), intra-ocular Foreign body (IOFB), and perforating injuries. Each term within this system has a unique definition to avoid confusion which used to exist in describing globe injuries before the BETT classification was described. For example, PEI is defined as an injury caused by a sharp object that produces a full-thickness entry into the globe. On the other hand, perforating eye injury is caused by a sharp object but results in both entry and exit wounds. Globe rupture occurs when a blunt object causes full-thickness wound.¹

Ocular trauma is a significant problem worldwide, with the burden of visual disability and psychological and social effects on the patient. Approximately 1.6 million people worldwide are blind due to ocular trauma, 2.3 million people have bilateral low vision due to trauma, and 19 million have unilateral vision loss.²³ Eye trauma constitutes 7% of all body injuries and 10–15% of all eye diseases.²

In the Western developed world, eye trauma is the leading cause of non-congenital unilateral blindness in individuals younger than 20 years.¹³ The American Academy of Paediatrics (AAP) reported that 66% of all ocular injuries occur in individuals 16 years of age or younger, with the highest frequency occurring between 9 and 11 years of age.⁵ The male-to-female ratio in published studies varies from 3:1 to 5.5:1,⁵ but most studies have shown no statistically significant difference between the affected eyes.

Various studies have reported that children account for 12.5–33.7% of all admissions for eye injury.²⁴ Trauma is the most significant and preventable cause of childhood blindness.¹³ The frequency of hospitalisation due to ocular trauma differs between developed and developing countries. For example, the rate is 8 per 100,000 people in Scotland and 33 per 100,000 in Guiana.²⁵

Paediatric eye trauma patterns are different from those in adults,²⁶ and the epidemiological features of OGI in paediatric age groups vary between communities.¹⁸ To our knowledge, this is the first study to address these features in our community, and we found males were more frequently involved in these injuries than females as described previously.^{3,22,27,28} The male-to-female ratio was 3.5:1 ($p = 0.003$), as shown in the histogram of the age frequency distribution in Figure 8 which was higher than that reported by Thompson et al in their study.²⁹ Al-Bdour and Azab,⁵ in a study of eye trauma in children in Jordan, found that male preponderance increases as children grow older, similar to our findings Table 1. This could perhaps be explained by the similarities in childhood activities at an early age (<5 years) and the likelihood of boys being involved in riskier activities as they grow older, especially in our community.⁵ In our study, the most common places where injuries occurred were in houses or neighbourhood areas, and school injuries were minimal.

Workplace injuries are of particular concern in the children in our study, as none of them were wearing any protective equipment. We report the highest incidence of OGI in children occurring in workplace (eight cases, 14%) compared to

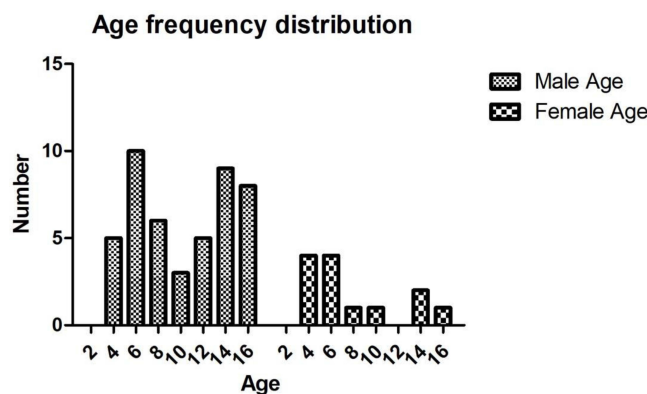


Figure 8 Histogram of age frequency distribution in boys and girls.

other studies like Sii et al,³⁰ where only one case (1.1%) was reported. This points to the fact that, in our community, children are more often exposed to riskier jobs at a younger age without access to any safety equipment, as much less frequent numbers have been found in other studies, such as by colleagues in Malaysia.⁶

We reported 2 cases of perforating eye injuries and 2 cases of globe rupture compared to Saksiriwutto et al,²² as there were no such cases in their study. The first case of globe rupture occurred in a patient with a previous history of full-thickness corneal graft, and the other case occurred in a patient with advanced congenital glaucoma, both of which were due to blunt trauma by a door handle and a metallic bar, respectively. These findings are in line with what most studies found in cases of ruptured globe being likely in eyes with previous intraocular surgery or significant pathology, as mentioned by N. Beshay et al.³¹

Bunting et al³ and others^{22,29} found that most of the OGI in children occur at home, and we report the same in the first two age groups (0–5 years and 6–10 years); however, in our community, the neighbourhood was the most common site where injuries occurred, followed by the workplace in the oldest age group (11–16 year). This is consistent with findings published from Egypt in El-Sebaity et al³² where road was reported to be the major place of injury for paediatric ocular trauma. The community and social lifestyles in our community are likely to be quite similar to those found in Egypt, leading to a higher number of paediatric ocular injuries on the road and in the neighbourhoods. The lack of safe play and recreational areas for children in the neighbourhoods add to the risks as it forces children to play outdoors on the roads unsupervised.

The most common reason for OGI in our study was injury due to sharp object (78%), and broken glass was the commonest cause both at home and in the neighbourhood followed by other sharp objects like knife, scissors and fork. Injuries that occurred at work were linked to the use of tools like cutting porcelain tiles or use of other tools like hammering. As most of injuries in the younger age group happen at home, educational awareness strategies aimed at improving home environment and limiting access to sharp objects at home could drastically reduce the risk to the young children. Moreover, local councils need to provide dedicated and safe play areas for children to avoid their exposure injury on the street of their neighbourhoods.^{20,32} Finally, the provision of safety equipment must be made mandatory at work places with other modifications at schools for example converting to use of blunt scissors or compass tools. Other published papers have also highlighted similar trends and recommended preventive measures to reduce the risk of ocular injuries in children.^{20,32} This includes public educational campaigns and recognition of specific hazards including certain toys.

There was no statistically significant difference between the right (47%) and left eye (53%) involvement which is comparable to other studies ($p = 0.795$). Penetrating eye injury was the most common type of OGI, followed by IOFB, which is comparable to that reported by Puodziuviene et al.²⁰

Saksiriwutto et al²² reported a final visual acuity of worse than 6/60 in 37% of patients. In our study, 51% (30 eyes) achieved visual acuity better than 6/12 at 12 months' follow-up and the vision was worse than 6/60 in 24% of patients. A comparison of the presenting and final vision in all 59 cases is shown in Figure 9.

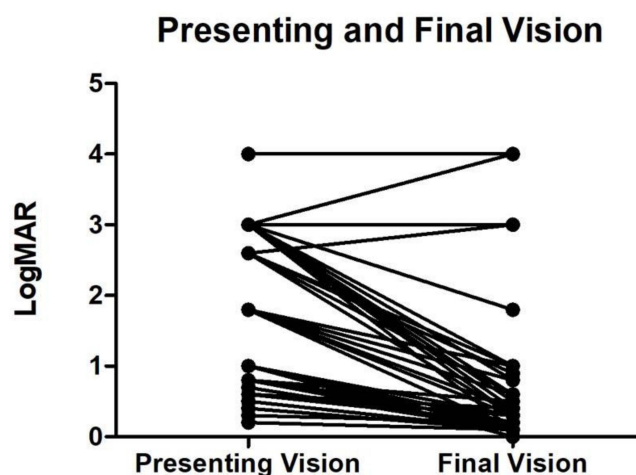


Figure 9 Comparison of presenting vision and vision at 12 months follow up.

Table 2 Showing a Breakdown of the Number of Operations

Number of Operations	1	2	3	4	5
Number of patients	9	29	16	3	2

Fifty out of 59 patients required more than one operation, and the breakdown of the number of operations is shown in Table 2. As far as the complications are concerned, the most common complication was corneal scarring of varying degrees (81%); other complications included cataract (12%), glaucoma (2%), retinal detachment (7%), phthisis bulbi (5%) and evisceration for a painful eye following multiple vitrectomy (2%). In the younger cohort, amblyopia was also a likely secondary complication due to reduction in best-corrected vision and the reasons included corneal scarring, corneal astigmatism, cataract development as well as anisometropia. In our series, there were some cases of delayed presentations, and public awareness regarding prompt presentation to specialist paediatric ophthalmic units can significantly help in improving outcomes.

There are a few limitations to our study, such as the retrospective nature of the study, relatively small sample size, and data from one tertiary hospital. Future studies with multicentre involvement and a larger sample size with a longer follow-up period will further improve our understanding of this devastating condition in vulnerable age groups.

Conclusion

Open globe injuries in children in our community occurred mostly in households and neighbourhood areas with common and accessible household objects. Public and parental awareness of these life-changing injuries should be increased to reduce the likelihood of such injuries and their devastating consequences. Providing safe playgrounds and play areas for children, running educational campaigns as well as the use of child-friendly tools such as blunt nose scissors/knives, may help reduce the risk of injury.

Disclosure

The authors report no conflicts of interest in this work.

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