Annals of Clinical and Analytical Medicine
Original Research

Clinical features and outcomes of pediatric ocular traumas

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Abstract

Aim: In this study, we aimed to evaluate clinical features and outcomes of pediatric ocular traumas in a tertiary hospital.

Material and Methods: Medical records of children under 18 years who underwent surgery for pediatric ocular trauma between January 2018 and December 2021 were reviewed. Ocular traumas were classified according to the Birmingham Eye Trauma Terminology system.

Results: The study included 19 patients (13 males and 6 females). The mean age was 9.83±5.02 (1-17) years. The mean follow-up was 4.7±3.7 (1-12) months. Injuries were caused by sharp objects [glass (57%), wires (28.5%), and knife (14.5%)] in 6 patients, and 5 children had blunt trauma. The types of traumas were open globe (52.6%), closed globe (15.8%), eyelid laceration (15.8%), closed globe injury with eyelid laceration (10.5%) and upper canalicular laceration (5.3%). Penetrating injury was detected in 7 children and globe rupture was detected in 2 patients. One patient had an intraocular foreign body. The mean interval between trauma and surgery was 6.2±11.2 (1-48) hours. Preoperative and postoperative BCVAs were 0.38±0.43 and 0.55±0.19, respectively. A corneal scar was observed in 6 eyes, iris deformity was found in 3 eyes, persistent hypotonia occurred in 1 eye and proliferative vitreoretinopathy developed in 1 eye.

Discussion: Children who needed surgery for ocular trauma had open globe injuries, notably glass-induced penetrating eye lesions. Pediatric eye injuries may cause persistent ophthalmologic sequelae and visual loss despite proper treatment. Hence, preventing eye injuries in youngsters may prevent lifelong vision loss better than treating them thereafter.

Keywords

Blunt Trauma, Eye Injuries, Open Globe Injury, Pediatric Ocular Trauma

DOI: 10.4328/ACAM.21750 Received: 2023-05-07 Accepted: 2023-06-21 Published Online: 2023-07-08 Printed: 2023-11-01 Ann Clin Anal Med 2023;14(11):995-999
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This study was approved by the Ethics Committee of Ordu University (Date: 2022-10-27, No: 2022-241)

Introduction

Ocular traumas, which account for 8%-14% of injuries, are important causes of acquired, unilateral vision loss in children [1]. Despite medical and technological advances, pediatric eye injuries can cause significant visual morbidity and permanent sequelae. Ocular traumas also impose severe psychological, sociological, and financial burdens on society and families [2]. In addition to the primary devastating effect of injury, amblyopia is an important problem in these patients.

Children have a low capacity to recognize potential dangers and perform movements in a less concentrated manner, so they are likely to be exposed to various traumas. Eye traumas constitute 7% of all bodily injuries [3]. Although most ocular injuries can be avoided with simple, preventive measures, most of children with ocular traumas suffer from visual loss.

Ocular injuries in pediatric and adult patients differ in several ways. It is often not possible to get accurate information about the cause of the injury in children. Additionally, it is often not possible to perform a complete ophthalmologic evaluation, especially in children under 3 years of age. Furthermore, ocular healing process is also different in children and adults. Inflammatory response is stronger in pediatric patients than in adult patients, leading to high tendency of scar formation [3]. In addition, even if eye injuries, especially those that occur at a young age, are treated well, amblyopia can result in serious vision loss in children.

A thorough understanding of the causes and characteristics of ocular injuries in children can help clinicians in analyzing the condition and providing the most effective treatment. Although many studies have been conducted on pediatric ocular injuries, detailed reports are needed to improve the understanding of these potentially sight-threatening traumas. The aim of this study was to evaluate the clinical characteristics as well as visual and anatomical outcomes of ocular injuries in pediatric patients who underwent surgery and followed up in a tertiary center accepting referrals from neighboring hospitals.

Material and Methods

Medical records of all children below the age of 18 who were admitted to our Ophthalmology Department for traumatic eye injury and operated between January 01, 2018 and December 31, 2021 were retrospectively reviewed. Patients who were referred to our clinic for additional surgery and children who were referred to another center for additional surgery after primary repair were excluded. Ethical approval was obtained from Clinical Research Ethics Committee (Approval number: 2022-241) on October 27, 2022. This study was conducted in accordance with the tenets of the Declaration of Helsinki. Informed consent forms were signed by the legal guardians of all children before surgery.

Data regarding age, gender, affected eye, time elapsed between trauma and admission, trauma setting, cause of trauma, traumatizing object, type and site of injury were retrospectively retrieved from the medical records of the patients. The patients were divided into three groups according to age: < 7 years (pre-school), 7-12 years, and 13-18 years old.

Best corrected visual acuity (BCVA), initial findings and intraocular pressure (IOP) at admission, the time elapsed between injury and surgical treatment, initial surgery, BCVA after treatment, follow-up period, the need and type of second surgery, and sequelae during follow-up were recorded. The Birmingham Eye Trauma Terminology (BETT) system was used to classify ocular injuries.

Intraocular pressure measurement with applanation tonometry was performed in patients who did not have an open globe injury. Applanation tonometry was not used in children with open globe injuries. Hypotony was considered when patient's eyes had IOP values lower than 6 mmHg, whereas ocular hypertension was considered in the eyes with IOP values higher than 21 mmHg with no evidence of glaucomatous damage to the optic nerve head.

Statistical Analysis

The Statistical Package for the Social Sciences® package program (SPSS version 20.0; IBM Inc., Chicago, IL, USA) was used for statistical analysis. The Snellen BCVA was changed to a logMAR value for statistical analysis. Categorical variables were presented as frequency and percentage, and medians and interquartile range (IQR) for non-normally distributed variables. The Kolmogorov-Smirnov test was used to see if the variables in each group had a normal distribution. Since there was no normal distribution, the Mann-Whitney U test, the Kruskal-Wallis test, and the Wilcoxon test were used to compare the data. The Chi-square test was used to look at count data and $p<0.05$ was considered statistically significant.

Results

The study included 19 eyes of 19 pediatric patients who underwent surgery for ocular injuries. The median age was 10 (IQR 5–13) years. Of all children, 13 (68.4%) were males and 6 (31.6%) were females. The number of boys with ocular traumas was significantly higher compared to girls ($p = 0.02$). There was no relationship between the trauma mechanism and gender ($p=0.38$). All patients had unilateral ocular injury. There was no statistically significant difference between the eyes in terms of laterality ($p = 0.53$). The median follow-up period was 3 (IQR 1–6) months.

Ocular injury occurred outdoors in 11 (57.9%) patients, at home in 7 (36.9%) patients, and at school in 1 (5.2%) patient. Six (31.6%) of the eye injuries were caused by penetrating injuries, and five (26.4%) of them were caused by blunt injuries. In blunt traumas, the most common causes of injury were wooden (n=2), toy (n=2), and pot handle (n=1). Glass (n=3), wire (n=2), and knife (n=1) were the causative agents in penetrating injuries. Other eye injuries occurred due to traffic accidents in 4 (21%) patients and due to falls in 4 (21%) patients. Due to blunt trauma, a globe rupture was observed in one eye, hyphema and iridodialysis in one eye, and only hyphema in two eyes. Seventeen patients (89.4%) were admitted to the hospital within the first 24 hours of trauma. The mean interval between the ocular trauma and primary repair was 3 (IQR 2–4) hours.

The patients were divided into three groups according to age: <7 years (%31.6, n=6), 7-12 years (%26.3, n=5) and 13-18 years (%42.1, n=8). In the <7 years group, the causes of ocular injuries were sharp objects (33.3%), blunt objects (33.3%), and falls (33.3%). In the 7-12 age group, the causes of injury were blunt objects (40%), falls (40%), and sharp objects (20%).

However, the most common cause of injury in the 13-18 age group was a traffic accident (50%), followed by sharp objects (37.5%) and blunt objects (12.5%).

Visual acuity could not be measured in 3 eyes (15.7%), and BCVA was below 0.1 in 9 eyes (47.3%) at admission. Patients whose preoperative visual acuity could be evaluated had a BCVA of 0.6 (IQR 0.1-3) logMAR before primary repair, whereas the BCVA at the last visit was 0.2 (IQR 0-1.1) logMAR. Preoperative and postoperative BCVAs were significantly different ($p = 0.01$).

After surgical treatment, applanation tonometry was performed in 14 eyes (73.6%), and IOP was below 6 mmHg in 1 eye (5.2%) and above 21 mmHg in 2 eyes (11.1%). In five eyes in which applanation tonometry could not be performed, IOP was assessed using finger palpation and evaluated as normal. None of the patients with high IOP required additional surgery and IOP could be controlled using topical antiglaucomatous agents.

According to the BETT system, the most common injury type was open globe injury, which occurred in ten children (52.6%). The most common open globe injury was a penetrating injury (70%, n = 7) (Table 1).

Table 1. Injury types in children with ocular traumas.

Injury types	n (%)
Open globe injury	10 (52.6)
Rupture	2
Penetrating injury	7
Intraocular foreign body	1
Closed globe injury	3 (15.8)
Contusion	1
Lamellar laceration	2
Eyelid laceration	3 (15.8)
Eyelid laceration + Closed globe injury	2 (10.5)
Canalicular laceration	1 (5.3)

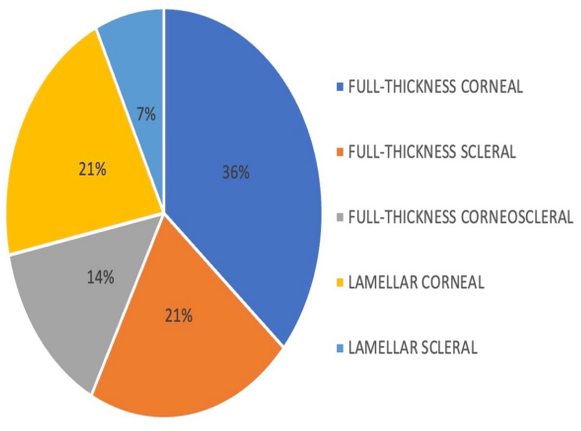

Figure 1. Sites of injuries.

The injury sites were full-thickness corneal, full-thickness scleral, full-thickness corneoscleral, lamellar corneal, and lamellar scleral in five (26.3%) patients, three (15.7%) patients, two (10.5%) patients, three (15.7%) patients, and one patient (5.2%), respectively (Figure 1).

Of the eyes with open globe injury, 4 (40%) had iris prolapse, 3 (30%) had hypotonia, 3 (30%) had traumatic cataracts, 2 (20%) had hyphema, 2 (20%) had superficial foreign bodies, 2 (20%) had vitreous prolapse, 2 (20%) had iridodialysis, and 1 (10%) had vitreous hemorrhage. All closed-globe injuries had hyphema.

Primary repair alone was performed in 16 eyes. Anterior chamber lavage was performed during primary repair in two eyes, and foreign body removal from the anterior chamber was performed during primary repair in one eye. A second surgery was required in four patients (21%). Two patients underwent intraocular lens (IOL) implantation after cataract surgery, one underwent iridoplasty simultaneously with IOL implantation after cataract surgery, and one underwent vitreoretinal surgery for vitreous hemorrhage. At the last follow-up, corneal scarring, iris deformity, hypotony, and proliferative vitreoretinopathy (PVR) were found in six (31.6%) eyes, three (15.8%) eyes, one (5.3%) eye, and one (5.3%) eye, respectively. None of the patients had sequelae after closed globe injury, whereas all eyes with sequelae had open globe injuries at the time of presentation.

Discussion

This study examined trauma-related ocular damage in children. Number of boys was greater than girls, which is consistent with earlier studies. Boys are more energetic and risk-averse than girls, which may explain the higher ocular trauma rate [4]. The mean age of children with ocular trauma in previous studies was 5-11.9 years [5,6]. Similarly, the mean age was 9.83 years, in our study. There was no difference between the two eyes in our study similar to previous ones reporting no ocular dominance in pediatric ocular traumas [7].

At admission, visual acuity could not be assessed in 3 patients (15.7%). In similar studies, visual acuity could not be evaluated at first admission in 16%-28% of patients [8,9]. In our study, 9 patients (47.3%) had visual acuity of 0.1 or lower at presentation. Perforating injuries or globe ruptures are associated with worse visual prognosis than closed globe and adnexal injuries [10]. In our study, visual results were worse in open globe injuries than in closed globe injuries. Ten patients (52.6%) had visual acuity better than 0.5 after surgical repair. A previous study showed that 65.4% of patients achieved a visual acuity better than 0.5 after surgery [11]. The proportion of the children who achieved a visual acuity of 6/12 or better was reported in a wide range from 36% to 92%, in different studies evaluating the treatment outcomes of pediatric eye injuries [12-14]. Varieties in the design of the studies and severity of ocular injuries may have led to these different results.

In pediatric eye injuries, it is crucial to ensure globe integrity by performing surgical repair as soon as possible to prevent complications and permanent vision loss. In our study, 89.4% of patients were admitted to the hospital within the first 24 hours, and the mean interval between ocular injury and first evaluation was 6.5 hours. In a multicenter study, the rate of

hospital admission within the first 24 hours was reported as 77.3%; however, a study conducted in Egypt reported a lower rate of hospital admission within the first 24 hours after injury (56%) [5,15]. Compared to previous studies, the interval between the trauma and admission to the hospital, and thus the initial evaluation, was shorter in our study.

Our research has shown that the main causes of eye injuries in the younger age groups (<7 and 7-12 years) were falls, blunt objects, and sharp objects, whereas traffic accidents were the most common cause of ocular injuries in the older age group (13–18 years). According to Saxena et al., bows and arrows were the most common cause of eye injuries among young people in India, followed by household appliances and firecrackers [16]. According to the findings of Sofi et al., the most common cause of eye injury in youngsters was wood, followed by stone and sharp objects [17]. These findings reflect the cultural and socioeconomic differences that exist between countries. It has been demonstrated that eye injuries caused by sharp objects are mostly seen in developing countries, whereas sports injuries are more common in developed countries [3].

The place where the injury occurred, differs according to the age of the children. It has been reported that childhood ocular traumas in the preschool age occur most frequently at home [8,11,13]. In our study, eye injuries most commonly occurred on the street (57.8%), which is an expected result considering the geographical location and sociocultural level of the region where this study was conducted.

Most studies on pediatric eye injuries have shown that the incidence of closed globe trauma is higher than that of open globe injury [1,11]. However, in our study, the incidence of open globe injury was higher than that of closed globe injury. This may be due to the fact that our hospital is the only tertiary care center in our province that receives many referrals from neighboring hospitals, and many patients are directly referred to our hospital without primary repair.

The most common clinical findings in the current study were corneal laceration (26.3%) and eyelid laceration (26.3%). In the Pediatric Ocular Trauma Study (POTS3), the most common clinical finding in children with eye injury was corneal laceration (40.7%), followed by eyelid laceration (30.2%) [10]. A study conducted in the USA reported that adnexal (43.7%) and corneal injuries (27.2%) were the most common ocular injuries in children [18]. Traumatic cataract associated with corneal laceration was the most important cause of vision loss after open globe injury. All children with corneal perforation eventually developed cataract in our study. It has been reported that eyelid defects, corneal opacities, cataract, posterior segment disorders, glaucoma, and phthisis bulbi may develop after pediatric ocular injuries [4]. In our study, ophthalmic sequelae (corneal scar, iris deformity, hypotony, and proliferative vitreoretinopathy) were observed in 11 (57.8%) patients in the last follow-up.

Study Limitations

There are certain limitations of this study, including the small sample size, relatively short-term follow-up period, retrospective design, and inability to evaluate visual acuity in some patients. The potential difference in group comparisons reported as “no difference” might not have been detected, since the insufficient sample size in our study increased the risk of type 2 error. However, the fact that our hospital is the only university-based tertiary center accepting referrals from neighboring hospitals enables to reach a sufficient number of cases of pediatric ocular traumas. Another limiting factor is that our study was not able to evaluate the effects of patients referred from another center on parameters such as time between injury and surgery and visual prognosis.

Conclusion

Open globe injuries, especially penetrating eye injuries caused by glass, were noteworthy in children who need surgical repair due to ocular trauma. Despite appropriate and effective management of pediatric eye injuries, patients may experience permanent ophthalmologic sequelae and vision loss. Therefore, measures to prevent eye injuries in children may be more effective in preventing permanent vision loss than any medical intervention after the injury.

Scientific Responsibility Statement

The authors declare that they are responsible for the article’s scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: *None*

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:
Hasan Burhanettin Kapti, Aslihan Uzun, Asena Keles Sahin. *Clinical features and outcomes of pediatric ocular traumas. Ann Clin Anal Med 2023;14(11):995-999*

This study was approved by the Ethics Committee of Ordu University (Date: 2022-10-27, No: 2022-241)