Severe Pediatric Perforating Ocular Trauma with Intraocular Foreign Body: A Case Report and Literature Review

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ABSTRACT

Pediatric ocular trauma is a significant cause of visual impairment and blindness in children, influenced by various demographic, socio-economic, and environmental factors. This case report discusses a severe instance of perforating ocular trauma with an intraocular foreign body (IOFB) in a child. The patient, a 16-year-old male, presented with extensive ocular injuries from an angle grinder accident. Initial treatment included a 25-gauge phacovitrectomy, removal of the IOFB, and silicone oil tamponade. Complications such as epiretinal membrane formation were observed, requiring subsequent surgical intervention. This case highlights the complexity and severity of pediatric ocular trauma, showing the importance of timely and precise surgical management to prevent long-term visual impairment. The literature review emphasizes the need for preventive measures and early intervention strategies to mitigate the incidence and impact of such injuries.

Keywords: Penetrating Eye Injuries, Perforating Ocular Trauma, Intraocular Foreign Body.

INTRODUCTION

Annually, over 600,000 residents of the Republic of Kazakhstan suffer from various types of injuries, with a significant proportion affecting the eyes.[1] Among these, eye injuries result in disability for 27-35% of working-age adults and 12-17% of children, representing a critical area of concern within vision-related health outcomes.

In the U.S., about 2.4 million eye injuries occur annually, with 35% affecting children under 17 and 18% under 12, with up to 25% of which is open globe injuries.[2, 3] Estimates of serious ocular trauma range from 8.85 to 15.21 per 100,000 annually with male children being dominant.[4-6] Globally, between 160,000 and 280,000 children under 15 require hospitalization for ocular trauma each year, with 21% to 35% being penetrating injuries. [2, 5] Less severe cases are more numerous, suggesting 3.3 to 5.7 million eye injuries in children under 15 annually.[7]

Perforating eye injuries, characterized by a foreign body penetrating through all layers of the eyeball twice, creating entry and exit wounds, are particularly severe. These injuries are complex due to the high risk of intraocular complications, including infection, retinal detachment, and potential loss of the eye, making them a significant challenge in ophthalmic trauma care.[6, 8] The management of these injuries requires timely and precise surgical intervention to minimize long-term damage and preserve ocular and visual function. Therefore, we would like to present our clinical case of severe pediatric perforating ocular trauma with an intraocular foreign body (IOFB). This case report, along with a literature review, is written

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in accordance with the Declaration of Helsinki and consent for publication was obtained from the adolescent's parents.

CASE REPORT

A 16-year-old male presented with pain, redness, and vision loss in his right eye after primary corneal wound repair for a penetrating corneal injury from an angle grinder. Due to the inability to remove IOFB, the patient was referred to the Kazakh Eye Research Institute in Almaty, Kazakhstan.

On admission, Best Corrected Visual Acuity (BCVA) was no light perception in the right eye and 0.0 Logarithm of the Minimum Angle of Resolution (logMAR) in the left eye. Intraocular pressure was 3 mmHg in the right eye and 14 mmHg in the left eye. Slit lamp biomicroscopy and B-scan ultrasound are shown in Figure 1a and 1b, respectively.

As the first stage of surgery, a 25-gauge phacovitrectomy for endophthalmitis was performed (Figures 1c and 1d) along with the removal of IOFB using a magnet and vitreal forceps (Alcon 25-gauge Grieshaber MaxGrip DSP forceps) through the corneal wound (Figures 2a and 2b). Subsequent silicone oil tamponade and corneal wound repair were also performed (Figures 2c and 2d). The removed metallic magnetic foreign body, 17 mm long, was identified as a furniture staple. Postoperatively, BCVA was counting fingers at 0.5 meters.

Two months later, the patient was referred for the planned second surgery (Figure 3a). Upon admission, epiretinal membrane (ERM) formation over the old retinal wound was observed (Figures 3b and 3c). Secondary intraocular lens (IOL) implantation, removal of silicone oil, and membrane peeling were performed. Postoperatively, BCVA reached 1.0 logMAR. For the following six months postoperatively, the patient's BCVA remained at 1.0 logMAR. Both the anterior and posterior segments showed stable conditions with a well-positioned IOL.

DISCUSSION

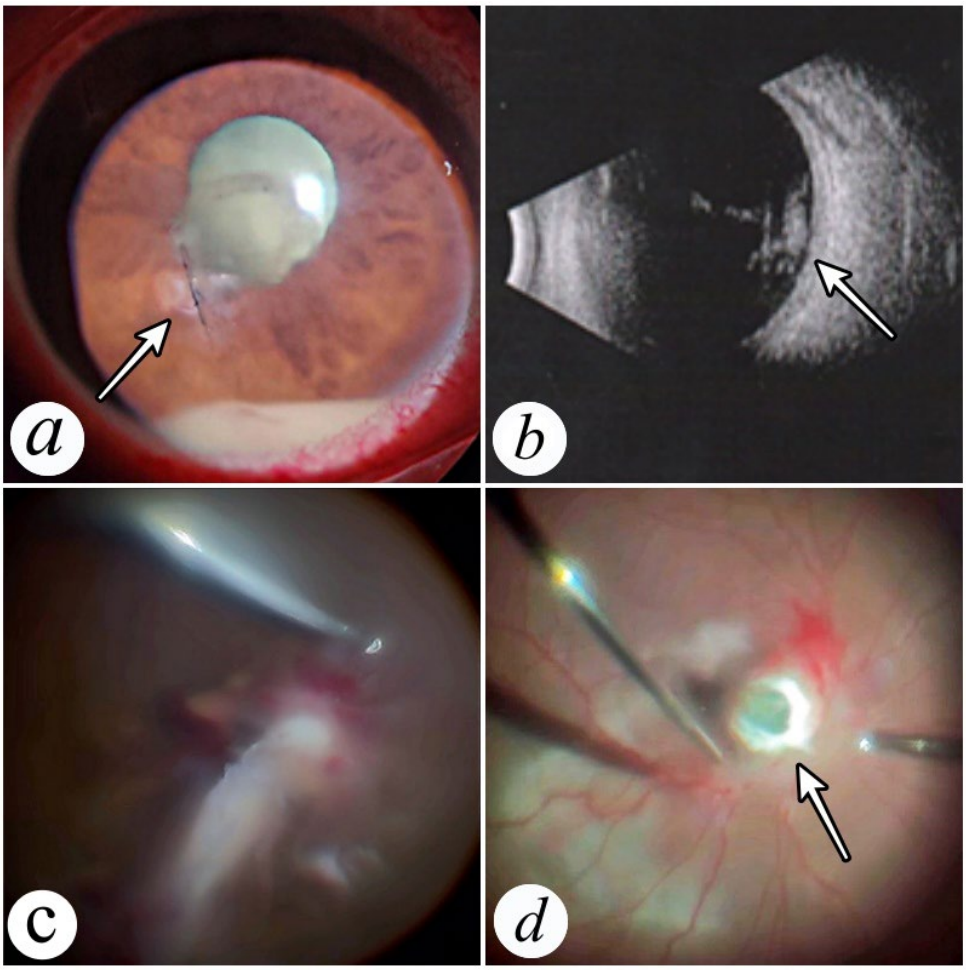

Figure 1. *(a) Photo of the patient's right eye upon admission. The eye has an edematous cornea with a 3 mm penetrating wound with a suture (arrow), a shallow anterior chamber with 3 mm hypopyon, an irregular pupil due to rupture, and an opaque, swollen lens. The deeper structures are not visible. (b) In the posterior segment, a shadow close to the posterior pole shows the intraocular foreign body (arrow). (c) Process of phacovitrectomy for endophthalmitis, with limited visualization due to opaque media. (d) Intraoperative view of the foreign body (arrow) which was carefully freed from the exudate after phacoaspiration of the cataract and pars plana vitrectomy were performed. Foreign body is protruding from the temporal edge of the optic nerve head.*

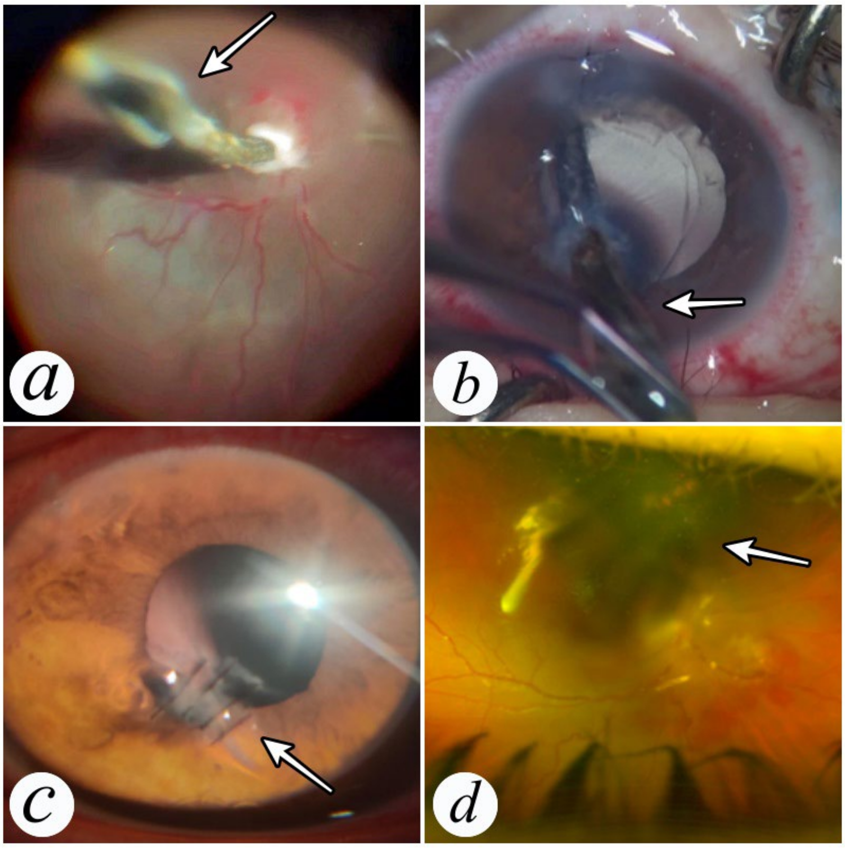

Figure 2. *(a) The process of extracting the foreign body from the posterior pole using Alcon 25-gauge Grieshaber MaxGrip DSP forceps. (b) The process of extracting the foreign body through the cornea from the initial penetrating wound. (c) Postoperative view of the anterior segment on the tenth day. The eye is aphakic with remnants of the lens capsule observed. The place of extraction on the cornea with newly applied sutures is pointed by the arrow. (d) Fundus view on the tenth postoperative day. Silicone oil tamponade is present and the retina is attached. A round retinal wound is visible in the area of the temporal edge of the optic nerve head. The arrow points to a corneal scar that interferes with the visualization of the fundus.*

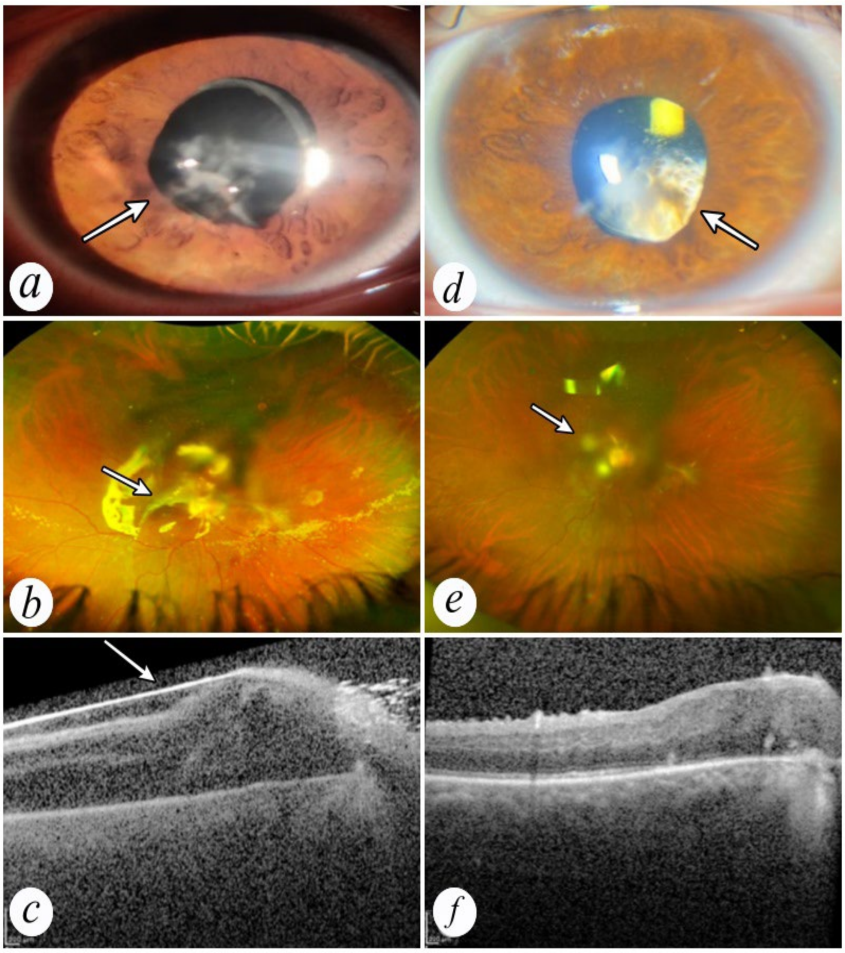

Figure 3. *(a-c) Two months after the first surgery, when the patient was admitted for the second surgery. (a) Anterior segment view. The arrow points to the site of the corneal scar with sutures. Remnants of the lens capsule is visible. (b) Fundus view with silicone oil tamponade. The retina is attached. The arrow points to the formed epiretinal membrane around the old retinal wound. (c) OCT image showing a clearly visible epiretinal membrane, which is contracting the retina and causing diffuse neuroepithelial edema. (d-f) Condition of the eye after the second surgery including secondary IOL implantation, silicone oil removal, and membrane peel. (d) Anterior segment view after suture removal from the corneal scar (arrow) and secondary IOL implantation, ten days after the second surgery. (e) Fundus view after silicone oil removal and membrane peel. The arrow points to the area where the epiretinal membrane was located. (f) OCT image of the retinal area where the epiretinal membrane was. As seen, the retinal edema has subsided and the traction has resolved.*

Pediatric ocular trauma is a significant public health issue and a major cause of visual impairment and blindness in children. The incidence, causes, and outcomes of these injuries vary globally, influenced by demographic, socio-economic, and environmental factors. Understanding these factors and implementing preventive measures is crucial for reducing the occurrence and severity of these injuries.

The etiology of ocular trauma in children is varied and closely linked to the age of the patients.[9, 10] Younger children (0-6 years) are more prone to domestic accidents and injuries caused by toys due to their immature motor skills and curiosity, with the most common causes being falls, toys, and household objects.[10, 11] As children grow older (7-12 years), injuries increasingly result from sports and recreational activities, as well as accidents involving sharp objects like pencils.[10, 12] In teenagers (13-18 years), the risk further shifts toward sports-related injuries, as well as trauma caused by fireworks and violence, reflecting their greater independence and engagement in high-risk activities. Boys are more frequently affected than girls, likely due to their more active and risk-prone behavior, with studies showing a higher prevalence of ocular trauma in males due to increased outdoor exposure.

Children's eyes differ anatomically from adult eyes, which significantly impacts surgical approaches and postoperative management.[1, 13] Pediatric eyes are smaller, with a less rigid sclera and cornea, making precise tissue apposition and sizing more challenging during surgery. The growing eye in children presents additional difficulties, as corneal and scleral scars may stretch and deform over time, potentially leading to irregular astigmatism, progressive globe distortion, and impaired visual development. Severe structural changes can contribute to phthisis bulbi, further compromising visual prognosis. Additionally, positive posterior vitreous pressure in pediatric patients can cause anterior displacement of the lens-iris diaphragm during surgery for open globe injuries, complicating intraoperative stability. Moreover, unlike adults, children often require general anesthesia for surgery, and postoperative management is more demanding, sometimes requiring follow-up examinations under anesthesia. Sutures in pediatric cases require earlier removal compared to adults, requiring additional anesthesia and careful postoperative monitoring.

A critical concern in pediatric ocular trauma is the significantly higher risk of amblyopia, requiring rigorous amblyopia therapy to optimize visual outcomes.[14] In adults, visual impairment is typically limited to the extent of structural damage, whereas children are highly susceptible to sensory deprivation amblyopia. Prolonged opacity in the visual axis can lead to cortical suppression of the affected eye. Even when anatomical repair is successful, children remain at high risk of developing irreversible amblyopia if visual rehabilitation measures, such as patching therapy or optical correction, are not promptly implemented. Since ocular media opacity and anisometropia can persist throughout life, early intervention is crucial to prevent permanent vision loss.

Ocular trauma in children can lead to various severe complications, significantly impacting vision. Penetrating eye injuries in children, particularly those including IOFB that traverse from the anterior to the posterior part of the eye, are serious and require immediate medical intervention. Key complications include cataract development, vitreous hemorrhage, opacity of the vitreous, endophthalmitis, and retinal detachment.[9-12] Traumatic cataracts in children can result from both blunt and penetrating ocular injuries, with the lens being relatively soft in children, making it more susceptible to opacification following trauma. Studies show that traumatic cataracts are a common complication, occurring in approximately 25-30% of pediatric ocular trauma cases, and noted across all pediatric age groups. A case series described nine patients with IOFBs penetrating eye injuries and main complications included corneal ruptures as the primary entry site, with subsequent complications such as traumatic cataracts, vitreous hemorrhage, and retinal detachment.[15] Management included surgical interventions like lensectomy, PPV, and endolaser treatment.

The presence of IOFB within the eye significantly increases the risk of complications like endophthalmitis and proliferative vitreoretinopathy (PVR). Endophthalmitis in the presence of IOFB can occur in up to 10.9% of cases and successful treatment of this condition can be achieved in up to 43% of cases with BCVA reaching 20/400 or 1.3 logMAR.[6, 8] PVR and ERM formation is a relatively common complication following penetrating retinal injuries and other retinal surgeries, emphasizing the need for careful monitoring and potentially early intervention to manage this condition effectively.[8] The formation of PVR and ERM after retinal injuries or surgeries results from inflammation and subsequent wound healing processes, which explains why the incidence rate can vary, reaching up to 41.8% of cases.[8, 16] Studies show that early surgical intervention and aggressive anti-inflammatory treatment can mitigate these risks, but outcomes remain less predictable compared to adults. Immediate and effective surgical management is crucial, with techniques such as pars plana vitrectomy commonly employed to remove the IOFB and address any retinal pathology.

Up to 90% of eye injuries are preventable.[17] Preventive measures, including the use of protective eyewear and increased supervision, are crucial in mitigating these injuries and preserving vision in pediatric populations.

In summary, pediatric ocular trauma is multifaceted and closely tied to children's age, developmental stage, socio-economic status, supervision, and environmental conditions. Preventive strategies, such as increased supervision, use of protective gear, and public education, are essential in reducing the incidence of these injuries and their long-term consequences. Early detection and timely intervention are crucial to mitigate these risks and preserve visual function in affected children.

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