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An unusual case of a high-impact perforating ocular injury by knife

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ABSTRACT

Purpose: To present a case of high-impact perforating eye injury by knife throwing witnessed during a public performance and initially classified as penetrating eye injury.
Observations: During the second reconstructive procedure an exit wound was identified, which had been missed during primary wound repair due to extensive swelling of adjacent soft tissue. The occult exit wound could be sealed and the retina attached under silicone oil.
Conclusions and Importance: An exit wound should always be considered in any case of penetrating ocular injury. Uniform terminology in ocular traumatic injuries is important for planning and execution of proper wound management.

1. Introduction

The spectacle of a knife-throwing performance is mainly attributed to the danger of possible injury and the narrow escape by the artist. In our case, the patient, a knife-throwing artist, had the misfortune of suffering a severe penetrating injury to the globe and laceration in the adnexal tissue from a throwing knife. She underwent a two-step procedure: primary wound management and closure of the entrance wound, followed by cataract surgery with pars plana vitrectomy and retinal detachment repair 4 days later. During the second surgery, a small, barely visible exit wound was identified by leakage of irrigation fluid, so the case was re-classified as a perforating open-globe injury. The exit wound was sutured watertight, and the globe was henceforth stable. This case may serve as an illustrative example of the complex surgical management of traumatic open-globe injuries and demonstrates the use of standardized terminology for eye trauma. Exit wounds should always be considered in penetrating ocular trauma. Furthermore, this case presents a strong argument for the use of eye protection in all professions, even though eye injuries are becoming increasingly rare in the workplace.

2. Case report

A 26-year-old female patient arrived at the emergency department with a traumatic open-globe injury to the left eye and laceration to the left nasolabial fold and adjacent soft tissue caused by a knife-throwing accident. The accident occurred during an artistic knife-throwing performance in a circus-like setting, and the knife was removed on site a few seconds after the accident. The patient, a professional entertainer, had been fastened to a vertically mounted wooden spinning wheel while knives were thrown at the spinning wheel, barely missing her body. Unfortunately, during a public show, one of the knives impacted and cut through the patient's left nasolabial fold, penetrating her nasal cavity and the globe leading to an open-globe zone III injury (Fig. 1).[1] A cranial computed tomography scan revealed deformation of the globe, emphysema of the orbital tissue, an intact optic nerve, and no bony deformations or fractures. A best-corrected visual acuity (BCVA) measurement at presentation indicated questionable light perception in the left eye. Owing to the obvious open-globe injury, the intraocular pressure (IOP) of the left eye was not measured. A slit-lamp examination revealed an open-globe injury with a lacerating wound to the inferior limbus, incarcerated iris and uveal tissue, but a relatively clear cornea (Fig. 2). The anterior chamber was flat, and the lens was clear. There was no view to the posterior segment.

During primary wound repair, a full-thickness corneal and scleral laceration of ≈15 mm in length was identified (Video 1). The laceration extended radially and posteriorly from the inferior limbus toward the posterior pole beyond the insertion of the inferior rectus muscle. A

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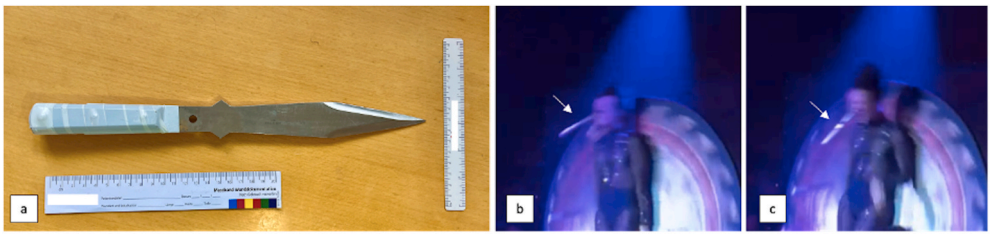

Fig. 1. Throwing knife (a) causing the injury inflicted during the performance. Photo of the accident, taken from a video of the performance showing the impacted knife (white arrow in b and c).

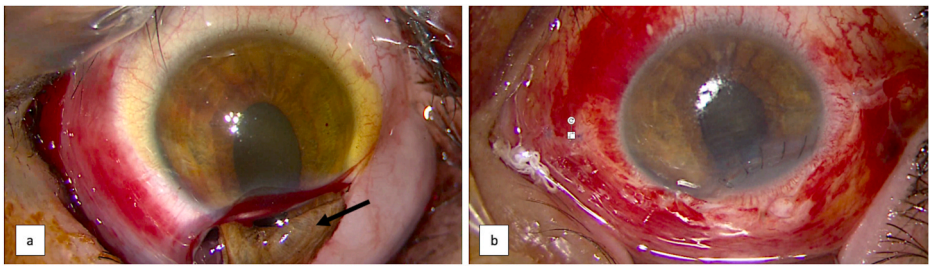

Fig. 2. Left eye after open-globe injury at initial presentation (a) and after primary wound closure (b). A lacerating open-globe injury with iris prolapse is evident at the inferior limbus (a). After repositioning the iris tissue, the corneal laceration was sutured watertight with 10–0 nylon interrupted sutures, as shown in (b), and the peritomy was sealed.

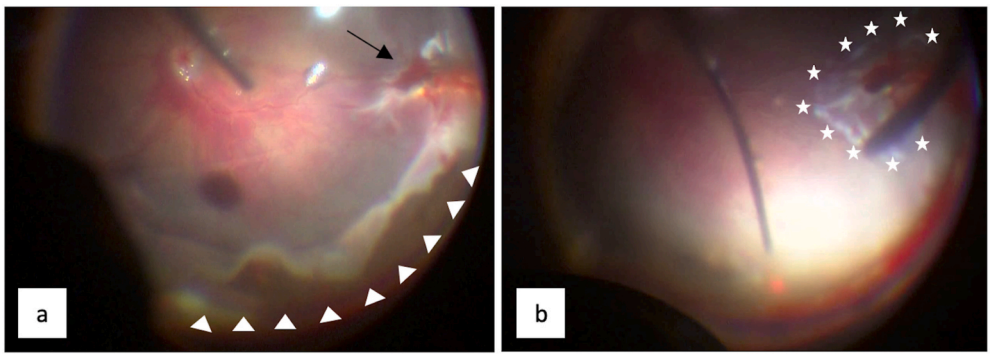

Fig. 3. Microscopic view of the posterior pole during vitrectomy and identification of the exit wound (black arrow) temporal to the macula, in close proximity to a giant retinal tear (white arrowheads) before (a) and after (b) argon laser retinopexy (white asterisks).

peritomy was performed, followed by repositioning of the iris tissue and closure of the corneal wound with 10–0 nylon interrupted sutures (Fig. 2). The inferior rectus muscle had to be temporarily detached to allow scleral wound closure with interrupted 7–0 vicryl sutures; however, wound exploration and closure was complicated by swelling of adjacent soft tissue, preventing primary comprehensive reconstruction. Hence, a two-step approach for wound management was chosen, including primary wound closure followed by secondary reconstruction. The conjunctival peritomy was closed with 8–0 vicryl sutures, and the skin lesions were closed with interrupted 5–0 vicryl sutures and 7–0 ethilon running sutures.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.ajoc.2024.102185

Postoperatively, the patient received topical 0.3 % ofloxacin eye drops (Floxal®, Bausch & Lomb, Vaughan, Ontario, Canada) four times daily, as well as 1 % prednisolone acetate eye drops (Inflanefran®, Abbvie, Chicago, Illinois, USA) six times daily. In addition, i.v. vancomycin (1 g, 2 × daily), i.v. ceftazidime (2 g, 3 × daily), and i.v. prednisolone (1 mg/kg body weight, per day) were given systemically.

The aim of the second procedure, scheduled 4 days after primary wound closure, was internal reconstruction, removal of cataract, posterior chamber intraocular lens (IOL) implantation, and retinal detachment repair (Video 2). The lens was removed by phacoemulsification, and the IOL was implanted in the bag. During 23-gauge vitrectomy, a giant inferotemporal retinal tear and retinal detachment were identified. Visualization of the posterior pole was impaired, and the IOP was unstable owing to continuous leakage, complicating the procedure. An unidentified exit wound was considered owing to a loss of irrigating fluid and consequential loss of IOP, as well as conjunctival chemosis during vitrectomy. Identification was challenging. After removal of the vitreous and subretinal hemorrhage, an exit wound was identified at the posterior pole, located ≈10 mm temporal to the fovea (Fig. 3). Therefore, the case was reclassified as a perforating open-globe injury. A temporal peritomy was performed, and a holding 4-0 silk suture was placed at the lateral rectus muscle to rotate the globe appropriately. The posterior perforation was identified, meticulously cleaned from any residual retinal pigment epithelium, uveal and orbital tissue, and sutured with a single 7–0 vicryl suture. The retina was reattached using laser retinopexy under heavy liquid, followed by fluid-silicone oil exchange with Densiron® 68 heavy silicone oil (Fluoron GmbH, Ulm, Germany). The peritomy was closed with 8–0 vicryl interrupted sutures.

Supplementary video related to this article can be found at htt

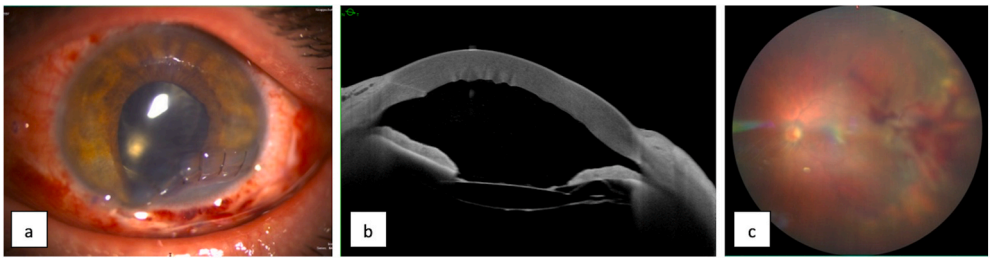

Fig. 4. Slit-lamp photograph (a), anterior segment optical coherence tomography B-scan (b), and color fundus photograph (c) of left eye 2 weeks after internal reconstructive surgery. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

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At the next follow-up 3 weeks after the second procedure, Snellen BCVA was 1/25 at 1 m, and IOP was 13 mmHg. The wounds were healing well, the retina was attached under heavy silicone oil tamponade, and the intraocular lens was stable in the capsular bag with mild posterior capsule opacification (Fig. 4).

Repeat vitrectomy with silicone oil removal and capsulotomy was scheduled 3 months after the second procedure. During this third procedure, capsular phimosis and posterior capsular opacification were cut and removed with vitrectomy scissors and a vitrector, respectively. Tractional membranes were removed at the site of the posterior exit wound and silicone oil 5000 cSts (Sil-5000-S, DORC, Zuidland, Netherlands) was chosen as tamponade.

At the last follow-up visit one week after the third procedure, the eye was healing well and the retina was attached with a complete silicone oil fill. Snellen BCVA was count fingers at 1 m and IOP was 20 mmHg.

3. Discussion

In this article, we present the case of a perforating ocular injury of a 26-year-old female artist caused by knife throwing during a performance. Traumatic eye injuries are one of the most common reasons for emergency department visits and remain a common problem in developed nations.[2–7] Furthermore, traumatic eye injuries are one of the most common causes of enucleation.[2,8]

The case was atypical, as most patients suffering from ocular trauma are male, with a male-to-female ratio of approximately 4:1.[2–4,9–11] Also, while a large proportion of ocular injuries occur in the workplace, the case presented herein may be considered unusual because the patient's profession and its associated high risk of injury is not representative of most other occupations.[2,12,13] Among the sharp objects involved in serious traumatic eye injuries, knives are commonly implicated, along with sticks, scissors, screwdrivers, and nails.[2] In general, the cheek is the most commonly injured area in impacted knife injuries to the face, which was also the case for the patient presented herein.[14] General recommendations state that an impacted knife or other foreign body in the facial area should be removed in theatre, which had not been followed in our case.[14] The knife had been removed at the site of the accident on impulse by laymen personnel; luckily, no expulsive hemorrhage had occurred, and extrusion of intraocular tissue was minimal. We can only speculate about the exact sequence of events of the traumatic injury. One hypothesis, based in part on a video filmed by one of the guests of the show, is that the handle of the knife hit the nasolabial area and flipped with the sharp advancing tip into the eye at lower speed perforating the front. While the knife was flipping, it may have injured the back of the eye and posterior orbit. Experimental studies have shown that sharp objects such as kitchen knives thrown at a distance of 4 m have formidable penetration depth of up to 4cm in an abdominal model.[15] An argument can be made for banning of dangerous games such as knife throwing for its potentially lethal consequences. Given the circumstances, the patient may even be considered lucky in that she suffered no lethal injuries.

Computed tomography (CT) imaging plays a pivotal role as the gold standard imaging technique in the management of traumatic eye injuries and is particularly helpful in cases where soft tissue swelling precludes examination of the globe.[16] Furthermore, detection of possible intraocular or intraorbital foreign bodes, bony fractures or transorbital routes of penetrating cranial injury are of vital importance preoperatively.[16] Sensitivity and specificity of CT imaging for detecting open globe injuries range around 78 % and 93 %, respectively.[17] Scleral irregularity, dislocation of the crystalline lens or vitreous hemorrhage are common findings in cases of open globe injury.[17] In our case, deformation of the globe was detected on CT scans, indicating an open globe injury, however, the posterior exit wound was not diagnosed.

Open-globe injuries need to be closed as soon as possible, firstly to prevent expulsive choroidal hemorrhage and secondly to prevent endophthalmitis. The choice between primary reconstructive surgery or a two-step approach with primary wound closure and secondary reconstruction must be made based on a patient's individual situation. Kuhn et al. recommend primary comprehensive reconstruction of open-globe injuries where possible to prevent secondary complications such as proliferative vitreoretinopathy (PVR) and ciliary body destruction.[18] In cases where a staged approach is chosen, early reconstruction (within 4 days of injury) offers advantages over late reconstruction (within 1–2 weeks of injury) in terms of PVR prevention, even though the surgery itself may be more challenging.[18] In our case, primary reconstruction was not possible owing to extensive swelling of the surrounding tissue and limited access to the injured globe. However, the choice of early reconstruction enabled prompt identification and closure of the exit wound and limited the patient's risk of PVR development and long-term complications. Posterior exit wounds in perforating eye injuries are notoriously difficult to suture owing to the restricted view to the posterior pole and the crowded anatomical situation within the orbit. As a general strategy, once the exit wound is identified, the infusion may be temporarily switched off and the globe left hypotonous to facilitate access to the posterior pole. In our case, this maneuver was unnecessary; however, continuous infusion was avoided to prevent further conjunctival chemosis and further hydratization and oedema of orbital tissues. Another important aspect of ophthalmic exit wounds is their propensity to produce extensive PVR secondary to incarcerated vitreous, retina, and uveal tissue. Meticulous removal of the incarcerated or prolapsed tissue is crucial to prevent PVR formation. One may consider primary chorioretinectomy, which may further reduce the rate of PVR formation and tractional retinal detachments.[19–21]

In the case described herein, prognosis in regards to final visual acuity was graded with an ocular trauma score of 2 according to Kuhn et al., prognosticating a 27 % probability of no light perception as the final BCVA, a 26 % probability of light perception or hand movements, a 18 % probability of 1/200–19/200, a 15 % probability of 20/200–20/50 and a 15 % probability of $\geq$20/40.[22] With a BCVA of count fingers 3 months after the injury with a silicone oil fill the patient fit relatively well the outcome prognosticated by the ocular trauma score. However, the relatively short follow-up period is a limitation of our case report, and we can only speculate about final anatomical and visual outcomes during long-term follow-up.

In the past, uniform terminology in ocular traumatic injuries has

been shown to be tremendously important for planning and execution of proper wound management.[23] Our case had first been categorized as a penetrating eye injury because the exit wound, located near the posterior pole, had remained unidentified owing to swelling of the adjacent soft tissue. During the second reconstructive procedure, the exit wound was identified during pars plana vitrectomy due to loss of irrigating fluid, and the injury was correctly re-categorized as a perforating eye injury and treated appropriately. A teaching point of this case report is the consideration of an exit wound in all cases of penetrating ocular injuries. A posterior exit wound such as that described herein may have an increased risk of PVR owing to posteroanterior traction exerted from the incarcerated vitreous and retina as well as direct contact with orbital tissues such as orbital fat. The wound should be meticulously cleared of extraocular tissue and foreign material. Obviously, protective eyewear could have prevented this accident. Wearing protective eyewear in the workplace—including for hobbyists—is one of the most effective actions for preventing serious traumatic eye injuries.[8,24] In our case, protective eyewear could have diminished the thrill of the spectacle of a knife-throwing event; however, the patient's sight may have been saved.

4. Conclusion

In conclusion, the case presented herein may serve as an example of an occult exit wound in a patient with a perforating ocular injury initially categorized as a penetrating trauma. Early reconstructive surgery not only minimized the risk of PVR but also identified the exit wound at the posterior pole. Protective eyewear could have prevented this vision- and eye-threatening injury.

Patient consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images and videos.

CRediT authorship contribution statement

Philipp K. Roberts: Writing – review & editing, Writing – original draft, Data curation, Conceptualization. **Marc A. Macek:** Formal analysis, Data curation. **Annekatrin Rickmann:** Writing – review & editing. **Philip Wakili:** Writing – review & editing. **Anna Theresa Lorenz:** Writing – review & editing. **Berthold Seitz:** Writing – review & editing. **Peter Szurman:** Writing – review & editing, Supervision, Resources, Data curation, Conceptualization. **Karl T. Boden:** Writing – review & editing, Supervision, Resources, Investigation, Conceptualization.

Declaration of competing interest

Prof. Peter Szurman has a patent for a device for preparing and introducing a transplant or an implant into a living body, in particular for ophthalmological interventions: EP2533724 B1; WO2012065602 A3.

All other authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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Appendix ASupplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ajoc.2024.102185.

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