

William M. Strub · Kenneth L. Weiss

## Self-inflicted transorbital and intracranial injury from eyeglasses

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**Abstract** Orbital injuries are commonly seen in the emergency department, and if they are high-energy they can lead to concomitant intracranial injuries. Plain films, CT, MRI, and ultrasound are used in various combinations to evaluate the extent of these injuries. We describe a unique case of self-inflicted transorbital penetrating intracranial injury from the temporal wire rim of a pair of eyeglasses. Imaging well demonstrates the full course of the wire rim in situ, and pathoanatomic correlates are highlighted.

**Keywords** Abducens nerve injury · Self-injurious behavior · Diagnostic imaging · Eye foreign bodies · Penetrating eye injuries

### Introduction

Orbital injuries are quite common but can be most unusual. High-energy orbital injuries from foreign bodies can often lead to concomitant intracranial injuries. Such injuries are most often projectile-related and are rarely deliberately self-inflicted. When intentional, they often reflect aberrant suicide attempts. Previous reports have described such injuries with a ballpoint pen [1], a toothbrush [2], and a pencil [2]. We report a unique case of nonprojectile self-inflicted transorbital intracranial injury with the temporal wire stem of a pair of

eyeglasses, resulting in relatively minor residual neurological injury. Imaging features with pathoanatomic correlation are highlighted.

### Case report

While awaiting admission to the psychiatric ward, a 42-year-old right-handed male with a history of bipolar affective disorder and paranoid schizophrenia broke the temporal piece off of his eyeglasses and forced it into his left orbit. After a temporary loss of consciousness, the patient had a seizure lasting approximately 5–10 s before regaining consciousness. Physical examination at that time showed a small piece of metal projecting 5 mm from his left orbit and an irregularly shaped left pupil with decreased reactivity to light. The globe was intact.

Initial plain films (Fig. 1a, b) showed a metallic wire extending from the left orbit to approximately 6 cm posterior to the sella turcica within the calvarium. No fractures were identified, and no air–fluid levels were present in the sinuses.

A CT examination was subsequently performed (Fig. 1c–e) delineating the full transorbital and intracranial course of the wire rim. The foreign body passed inferomedial to the left globe, exiting the orbit through the medial aspect of the superior orbital fissure. Intracranially the wire extended along the inferomesial aspect of the temporal lobe, coursing immediately lateral to the cavernous sinus, then superior to the petrous apex along the tentorium. The foreign body terminated in the anterior inferior aspect of the lingual gyrus of the left occipital lobe (Fig. 1e) No acute hemorrhage was seen, and no skull or facial bone fractures were identified. The ventricles were normal in size and position.

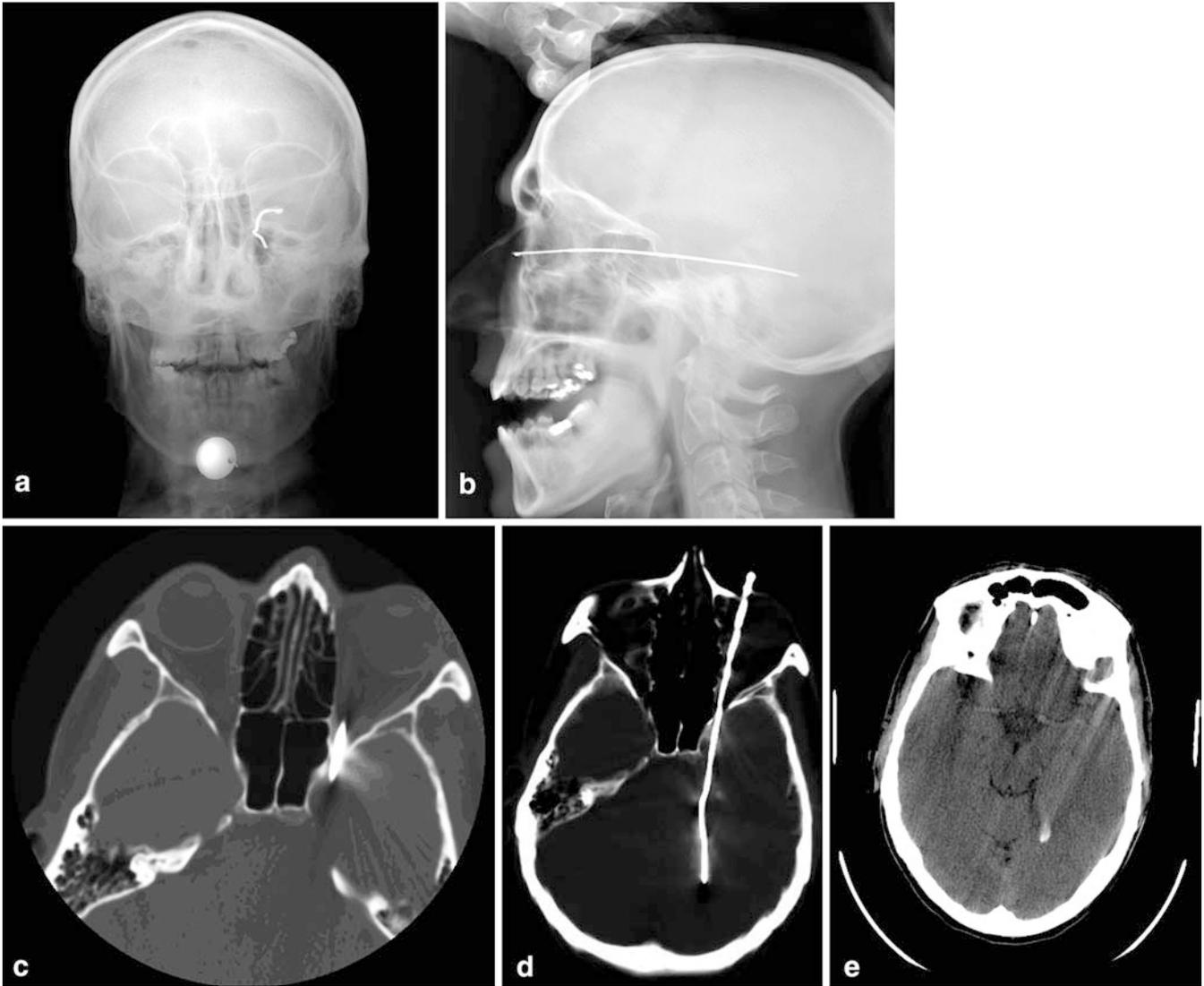
Neurosurgical and ophthalmological consultations were obtained, and it was felt that the best course of action was to remove the foreign body under local preparation in the emergency department. After the patient was intubated for airway control, the foreign body was removed and prophylactic vancomycin and ceftriaxone were given.

After removal of the foreign body, a repeat CT examination was performed which showed a small left subdural tentorial hematoma. No other areas of hemorrhage were identified. The ventricles continued to remain normal in size and position.

Three days after the event, the patient was discharged from the hospital. No abnormalities were seen on fundoscopic exam, and there were no visual field deficits. The pupils were equal bilaterally. The patient had an abducens nerve palsy that will probably be permanent according to ophthalmologic opinion. Outpatient visual acuity tests and follow-up radiographic studies were unavailable.

W. M. Strub  
Department of Radiology, University of Cincinnati,  
Cincinnati, Ohio, USA

K. L. Weiss (✉)  
Departments of Radiology, Psychiatry,  
and Biomedical Engineering, The Neuroscience Institute  
and Center for Imaging Research, University of Cincinnati,  
234 Goodman Street ML 0762, OH 45267 Cincinnati, USA  
E-mail: weisskl@healthall.com  
Tel.: +1-513-5846016  
Fax: +1-513-5840431



**Fig. 1** **a** AP and **b** lateral radiographs of the skull reveal the transorbital and intracranial course of the wire-rim foreign body in two orthogonal projections. **c** Axial CT image depicts the wire as it transveres the superior orbital fissure. **d** Axial maximum intensity projection of contiguous 5-mm-thick CT sections reveals the foreign body's full course in this projection. **e** Axial CT image with brain windows depicts the foreign body tip terminating at the anterior inferior margin of the left occipital lobe without evidence of intracranial hemorrhage

## Discussion

Orbital–cranial injuries can have complications such as orbital cellulitis, localized meningitis, leakage of cerebrospinal fluid through the wound [3, 4], and post-traumatic epilepsy [4]. The management of these injuries has been previously described [3, 4, 5, 6].

Radiologic assessment of penetrating orbitocranial injuries and possible resultant foreign bodies can include plain films, CT, MRI, or ultrasound. Plain films are limited in their ability to delineate soft tissue and precisely localize radiopaque foreign bodies with respect to

their intraorbital or intracranial location. This often necessitates a CT examination which facilitates localization and better demonstrates other injuries such as cellulitis, fractures, and hemorrhage [7]. While CT has much greater sensitivity than plain films in detecting foreign bodies, it may fail to detect wood fragments [5, 7, 8], as wood and air can have a similar hypoattenuative CT appearance. The use of CT scans in the removal of orbital–frontal lobe foreign bodies has been described, highlighting the importance of determining the foreign body's relationship to cerebral blood vessels and of monitoring postoperatively for cerebral hemorrhage [6].

MRI of penetrating orbital or orbitocranial injuries may be limited or contraindicated by the metallic and/or ferromagnetic properties of the foreign body. MRI may be helpful in cases where orbital penetration by a wooden foreign body is suspected, but CT fails to demonstrate the wood fragment [9]. MR evaluation of bony injuries is limited, but MRI is valuable in examining the optic nerve, detecting globe injuries, and as an adjunct modality [10]. It may also be more sensitive to subtle soft

tissue injuries not noted by CT [7]. Although neither recommended nor performed in the acute setting in our patient, a follow-up MRI may be beneficial to investigate the cause of the patient's seizure, visualize any sources of infection [8] secondary to the foreign body, and further evaluate the cranial nerves and brain parenchyma.

Ultrasound has been used in the evaluation of intraocular foreign bodies; however, it is limited in its ability to identify their shape and composition [7]. Given the transorbital course of the wire stem and sparing of the globe, it is unlikely to yield any further diagnostic information not appreciated on CT.

The presence of the foreign body in situ allowed excellent pathoanatomic correlation with imaging modalities. The oculomotor, trochlear, and abducens nerves course through the superior orbital fissure in addition to the ophthalmic division of the trigeminal nerve and the superior ophthalmic veins. More specifically, the thin superolateral portion of the superior orbital fissure contains cranial nerve IV, the frontal and lacrimal branches of cranial nerve V<sup>1</sup>, the superior ophthalmic vein, and the recurrent laryngeal artery. The wide inferomedial portion of the fissure contains cranial nerve III, the nasociliary branch of cranial nerve V<sup>1</sup>, cranial nerve VI, sympathetic nerve fibers, and the inferior ophthalmic vein [2]. The superolateral portion and the inferomedial portion of the superior orbital fissure are separated by the annulus of Zinn. It is likely that the course of the object was entirely through the inferomedial portion of the superior orbital fissure. The patient's transient pupillary irregularity suggests possible injury/irritation of the oculomotor nerve or the sympathetic nerve fibers. The fixed abducens nerve palsy likely reflects a more profound direct injury to cranial nerve VI within the superior orbital fissure. Furthermore, the patient's seizure may be related to injury or irritation to the inferomesial aspect of the temporal lobe. Fortunately, the foreign body did not enter the optic canal and avoided major intracranial vascular structures.

The three patients described in the literature with self-inflicted transorbital intracranial injury suffered more extensive injury than our patient. The patient who used a ballpoint pen [1] suffered blindness in the affected eye, damaged all three divisions of the trigeminal nerve, and injured the ipsilateral cavernous carotid artery.

The patient impaled with a pencil had a persistent lack of light perception in the affected eye along with partial loss of corneal sensation after the return of third, fourth, and sixth nerve motor function [2]. Finally, the patient with a self-inflicted toothbrush injury suffered a persistent loss of light perception in

the affected eye as well as partial third, fourth, and sixth nerve palsies [2].

As in our case, the three previously reported [1, 2] patients had psychiatric disturbances and spared injury to their globes. By contrast, our patient penetrated his left rather than right orbit with his dominant hand. This may violate Lasky's theory that the "avoidance head turn protects the orbit contralateral to the hand used for injury." The fact that our patient spared his vision and vascular structures may in part reflect the relatively small diameter of the wire stem in comparison to the other penetrating objects. Although he continues to manifest a sixth nerve palsy, it is possible this condition may improve [2].

Orbital injuries can be severe and in some cases even involve injuries to intracranial structures as well. Their diagnosis and management require a multidisciplinary approach between the emergency medicine physicians, radiologists, neurosurgeons, ophthalmologists, and, in the cases of intentional, self-inflicted injury, psychiatrists.

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