Case Report

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Penetrating transorbital injury by a coloring pencil in a 3-year-old child: A case report

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Abstract

A transorbital penetrating injury by a foreign body is an extremely rare type of injury, and its severity is often difficult to estimate by examination of the superficial wound alone. Thus, such injuries are challenging for neurosurgeons to investigate and manage. We herein present a peculiar case involving a 3-year-old girl with a penetrating transorbital skull-base injury caused by a coloring pencil and discuss the anatomical location of the foreign body, radiological examination findings, diagnosis, and treatment strategy. The pencil was completely removed by manual extraction. Follow-up investigations confirmed a good outcome. Multidisciplinary cooperation, radiological examination, correct diagnosis, timely treatment, and detailed follow-up studies are necessary to manage penetrating transorbital skull-base injuries caused by foreign bodies. The orbital walls are very thin in children, and the orbital roof and superior orbital fissure are often penetrated by foreign bodies in cases such as that described herein. The anatomical location of the foreign body influences the clinical management strategy.

Keywords

Penetrating, transorbital injury, child, treatment, imaging examination, foreign body

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Introduction

Penetrating transorbital injuries account for approximately 0.4% of all head injuries, and the involvement of a foreign body in such injuries is a peculiar clinical situation. These types of injuries account for only about 25% of all penetrating head injuries in adults and 50% of those in children.[1–3] They are usually the result of falls or motor vehicle collisions and occur more commonly in children because children are prone to trauma while playing games and catching each other.[4–6] Intraorbital foreign body penetration may lead to blindness or even death caused by concomitant intracranial tissue injury.[4,5] Transorbital impalement by a pencil is unusual and should be promptly managed because of its association with high infection and mortality rates.[7,8] We herein report a case involving a 3-year-old girl with a penetrating craniofacial injury and discuss the mechanism of injury, imaging evaluation findings, surgical intervention, postoperative monitoring, and surgical features of this unusual case.

Case presentation

A 3-year-old girl with a penetrating transorbital skull-base injury caused by a coloring pencil was sent to our hospital more than 3 hours after the injury. She had no history of vomiting or loss of consciousness. The child had fallen, and the pencil in her hand had directly penetrated her left orbit.

Initial ophthalmic examination showed the coloring pencil penetrating through the inferior palpebra. The skin around the eye was edematous, and blood was present around the puncture site; however, no active bleeding was found (Figure 1). Further physical examination showed that the patient's Glasgow coma scale score was 15 points and that her bilateral pupils were equally reactive to light; she exhibited no neurological deficits or superior orbital

Figure 1. Foreign body as seen at the initial examination

Figure 2. Computed tomography scan showing that the pencil had penetrated the left medial orbital wall

fissure syndrome. Visual acuity and intraocular pressure measurements could not be performed because of the patient's lack of cooperation. A plain orbital and brain computed tomography (CT) scan revealed that the pencil had penetrated the left lamina papyracea (Figure 2).

Three-dimensional image reconstruction showed passage of the foreign body through the superior orbital fissure into the cranium (Figure 3), ending 5 mm anterolaterally to the clinoidal part of the internal carotid artery (ICA) (Figure 4). The image also showed that the intracranial length of the pencil was about 7.0 cm (Figure 5). The patient underwent an emergency operation performed by a

Figure 3. Lateral three-dimensional image reconstruction depicting passage of the foreign body through the superior orbital fissure into the cranium

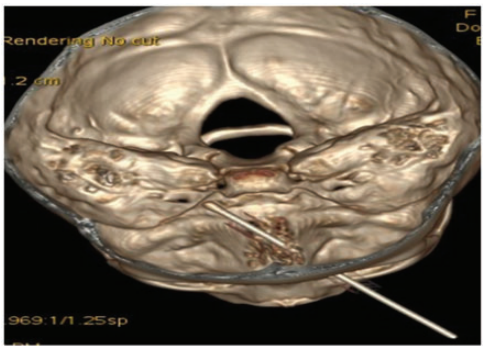

Figure 4. Bird's-eye view of the three-dimensional image reconstruction of the foreign body in relation to the skull base

Figure 5. Tip of the pencil after removal from the left eye

Figure 6. Postoperative suturing of the patient's wound

neurosurgeon jointly with an ophthalmologist under general anesthesia after prophylactic administration of an intravenous antibiotic (cefotaxime sodium, 0.06 g/kg). The pencil was slowly removed with surgical pliers by the neurosurgical and ophthalmological specialists. When the foreign body was pulled out, a small amount of blood and cerebrospinal fluid flowed out, and saline was repeatedly irrigated into the wound until no exudate was observed (Figure 6). The globe and ocular adnexa were subsequently examined, and no lacerations were found. The extracted pencil appeared intact and was 5 mm away from the ICA. No obvious bleeding seen in the preoperative CT scan; therefore, there was no further reason to perform a craniotomy.

Postoperatively, topical chloramphenicol 0.5% eye drops and erythromycin ointment were administered, and an intravenous antibiotic (cefotaxime sodium, 0.05 g/kg) was given for 7 days. The patient was also managed with sedation and pain relief. Plain CT and CT angiography (CTA) were performed immediately after the operation. CT demonstrated mild bilateral frontal brain contusion and edema along the trajectory of the pencil with no residual cranio-orbital foreign debris (Figure 7). CTA showed normal vascular morphology and

Figure 7. Axial computed tomography scan on postoperative day 1

no injury to the ICA, middle cerebral artery, or anterior cerebral artery.

Outcome and follow-up

The patient recovered completely without ophthalmic or cognitive function deficits and was discharged on postoperative day 7. An ophthalmological examination at the 1-month follow-up revealed normal visual acuity, normal optical coherence tomography findings, normal eye movement, and normal fundus examination findings with no diplopia or pain. A neurological examination revealed no cerebrospinal fluid leakage. The patient developed no ocular or neurological deficits throughout the 3-month follow-up.

Discussion

Multidisciplinary approaches to the presurgical evaluation and radiological examination in patients with penetrating transorbital injuries are mandatory and should include neurological and ophthalmological examinations.[7,9–11] For example, the Kerning or Babinski signs are negative, the bilateral pupils are isocoric and normally responsive to light, the eyeball is intact, and visual acuity and ocular movements are normal. The outcome of intraorbital penetrating injuries varies significantly depending on the type of injury and the involvement of vital structures.[2,4,5] Ozer et al.[4] described a 4-year-old boy who presented with a craniofacial injury caused by a pencil that had penetrated the anterior wall of the right maxillary sinus, medial orbital wall, ethmoidal air cells, nasal septum, and cribriform plate. Surgery was performed with manual extraction of the pencil in the operating room. The patient then developed cerebrospinal rhinorrhea, which was successfully resolved by an endoscopic surgical intervention. Mzimbiri et al.[5,12] described a 2-year-old boy who injured his right eye with a chopstick that had penetrated the orbital roof and entered the frontal lobe after fracturing the frontal sinus. The chopstick and bone fragments were removed through its trajectory by a subfrontal craniotomy. The patient was discharged on postoperative day 10 and developed no neurological deficits during follow-up.

The orbital walls are very thin in children, and the orbital roof and superior orbital fissure are often penetrated by foreign bodies with accompanying frontal lobe contusion.[5,8,13] Removal of the foreign bodies should be undertaken after sufficient imaging is performed.[3]

In the present case, the patient was transferred to our hospital more than 3 hours after the injury, and no bleeding or hematoma formation was seen on the CT scan. Furthermore, according to the CT examination and three-dimensional reconstruction, the injury site was located away from the ICA, middle cerebral artery, anterior cerebral artery, and other important arteries. Therefore, to shorten the preoperative duration, the foreign body was removed without further head CTA. This management strategy differs from the recommendation of the Guidelines for the Management of Penetrating Brain Injury.[12] After the operation, the patient immediately

underwent CT and CTA, and a physical examination was performed. No abnormalities were observed, and the patient was discharged uneventfully.

In total, 35 cases of transorbital penetrating foreign bodies in 33 publications have been described.[3] The literature contains case reports of transorbital penetrating brain injuries with foreign bodies such as chopsticks, pens, pencils, and similar objects. The pattern of injury is a stab wound in the periorbital area, which may be the only clinical manifestation of this injury. Foreign bodies that penetrate the brain through the transorbital route can injure both orbital and cerebral structures. Most cases in the literature involved some form of surgical treatment. In our case, the penetrating object was removed under general anesthesia because there was neither radiographic evidence of an intracranial hematoma nor damage to the orbital neurovascular structures. Nevertheless, most surgeons approve of surgical removal of a foreign body because it is an origin of life-threatening hemorrhage and infectious complications.[1,11,14,15] In our case, there was a high risk of injury to the ICA if the foreign body had been pulled out from the outside because of its close proximity to this artery. It may be safer to remove such foreign bodies under visual monitoring.

In conclusion, the recent trend is toward a less aggressive strategy for management of penetrating craniofacial injury,[7] particularly for patients whose injury site is located away from vital intracranial arteries and eloquent areas. For patients with intracranial artery damage, simple withdrawal of a foreign body that has penetrated the cranium may be disastrous because of catastrophic arterial bleeding. Preoperative cerebral angiography or CTA is recommended to evaluate suspected vascular injury or reveal the location of the hematoma.[16] Follow-up CT angiography or digital subtraction angiography is beneficial to rule out the possibility of a delayed carotid cavernous fistula and traumatic aneurysm. When a vascular injury is highly suspected based on CTA or digital subtraction angiography findings,[17] a craniotomy and removal of the foreign body under direct vision are recommended as the best approach.

Consent

We have de-identified the details regarding the identity of the patient. Thus, written patient consent was not required.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Ethics approval

The requirement for informed consent was waived because of the retrospective and anonymous nature of this case report.

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