



Case Report

Retrograde cranio-orbital penetrating injury: A case report

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ABSTRACT

Background: Transorbital (Orbito-cranial) injuries are uncommon, but they are among the most debilitating types of traumatic brain injury (TBI), mainly caused by high-velocity gunshot wounds. In addition, the management of transorbital TBI is well documented in the literature. In contrast, the cranio-orbital migration of a bullet following TBI is rarely reported. In this article, we report a reverse cranio-orbital penetration of a bullet after a TBI from the occiput with a discussion about its management.

Case Description: A 34-year-old male presented with a loss of consciousness to the emergency department. His Glasgow Coma Scale was 10 (E3, V3, M4), with a left-sided weakness grade of 3 on the Medical Research Council of Canada scale. A head computed tomography (CT) scan was performed, which revealed a bullet embedded in the right orbit with an entrance point from the right occipital bone. Moreover, the CT scan showed an intraventricular hemorrhage in the lateral ventricle. The surgery was performed where the hematoma was evacuated, the scalp was debrided, and the bullet was removed successfully. However, the patient died on the 7th postoperatively.

Conclusion: Cranio-orbital penetrating brain injury is a severe yet rare type of penetrating brain injury. The direction of cranio-orbital injury is usually from the orbital region to the cerebrum. In our case, the retrograde fashion of the bullet migration renders it unique and calls for further studies to highlight the differences in injury and management of such cases.

Keywords: Cranio-orbital, TBI, Traumatic brain injury

INTRODUCTION

Penetrating head injury represents one of the most severe traumatic brain injuries (TBIs). They account for the majority of brain injuries and cause a high death rate in the civilian population.^[9] However, transorbital (Orbito-cranial) injuries are uncommon yet represent devastating types of TBI, especially in high-velocity gunshot wounds.^[2] Moreover, transorbital TBI is well documented in the literature regarding its management. On the other hand, cranio-orbital migration of a bullet after TBI is scarcely reported. In our case, we report a reverse cranio-orbital penetration of a bullet after a TBI from the occiput with a discussion about its management.

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CASE PRESENTATION

An otherwise healthy 34-year-old male presented with a loss of consciousness to the emergency department (ER). A gunshot wound entry was observed on his occiput with the right orbital swelling. His Glasgow Coma Scale (GCS) was 10 (E3, V3, M4), with a left-sided weakness grade of 3 on the Medical Research Council of Canada (MRC) scale. An ophthalmological examination was performed and revealed avulsed damaged globe. A head computed tomography (CT) scan was performed, which revealed a bullet lodged in the right orbit with an entrance point from the right occipital bone [Figure 1]. In addition, the CT scan showed an intraventricular hemorrhage in the lateral ventricle due to the spontaneous migration of the bullet through the brain [Figure 2].

The patient is transferred to the operating room, where an interdisciplinary team of surgeons is prepared. The surgery

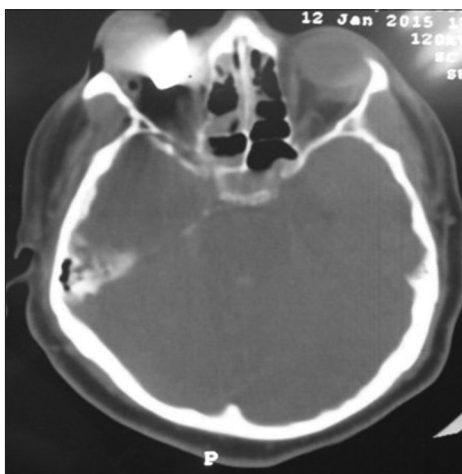


Figure 1: A head computed tomography scan (Axial section) bone window shows a bullet lodged in the right intra-orbital region with possible tract hematoma extending from the right occipital bone.

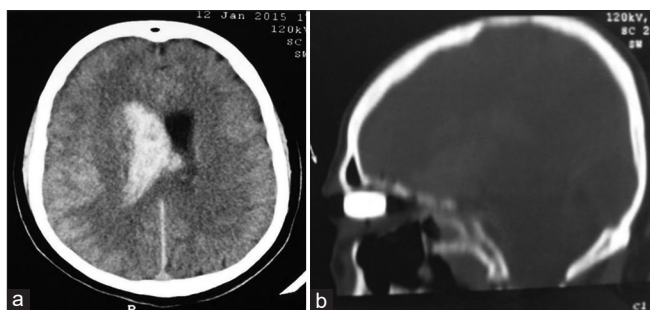


Figure 2: (a) A cranial computed tomography (CT) scan (Axial section) reveals intraventricular hemorrhage in the right lateral ventricle extending to the left side. (b) A cranial CT scan (Sagittal view) shows the bullet's settlement in the orbit.

was focused on three targets (1) hematoma evacuation, (2) scalp debridement, and (3) gentle bullet removal, which was performed successfully. The surgery went unremarkable. Furthermore, the postoperative course featured GCS 12 (E3, V4, M5) and a left-sided weakness MRC grade of 3. In the neurointensive care unit (ICU), measures were taken to decrease the intracranial pressure (ICP), including head elevation and mannitol boluses, according to the follow-up neurological examinations alone, as ICP monitoring is not available. In addition, essential care was performed, which included primary wound care and closure of both inlet and outlet in the neuro ICU. However, the patient died on the 7th day postoperatively, which mainly contributed to the patient's TBI.

DISCUSSION

Penetrating brain injuries can be caused by a missile or non-missile mechanisms. Penetration of the missile is more common with high-velocity objects.^[4] The migration of an intracerebral bullet can be attributable to gravitational force, cerebral softening, or local tissue damage. Spontaneous bullet migration through the cerebrospinal fluid and brain parenchyma have been reported in multiple cases in the literature.^[3] Bullet migration is usually seen in the ventricular system, cisterns, ipsilateral cerebral lobes, or cerebellum.^[10] The resulting effective gravitational force on the heavy object is most likely the cause of migration; a bullet will always tend to migrate away or take a retrograde motion in the inlet pathway.^[3,6] Cranio-orbital brain injury, although not frequent, is a severe type of penetrating brain injury with a mortality rate reaching approximately 12% of the affected individuals. The direction of the penetrating object in cranio-orbital injury can vary; however, most cases (86%) reported the orbital roof as the main entry point.^[2,4] In our case, the penetrative bullet has entered the intracerebral hemisphere from the occipital lobe and managed to migrate to the contralateral orbital region giving it a retrograde direction for cranio-orbital penetrating injury.

Management of migratory fragments of penetrative bullets is still a subject of debate. Some authors recommend that bullets within the brain should be evacuated if accessible and if they can be removed without further neurological damage.^[11] Removal is also advised if the bullet's trajectory affects the air sinuses, ventricular system, mastoid air cells, or other significant sites of infection.^[1] Management of penetrating cranial-orbito injury usually includes craniotomy to obtain control of the intracerebral vessels and intracranial pressure before retrieving the penetrating object causing injury. The immediate life-threatening complications are mainly associated with intracranial pressure and damage to the cranial nerves. Although considered delayed complications, infectious complications

are the most commonly encountered complications associated with cranio-orbital injury.^[4] Moreover, the management also depends on the severity of the condition, which varies according to many factors related to the penetrating foreign body's size, type, site of penetration, and direction inside the brain.^[13,14] Moreover, Rinaldi *et al.* describe an unusual case of a 30-year-old man with a craniocerebral missile injury with orbital roof penetration and subsequent bullet migration into the maxillary sinus.^[12] The emergency management included a broad craniectomy around the bullet entrance location, as well as the removal of blood and foreign bodies. Subsequently, the patient developed a brain abscess that required antibiotics and drainage. Further, the patient's condition was complicated by chronic epilepsy that required antiepileptics mediations.^[12]

Infectious complications caused by bullet migration induce a notable rise in morbidity and mortality rates. Local wound infections, meningitis, ventriculitis, and cerebral abscess are exceptionally high among these patients because contaminated foreign objects, skin, hair, and bone fragments were propelled along with bullets into the projectile track.^[5]

Removal of the bullet in our case might have induced iatrogenic injury to the brain parenchyma. The expected complications are visual deterioration secondary to damage to the eyeball, cranial nerve palsies, severe infections such as meningitis and cerebral abscess, cerebral contusion and hematoma, and vascular lesions.^[7,8,15]

The cranio-orbital versus orbitocranial trajectory of penetrating TBI may impact the planning of treatment and the priority in managing brain and eye injuries. In classic instances, the penetrating missile passes through the orbital, causing extensive injury to the eye globe with an inevitable vision violation. The ophthalmologist treats such injury at a later stage after stabilization of the neurological condition, and that treatment would include inoculation of the affected eye by implanting an artificial one. On the other hand, the next phase of injury entails a penetration to the retro-orbital parts of the cerebral hemisphere with a high risk of injury to the vascular bed at the base of the brain.

In the present scenario, the trajectory is cranio-orbital and opposite to the typical orbitocranial pathway, with the initial phase of injury affecting the brain and the eye representing a settling destination. This may result in less extensive orbital damage and more aggressive cerebral insult.

The unique direction of the bullet migration, in this case, sheds light on the proper considerations that should be accounted for to identify retrograde cranio-orbital penetrating injuries and encourage future studies to explore the different aspects of management and outcome in such cases and to prevent further complications.

CONCLUSION

Cranio-orbital penetrating brain injury is a severe yet rare type of penetrating brain injury usually associated with high-velocity objects such as bullets. The direction of cranio-orbital injury is usually from the orbital region to the cerebrum. In our case, the retrograde fashion of the bullet migration renders it unique and calls for further studies in the literature to highlight the differences in injury and management of such cases.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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