

Retained Piece of Motorized Wood Cutter Blade Causing Transorbital Intracranial Injury: A Modern Industrial Hazard

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Abstract

Penetrating injury of brain is potentially life threatening. Majority of such injury is caused by high-velocity missile injury, unlike to civilian injury being caused by low velocity. Penetrating object getting entry through transorbital route is considered rarer with few published reports in literature. Penetrating objects can be made up of metal, glass, or even wood. Patient can seek medical advice immediately or after some delay. Authors report a case, who rushed to hospital immediately after sustaining injury by broken piece of motorized wooden cutting blades. He underwent surgery for removal of foreign body and tolerated surgery well. Proper elicitation of clinical history, neurological examination, and timely appropriate neuroimaging and expeditious surgical treatment are crucial and can be helpful in generating exceptionally good outcomes despite a major trauma. Pertinent literature is briefly reviewed.

Keywords

- ▶ retained transorbital metallic blade
- ▶ anterior skull base
- ▶ metal blade
- ▶ penetrating injury

Head injuries constitute common cause of accidental trauma affecting all age groups, while penetrating head trauma is comparatively rarer and represent approximately 0.4% of all head injuries.^{1,2} It constitutes external compound group of injury associated with different levels of contamination determined by velocity of penetrating object, route travelled through, paranasal sinus, scalp, orbit, or aerodigestive tract. In penetrating injury in civil population is mostly low-velocity type can be caused by metallic objects which can be readily detected on computed tomography scan including knife, spikes, iron rod, scissor, and screw drivers, while wooden material, plastic piece, glass may not be easily detected on computed tomography (CT) scan. With advances in neuroimaging techniques such as high-resolution CT (HRCT) with three-dimensional reconstruction, assessment of injuries can be done more

accurately. Penetrating object commonly enters through the thin-walled skull bones. The mechanisms of low-velocity penetrating wounds causing neurovascular injury may be different compared with other types of head trauma as penetrating injury characteristically lacks concentric zones of coagulative necrosis caused by dissipated energy, typically present in missile injuries. Low-velocity penetrating injury usually does not cause diffuse shearing injury to the brain, which commonly occurs in motor vehicular accidents, and characteristically cerebral tissue damage caused by penetrating injury is typically restricted to the traversing wound tract, unless tract causes injury to important neurovascular structures causing infarct or hematoma. In a series of penetrating injury wounds, de Villiers reported a mortality of 17%, mostly related to vascular injury and massive intracerebral hematomas.³

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Fig. 1 Preoperative clinical photograph showing lacerate eyelids with a visible foreign body.



Fig. 3 Noncontrast computed tomography head, bone window view, showing foreign body penetrating orbital roof and causing basifrontal injury.

Case Report

A 23-year-old man reported to emergency services with history of injury by broken pieces of metallic blade of electrical motorized wooden cutting machine 4 hour back with severe pain in orbital region. Physical examination at admission revealed presence of lacerated wound of left eye lid with foreign body visible causing downward deviation of eye ball (**Fig. 1**).

Neurological examination revealed a Glasgow coma score (GCS) of 15/15. He could not perceive light in left eye with restriction of all gaze of movement. The rest of the examination was essentially within normal limit. There was no other motor or sensory deficit.

Plain X-ray showed presence of foreign body of triangular shape with serrated base lying in the orbit and apex penetrating through floor of anterior cranial fossa (**Fig. 2**). A noncontrast CT scan head demonstrated presence of a

triangular metallic piece penetrating through anterior cranial fossa into basifrontal cortex (**Fig. 3**). A CT angiogram of cranial vessel excluded any vascular injury.

He was put on prophylactic antibiotics and high-dose steroids. He was planned for emergent surgery for removal of piece of cutting metallic blade. He underwent left frontal osteoplastic craniotomy. After retracting dura, projecting apex of foreign body was visualized, which was entering dura after perforating orbital roof (**Fig. 4**). However, triangular shape of foreign body and only apex pointing into anterior cranial fossa, it was decided to remove object through lacerated wound of left upper eyelid. Foreign body was retrieved under vision, dura was repaired watertight, orbital roof was reconstructed using inlay bone graft (**Fig. 5**). Eyelids were repaired meticulously. After surgery, antibiotics continued for 5 days. He was discharged on 5th day after surgery. Postoperative CT scan revealed removal of cutting metallic blade and no fresh intraparenchymal or extradural hematoma (**Fig. 6**). At the



Fig. 2 X-ray skull showing triangular foreign body with apex projecting into the anterior cranial fossa.



Fig. 4 Operative photograph showing metallic foreign body entering anterior cranial fossa and causing dura perforation after penetrating orbital roof.



Fig. 5 Photograph of extracted foreign body.

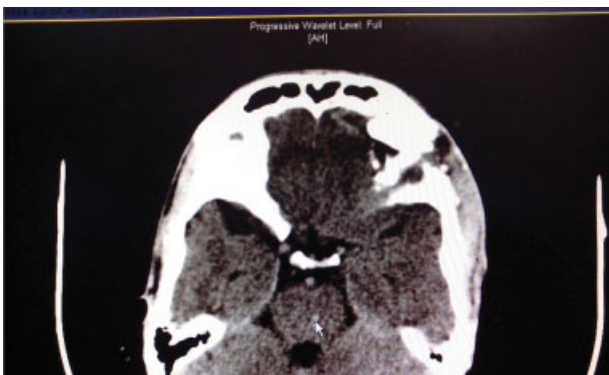


Fig. 6 Postoperative, noncontrast computed tomography head, showing complete removal of foreign body.

last follow-up at 1 year following surgery, he showed no improvement in the vision.

Discussion

Penetrating head injury, where foreign body gets entrance through orbital route and secondarily causing brain injury is considered very rare occurrence and may be either high- or low-velocity type but mostly are caused by missile injuries, gunshot, and shrapnel wounds. However, nonmissile-penetrating injury are usually caused by metallic or sharp cutting objects but also reported by wooden sticks.²⁻⁴

The most frequently encountered penetrating foreign bodies in brain and orbits are different metallic objects and glass fragments, and usually cause minimal inflammatory reaction within the periorbital fat, excepting of copper material. However, wooden material is known to cause

intense acute inflammatory reaction as high microbial contamination load due to their porous consistency, which may become chronic with grave sequelae, if left untreated.⁵ Various complications include periorbital abscess, panophthalmitis, meningitis, and brain abscess.^{4,6}

Penetrating craniocerebral injuries are more amenable to treatment compared with devastating effects of missile injuries. A penetrating injury only creates a narrow hemorrhagic infarction mainly confined around the wound tract. However, missile injury produces concentric zones of coagulative necrosis resulting from cavitating forces of blast waves.

Vascular compromise may be effect of direct vascular trauma of internal carotid artery both in its intracavernous and paraclinoid cause, to distortion and displacement of the vessel caused by mass effects of hematoma formation or edema, or vasospasm.

The damage incurred is largely dependent on the kinetic energy, trajectory, reactivity, and contamination loads carried with the object through the brain.⁷

A clinical history and detailed clinical evaluation can be helpful in judging local injury to eye globe and optic nerve. An array of neuroimaging studies of head like X-ray, CT, magnetic resonance imaging (MRI), and sonography have been advocated for the detection of entry wounds, retained foreign bodies, and current placement of objects.⁵⁻⁹ However, wooden foreign bodies are difficult to detect through ordinary X-ray, has only pick-up rate of 15% of patients, causing often missed or delayed diagnosis.

Ultrasonography is noninvasive, can be used to exclude metallic objects, that is, negative results identify those patients, who may safely proceed to MRI scanning.^{10,11} Although CT scanning is excellent for high-density material, such as glass or metal, it is much less sensitive for low-density objects such as organic material.⁴ Dry wood appears as a linear, circular or oval lucency, similar to air. However, green wet wood is more difficult to be detected on CT scan and resembles that of the surrounding periorbital fat.¹²

Noncontrast CT head and maxillofacial region is the best imaging modality for this trauma, can be helpful in delineating trajectory taken by foreign body and if traversing Sylvian fissure or carotid cistern increases possibility of injury to internal carotid artery, anterior or middle cerebral arteries. In case of suspicion for vascular injury, an angiography must be performed to evaluate for traumatic aneurysm.^{13,14}

Complication of penetrating injury includes cerebrospinal fluid (CSF) fistulas, cerebral contusions, subdural and epidural hematoma, subarachnoid hemorrhage, pneumocephalus, cerebral edema, etc. Infective sequelae include brain abscess, encephalitis, meningitis, and scalp abscess. Vascular involvement in trajectory may cause posttraumatic arteriovenous fistula formation, pseudoaneurysm is relatively rare, but diagnosis of rare but important entity is quite essential.^{3,5,8,14}

The surgical management aims at initial resuscitation, removal of foreign body, and skull bone fragments, meticulous watertight dural repair, focal debridement of the scalp, skull, and involved parenchyma. Satyarthee et al advised

watertight dural closure is the mainstay of the surgical management of penetrating brain injuries, which can be repaired either primarily or duraplasty utilizing harvested pericranium, temporalis fascia or fascia lata to avoid CSF fistula development in the postoperative period.¹⁴ Surgical reparation of lacerated facial injury was performed in a single surgical procedure by a team comprising of neurosurgeons and maxillofacial surgeons and plastic surgeon.

Final prognostic outcome is dependent on multiple factors including the GCS at presentation at causality, cardiorespiratory functional status and comorbid illness.^{5,14} Despite modern advances, penetrating injuries of head carries a higher morbidity than blunt trauma even in a civilian injury. However, after timely removal of the penetrating objects and intensive medical management, outcome may remain gloomy. However, definitely constitute an occupational hazard, beside promoting helmet while driving vehicle, personal protective instrument in factory can be made a legal requirement for prevention of such injury in future. Adequate use of protective head and facial gear by the workers can be additional preventive measures.

Note

This study was conducted at the Department of Neurosurgery, Neurosciences Centre, All India Institute of Medical Sciences (AIIMS), New Delhi, India.

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