

■ CASE REPORT

DOI: 10.70620/CRROA/v7i2/161

Penetrating Craniocerebral Injury With a Retained Axe Blade: A Case Report

Abdirisak Ali Abukar¹, Hussein Salad Yusuf^{1,*}, Kudret Tezel¹, Abdiaziz Siad Mohamed¹, Zakariye Yusuf Mohamed¹, Mustaf Abdi Ulusow¹, and Mohamed Osman Dahir Alasow²

¹Department of Neurosurgery, Mogadishu Somali Turkey Recep Tayyip Erdogan Training and Research Hospital, Mogadishu, Somalia.

²Department of Radiology, Mogadishu Somali Turkey Recep Tayyip Erdogan Training and Research Hospital, Mogadishu, Somalia.

***Corresponding author:** Hussein Salad Yusuf, Department of Neurosurgery, Mogadishu Somali Turkey Recep Tayyip Erdogan Training and Research Hospital, Mogadishu, Somalia | Email: husseinsaladyusuf@gmail.com | ORCID ID: <https://orcid.org/0009-0002-9333-3826>

Received: 17 September, 2026 · Accepted: 13 October, 2026 · Published: 19 October, 2026



© 2026 The Author(s). Published by Gnoscience Publishing House. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) License.

ABSTRACT

Background: Penetrating traumatic brain injury (pTBI) is an uncommon but potentially devastating form of traumatic brain injury characterized by violation of the skull and intracranial structures by a foreign object. Although most penetrating brain injuries described in the literature are caused by firearms or other missiles, non-missile penetrating injuries caused by sharp or heavy objects such as knives, axes, and other tools are rare. These injuries may produce extensive skull disruption, cerebral laceration, vascular injury, contamination, and secondary brain damage. Prompt resuscitation, appropriate neuroimaging, controlled removal of the penetrating object, surgical debridement, hemostasis, and dural reconstruction are central components of management.

Case Presentation: An 18-year-old male presented to the Emergency Department approximately 10 hours after sustaining a severe penetrating craniocerebral injury caused by an axe. On arrival, his Glasgow Coma Scale (GCS) score was 7/15. Both pupils were 3 mm, equal, and reactive to light. He was immediately endotracheally intubated for airway protection and ventilatory support. Cranial computed tomography demonstrated a retained metallic axe blade traversing the cranial vault from the left temporal region toward the right parieto-temporal region, with extensive comminuted and displaced calvarial fractures and a large underlying cerebral parenchymal defect and traumatic laceration. Metallic streak artifact from the retained blade substantially limited evaluation of the remaining intracranial structures. The patient underwent emergency neurosurgical intervention, including controlled removal of the axe blade, debridement of devitalized cerebral tissue, hemostasis, dural reconstruction, and management of the extensive cranial defect. Postoperatively, he remained critically ill and mechanically ventilated. On the second postoperative day, his GCS was 6/15 and both pupils were 4 mm with sluggish bilateral light responses. Despite intensive postoperative management, his neurological condition remained poor. He subsequently deteriorated and died on postoperative day 11.

Conclusion: This case demonstrates the catastrophic nature of severe non-missile penetrating craniocerebral trauma caused by an axe. Extensive calvarial destruction, major cerebral laceration, retained intracranial foreign material, and profound neurological impairment at presentation were associated with an unfavorable outcome despite urgent surgical management. Early recognition, airway stabilization, careful imaging, controlled extraction of the penetrating object, appropriate debridement, hemostatic control, and dural reconstruction remain important principles in the management of these rare injuries.

Keywords: Penetrating brain injury; Axe injury; Non-missile trauma; Retained foreign body; Cerebral laceration; Neurosurgery; Case report.

Citation: Abukar AA, Yusuf HS, Tezel K, et al. Penetrating Craniocerebral Injury With a Retained Axe Blade: A Case Report. *Case Rep Rev Open Access*. 2026;7(2):161. DOI: 10.70620/CRROA/v7i2/161

1. Introduction

Penetrating traumatic brain injury (pTBI) is a severe form of traumatic brain injury in which an external object violates the skull and penetrates the intracranial compartment, potentially causing direct injury to the dura, cerebral parenchyma, and intracranial vascular structures [1]. Penetrating injuries are encountered in both civilian and military populations and are associated with substantial morbidity and mortality. The severity of injury depends on the mechanism, trajectory, velocity and mass of the penetrating object, anatomical structures involved, extent of cerebral destruction, and associated vascular and systemic injuries [2].

Non-missile penetrating brain injuries caused by objects such as knives, axes, rods, and other sharp or heavy tools are less common [2,3]. Axe-related cranial injuries are particularly unusual and may produce a combination of sharp-force penetration, depressed and comminuted skull fractures, extensive cerebral laceration, and retained foreign material. Published reports describe variable outcomes following axe-related cranial injuries [3-5].

Much of the published penetrating traumatic brain injury literature focuses on missile-related mechanisms, whereas non-missile injuries are comparatively uncommon [2,6].

Computed tomography (CT) is an important initial imaging modality for defining the bony injury, trajectory of the penetrating object, intracranial hemorrhage, and associated cerebral injury [1,3]. However, metallic objects can produce substantial streak artifact, potentially limiting assessment of adjacent intracranial structures. When vascular injury is suspected based on the trajectory or imaging findings, vascular imaging may be required [1].

Management requires rapid resuscitation and multidisciplinary decision-making. The contemporary Brain Trauma Foundation guidelines emphasize individualized assessment of penetrating brain injuries, including resuscitation, imaging, surgical management, prevention of complications, critical care, and prognosis. Surgical principles include controlled removal of the penetrating object when indicated, management of devitalized tissue and accessible bone fragments, control of hemorrhage, and repair of dural defects [1,6].

We present an exceptionally severe axe-related penetrating craniocerebral injury in an 18-year-old male, characterized by extensive calvarial destruction, a retained intracranial axe blade, major cerebral parenchymal laceration, severe neurological impairment, and death despite emergency neurosurgical intervention.

2. Case Presentation

An 18-year-old male patient was brought to the Emergency Department approximately 10 hours after sustaining a severe penetrating craniocerebral injury caused by an axe (Figure 1).

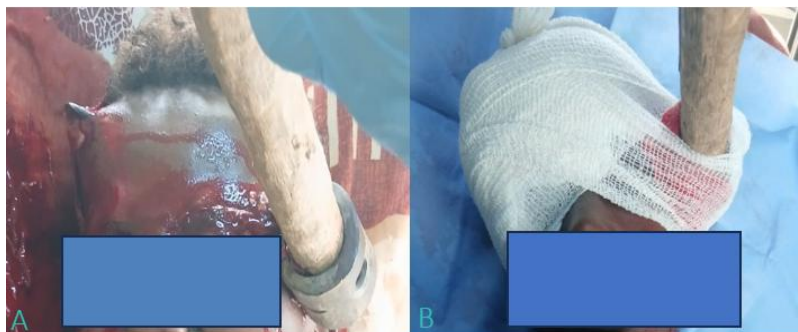


Figure 1. Clinical photographs. (A) Preoperative view of the axe penetrating the cranial region. (B) View of the retained axe with surrounding head dressing.

On initial presentation, the patient had a Glasgow Coma Scale (GCS) score of 7/15, consistent with severe traumatic brain injury. Both pupils measured approximately 3 mm, were equal and isocoric, and were reactive to light bilaterally. Given the depressed level of consciousness and severity of the injury, the patient was immediately endotracheally intubated to secure the airway and provide adequate ventilation. The results of routine preoperative laboratory investigations are presented in Table 1.

Table 1. Laboratory Results

Test	Result	Unit	Reference Range	Note
WBC	5.98	$10^3/\mu\text{L}$	4.0–10.0	Normal
RBC	4.83	$10^6/\mu\text{L}$	4.2–5.4	Normal
HGB	12.1	g/dL	12.0–16.0	Normal
HCT	46.4	%	36–46	High
PLT	237	$10^3/\mu\text{L}$	150–400	Normal
MCV	96	fL	80–100	Normal
MCH	29.3	pg	27–33	Normal
MCHC	30.5	g/dL	32–36	Low
PT	11	sec	11–13.5	Normal
INR	1.09	—	0.8–1.1	Normal
APTT	20.9	sec	25–35	Low
TSH	2.44	$\mu\text{IU/mL}$	0.4–4.0	Normal

3. Neuroimaging

Initial cranial computed tomography demonstrated a catastrophic penetrating cranial injury with a large retained metallic foreign body corresponding to the axe blade (Figure 2). The blade traversed the cranial vault from the left temporal region toward the right parieto-temporal region.

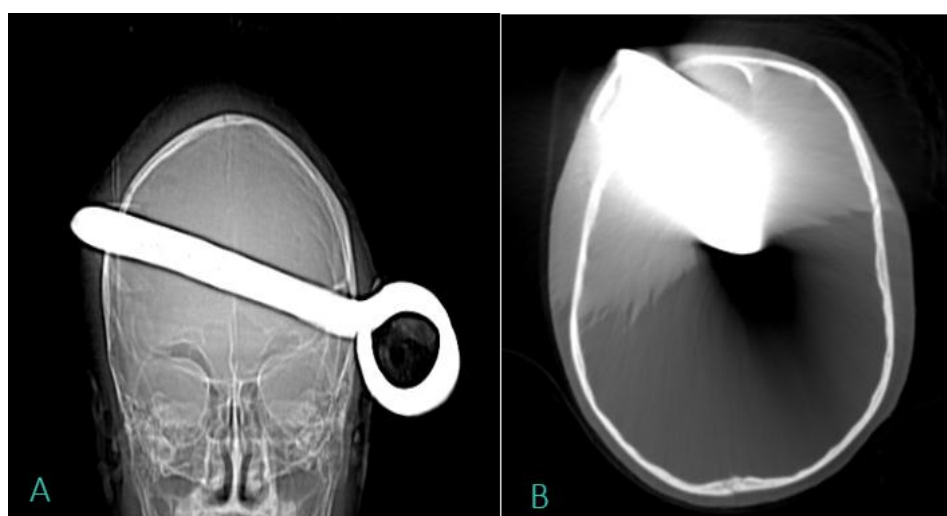


Figure 2. Preoperative cranial imaging. (A) Frontal scout/localizer view showing the retained metallic axe and handle projected across the head. (B) Axial CT image showing the retained metallic axe blade and pronounced streak artifact obscuring adjacent structures.

There was extensive destruction of the calvarium along the trajectory of the penetrating object, with multiple comminuted and displaced osseous fragments. A large underlying cerebral parenchymal defect with extensive traumatic laceration was present along the trajectory of the axe blade, consistent with severe penetrating brain injury.

Extensive metallic streak artifact generated by the retained axe blade substantially impaired evaluation of the remaining intracranial structures, limiting assessment for additional intracranial hemorrhage and other associated traumatic lesions.

4. Surgical Management

Given the severity of the penetrating injury, the retained intracranial foreign body, extensive calvarial disruption, and major underlying cerebral parenchymal injury, the patient was transferred emergently to the operating room for definitive neurosurgical management.

An extensive craniocerebral surgical procedure was performed. The retained metallic foreign body was carefully removed under operative conditions. Devitalized cerebral tissue was debrided, and the traumatic cranial defect was surgically managed. Intraoperative hemostasis was achieved, followed by dural reconstruction (duroplasty) and appropriate surgical management of the extensive calvarial injury (Figure 3). Intraoperative blood product transfusion consisted of 3 units of packed red blood cells (erythrocyte concentrate) and 2 units of fresh frozen plasma.



Figure 3. Operative photographs. (A) Exposed operative field showing the penetrating axe and cranial surgical exposure. (B) Extracted axe displayed on a surgical drape alongside instruments.

5. Postoperative Course

Following surgery, the patient was transferred to the intensive care unit for postoperative neurocritical care and close neurological and systemic monitoring. He remained critically ill and mechanically ventilated.

Postoperative medical management included ceftriaxone 1 g twice daily, levetiracetam 500 mg twice daily for seizure prophylaxis, 20% mannitol 100 mL four times daily, pantoprazole 40 mg once daily, paracetamol infusion 10 mg/mL twice daily, and intravenous metronidazole 500 mg every 8 hours, together with appropriate intravenous fluid management to maintain adequate hydration, hemodynamic stability, and fluid-electrolyte balance.

On the second postoperative day, his vital signs remained within normal limits; however, there was no meaningful neurological recovery. His GCS was 6/15. Both pupils measured 4 mm and were sluggishly reactive to light bilaterally.

Despite intensive postoperative management, including antimicrobial therapy, seizure prophylaxis, osmotherapy, analgesia, and supportive critical care, the patient's neurological condition remained poor. On postoperative day 4, further clinical deterioration was reported. His neurological status did not recover, and he subsequently died on postoperative day 11.

The patient remained in a state of severe neurological impairment throughout the postoperative period, with no documented meaningful neurological recovery. On postoperative day 4, further clinical deterioration was observed. From postoperative day 5 through postoperative day 11, the patient's clinical condition remained critical, with persistent severe neurological dysfunction. Repeat cranial computed tomography (CT) was not performed because of the patient's hemodynamic instability and critical clinical condition, which precluded safe transportation to the radiology department. Consequently, interval radiological assessment of intracranial changes and potential secondary complications was not possible.

Despite ongoing medical management and supportive care, the patient did not demonstrate significant clinical improvement and subsequently died on postoperative day 11.

6. Discussion

Penetrating brain injury represents a particularly severe form of traumatic brain injury because the penetrating object directly violates the skull and intracranial structures. Unlike closed head trauma, pTBI can produce a combination of focal tissue destruction, skull fragmentation, dural disruption, contamination, vascular injury, and secondary brain injury [1,2]. The 2026 second edition of the Brain Trauma Foundation guidelines specifically addresses modern management of penetrating traumatic brain injury and emphasizes that the available evidence remains limited, with much of the literature derived from observational studies and case series [1].

Axe-related penetrating cranial trauma is uncommon. Previous reports have documented severe craniocerebral injuries caused by axe strikes, including cases in which the axe blade remained embedded within the skull and brain [3-5]. In one previously reported case, a young patient presented comatose following an axe injury, underwent craniectomy around the retained blade and removal of the object, followed by evacuation of contused and necrotic brain tissue, and ultimately had an uneventful recovery [3]. More recently, a 2026 case report described a retained axe blade penetrating the parietal region in a 23-year-old man who underwent controlled removal, debridement, and dural repair, with a favorable short-term outcome [4]. These reports illustrate the considerable variability in outcome following apparently similar mechanisms of penetrating cranial injury.

The present case had extensive structural injury and a fatal outcome, but its severity cannot be ranked reliably against published cases using the available case-report descriptions. In particular, a previously published patient was also comatose at presentation [3]. The patient presented approximately 10 hours after injury with a GCS of 7/15 and CT evidence of extensive bilateral calvarial disruption along the trajectory of the axe blade, together with major underlying cerebral parenchymal laceration. The retained blade traversed the cranial vault from the left temporal region toward the right parieto-temporal region. Such a trajectory indicates extensive structural disruption and raises concern for injury to multiple intracranial compartments and potentially major vascular structures.

The initial neurological status is an important prognostic consideration in penetrating brain injury. A profoundly depressed GCS at presentation may reflect extensive primary cerebral destruction, associated intracranial hemorrhage, cerebral edema, or other secondary injuries. In the present patient, the initial GCS was 7/15, and meaningful neurological recovery did not occur despite emergency surgical intervention and intensive postoperative management.

CT is central to the initial evaluation of penetrating brain injury because it provides information regarding the trajectory of the foreign body, skull fractures, intracranial hemorrhage, pneumocephalus, and associated parenchymal injury [1,4]. However, metallic foreign bodies may produce extensive streak artifact, as occurred in this patient, limiting visualization of intracranial structures adjacent to the object. This limitation is particularly important when assessing the extent of associated hemorrhage and potential vascular injury.

Vascular injury is an important concern in penetrating brain trauma. The trajectory of a penetrating object near major intracranial vessels or venous structures may warrant vascular imaging when clinically feasible [1,7]. However, the decision must be individualized according to the patient's condition, trajectory, available resources, and the urgency of surgical intervention. In the present case, the CT examination was substantially limited by metallic artifact, and the clinical severity necessitated emergency operative management.

The timing and technique of foreign-body removal are critical. Penetrating objects should not be removed casually or before adequate surgical preparation because removal may precipitate catastrophic hemorrhage or additional neurological injury if the object is tamponading an injured vessel or has become embedded within critical structures [1,6]. Contemporary management emphasizes controlled operative removal when indicated and appropriate preparation for potential vascular or parenchymal complications.

In this patient, the axe blade was removed during emergency neurosurgical intervention rather than being extracted before definitive operative management.

Surgical debridement also requires careful balance. Devitalized tissue and accessible contaminated or nonviable material may require removal, but excessive manipulation of viable brain tissue can produce additional neurological injury [6]. The goal is therefore to achieve adequate debridement while preserving viable cerebral tissue. In the present case, extensive traumatic cerebral laceration and devitalized tissue required surgical debridement.

Dural reconstruction is another important component of surgical management. Extensive dural disruption can predispose to cerebrospinal fluid leakage, wound complications, and intracranial infection. Repair of the dural defect aims to restore separation between the intracranial and extracranial compartments and facilitate wound healing [1,6,8]. Dural reconstruction was therefore performed in the present patient following removal of the axe blade and cerebral debridement.

The prognosis following penetrating brain injury is influenced by the initial neurological status, extent and location of brain injury, bihemispheric involvement, vascular injury, associated systemic trauma, and secondary complications [1]. The recently published Brain Trauma Foundation guideline identified bihemispheric injury as one of the factors associated with mortality in adult penetrating brain injury and emphasizes the importance of individualized prognostic assessment [1]. In this case, the combination of severe initial neurological impairment, extensive calvarial destruction, major cerebral laceration, and persistent postoperative coma was associated with an ultimately fatal outcome.

This case also demonstrates the heterogeneity of outcomes after axe-related penetrating brain trauma. Previously published patients with retained axe blades have survived with either good or partially improved neurological outcomes [3,4], whereas the present patient died despite emergency surgical treatment. This difference emphasizes that the presence of an axe or other low-velocity object alone does not determine prognosis; rather, the extent and anatomical distribution of the resulting intracranial injury are critical.

There are several limitations to this case report. This case report is limited by incomplete operative documentation; the arrival-to-surgery interval, operative approach, extent of bone removal, estimated blood loss, and intracranial pressure monitoring data were not available for inclusion. Intraoperative transfusion of 3 units of packed red blood cells and 2 units of fresh frozen plasma was documented; however, the estimated blood loss was unavailable. Repeat cranial CT was not performed because the patient's clinical instability prevented safe transportation for imaging, and the immediate cause or mode of death was not documented in the available records. As a single-patient report, this case cannot establish treatment effectiveness or generalize outcomes. The initial CT assessment was substantially limited by metallic artifact. The patient presented approximately 10 hours after injury following travel from a distant area, without medical management before arrival at our institution; detailed prehospital information was therefore unavailable. Postoperative medical management and supportive treatment provided at our institution are described above.

7. Conclusion

Axe-related penetrating craniocerebral injury is a rare but potentially catastrophic form of non-missile penetrating brain trauma. The present case was characterized by extensive calvarial destruction, a retained intracranial axe blade, major cerebral parenchymal laceration, severe neurological impairment at presentation, and an ultimately fatal postoperative course.

Management requires rapid stabilization, careful imaging, urgent multidisciplinary neurosurgical assessment, controlled removal of the penetrating object, appropriate debridement of devitalized tissue, meticulous hemostasis, management of the cranial defect, and dural reconstruction. Despite aggressive treatment, extensive primary cerebral injury may result in irreversible neurological damage and death. This case adds to the limited literature on severe axe-related penetrating brain injuries and highlights the importance of early recognition and definitive neurosurgical management.

8. Ethics Approval and Consent to Participate

Ethical approval was not required for this case report in accordance with applicable institutional policies. Written informed consent for publication was obtained from the patient's next of kin.

9. Consent for Publication

Written informed consent for publication of this case report and the accompanying clinical images was obtained from the patient's next of kin.

10. Funding

The authors received no funding for this study.

11. Conflict of Interest

The authors declare that they have no competing interests or financial or commercial relationships that could have influenced the work reported in this manuscript.

12. Clinical Trial Registration

Not applicable.

13. Data Availability

No datasets were generated or analyzed during the current study. Additional patient information is not publicly available because of patient privacy and confidentiality.

14. Authors' Contributions

Abdirisak Ali Abukar: Investigation, Clinical Management, Data Curation, Writing – Review & Editing.

Hussein Salad Yusuf: Conceptualization, Methodology, Investigation, Clinical Management, Surgical Procedure, Writing – Original Draft, Supervision.

Kudret Tezel: Investigation, Clinical Management, Writing – Review & Editing.

Abdiaziz Siad Mohamed: Investigation, Data Curation, Writing – Review & Editing.

Zakariye Yusuf Mohamed: Investigation, Data Curation, Writing – Review & Editing.

Mustaf Abdi Ulusow: Formal Analysis, Data Curation, Visualization, Writing – Review & Editing.

Mohamed Osman Dahir Alasow: Radiological Assessment, Imaging Analysis, Visualization, Writing – Review & Editing.

All authors reviewed and approved the final manuscript and agreed to be accountable for all aspects of the work.

15. Acknowledgements

The authors thank the medical staff involved in the management of this patient.

16. References

1. Bell RS, Selph S, Ghajar J, et al. Brain trauma foundation guidelines for the management of penetrating traumatic brain injury, second edition. *Neurosurgery*. 2026;98(3 Suppl). [PubMed](#) | [CrossRef](#).

2. Hawryluk GWJ, Selph S, Lumba-Brown A, et al. Rationale and methods for updated guidelines for the management of penetrating traumatic brain injury. *Neurotrauma Rep.* 2022;3(1):240-247. [PubMed](#) | [CrossRef](#).
3. Stephanov S. Severe craniocerebral injury by an axe with good outcome: Case report. *Swiss Surg.* 1999;5(2):80-82. [PubMed](#) | [CrossRef](#).
4. Golmei J, Kaushal S, Prasad H, et al. Low-velocity penetrating cranial trauma with a retained axe: Surgical management and operative challenges in a civilian assault case. *Cureus.* 2026;18(3):e105822. [PubMed](#) | [CrossRef](#).
5. Pirjavec A, Lulić I, Ković I, et al. Severe traumatic brain injury after the assault with an axe handle. *Coll Antropol.* 2012;36(1):339-344. [PubMed](#).
6. Kazim SF, Shamim MS, Tahir MZ, et al. Management of penetrating brain injury. *J Emerg Trauma Shock.* 2011;4(3):395-402. [PubMed](#) | [CrossRef](#).
7. Bell RS, Lumba-Brown A, Wright DW, et al. Treatment algorithms from the brain trauma foundation guidelines for the management of penetrating traumatic brain injury, second edition. *Neurosurgery.* 2026;98(3 Suppl):S165-S182. [CrossRef](#).
8. Kitagawa R, Dengler B, Hawryluk GWJ, et al. Executive summary of the brain trauma foundation guidelines for the management of penetrating traumatic brain injury, second edition. *J Trauma Acute Care Surg.* 2026;100(3):371-379. [PubMed](#) | [CrossRef](#).