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Case Report

Complete Recovery from a Destructive Penetrating Craniofacial Gunshot Wound with a Low Initial GCS: A Case Report

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Abstract

Background: Penetrating craniofacial gunshot wounds (GSWs) are among the most lethal forms of traumatic brain injury (TBI). Civilian survival rates are frequently below 15%, and mortality rates approach 80–98% in patients presenting with a Glasgow Coma Scale (GCS) score ≤5. Although admission GCS is the strongest predictor of outcome, limited cases of meaningful recovery suggest that prognosis should not rely on GCS alone.

Case Presentation:A 25-year-old man presented one hour after a self-inflicted point-blank craniofacial gunshot wound. On arrival, he was hypotensive (80/50 mmHg), hypoxic (SpO_2 ~60%), and comatose with GCS 5 (E1V1M3). Examination revealed a large destructive left craniofacial wound with exposed brain tissue, a ruptured left globe, decorticate posturing, and a fixed dilated right pupil. After aggressive resuscitation and stabilization, computed tomography demonstrated extensive comminuted craniofacial fractures, a large left frontal bone defect, and unilateral frontal lobe contusions without ventricular violation or a transhemispheric trajectory. Emergent multidisciplinary surgery included extensive debridement, removal of bone and foreign fragments, hemostasis, duraplasty using fascia lata graft, and staged facial reconstruction. Postoperatively, the patient demonstrated rapid neurological improvement. By postoperative day 7, he was fully conscious, oriented, and neurologically intact except for left monocular blindness. A transient cerebrospinal fluid (CSF) leak resolved with conservative therapy. At 12 months, he exhibited normal speech, intact motor function, and stable cognitive recovery.

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Conclusion: Extremely low admission GCS should not automatically preclude aggressive intervention in penetrating brain injury. Injury trajectory, ventricular involvement, rapid correction of secondary insults, and coordinated multidisciplinary management critically influence outcome. Carefully selected patients may achieve meaningful recovery despite traditionally grave prognostic indicators.

Keywords: CranioPenetrating brain injury; Craniofacial gunshot wound; Glasgow Coma Scale; Prognosis; Multidisciplinary surgery

Introduction

Penetrating gunshot wounds (GSWs) are a major cause of traumatic brain injury (TBI) in many regions, and are largely driven by firearm violence and suicide [1]. Self-inflicted cranial GSWs are associated with particularly high mortality compared with assault- or accident-related injuries [2]. Overall survival following civilian craniocerebral gunshot wounds remains poor, frequently below 15% [3].

Ballistic injury results from both permanent cavitation caused by the projectile tract and temporary cavitation from shockwave energy transmission, which extends tissue damage beyond visible disruption [4]. Compared with other penetrating mechanisms such as stab wounds, gunshot-related TBI carries substantially higher mortality and worse neurological outcomes [5].

Admission neurological status, particularly the GCS score, remains the most reliable predictor of survival. Mortality exceeds 80–90% in patients presenting with GCS 3–5 [6,7]. Additional predictors of poor outcome include nonreactive pupils, bihemispheric or transventricular trajectory, advanced age, hypotension, and hypoxia [7-10].

Craniofacial GSWs introduce further reconstructive complexity and contamination risk. Management requires rapid resuscitation, early surgical intervention, and multidisciplinary coordination. We report a case of severe self-inflicted craniofacial GSW with initial GCS 5 and complete neurological recovery.

Report

Clinical Presentation:

A 25-year-old man was brought to the emergency department approximately one hour after a self-inflicted craniofacial gunshot wound. He was comatose and bleeding profusely from the face.

On arrival, he was pale and hemodynamically unstable, with a blood pressure of 80/50 mmHg and a weak pulse. His airway was compromised by blood in the oropharynx, resulting in obstructed respirations and hypoxia (SpO_2 approximately 60%). Neurological examination revealed GCS 5 (E1V1M3) with decorticate posturing. The right pupil was fixed and dilated; the left pupil was unassessable due to globe rupture.

Advanced Trauma Life Support protocols were initiated immediately. Endotracheal intubation secured the airway. Mechanical ventilation, intravenous fluid resuscitation, hemorrhage control, and cervical spine

immobilization were performed. No prior psychiatric history was reported.

Local Examination and Further Management:

After hemodynamic stabilization, a detailed assessment revealed a large, irregular laceration involving the left face and forehead, extending from the submental region upward through the cheek and temple into the cranial cavity, consistent with a through-and-through craniofacial trajectory. There was extensive soft tissue destruction, comminuted facial fractures, and gross contamination. The left globe was ruptured with significant orbital disruption. A large defect of the left frontal bone exposed underlying brain tissue (**Figure 1**).

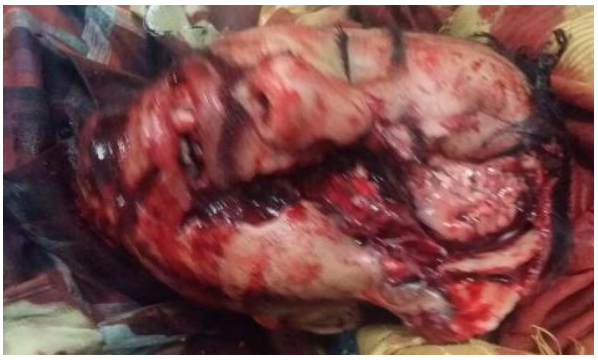

Figure 1: Large lacerated wound in the left aspect of the face and left cranial region with exposure of the underlying brain tissue and matter.

Adjunctive management included tetanus prophylaxis, broad-spectrum intravenous antibiotics, anticonvulsant loading for seizure prevention, and general methods of intracranial hypertension management. After stabilization, urgent imaging was obtained.

Imaging Findings:

Non-contrast head CT demonstrated extensive craniofacial trauma. Three-dimensional reconstructions revealed a large defect of the left frontal skull extending into portions of the right frontal and left parietal bones, with outwardly beveled margins consistent with an exit wound. Comminuted fractures involved the left orbit, zygoma, maxilla, and mandible. The left globe was destroyed. Axial CT images showed extensive left frontal lobe contusions beneath the bony defect, with mixed-density hemorrhagic injury and pneumocephalus. Scattered intracranial bone and projectile fragments were present in the frontal region (**Figure 2**). Importantly, no clear projectile tract crossed the midline, and the ventricular system remained intact. Cervical spine CT showed no fracture or instability.

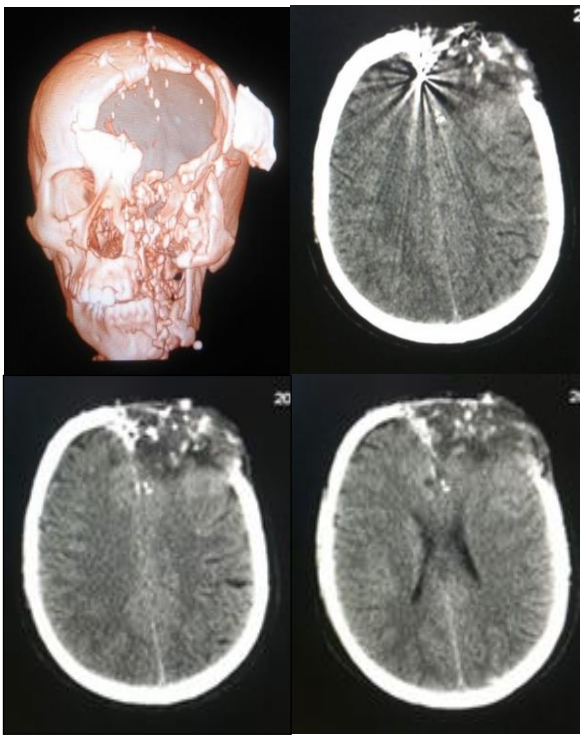

Figure 2: Preoperative non-contrasted head CT: **3D cut** demonstrating a large bone defect in the left frontal cranium with loss of bone and extension into the right frontal and left parietal regions, along with multiple comminuted facial bone fractures. **Axial cuts**: Axial CT showing extensive contusions in the left frontal lobe beneath the skull defect, with scattered bone and bullet fragment shrapnel in the brain parenchyma.

Operative Management:

Emergent multidisciplinary surgery was performed within hours of admission after obtaining high-risk informed consent. Neurosurgery and maxillofacial teams collaborated.

The neurosurgical procedure included extensive debridement of devitalized and contaminated brain tissue, removal of bone fragments and foreign debris, copious saline irrigation, and meticulous hemostasis. Dural and cortical bleeding was controlled using bipolar cautery and hemostatic agents. A duraplasty was performed with a fascia lata graft to reconstruct the frontal dural defect.

Concurrently, the maxillofacial team debrided nonviable facial tissue and initiated primary reconstruction, including layered closure of soft tissue defects and stabilization of remaining bony structures where feasible. The ruptured left globe was managed by the ophthalmology team with evisceration and wound closure.

After achieving adequate hemostasis and closure of the craniofacial wounds, the patient was transferred intubated to the intensive care unit for postoperative management.

Postoperative Course:

The patient remained mechanically ventilated and sedated for 48 hours. Intracranial pressure was managed conservatively with head elevation and osmotic therapy.

By postoperative day 3, neurological improvement was observed. The patient`s GCS score improved to approximately 10 (E4 M5 T1), and he began following simple commands. He was extubated the same day.

By postoperative days 6–7, he was fully conscious, oriented, and conversant, with intact motor strength and speech (Figure 3). The primary persistent neurological deficit was complete loss of vision in the left eye.

Figure 2: Postoperative images for the patient indicating his abilities to move, stand up and sit freely.

A cerebrospinal fluid (CSF) leak from the left orbital region developed during recovery. This was managed conservatively with acetazolamide and head elevation, resolving completely within two weeks. Follow-up CT imaging demonstrated stable postoperative findings without new hemorrhage or hydrocephalus (Figure 4).

The patient exhibited retrograde amnesia and mild behavioral changes consistent with frontal lobe injury. Psychiatric evaluation and counseling were initiated. He was discharged on postoperative day 25, neurologically intact except for blindness in the left eye and mild cognitive changes. He was independently ambulatory and maintained on anticonvulsant therapy for seizure prophylaxis. Delayed cranioplasty was planned following neurological stabilization.

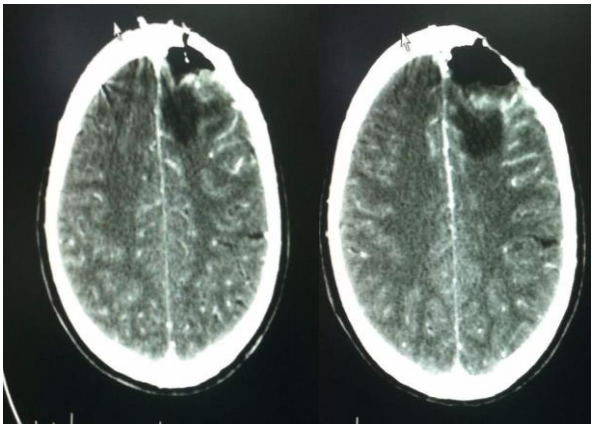

Figure 4 : Postoperative Day 8 head CT shows postoperative changes with the left frontal craniectomy defect and resolving contusions in the left frontal lobe.

Long-Term Follow-Up

At follow-up visits up to 12 months post-injury, the patient remained neurologically stable with normal speech, coordination, and motor function. There were no recurrent CSF leaks or infectious complications. Behavioral and cognitive symptoms improved over time.

Discussion

Penetrating craniocerebral gunshot wounds (GSWs) remain among the most lethal forms of traumatic brain injury, with reported civilian survival rates ranging from 7% to15% [3,10]. Mortality is particularly high in self-inflicted injuries and close-range discharge [2]. Contemporary comparative analyses further confirm that penetrating TBI carries significantly higher mortality and worse functional outcomes than severity-matched blunt TBI, emphasizing the distinct biological severity of ballistic injury [11].

Admission neurological status remains the strongest independent predictor of survival. Mortality rates exceeding 80–90% have been reported in patients presenting with GCS 3–5 [6,7]. Sustained functional recovery in such a clinical constellation is distinctly uncommon in contemporary civilian case series. Pupillary nonreactivity and bihemispheric injury further increase the mortality risk [7,10]. Recent large-cohort analyses reaffirm that GCS, non-reactive pupils, and trajectory pattern independently predict both mortality and long-term outcome [12].

However, GCS alone does not fully capture the biological complexity of penetrating brain injury. Ballistic trauma causes both permanent cavitation and temporary cavitation, resulting in tissue destruction beyond the visible tract [4]. Yet the outcome is strongly influenced by the trajectory, anatomical structures involved, and secondary physiological insults.

In the present case, several adverse predictors were present: GCS 5, unilateral fixed pupil, hypotension, and extensive craniofacial destruction. Based on historical data, the predicted mortality would exceed 80–90% [6,7]. However, imaging demonstrated a predominantly unilateral anterior cranial fossa injury without transhemispheric extension or ventricular violation. Multiple studies demonstrate that bihemispheric and transventricular injuries are associated with near-uniform mortality, whereas unilateral injuries confined to frontal regions may retain salvage potential [10].

Equally critical is the prevention of secondary insults. Hypotension and hypoxia independently worsen TBI outcomes [9]. Modern systematic reviews confirm that hemodynamic instability remains a dominant determinant of mortality in firearm-related TBI [13]. Rapid correction of systemic

instability in this patient likely mitigated secondary ischemic injuries.

Recent high-volume trauma center data suggest that aggressive surgical intervention is associated with improved functional outcomes in selected civilian GSW patients [14]. Early debridement, dural repair, and contamination control may reduce inflammatory cascade activation and mass effect progression.

Reconsidering Absolute Prognostic Thresholds

Historically, extremely poor outcomes among patients with GCS ≤5 led some centers to adopt restrictive operative thresholds. Contemporary evidence increasingly supports individualized assessment rather than rigid exclusion criteria [2,15]. Rare but documented cases of meaningful recovery in patients with GCS 3–5 reinforce that initial neurological score alone should not dictate therapeutic futility [15,16].

Multivariable models such as the GCS, pupillary response, and trajectory can improve prognostic accuracy [17]. Emerging machine-learning models further refine trajectory-based risk stratification [12]. These tools emphasize composite evaluation rather than reliance on a single parameter.

Ethical Considerations

Most survivors of a cranial GSW sustain long-term deficits [1,4]. Ethical decision-making must balance the probability of meaningful recovery against the risk of survival with severe disability. However, premature nihilism may deny salvageable patients appropriate intervention. This case illustrates that carefully selected patients, particularly young individuals with unilateral injury patterns, may achieve substantial recovery.

Conclusion

Penetrating craniofacial gunshot wounds presenting with GCS ≤5 carry an extremely high mortality rate. However, low GCS alone should not automatically preclude aggressive intervention. Injury trajectory, ventricular involvement, physiological stabilization, and early multidisciplinary surgery significantly influence outcome. Carefully selected young patients with unilateral injury patterns may achieve meaningful neurological recovery despite traditionally grave prognostic indicators. Individualized assessment remains essential in guiding management decisions for severe penetrating brain injury.

Limitations

This report represents a single case. Prognosis in penetrating brain injury varies widely depending on trajectory, hemodynamic status, and resource availability. Larger multicenter studies are required to better define surgical candidacy among patients presenting with severe neurological impairment.

Conflict of Interest Statement

The authors declare that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Informed Consent

A written informed consent was obtained from the patient's family member for publication of this case report and accompanying images

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