



# Compound Elevated Skull Fracture: A Report of Two Cases and Literature Review

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**Abstract:** Elevated skull fracture unlike depressed skull fracture is rare with few cases reported in the literature. Some cases have been reported from the South-western part of Nigeria. The aim of this report is to present an unusual aetiology for compound elevated skull fracture and to highlight the need for proper imaging and careful examination under anaesthesia to identify any dura tear and institute appropriate care. This is a report of 2 cases with compound elevated skull fractures. The first patient is a 2 year old boy who sustained injury following contact with a rotating ceiling fan blade while he was being lifted up by his uncle. Whereas the other patient, a 45 year old man, had his injury inflicted following assault. Examination findings in both patients revealed scalp laceration. The first patient had no focal neurological deficit but the second patient had significant focal neurological deficit. CT scan in both patients showed elevated skull fracture and evidence of dura tear. Both patients were worked up for surgery and had craniotomy, wound debridement, duroplasty and primary wound closure. They have been doing well since discharge. In conclusion, a rotating fan blade making contact with the head with downward pull produced elevated skull fracture in young children. Early recognition and treatment of this type of fracture would reduce the morbidity and mortality and improve outcome.

**Keywords:** Compound Elevated Skull Fracture, Rotating Fan Blade, Assault, Machete

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## 1. Introduction

Elevated or everted skull fracture is defined as a fracture in which the fractured portion is elevated above the level of intact skull. [1] This was described as early as 1650–1550 BC in the Edwin Smith Papyrus which is a didactic trauma treatise of neurosurgical interest [2], [3] The first reported case in modern times was in 1976. [4] Compound elevated skull fracture (CESF) is an unusual type of fracture with few reported cases in the literature since the first reported case. [4]-[16] The largest case series reported only 8 patients. [14] Most of the reported cases are from India [7]-[9], [11], [12], [14], [15] and Turkey. [7], [8], [15] In Nigeria, some cases have been reported from the South Western part of the country. [6]

The aim of this report is to present an unusual aetiology for compound elevated skull fracture and to highlight the need for proper imaging and careful examination under anaesthesia to identify any dura tear and institute appropriate care to prevent life threatening complications.

## 2. Case Reports

### 2.1. Case 1

A 2 year old boy presented with head injury after being hit by a rotating blade of a ceiling fan when he was lifted up by his uncle. He bled from a wound on the fronto-parietal part of the scalp. He was conscious but cried excessively thereafter. He had no history of convulsion, vomiting or bleeding from any craniofacial orifices. When he presented at the accident

and emergency, his pulse rate was 140 beats per minute regular and moderate volume and his blood pressure was 90/60 mmHg. His respiratory rate was 30 cycles per minutes. His Glasgow Coma Scale (GCS) Score was 14/15 (E4V4M6). Pupils were bilaterally equal and reacting normally to light. The patient was moving all four limbs equally. Local examination revealed an inverted U-shaped wound with active bleeding on the left parieto-frontal region of the head with slight extension across the midline and there was brain matter coming out from the wound. (Figure 1a)

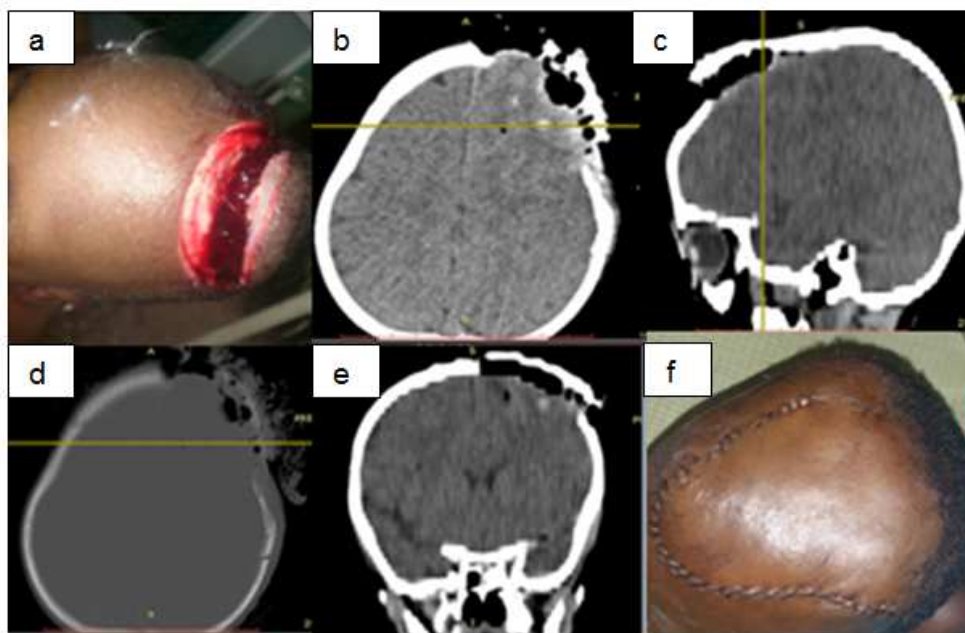
The examination of the abdomen and musculoskeletal system were essentially normal with no evidence of injuries to other organs.

The patient was resuscitated at the emergency room. After hemodynamic stabilization a non-contrast enhanced

computer tomographic (CT) scan was done. This showed a fronto-parietal elevated fracture with contusion of the underlying brain, cerebral tissue herniation and pneumocephalus. (Figure 1b-1e)

He was optimised and taken to the operating room for emergency surgery. The ends of the U-shape laceration were extended and the fractured bone flap was completed with Kerrison rongeur and delivered from the wound. The wound was irrigated thoroughly with normal saline. Contused and necrotic brain tissue was evacuated and a free pericranial graft was harvested for the repair of the dura (lax duroplasty). The bone flap was thoroughly washed with povidone-iodine and hydrogen peroxide, and was replaced.

Hemostasis was secured and the scalp wound was closed primarily. (Figure 1f)



**Figure 1.** Showing Pre-operative (a), CT Scan (b-e) and Post-operative images of case 1.

The patient was placed on broad spectrum antibiotics and anticonvulsant post-operative. He did very well subsequently and was discharged home with no neurological deficit. He has since being doing well 18 months thereafter.

## 2.2. Case 2

A 45year old man referred to our facility with sutured left sided scalp laceration from assault with a machete. He bled profusely from a wound on the left fronto-parietal part of the scalp. He was initially taken to a peripheral hospital where he was resuscitated and the scalp laceration was sutured. He was at the peripheral hospital for 48 hours and was subsequently referred to our facilities when he started deteriorating. He had history of deteriorating level of consciousness and decrease ability to move the right part of his body. He had no history of convulsion, vomiting or bleeding from any craniofacial orifices. When he presented at the accident and emergency unit of our hospital, his pulse rate was 110 beats per minute regular and moderate volume and his blood pressure was

120/85 mmHg. His respiratory rate was 18 cycles per minute. His Glasgow Coma Scale (GCS) Score was 12/15 (E4V2M6). He had anisocoria with the left pupil, 5mm dilated and sluggishly reactive to light. The right pupillary response to light was essentially normal. The power on the right upper and lower limbs was both 3/5. The power on the left upper and lower limbs was both 5/5.

Local examination revealed a sutured laceration on the left fronto-parietal part of the scalp and scalp swelling.

The examination of other systems was essentially normal. He was resuscitated at our Accident and Emergency unit and subsequently sent for emergency non contrast CT scan of the brain.

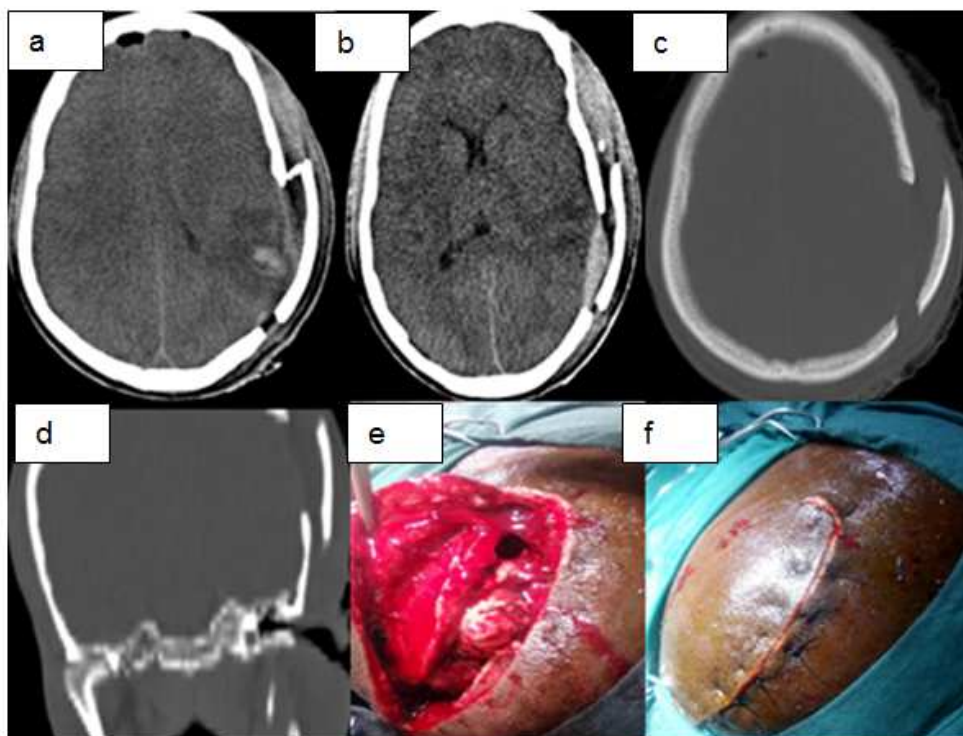
The CT brain scan showed an elevated left parieto-temporal bone fracture with contusion of the underlying parieto-temporal lobe, brain oedema, left brain evisceration, left epidural hematoma and pneumocephalus. (Figure 2a -2d)

He was immediately optimised and taken to the operating room. He had emergency surgery under general anaesthesia.

The sutured laceration was untagged and the wound ends were extended. Necrotic brain tissue was extruding out of the wound with active on-going bleeding. (Figure 2e and 2f) A completely detached bone flap was dissected from it only attachment to the overlying temporalis muscle. Epidural congealed blood was evacuated. The wound was irrigated thoroughly with normal saline. Contused brain tissue was

evacuated and a free pericranial graft was harvested for the repair of the dura (lax duroplasty). Bone flap was thoroughly washed with povidone-iodine, hydrogen peroxide and then normal saline, and was replaced.

Hemostasis was secured and the scalp wound was closed primarily. (See figure 2e and 2f for intraoperative images)



*Figure 2. Showing CT Scan (a -d) and intraoperative images (e and f) of Case 2.*

He was commenced on physiotherapy and he did very well subsequently as no focal neurologic deficit was noted prior to discharge ten days later. Glasgow outcome score at discharge was 5. He has since returned to his pre-injury activities.

### 3. Discussions

Fractures of skull bone are defined as any breach in the continuity of the skull bone and are common following trauma. [16] Classification of skull fractures is based on type (simple or compound), communication with exterior (open or closed), location (vault or basilar), and pattern (linear, diastatic, comminuted, depressed). [16] In most cases the forces causing the trauma is directed inward, thus, producing a depressed skull fracture. [15], [16] However some mechanism of injuries may produce a fractured segment that is elevated above the level of the intact skull. [6], [14] Some reported causes of elevated skull fractures are gunshot injury, railway accident, crane injury, assault, and road traffic accident. [4]-[14] The causes of the elevated skull fractures in this report were ceiling fan and assault with a machete.

The reported mechanisms for elevated skull fracture includes: (1) sharp heavy object elevating the skull by a lateral pull of weapon; (2) elevation of free fragment while

retrieving the weapon; (3) and tangential force applied to the calvarium associated with the rotation of the head. [6], [14] To this we will add a fourth mechanism which occurred in the first patient; the application of a rotating sharp blade to the head with a downward pull of the patient.

Prior to this report, few cases of elevated skull fracture in paediatric age group were reported in the literature. [14], [15] The first case in this report is one of the youngest reported patient with compound elevated skull fracture. The two patients were males which is consistent with findings among other reported cases. [16]

Clinical features in these patients depend on the site, extent, and severity of the brain injury. [4]-[8] In this report, the first patient presented with minimal neurological deficit, this may not be unconnected with the fact that elevated skull fracture unlike a depressed skull fracture does not exact mass effect on the brain. Symptoms usually occur as a result of dura tear with subsequent infection and development of brain abscess. [6], [12], [14] However, the second patient presented with deteriorating neurological deficit because of the associated dural tear, acute epidural haematoma and pneumocephalus. He may also likely have started developing brain abscess prior to his referral.

Almost in all reported cases, the patient sustained

compound wound (with herniation of the brain parenchyma and dural tear) and had maximum neurological deficits at the time of presentation. [4]-[11] The two patients in this report presented with compound elevated skull fractures. There are however few reports of closed elevated skull fracture. [16]

Non contrast enhanced CT scan of the brain with bone window is the primary investigation of choice to diagnose compound elevated skull fractures. In addition, CT scan will also show the extent of the defect and any associated injury to the underlying brain parenchyma or any other intracranial hematomas. [12], [14], [15] The first case in this report had lesion that crossed the midline, CT venography would have been necessary to rule out injury to the superior sagittal sinus but the facility is not available in our center. A case of occlusion of the superior sagittal sinus has been reported. [16]

The basic principles for the management of compound elevated skull fractures are the same as for any the other compound depressed skull fractures, these include, early recognition and prompt intervention using broad spectrum antibiotics, wound debridement, removal of loose bone fragments, removal of in-driven hairs and the repair of the dura with primary closure of the wound. [4]-[15] This was the approach in managing these patients. Some have however advocated not returning the fracture bone flap with cranioplasty done at a later date to reduce the incidence of infection. [12], [14]

It is important to note that the second case had his laceration sutured in a peripheral hospital. In one reported series this was a cause of delayed presentation and subsequent development of brain abscess which led to mortality in that report. [6]

#### 4. Conclusion

Rotating fan blade making contact with the head with downward pull may produce compound elevated skull fracture in a child. Early recognition and appropriate treatment of this type of fracture would reduce the morbidity and mortality and improve outcome.

It is recommended that compound elevated skull fracture should be included in the classification of skull fractures.

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