



Traumatic skull indentation

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A 28 years old man was brought to AED by ambulance with spinal immobilization to AED after being found unconscious on the floor of a restaurant.

On arrival to AED, he had a strong alcohol smell. His vitals were

- BP: 113/71mmHg, Pulse 105/min
- Respiratory rate: 16 breaths per minute with SpO2: 98% on room air
- GCS: 13 (E3V4M6), Pupils equal and reactive

He had 2 deep lacerations over the vertex with active bleeding. The cause and mechanism of injury were unknown. Limb power was normal except for paresis of right lower limb with power of 4. Imaging was arranged for further investigation.

What is the role of skull x-ray in head injury?

Skull x-ray is rarely indicated for detection of skull fractures. Non-contrast CT scan of brain with bone windows is the imaging modality of choice for patients with a suspected skull fracture.¹

However, if CT scan is unavailable, skull x-ray should be performed which include

angled PA radiograph of the skull which provides an overview of the entire calvarium without highlight any one region.

2. Lateral view (Figure 2): non-angled lateral radiograph of the skull which provides an overview of the calvarium
3. Towne view / AP axial view (Figure 3): angled AP radiograph of the skull which is used to visualize the occipital bone, temporal bone with less bony overlapping shadow.

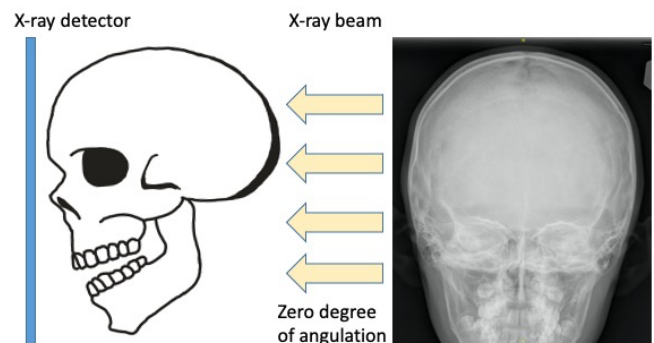


Figure 1: Skull x-ray (PA view)

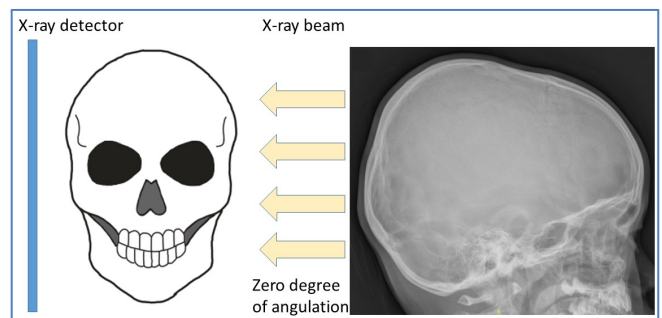


Figure 2: Skull x-ray (Lateral view)

1. PA (occipital-frontal) view (Figure 1): non-

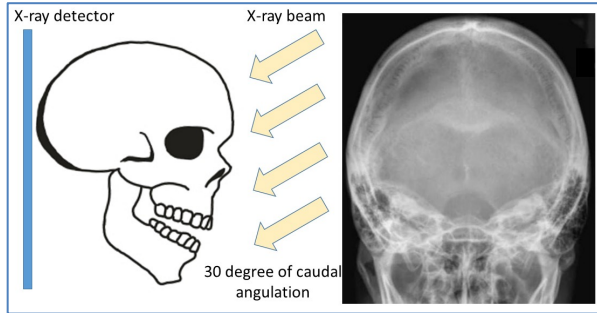


Figure 3: Skull x-ray (Towne view / AP axial view)

However, some fractures, especially depressed skull fractures, may be difficult to be seen on plain radiographs. Views that are tangential to the fractures may improve detection.

Skull base visualization by plain x-ray is suboptimal when compared to CT scan. A CT scan of the head should be obtained if plain radiographs reveal a skull fracture or when skull base fracture is suspected.

Progress of patient

In view of deep scalp lacerations with depressed conscious level and right lower limb paresis, skull x-ray and CT scan of the brain were performed.

Depressed skull fracture over high parietal region was noted in lateral view of skull XR. (Figure 4)



Figure 4: Skull x-ray (lateral) showing depressed skull fracture (blue arrow)

CT scan of the brain showed depressed skull fracture in vertex (Figure 5) with small amount of acute subarachnoid haemorrhage on the left vertex.

Can the findings in CT scan explain the right lower limb weakness in our patient?

The subarachnoid haemorrhage was located on the left vertex which is close to the primary motor cortex. Different areas of the primary motor cortex control different parts of the body.

According to the motor homunculus, the site of the subarachnoid haemorrhage in our patient is responsible for the control of lower limb function. Therefore, the CT scan finding is compatible with the clinical finding of right lower limb paresis.

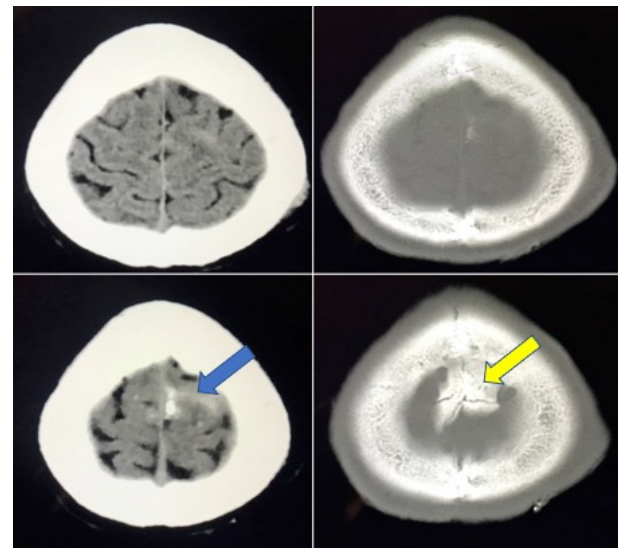


Figure 5: CT scan of the patient: Brain window (left) and bone window (Right): subarachnoid haemorrhage on left vertex (Blue arrow) and depressed skull fracture (yellow arrow)

What is a depressed skull fracture?

Depressed skull fractures result from a high-energy direct blow to a small area of the skull leading to indentation of the affected segment.

Depressed skull fractures are classified as closed (or simple) or open (or compound). Majority of them are open fractures resulting in communication between the cranial cavity and outside.

Wounds associated with depressed skull fractures should be examined in detail. The area around the wound should be palpated carefully, but they should NOT be blindly probed. Bone fragments and the edges of depressed skull segments may lacerate the underlying dura mater and lead to central nervous system infection.

Since depressed skull fracture are often caused by high energy trauma, injury to the brain is common.

Haematoma (extradural, subdural), cerebral contusion, subarachnoid haemorrhage and venous sinus involvement may be associated with depressed skull fracture. Injuries to brain parenchyma may lead to early post-traumatic seizure.²⁻⁶

The clinical presentation of the patients is determined by the degree of underlying brain injury. The mortality rate for patients who suffer from depressed skull fracture with a decline in mental state is high.⁷

Nearly 97.3% patients who presented with GCS between 13 and 15 had good outcome as against 16.7% patients who had GCS of 8 or below.⁸

The depressed skull fracture is located on the vertex. Are there any special precautions?

A depressed skull fracture located on the vertex is considered as a midline depressed skull fracture (MDSF).

MDSF can lead to compression of the superior sagittal sinus (SSS) which may lead to stenosis, obstruction or thrombosis of the sinus with subsequent intra-cranial hypertension, venous

ischaemia and infarction.

Symptoms of venous sinus occlusion can be non-specific and varies from completely asymptomatic to a fulminant course with cerebral haemorrhage and death. Common presentations include headache, visual disturbance, seizure, hemi- or quadriplegia and neck rigidity.^{9,10}

Progress of patient

The patient was admitted to the neurosurgical ward for further management. CT venogram of the brain was performed which showed depressed skull fracture in the vertex compressing on the underlying superior sagittal sinus. The sinus was patent. (Figure 6)

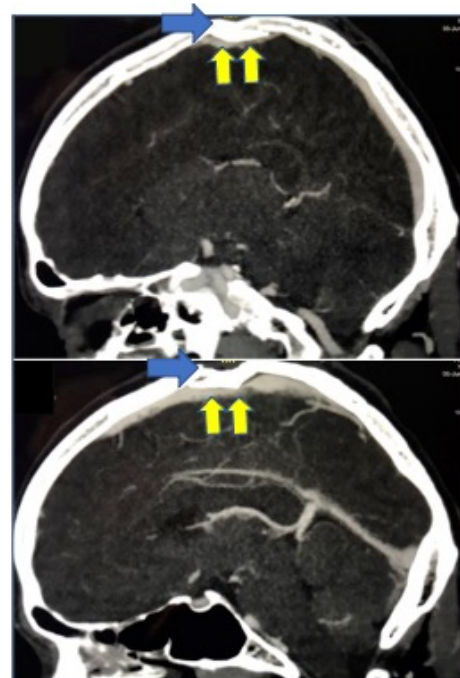


Figure 6: CT venogram showed depressed skull (blue arrow) fracture with compression of the SSS (yellow arrow)

What are the findings of superior sagittal sinus (SSS) thrombosis in CT scan?

Plain CT scan is usually the first line investigation performed. The findings on plain CT scan are subtle when there is no associated

venous haemorrhage or infarction. They include:¹¹

- Cord sign (cord-like hyperattenuation within a dural venous sinus)
- Dense vein sign (hyperattenuating thrombus within a cortical vein or dural venous sinus due to acute venous thrombosis)
- Cerebral edema (secondary to venous hypertension)
- Cerebral / cortical swelling
- Unilateral or bilateral venous haemorrhage including the cashew nut sign (small:<20 mm, concave-shaped intracerebral hemorrhage in the juxtacortical white matter)

What is the management for patients with depressed skull fracture?

General measures

Patients with depressed skull fracture are at risk of infection and seizures. Prophylactic antibiotics and anticonvulsant are recommended. Tetanus prophylaxis should also be given as appropriate.

Conservative vs. surgical treatment

In general, the depressed skull fracture can be treated conservatively or with operation.

Conservative management includes scalp debridement alone with irrigation.

Surgical treatment involves irrigation with scalp debridement, removal of free bone fragments, fracture elevation, restoration of the depressed bone flaps, dural examination and repair as needed.

There is still controversy regarding the management (conservative vs. surgical) of depressed skull fracture.¹² Traditionally, open depressed skull fractures are treated surgically so as to reduce the risk of infection. Closed depressed skull fracture are usually treated

conservatively.

However, some studies showed that patients with open depressed skull fracture may be treated conservatively when the wound is clean, with only mild bone displacement (less than the thickness of the skull) and no clinical or radiographic evidence of dura laceration.^{13,14}

A list of consensus indications for surgical treatment for closed and open depressed skull fracture are shown in table 1.¹⁵⁻¹⁸

Table 1: Indications for surgical treatment for closed and open depressed skull fracture

Closed depressed skull fracture
<ul style="list-style-type: none"> - Mass effect - Intra-cranial haematoma or large contusion requiring surgery - Severe bone depression (greater than the thickness of the skull) - Focal neurological deficit - Evidence of dural laceration - Cosmetic deformity
Open depressed skull fracture
<ul style="list-style-type: none"> - Same as closed fracture - Depression > 1cm deep or >1 skull thickness - Evidence of dural laceration including pneumocephalus - Grossly contaminated wound - Infected wound - Large complex scalp laceration

Is there any difference in management of patients with midline depressed skull fracture (MDSF)?

MDSF may compress or lacerate the superior sagittal sinus. Management of a MDSF can be a dilemma because of the risk of fatal venous haemorrhage from SSS during surgery.

In the past, a depressed fracture over the superior sagittal sinus is a contraindication for surgery and conservative treatment is adopted.^{16,17}

However, not all cases can be treated conservatively. MDSF with SSS injury can result in sinus stenosis or occlusion secondary to direct compression or thrombosis.

This can lead to increased intracranial pressure and fatal brain swelling. The thrombosis may also extend proximally or distally leading to venous infarction.

Recent literature shows that elevation of the depressed fragment restores patency of the venous flow with resolution of symptoms due to raised intracranial pressure.^{18,19}

Therefore, the decision for surgical intervention should be individualized for each patient and weighed against its risk.

Progress of patient

Intravenous prophylactic antibiotics and tetanus immunization were given. The patient underwent emergent debridement and craniectomy on the same day of admission.

There was a 15cm full thickness scalp laceration with moderate contamination

Intraoperative findings: The depth of the depressed skull fracture is more than one skull thickness. The dura is intact. There was bleeding from the sagittal sinus after the fracture was elevated and removed. Repair of the sagittal sinus was performed.

The patient regained power over right lower limb and walked unaided after the operation. Antibiotic prophylaxis was given and he was discharged in about a week's time.

Reference

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