# 53 Head Trauma

**Objectives:**
1. Understand the role of skull radiographs in head trauma.
2. Describe the appearance of an epidural hematoma on a head CT scan.
3. Describe the appearance of a subdural hematoma on a head CT scan.
4. Describe the appearance of a subarachnoid hemorrhage on a head CT and MRI.
5. Be able to list the findings on CT/MRI in a patient with cerebral contusion.
6. Describe the appearance of diffuse axonal injury on CT/MRI.

## Skull Radiograph

With the advent of CT scans, the role of routine skull radiographs in neurologic trauma has become limited. In moderate and severe head trauma, a CT scan is the study of choice. Skull radiographs are only indicated in minor head trauma patients where a CT scan is otherwise not clinically indicated during the initial evaluation.

Skull radiograph may be helpful and can complement other imaging modalities in the following conditions:

1. Depressed fracture is suspected clinically or by the nature of the injury.
2. Penetrating injury by metal or glass is suspected.
3. Radiodense foreign body is suspected.

The basic skull projections used in evaluation of head trauma are the lateral and the fronto-occipital (AP) views (Fig. 53.1).



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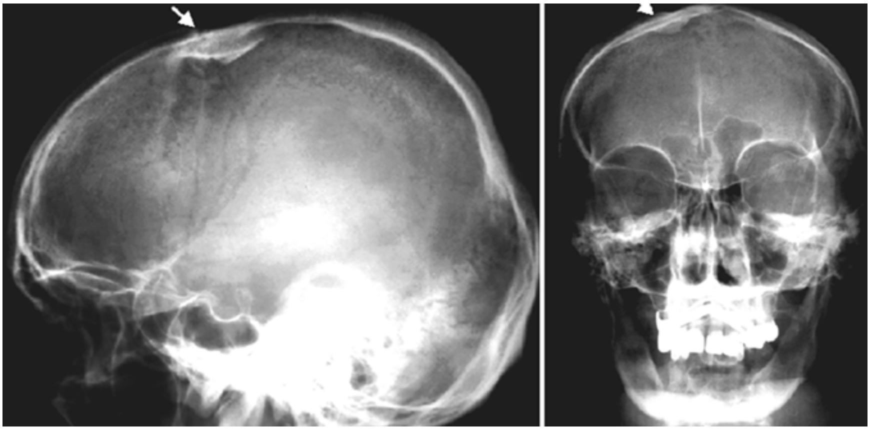

**FIGURE 53.1 - SKULL RADIOGRAPH**
Lateral and AP views show a depressed fracture of the right parietal bone with displacement of the bone fragment into the skull

## Epidural Hematoma

Figure 53.2 shows a CT of a patient with a known skull fracture and acute hemorrhage. Blood appears as white material on head CT. The biconvex appearance of the epidural blood is caused by the tight attachment of the dura to the skull. Midline shift is present secondary to the mass effect of the hematoma.

## Subdural Hematoma

Figure 53.3 demonstrates a subdural hematoma which is hemorrhage under the dura. Note that the blood is free to follow the contour of the brain so that it has a flat or concave inner surface.

In the normal evolution of a subdural hematoma, the collection becomes hypodense (more gray) with respect to brain tissue. As more time passes, it becomes isodense (equally dense) with respect to the brain tissue. Diagnosis during this period of isodensity can be difficult. Chronic subdural hematomas that are hypodense with respect to the brain substance are referred to as subdural hygromas.

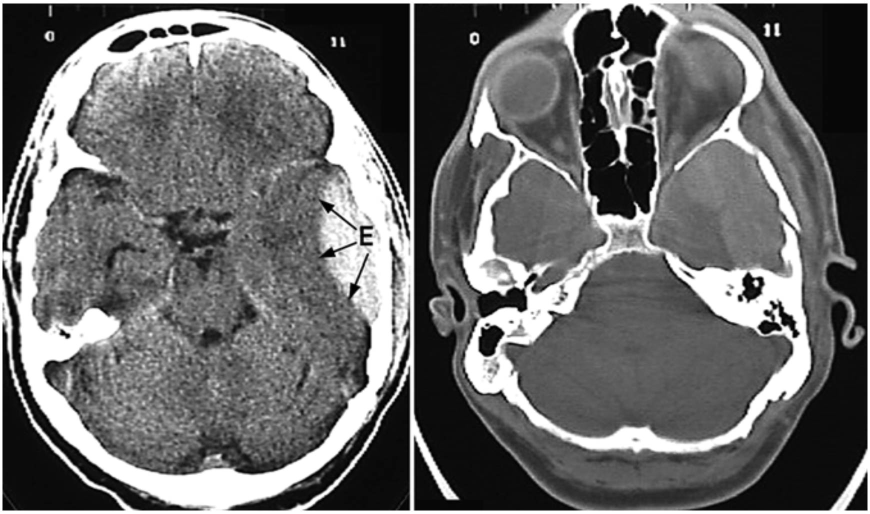


**FIGURE 53.2 - EPIDURAL HEMATOMA WITH SKULL FRACTURE**
In this trauma victim, there is an epidural hematoma (*E*). It has the typical elliptical shape. There is mass effect, centered on the bleed (*arrows*). The image on the *right* is further evidence of head trauma and the likely cause of the epidural hematoma. Did you notice the left temporal bone fracture?

## Subarachnoid Hemorrhage

Trauma is the most common cause of subarachnoid hemorrhage (SAH) overall. A large percentage of traumatic brain injuries include of this type of bleeding. On CT scans, SAH appears as a high-attenuating (white), amorphous substance that fills the normally dark, CSF-filled subarachnoid spaces around the brain (Fig. 53.4). These findings are most evident in the largest subarachnoid spaces, such as the suprasellar cistern and sylvian fissures. It can also be seen tracking along the sulci, outlining the gray matter. MRI is more sensitive in diagnosing subarachnoid bleed, especially in hyperacute and chronic phases where CT may be completely negative because blood in those states is equal density to brain on CT.

## Parenchymal Contusion

Figure 53.5 shows an area of generally decreased attenuation (gray) with an area of lobular increased densities. There is subtle mass effect with contralateral midline shift (to the patient's right). This displacement and low density are caused by edema


**FIGURE 53.3 - SUBDURAL HEMATOMA**
In this trauma victim, there is a large left holohemispheric subdural hematoma (*S*). It has a distinctly flat/concave inner surface which allows one to distinguish it from an epidural hematoma

with the lobular areas representing hemorrhage. This is the radiographic appearance of a cerebral contusion or, literally, "a bruise of the brain." In all of the above diagnoses, there may be associated findings such as a skull fracture and associated soft tissue swelling external to the skull. These abnormalities may give you a clue as to where to look within the brain for abnormalities, as these findings can sometimes be quite subtle.

## Diffuse Axonal Injury

Diffuse axonal injury (DAI) is a frequent result of traumatic deceleration injuries and a frequent cause of a persistent vegetative state. Typically, the process is diffuse and bilateral, involving the lobar white matter at the gray-white matter interface

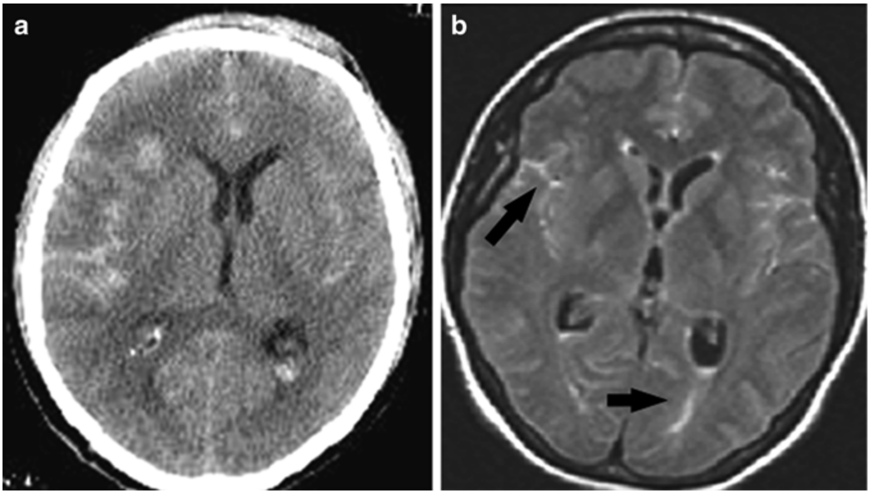


**FIGURE 53.4 - CT AND MRI OF SUBARACHNOID HEMORRHAGE**
(**a**) CT shows hyperdensity within the CSF sulci spaces, most prominently along the sylvian fissures (*arrow*), consistent with subarachnoid hemorrhage. (**b**) MRI on the same patient shows corresponding areas of T2 hyperintensity within the sylvian fissures along with intraventricular hemorrhage

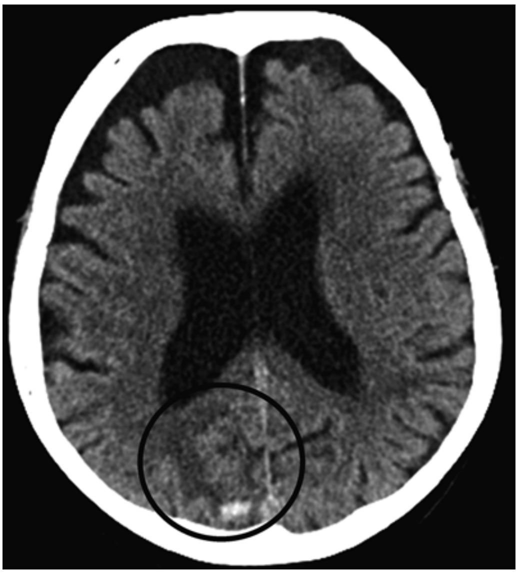

**FIGURE 53.5 - PARENCHYMAL CONTUSION**
There is blood in the parenchyma with some surrounding edema consistent with a contusion. Note the subtle mass effect at this level

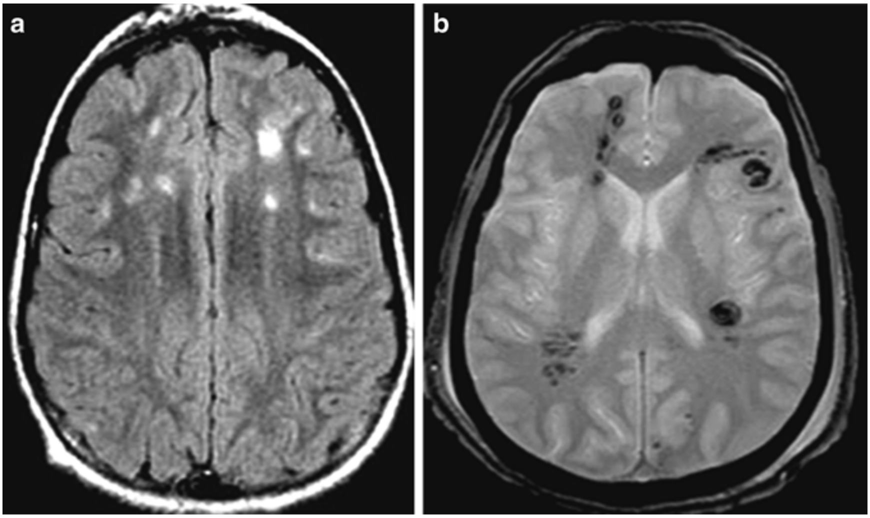


**FIGURE 53.6 - HEAD TRAUMA IMAGING**
MRI in a young patient with trauma and negative head CT shows multiple areas of T2 hyperintensity at the gray-white matter junction (**a**). The petechial hemorrhages are seen as low signal areas on gradient images (**b**). (Gradient echo is a MRI sequence which is very sensitive to blood products)

(Fig. 53.6). The corpus callosum frequently is involved, as is the dorsolateral rostral brainstem. On CT, 60–90 % of patients with DAI may have a normal CT scan on presentation. Small petechial hemorrhages located at the grey-white matter junction and corpus callosum are characteristic but only occur in about 20 %. MRI is the modality of choice for diagnosing DAI. Most common MRI findings are multiple focal areas of abnormally bright signal on T2-weighted images in the white matter of the temporal or parietal corticomedullary junction or in the splenium of corpus callosum. Gradient echo sequences are very useful in demonstrating petechial hemorrhages. The paramagnetic properties of blood cause a loss of signal, represented by black areas.