47 Fractures 1

Objectives:
1. List five major categories of description when evaluating a fracture.
2. Identify internal and external rotation views of the shoulder.
3. Define normal and abnormal anatomy on the "Y" view of the shoulder.
4. Discuss the significance of a joint effusion in the elbow in the presence of acute trauma.
5. State the mechanism of injury in a Colles' fracture.
6. Discuss the concept of the "Scottie dog" in evaluating the lumbar spine.
7. Describe the "bony ring" principle and relate its importance to acute trauma involving the pelvis.

Fractures are ubiquitous in medical practice. Radiographs have been used to evaluate fractures from the earliest days of diagnostic radiology and remain a cornerstone of clinical care in the diagnosis and treatment of skeletal trauma.

The Simple Fracture

Figure 47.1 demonstrates an acute fracture of the fourth proximal phalanx in the left foot. Note the presence of a linear lucency, sharp edges without marginal sclerosis, and soft tissue swelling.

H. Singh et al. (eds.), *Radiology Fundamentals: Introduction to Imaging & Technology*, DOI 10.1007/978-3-319-10362-4_47

FIGURE 47.1 - SIMPLE FRACTURE
Oblique, nondisplaced fracture of the fourth proximal phalanx of the left foot

Fracture Nomenclature

It is important to verbally describe a fracture since you will often need to communicate the radiographic findings to other healthcare professionals. Features that must be mentioned include the following:

1. *Location:* The name and part of the bone involved. In long bones, the fracture can involve the epiphysis, metaphysis, diaphysis, and even the physis (growth plate). Other designations such as head, neck, body, waist, etc. (depending on the bone) may be employed (Fig. 47.2).
2. *Types of fracture:* Transverse, oblique, spiral, and butterfly are all appropriate descriptors. Comminuted is used when there are multiple fracture fragments. It is also important to note any intra-articular extension of the fracture (extension into the joint) (Fig. 47.3).
3. *Displacement (nonalignment of periosteal surfaces of the bone):* Displacement is described using the location of the distal fragment with respect to the proximal fragment. Hence, if the distal fragment is medially displaced, the fracture is medially displaced. Open or compound fractures are fractures which penetrate the skin (Fig. 47.4).

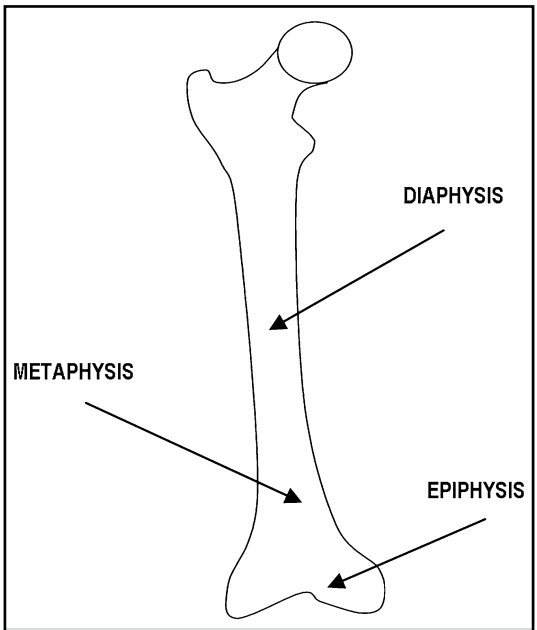

FIGURE 47.2 - BASIC LONG BONE ANATOMY
It is important to have familiarity with the long bone anatomy

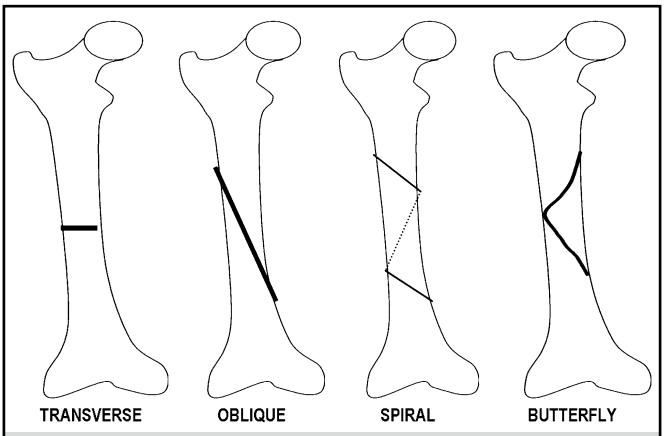

FIGURE 47.3 - FRACTURE NOMENCLATURE
In describing fractures, the referring physician should be able to visualize the fracture without the x-rays. Knowing the nomenclature greatly facilitates this communication

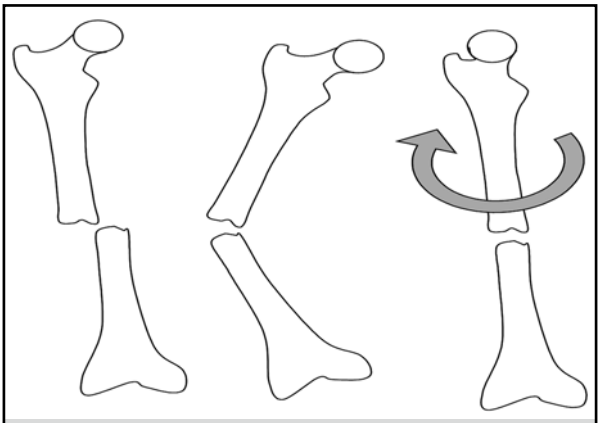

FIGURE 47.4 - FRACTURE FRAGMENT ORIENTATION
In the image on the *left*, there is one shaft width medial displacement of the distal fracture fragment. In the *middle* image, there is lateral angulation of the fracture apex. In the image on the *right*, there is rotation of the fracture fragments

4. *Angulation of the "apex" of the fracture:* The direction that the angle of the fracture points is used to describe the fracture position. A common phrase used would be "the apex of the fracture is directed laterally" (Fig. 47.4).
5. *Rotation of the distal fragment:* If the distal fragment is rotated relative to the proximal fragment, this should be included in the description (Fig. 47.4).

Note that at least two views are required to completely visualize and describe the position of a fracture. An example of a complete description of a fracture would be: "There is a comminuted fracture of the diaphysis of the left femur with medial displacement of the distal fragment, apex lateral angulation, and internal rotation of the distal fragment."

Shoulder Views

Figure 47.5 shows a normal two-view study of the shoulder as might be obtained in the emergency room.

Note the difference between the internal and external rotation views. On internal rotation views, the appearance of the humeral head is similar to the smooth round top of an ice cream cone (**I**ce cream = **I**nternal). On external rotation views, the greater tuberosity is seen clearly in profile. These two views will usually suffice to exclude a fracture. However, dislocation may be more difficult to exclude without views from another projection.

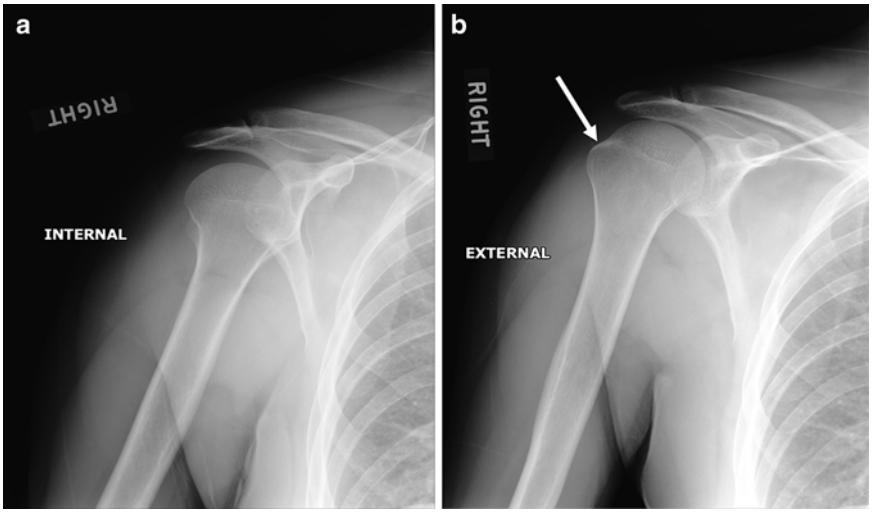

FIGURE 47.5 - INTERNAL AND EXTERNAL ROTATION VIEWS OF THE RIGHT SHOULDER
Arrow shows the greater tuberosity of the humeral head

Figure 47.6 shows an axillary and scapular "Y" view of the shoulder. The axillary view is projected so that you are looking upward through the axilla toward the ceiling in a standing patient. You should be able to visualize the clavicle and acromion process anteriorly, the acromioclavicular joint, and the glenohumeral articulation. Because of the projection of the axillary view, anterior or posterior dislocations are usually well demonstrated. The problem with this view is that it is often very uncomfortable for a patient with an acutely injured shoulder.

A different way of imaging the shoulder in a plane perpendicular to the anterior-posterior projection is called a scapular Y view. In this case, the patient is obliqued slightly, and a "lateral view" of the shoulder is obtained. The stem of the Y is the scapular body, while the two upper arms of the Y are the acromion and coracoid processes. At the center of the Y is a circle corresponding to the glenoid fossa. The humeral head should project over the confluence of the three arms of the Y. If the humeral head is posterior to the intersection of the arms of the Y, a posterior dislocation may be diagnosed. Again, remember that posterior dislocation may look normal in the AP view. Note that the scapular Y view is not as good as the axillary lateral view for assessing dislocations or subluxation.

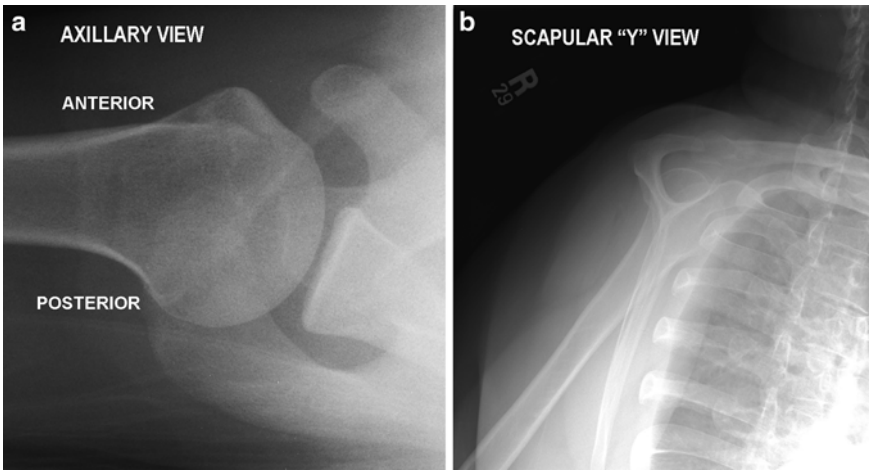

FIGURE 47.6 - (a) AXILLARY AND (b) SCAPULAR Y VIEWS OF THE RIGHT SHOULDER

Shoulder Dislocation

Figure 47.7 shows a typical anterior (most common) dislocation of the humerus. In anterior dislocation, the humeral head moves inferiorly under the coracoid and slightly medially. This can usually be identified on the routine anterior views (a). The axillary view (b) demonstrates the humeral head anterior to the glenoid.

Figure 47.8 demonstrates a typical posterior dislocation of the humerus. The dislocation is hard to appreciate on the AP view (a), but in posterior dislocations the humerus is always internally rotated (patient cannot externally rotate). Image (b) shows the axillary view with the humeral head posterior to the glenoid. The Grashey view (c) reveals overlap of the humeral head at the glenohumeral joint.

Fat Pad Sign

Figure 47.9 shows a normal and abnormal lateral view of the elbow. In the image on the right, note the presence of the triangular-shaped lucency just anterior to the distal humerus representing the anterior fat pad of the elbow. Fat pads serve as markers for elbow joint effusions. Fluid or blood within the joint will displace them. Elbow joint effusions in the setting of acute trauma almost always indicate a fracture. In the image on the right, no obvious fracture is seen. However, there is evidence of an elbow joint effusion since the anterior fat pad is displaced (compare to normal). In addition, a posterior fat pad along the posterior aspect of the distal humerus is seen. This always indicates the presence of a joint effusion and usually indicates a

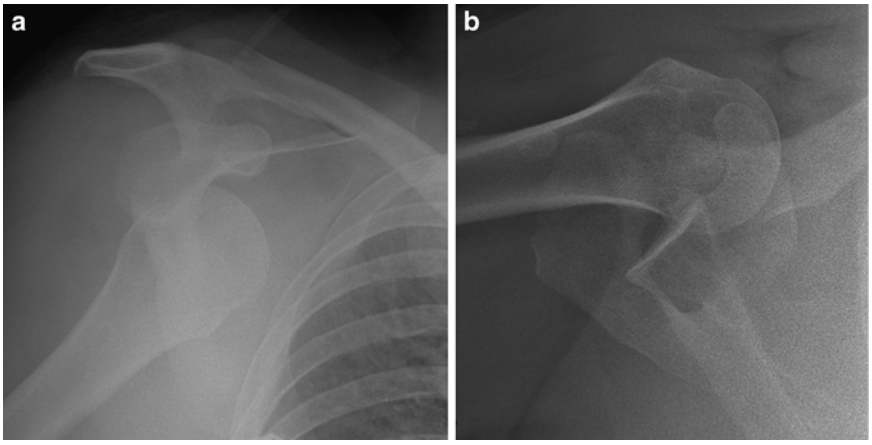

FIGURE 47.7 - ANTERIOR DISLOCATION OF THE SHOULDER

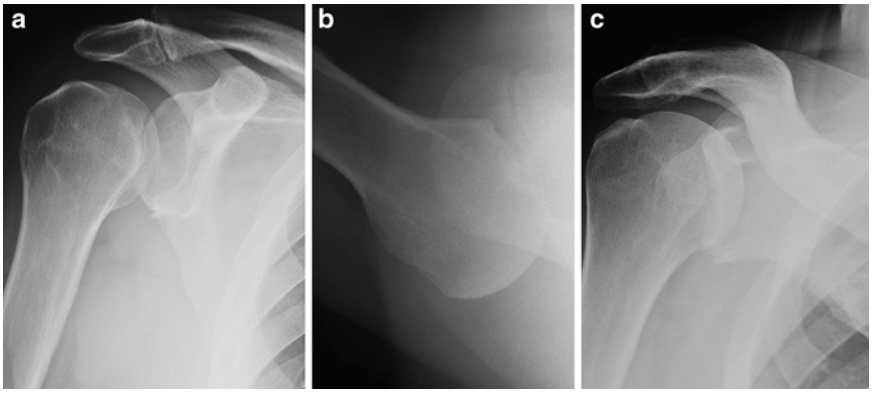

FIGURE 47.8 - POSTERIOR DISLOCATIONS OF THE SHOULDER

fracture, in the proper clinical situation. It is important to understand that while an anterior fat pad sign is more sensitive for joint pathology, a posterior fat pad sign is more specific for occult fracture.

The elbow is not the only joint in which fat pads can be useful. For instance, ankle injuries may reveal a fat pad anterior to the joint between the talus and tibia which may suggest fracture.

These fractures may be occult radiographically. Occasionally, a small fracture of the radial head can be demonstrated with further or follow-up views. Again, whenever an elbow joint effusion is seen in the setting of acute trauma (and in the absence of other preexisting reasons for an elbow joint effusion such as rheumatoid arthritis, hemophilia, etc.), the patient should be treated for a fracture.

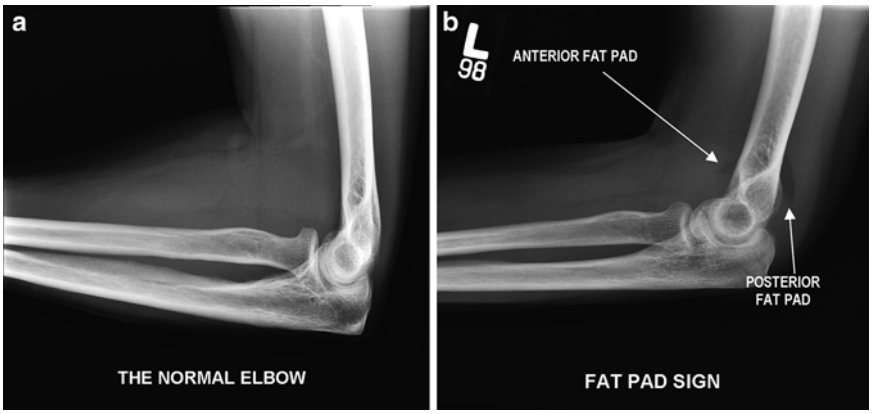

FIGURE 47.9 - NORMAL (a) AND ABNORMAL (b) VIEWS OF THE ELBOW AND FAT PAD SIGN
The image on the left is a normal lateral elbow. The triangular lucencies anterior and posterior to the humerus on the right image represent displaced fat (fat pad sign) when there is fluid in the elbow joint. Fluid in the joint can be seen in inflammatory conditions. In the setting of trauma, displaced fat pads have a high association with fracture even if the fracture is not immediately visualized

Colles' Fracture

Figure 47.10 demonstrates one of the most common wrist injuries. The Colles' fracture is defined as a transverse fracture of the distal metaphysis of the radius with dorsal angulation of the distal fragment commonly caused by falling on an outstretched hand. Based on the previously described nomenclature, it would be appropriate to describe this fracture as apex volar (palmar) angulation. However, in the case of a fracture near an articular surface, the direction of the articular surface is used to describe angulation. Often a Colles' fracture will have an associated fracture of the ulnar styloid process.

The Scottie Dog

Another term you should be familiar with is the Scottie dog. This refers to the outline of a dog that can be seen on an oblique view of the lumbar spine. As depicted in the figures below, the eye of the dog corresponds to the pedicle, the snout the transverse process, the neck the pars interarticularis, the ear the superior articular facet, and the front leg the inferior articular facet.

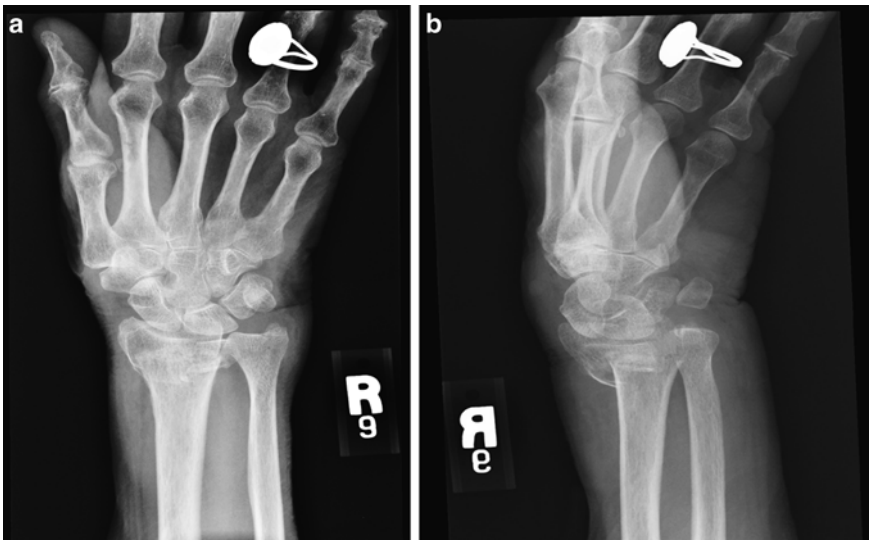

FIGURE 47.10 - COLLES' FRACTURE
AP (**a**) and lateral views (**b**) of the right wrist demonstrate a comminuted, impacted, and intra-articular fracture of the right distal radius, with approximately 20° of dorsal angulation of the distal fragment. Note that there is also deformity and marked soft tissue swelling at the site of injury

It is important to evaluate these structures, especially the pars interarticularis. A fracture or congenital defect in this region will manifest itself as a lucent (dark) line in the neck of the dog (it looks like a dog collar). This is termed spondylolysis. Spondylolysis can lead to spondylolisthesis which is a slippage of the superior vertebra on the inferior one, most often in the anterior direction. There is a grading system based upon what percentage of the vertebra has slipped forward, but for now, just understand the concept.

Roughly 5 % of the population has L5 spondylolisthesis, and of those, roughly 5 % are symptomatic. In general, spondylolysis with spondylolisthesis is more likely to be symptomatic (Fig. 47.11).

Pelvic Fractures

Evaluation of the pelvis is often a part of the radiographic evaluation of acute trauma patients. One helpful principle in looking for fractures of the pelvis is the "bony ring" concept. This concept states that a bony ring will always break in two places. A fracture or separation in a bony ring is usually associated with at least one other fracture in that ring. Figure 47.12 illustrates this principle. Remember that pelvic fractures also occur in the elderly with much less force of trauma secondary to osteoporosis.

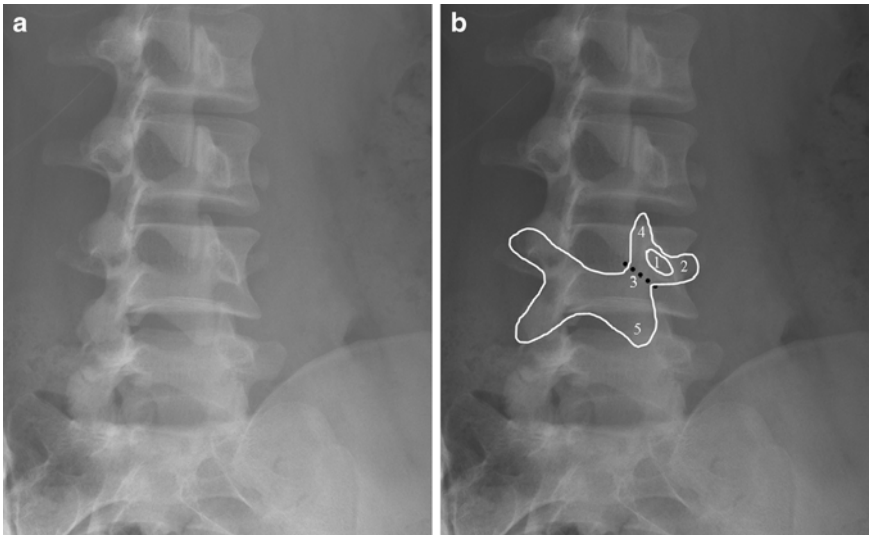

FIGURE 47.11 - THE SCOTTIE DOG CONCEPT
This figure outlines the Scottie dog on an oblique lumbar radiograph: *1* pedicle, *2* transverse process, *3* pars interarticularis, *4* superior articular facet, and *5* inferior articular facet. The *dashed line* through the neck that looks like a collar represents what a pars fracture would look like

FIGURE 47.12 - PELVIC FRACTURE
There is marked widening of the left sacroiliac joint and the pubic symphysis. Also note that there is extensive soft tissue density in the pelvis consistent with hematoma