Diagnostic imaging plays an important role in the detection, management, and follow-up of skeletal and soft tissue injuries. The use of routine radiography to identify fractures constituted one of the earliest applications of this technique. Fractures represent incomplete or complete breaks in the continuity of bones, which may result from a single episode of excessive stress applied to normal bone, multiple episodes of excessive stress applied to normal bone, or normal or excessive stress applied to abnormal bone. Injuries may be due to direct trauma, load applied directly upon the osseous structures, or more commonly due to indirect forces applied through muscles or tendons.

The configuration of the fracture is dependent on the magnitude, type, and site of applied force. Bone may fail secondary to tension, compression, bending, torsion, or combined loading. The location and configuration of a fracture are dependent not only on the mechanism of injury but also on the age of the patient and the presence of any predisposing factors that might alter the bones or soft tissues. The sites most frequently injured are the physeal and metaphyseal regions in children, the epiphyses in teenagers, the diaphyses in young adults, and the subarticular area and diaphyses of the tubular bones in the elderly (Fig. 6.1).

The fatigue type of stress fracture results from repeated application of abnormal stresses on normal bone. The insufficiency type of stress fracture occurs when abnormally weakened bone encounters physiologic stresses. Diseases associated with insufficiency fractures include a variety of metabolic bone disorders such as osteoporosis, osteomalacia, and hyperparathyroidism (Fig. 6.2). Pathologic fractures specifically refer to fractures occurring in areas of bone replacement by tumor. These fractures typically are transverse and show little comminution since the preexisting abnormality impairs the bone's ability to absorb energy and the fracture occurs with minimal loading (Fig. 6.3).

This chapter emphasizes imaging abnormalities associated with acute and stress fractures. A discussion of diagnostic imaging of pathologic fractures is beyond the scope of this chapter.

Conventional Radiography

The evaluation of complications of trauma represents the most common indication for skeletal radiographs. Plain film radiography is well suited to the assessment of skeletal injuries because it is sensitive to osseous injury, has excellent spatial resolution, and is widely available. Examination of injuries of the extremities should include at least two views at right angles to each other of the site of involvement. If the shaft of a long bone is fractured, the joints at either end of the bone should be evaluated to exclude a concomitant dislocation (Fig. 6.4). If the suspected injury involves only the metaphyseal or epiphyseal area, then only that area...
FIGURE 6.1. Injuries of the immature skeleton typically involve the physeal region. Avulsion of the medial epicondyle (a) is the most common bony injury associated with elbow dislocations in children. The epicondyle is displaced into the joint in this case. The Tillaux fracture of the distal tibia (b) is an avulsion of the anterolateral epiphysis seen in the setting of partial physeal fusion.

and the adjacent joint should be examined to provide optimal detail. Oblique views often are necessary for assessment of articular injuries.

Indirect evidence of skeletal injuries may be noted in the overlying soft tissues. The soft tissues themselves may be the primary site of injury and should be carefully assessed in all cases of trauma. Radiographic findings associated with trauma include nonspecific soft tissue swelling, blurring, or displacement of the normal fat stripes that outline the fascial planes, and focal masses representing hematomas or fracture blisters. The presence of soft tissue gas or radiopaque foreign bodies implies that a penetrating injury has occurred. Articular trauma typically produces joint effusions, which are readily identified in the knee, ankle, and elbow, but are difficult to detect in other locations such as the wrist, hip, and shoulder. It generally is believed that the presence of intraarticular fluid is strong evidence of an occult fracture, particularly if the effusion contains fat. Some authors state that a radiographically evident lipohemarthrosis, most commonly seen in the knee on cross-table radiographs, is virtually pathognomonic of an intraarticular fracture.

Most fractures are readily apparent on good-quality radiographs. To determine the mechanism of injury and appropriate management, it is essential to understand the forces that produce the typical fractures encountered in daily practice. The conventional radiographic appearances of fractures produced by tensile, compressive, rotary, and angular forces are well known. A brief review of these classic injuries is presented here, but many injuries result from a complex combination of these forces. Complete fractures occur when the