

Bones and Joints

Bone lends itself readily to radiographic examination. Being composed primarily of calcium and phosphorus, it is relatively dense and its radiographic opacity contrasts well with surrounding tissues.

Structure

During development, each long bone consists of a shaft (diaphysis), two metaphyses, and two extremities (epiphyses). The diaphysis is composed of dense, compact bone. This dense bone surrounds the medullary cavity, which contains the bone marrow.

JOINTS

A synovial (diarthrodial) joint consists of two apposing bone surfaces, each covered by articular cartilage and surrounded by a joint capsule. The term enarthrodial is used to describe a ball-and-socket joint, allowing movement in all directions.

Radiography

Radiography of the joints of very young animals is often unrewarding because of the large amount of radiolucent tissue present. Even severe abnormalities may not be demonstrated.

Abnormalities

Congenital, developmental, metabolic, and various other conditions can affect bones and joints.

Luxations.

Luxations usually present no problems of diagnosis, provided adequate radiographic studies are available. At least two standard views, made at right angles to one another, are necessary for proper evaluation of the degree and direction of the displacement.

Radiologic Signs

- 1- The articular surfaces are displaced and do not articulate properly with one another.
- 2- There is disruption of adjacent fascial planes.
- 3- There may be associated avulsion fractures.
- 4- In the case of the stifle joint, there will be a disruption of the normal intraarticular fat pad.

Luxation of the Shoulder Joint

Congenital. Congenital luxation of the shoulder joint is occasionally seen in smaller breeds of dogs. It may be bilateral.

Radiologic Signs

- 1- The head of the humerus is displaced medially.
- 2- On a craniocaudal view the medial displacement of the humeral head is obvious.
- 3- The glenoid cavity may be shallow, flattened, or otherwise malformed.
- 4- On a lateral view a normal joint space cannot be identified.

Luxation of the Elbow Joint

Congenital. Congenital luxation of the elbow joint is seen in smaller breeds of dogs. Clinically there is either a marked lameness or the limb is being carried. Two types of congenital luxation of the elbow joint are recognized.

Luxation of the Hip Joint.

In hip joint luxation as a result of trauma, the femoral head is usually displaced dorsally and cranially. It may displace ventrally or come to lie immediately dorsal to the acetabulum, where it may be easily missed. Two views at right angles to one another are necessary because a dislocation may be missed on one or the other view.

The Stifle Joint

Rupture of the Cranial Cruciate Ligament. Rupture of the cranial cruciate ligament from trauma may affect any breed of dog. In the larger breeds of dog such as the Rottweiler and Saint Bernard, it may result from degenerative changes in the ligament.

Radiologic Signs

- 1- Early cases show an intraarticular soft tissue swelling.
- 2- Cranial displacement of the tibia relative to the femur may or may not be evident
- 3- When the rupture has been present for some time, inflammatory and degenerative joint changes will be evident.
- 4- Avulsion fracture fragments may be present within the joint.
- 5- In middle-aged, smaller breed dogs and in older dogs, rupture of the cranial cruciate ligament may be associated with medial luxation of the patella.

Degenerative Joint Disease

Osteoarthritis.

Osteoarthritis, or degenerative joint disease, is a condition that involves splintering and loss of articular cartilage. It may be primary or secondary. Primary degenerative joint disease is seen in old dogs and cats in whom there is no apparent reason for the condition. Secondary degenerative joint disease occurs as a result of abnormal stresses on a joint.

Radiologic Signs

- 1- Lipping of the joint margins with osteophyte and enthesophyte formation is common.
- 2- Sclerosis of the subchondral bone results from damage to, fissuring of, or erosion of the articular cartilage.
- 3- There is narrowing of the joint space, although it is sometimes difficult to demonstrate in dogs and cats.
- 4- Subluxation can sometimes be demonstrated on weight-bearing studies, as can narrowing of the joint space. Radiation safety precautions should be observed.
- 5- Radiolucent cystic areas may develop in the subchondral bone.

Inflammatory Joint Disease

Arthritis. Arthritis is inflammation of a joint and may be infectious or noninfectious. The condition involves inflammation of the synovial membrane with a variable degree of involvement of the surrounding joint structures.

Infectious (Septic) Arthritis.

Infectious arthritis may result from wounds or spread of an infectious process from neighboring structures. It may also result from invasion of the joint by blood-borne agents. Clinically, severe lameness, distention of the joint capsule, heat, and pain on palpation occur. Joint movements are limited.

Erosive

Rheumatoid Arthritis. This type of erosive arthritis is rare in dogs and even rarer in cats. It affects multiple joints symmetrically, particularly the carpus and hock, which are swollen and painful. It occurs in middle age in medium-sized and small dogs. Radiologic changes include periarticular soft tissue swelling and rarefaction and loss of trabecular patterns in adjacent bones.

Radiologic Signs

- 1- It affects multiple joints, especially the carpal joints.
- 2- Soft tissue swelling is present.
- 3- There is articular and periarticular bone lysis, especially the small, cuboidal carpal bones.
- 4- Collapse of the joint space occurs in chronic cases.
- 5- Subluxation may be present.

Developmental Anomalies

Osteochondrosis. Osteochondrosis is an abnormality in endochondral ossification. Articular cartilage becomes thickened in the affected area, and chondrocytes in the deeper layers die. The surrounding cartilaginous matrix then fails to ossify.

Radiologic Signs

- 1- There is a flattened area or broad, shallow concave defect in the subchondral bone at the caudal third of the articular surface of the humeral head.
- 2- The defect frequently has a sclerotic margin.
- 3- A loose flap of calcified cartilage may be seen overlying the bone defect.
- 4- Radiopaque fragments of calcified cartilage may be seen lying free within the joint. These fragments may be found in the caudal recess or in the cranial pouch.
- 5- Advanced cases show secondary degenerative changes in and around the joint

Elbow Dysplasia.

The term elbow dysplasia is sometimes used to characterize three developmental disorders of the elbow joint. These are nonunion of the processus anconeus, fragmented coronoid process, and osteochondrosis of the distal humerus. Inherited polygenic traits cause these three conditions, which may occur independently or concurrently. It has been suggested that asynchronous growth of the radius and ulna and incongruity of the elbow joint may be causal factors in nonunion of the processus anconeus and fragmented coronoid process. The syndrome occurs in large and giant dog breeds. An oblique, 20-degree craniolateral-caudomedial view is most helpful in evaluating the medial coronoid process.

Osteochondrosis of the Shoulder Joint.

Clinically there is lameness, and extension of the shoulder joint evokes pain. Three views of the shoulder joint are necessary to demonstrate adequately the caudal third of the humeral head.

Osteochondrosis of the Medial Humeral Condyle.

This condition manifests itself as a defect on the articular surface of the medial trochlea of the distal humerus. Clinically there is an elbow lameness, and manipulation of the elbow joint is resented.

Fractures

A fracture may be defined as a break or solution in the continuity of a bone. A break in continuity between the metaphysis and the epiphysis is often referred to as an epiphyseal or physeal separation and sometimes as an epiphyseal fracture.

Classification.

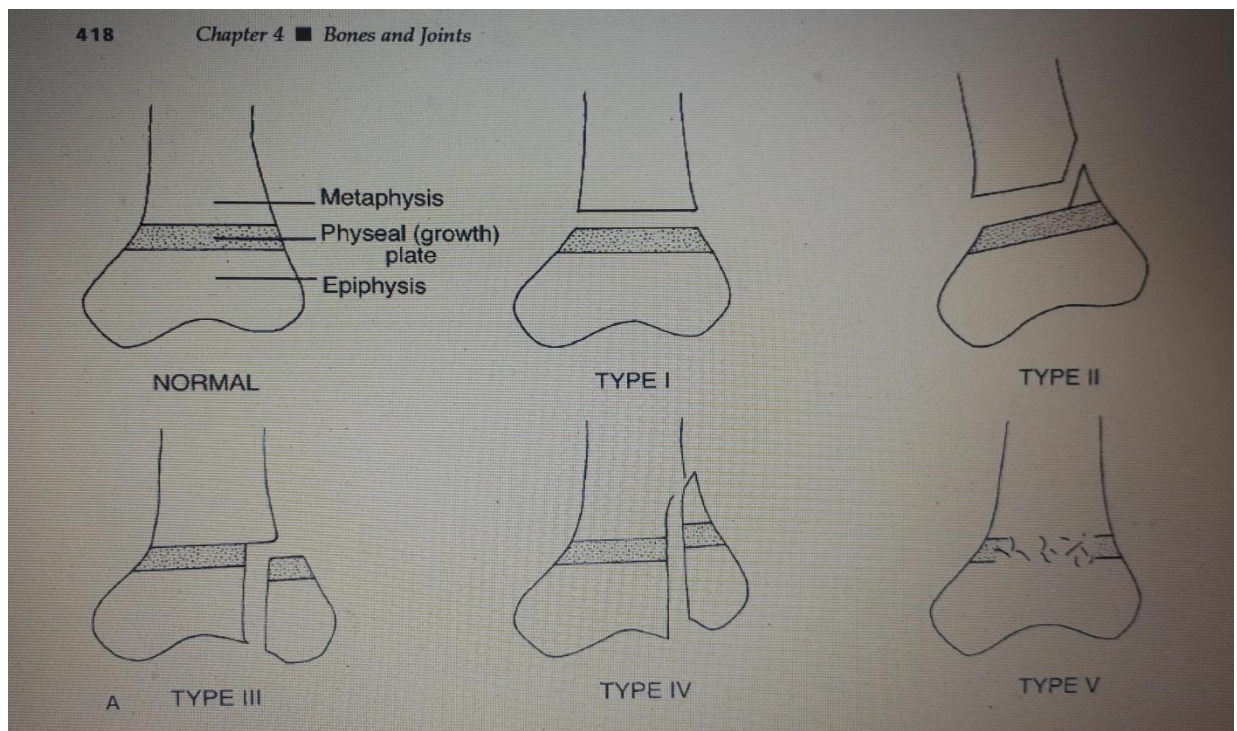
For descriptive purposes, fractures may be classified as follows.

- 1- Complete or Incomplete. In a complete fracture there is a break through the entire substance or width of the bone. An incomplete fracture retains some degree of continuity between the fractured ends, such as occurs in a fissure or greenstick fracture.
- 2- Closed or Open (Compound). A closed fracture has no communication with the exterior. An open (compound) fracture is associated with a wound and is thus in communication with the exterior.
- 3- Simple or Comminuted. A simple fracture has only two fracture fragments; a comminuted or multiple fracture has three or more associated fragments. A “butterfly” fragment is a wedge-shaped piece of bone at a fracture site.
- 4- Transverse, Oblique, or Spiral. In a transverse fracture the fracture line is at right angles to the long axis of the bone. In an oblique fracture the fracture line is at an angle to the long axis of the bone.
- 5- Avulsion or Chip. In an avulsion fracture a bone fragment is pulled away from the bone at the point of attachment of a tendon or ligament. A chip fracture is a separation of a small piece of bone without disruption of its general continuity.
- 6- Impacted (Compression) or Overriding. An impacted fracture has the fracture fragments embedded in one another as a result of compression.
- 7- Pathologic or Stress. A pathologic fracture occurs at a site where a disease process has weakened the bone. An incomplete pathologic fracture is referred to as a folding fracture because the bone appears to fold in on itself.
- 8- Diaphyseal or Epiphyseal. A diaphyseal fracture occurs in the shaft of a long bone. An epiphyseal fracture or, perhaps more correctly,

epiphyseal (or physeal) separation or slip, occurs when the epiphysis of a bone is displaced from its normal position.

The Salter-Harris classification is often used to describe fractures in the region of the physis associated with an epiphyseal separation.

- 1- Type I: A simple epiphyseal separation. The epiphysis is separated from the metaphysis without any bone fracture
- 2- Type II: An epiphyseal separation with a fracture of a corner of the metaphysis
- 3- Type III: A fracture extending from the joint surface to the physeal plate with separation of the detached piece
- 4- Type IV: A fracture extending from the joint surface through the physeal plate and through a portion of the metaphysis
- 5- Type V: A condition in which the physeal plate is crushed between the epiphysis and the metaphysis. There is usually no displacement.



Radiography

- 1- To confirm a clinical diagnosis.
- 2- To demonstrate the positions, relations, and nature of the fractured bone fragments
- 3- To determine the age of a fracture.
- 4- To measure the length of a bone and the width of the medullary cavity, with a view to selecting the right size of prosthesis.
- 5- To visualize a suspected fracture not demonstrable clinically.
- 6- To assess the degree of healing.

Radiographic appearance of a healing fracture:

- 1- Recent fractures: The fracture line is sharp and well defined.
- 2- Fractures of 1 week to 10 days: The fracture line is no longer sharp because of the resorption of bone along the fractured ends.
- 3- Fractures of 2 to 3 weeks: Periosteal reaction is more marked, and the callus is being mineralized.
- 4- Fractures of 4 to 8 weeks: The fracture line becomes filled in with bony callus
- 5- Fractures of 8 to 12 weeks: The callus is being remodeled, organized and incorporated into the general bone structure.

Nonunion fractures

Radiographic signs

Viable

- 1- A clearly visible fracture line, long after the fracture has been sustained
- 2- A nonbridging callus that varies in size from small to large, the latter often being referred to as an “elephant foot” callus
- 3- A rounding off of the fractured ends, which become smooth and sclerotic

Nonviable

- 1- A clearly visible fracture line
- 2- Little if any callus formation
- 3- Fracture ends that tend to taper off, with sclerotic margins
- 4- Sclerotic medullary cavity