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Fracture Identification

Anne M. Sylvestre

Focus and Flourish, Cambridge, Ontario, Canada

Using proper terminology to describe a fracture is important as it allows for accurate communication among veterinarians and, to a certain extent, with clients. It only takes a little bit of practice in describing fractures to become fluent with the terminology. Fractures are described according to:

1) Number of fragments.
2) Fracture configuration.
3) Location on the bone.
4) The bone that is fractured. Descriptions of fractures involving a two-bone system (radius and ulna; tibia and fibula) are limited to the main bone involved with mention of the smaller bone if it is not fractured (e.g. two-piece transverse mid-diaphyseal fracture of the left radius and intact ulna).

1.1 Number of Fragments (Figure 1.1)

- Two-piece: Describes a bone with one fracture line and two large fragments; the simplest type of fracture to reduce. An accurately reconstructed bone will contribute to the stability and strength of the repair.
- Two-piece plus reducible wedge: Describes a fracture with two main large fragments and one smaller fragment that is large enough to be secured to the reconstructed bone with a screw or cerclage wire. This description implies that the fracture can be accurately reconstructed but with more difficulty than the two-piece fracture.
- Two-piece with small (non-reducible) fragments: Describes a fracture with two main fragments and some small fragments that are not reducible. This configuration implies that accurate reconstruction may be difficult and that (a) bony defect(s) may be present. A repair technique of adequate strength must be chosen to overcome the forces that will not be negated due to the defect (usually bending and compressive forces).
- Multiple fragments, or, complex: Describes a fracture with more than three large fragments. Because there are numerous fracture lines, it is not possible, or necessary, to describe a predominant configuration. This descriptor implies that the fracture will be very difficult or impossible to reconstruct. A repair technique with a strong and very stable construct to bridge the unconstructed defect is necessary in order for this fracture to heal with minimal complications.

1.2 Fracture Configuration (Figure 1.2)

- Incomplete or greenstick: Describes a fracture that only involves one cortex; because the fracture is not complete there are no true pieces or fragments. Incomplete fractures occur almost exclusively in immature animals.
- Transverse: Describes a fracture line that crosses the bone approximately perpendicular (within 30°) to the long axis of the bone. This fracture configuration, once reduced, tends to counteract the compressive forces, so the repair needs only to focus on stabilizing the rotational and bending forces.
- Short oblique: Describes a fracture line that is at an angle greater than 30° to the long axis of the bone, but the length of the fracture line is less than twice the

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Figure 1.1 Fractures are described according to *the number of fragments* as well as fracture configuration, location on the bone and bone. (a) *Two-piece long oblique*, distal diaphyseal fracture of the (left) tibia and fibula. (b) *Two-piece with reducible wedge*, transverse fracture of the mid-diaphysis of the (right) tibia and fractured fibula. (c) *Two-piece with multiple small fragments*, short oblique, mid- to distal third diaphyseal fracture of the right femur. (d and e) *Complex, or multi-fragmented* mid- to proximal diaphyseal fracture of the right tibia and fractured fibula.

Figure 1.2 Fractures are described according to the *fracture configuration* as well as the number of fragments, location on the bone and bone. (a and b) Incomplete, or greenstick, spiral fracture of the entire diaphysis of the left tibia with intact fibula. (c) Two-piece with small fragments, transverse mid-diaphyseal fracture of the (right) tibia with fractured fibula. (d) Two-piece, short oblique, mid-diaphyseal fracture of the (right) femur. (e) Two-piece, long oblique, mid- to distal left humeral fracture. (f) Two-piece, spiral, mid-diaphyseal, right femoral fracture. An attempt was made to "stabilize" this fracture with a splint that is clearly visible on the radiographs. A femoral shaft fracture cannot be immobilized with a splint, but rather, the splint can act as a fulcrum at the fracture line and function to further cause pain and damage of the soft tissues. Splinting a femoral fracture is contraindicated. (g) Three-piece, segmental, diaphyseal, (right) humeral fracture. (h) Complex, segmental, diaphyseal, (left) tibial fracture with fractured fibula. (i) Avulsion fracture of the (right) tibial tuberosity. (j) Two-piece with small fragments short oblique mid-diaphyseal (right) tibial fracture with fissure lines (arrows). (k) Complex fracture of the distal diaphysis of the (left) femur, minimally displaced.

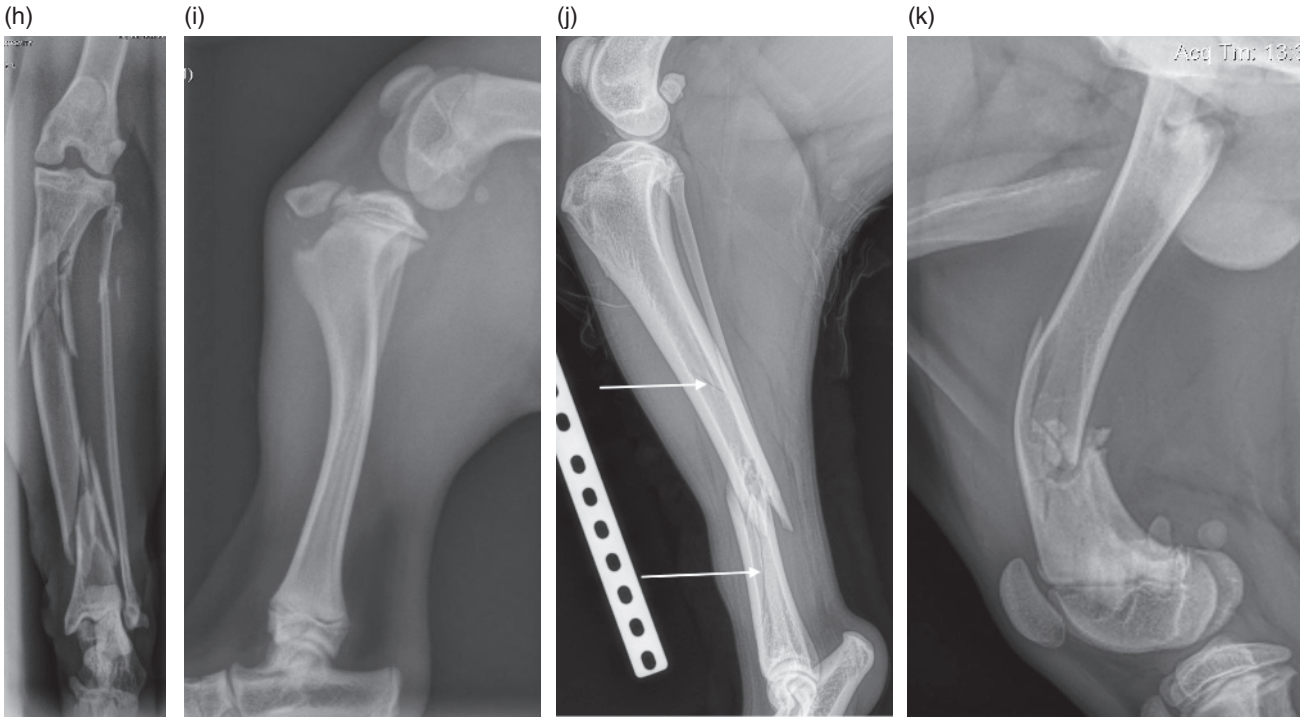

Figure 1.2 (Continued)

diameter of the bone, at the level of the fracture. This configuration is subject to the compressive forces even once reduced, and its short obliquity implies that the rotational forces will not be counteracted by cerclage wires. Therefore, an intra-medullary pin and cerclage wires are *not* an appropriate choice of repair for this configuration.

- Long oblique and spiral: Describes a fracture line that is at an angle greater than 30° to the long axis of the bone and the length of the fracture line is at least twice the diameter of the bone, at the level of the fracture. This configuration is subject to the compressive forces even once reduced, and its long obliquity implies that the rotational forces can be counteracted by cerclage wires. Therefore, an intra-medullary pin and cerclage wires *may be* (depending on the ability to reconstruct the bone) an appropriate choice of repair for this configuration. The spiral fracture is when the long oblique fracture curves around the diaphysis of the bone.
- Segmental: Describes a bone with two fracture lines that do not intersect with one another, creating at least three large fragments. The nature of this configuration implies that most of the diaphysis will be involved. This type of fracture is the least common and tends to be challenging to repair.
- Avulsion: Although "avulsion" truly refers to the type of stress that is applied to a portion of bone to create a fracture, rather than a configuration, it is frequently used by surgeons to describe this specific fracture. Avulsion fractures occur on bony prominences where large tendons attach: acromion process, supraglenoid tuberosity, olecranon, greater trochanter, tibial tuberosity, calcaneus. Because these fractures are so specific in location and configuration, no other terms (other than location) are necessary to describe them.
- Additional terms: Fissure lines can add to the level of complexity of a fracture repair and should be mentioned in the description if they are present. The degree of displacement of the fragments can also affect decision making when it comes to fracture management. Conservative management may be adequate for a minimally displaced fracture where as a markedly displaced one may convey a sense of urgency and concern for the surrounding soft tissues. An open fracture should also be identified in the description.

1.3 Location on the Bone (Figure 1.3)

- Articular: Describes a fracture that involves the articular cartilage and by definition the epiphysis.
- Epiphysis: The epiphysis is the end of a long bone, either proximal or distal. It is usually covered in articular cartilage and is separated from the rest of the bone by the physis, or physeal scar in a mature animal.
- Physis: Describes the proximal and distal cartilaginous growth plates located between the epiphysis and metaphysis. The physes close at skeletal maturity and only a faint white line is visible on radiographs; it is termed the physeal scar. Fractures of the physes in immature animals are called Salter–Harris (SH) fractures (details below).
- Metaphysis: Describes the proximal and distal portions of the long bones between the physis and diaphysis. Bone growth occurs at the section of the metaphysis adjacent to the physis. The metaphysis is usually wider than the physis, is composed of cancellous bone and has thinner cortices than the diaphysis.
- Diaphysis, or shaft: Describes the mid-section of a long bone. It is located between the proximal and the distal metaphyses and is composed of cortical bone, which has a thicker and harder cortex than the metaphyseal bone; it often has an adipose-filled marrow cavity.
- Anatomically specific components of a bone: The location of fractures that occur at specific anatomic regions on a bone will often be described according to that anatomic part; for example, supracondylar, trochanteric, femoral neck.

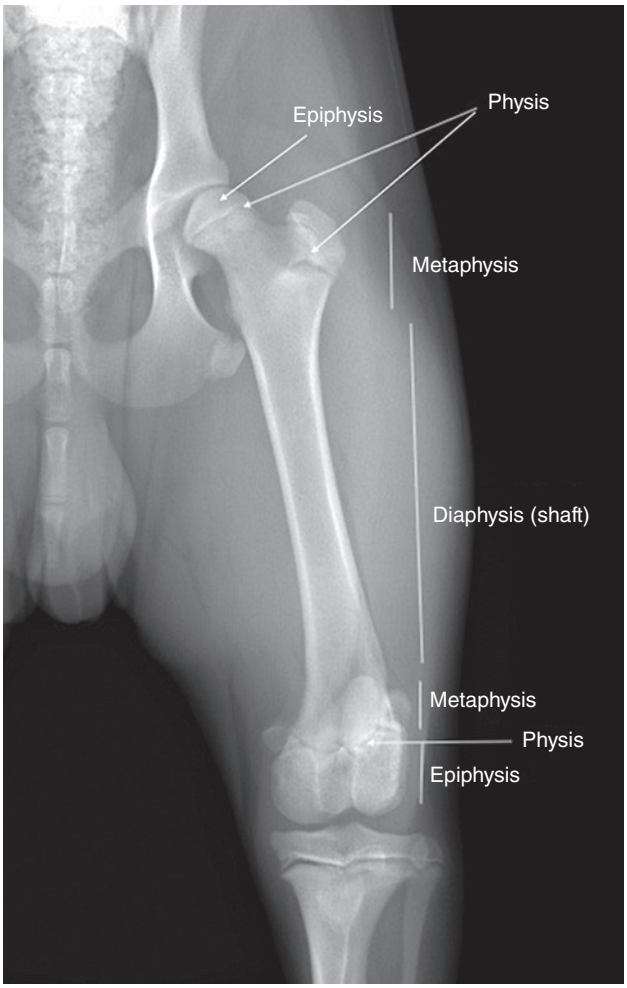

Figure 1.3 A craniodorsal radiograph of an intact femur of an immature dog is used to show the anatomic locations on the bone. The full description is found within the text.

1.4 Salter–Harris Fractures (Figure 1.4)

Salter–Harris fractures are specific to fractures involving the physes, or growth plates. There are five different types of SH fractures and they are designated by the Roman numerals I–V. In general, the prognosis declines as their numerical designation increases:

- SH I: The fracture is confined to the growth plate itself; often termed a "slipped physis."
- SH II: The fracture is along the physis and extends into the metaphysis.
- SH III: The fracture is along the physis and extends into the epiphysis, which makes this an articular fracture. SH III fractures are rare.
- SH IV: These fractures run perpendicular to the physis, extending from the articular surface through to the metaphysis. These too are articular fractures. They are most commonly seen in the elbow (lateral condylar fractures in immature animals).
- SH V: This is a compression fracture of the physis and therefore may not be evident on radiographs taken after the initial trauma. The distal ulnar physis is the one that most commonly sustains this type of SH fracture because of its conical shape. An SH V fracture is usually detected because the physis, or a portion of it, closes prematurely, resulting in an angular limb deformity.

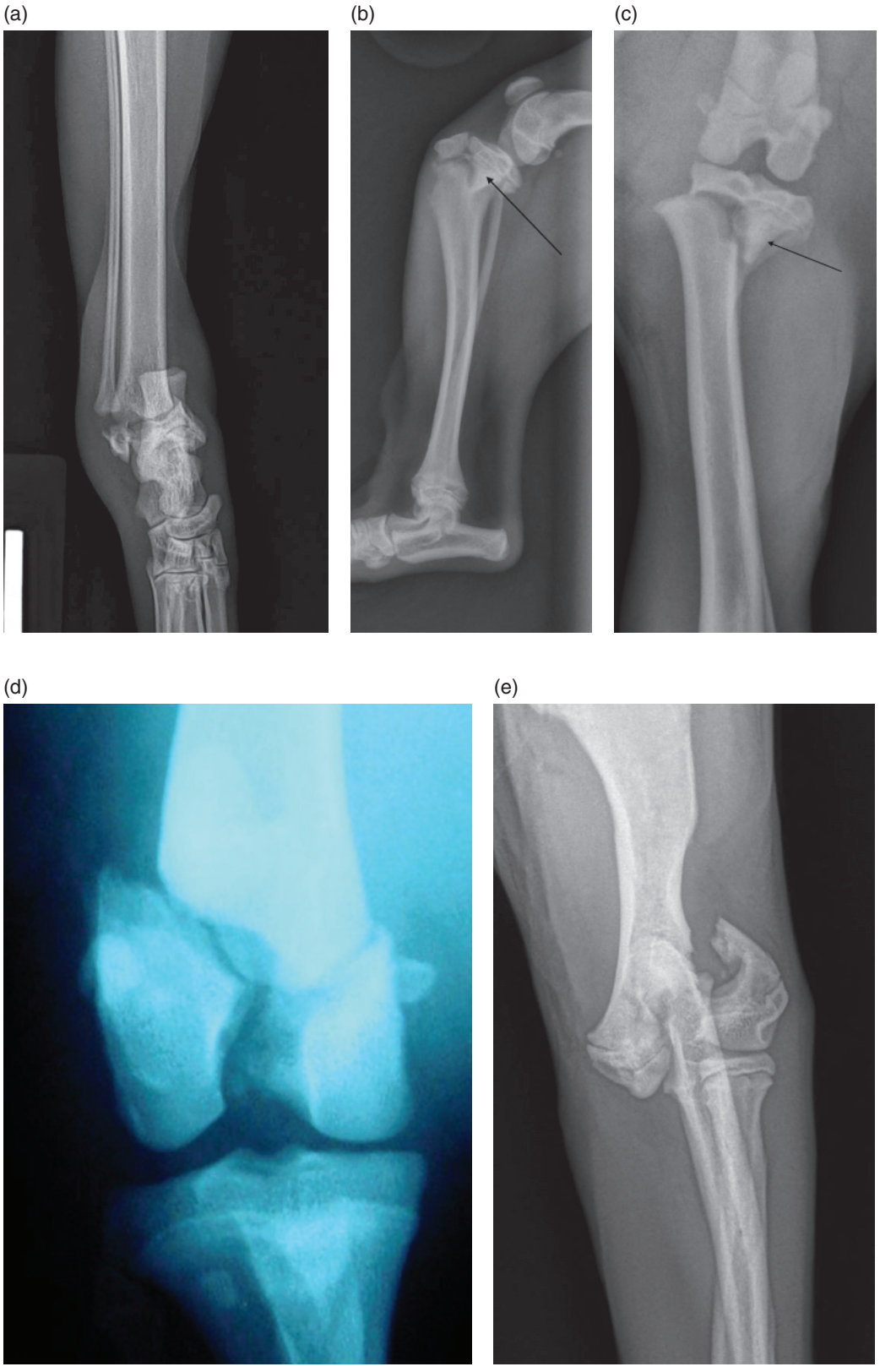

Figure 1.4 The Salter–Harris (SH) classification for physeal fractures. (a) SH I fracture of the distal (left) tibia and fibula. The fracture is located along the physis only. (b and c) SH II of the proximal (right) tibia. The fracture is located along the physis and extends into the metaphysis. The arrow points to the metaphyseal component of the fracture. (d) SH III fracture of the (left) distal femur. The fracture is along the physis and extends into the epiphysis. (e) SH IV of the (left) distal humerus. The fracture extends from the epiphysis to the metaphysis, crossing the physis.