Fracture or luxation of the forepaw is a result of direct trauma, such as being dropped from a height or having a paw caught in a door, or of twisting trauma of a digit. While these present as rather common problems, they are often difficult to treat.

ANATOMY OF THE REGION
The dog and cat have five metacarpal bones. Metacarpal bones II and V are relatively similar in size, and metacarpal bones III and IV are similar in size, although longer than II and V. Metacarpal I is much smaller than bones II and V. The four major metacarpals are arranged with a caudal convexity that probably allows the upper paw to absorb the shock of foot strike.

The metacarpophalangeal joints are typical condylar joints, possessing a medial and lateral collateral ligament and a synovial joint capsule. These joints also possess two elongated palmar sesamoid bones, and one small round dorsal sesamoid, dorsally over the joint. Metacarpophalangeal joint I has only one sesamoid, which is palmar.

The proximal interphalangeal joints and the distal interphalangeal joints are also condylar joints. Each has a medial and lateral collateral ligament and a synovial joint capsule. There are no sesamoids around these joints.

Digit I in the dog and cat has only two phalanges. The remaining digits II to V have three: a proximal or first phalanx, a middle or second phalanx, and a distal or third phalanx. The third phalanx possesses an ungual process over which the nail grows.

SURGICAL APPROACHES
Surgical approaches to the metacarpus and paw require a thorough understanding of the regional anatomy. Most bones or joints are approached using an incision directly over the desired area. Deeper dissection requires identification and retraction of extensor tendons and the arteries and veins of the region.

Palmar approaches to the paw are very difficult because the metacarpal and digital pads overlie the bones and joints. Dissection through or under the pads is not encouraged.
FRACTURES OF THE METACARPAL BONES
Metacarpal bone fractures are seen most commonly in young puppies or kittens that have been stepped on or dropped. The fracture or fractures can be incomplete, complete, two-part fractures, or comminuted fractures and may involve one or more bones.

CLINICAL PRESENTATION
Animals present carrying the affected limb. Palpably, there is soft tissue swelling and pain over the fracture or fractures. Crepitus may be palpable if more than one bone is involved. Gross deformity of the paw will be evident if bones II to V are fractured.

Radiography will confirm the number and kind of fractures present and the degree of deformity.

ASSOCIATED SOFT TISSUE INJURIES
Very few problems occur when metacarpal bones fracture. Sharp ends of bone in a mature animal may lacerate tendons or vessels, but this occurs only rarely.

REDUCTION AND FIXATION
EXTERNAL FIXATION
Incomplete fractures of one or more metacarpals are treated in external fixation. The splint or cast should immobilize the carpus completely to be effective. Complete fracture of one or two bones can be properly treated in external fixation. If three or four metacarpals are fractured and displacement is present, external fixation is a poor choice. When multiple bones are fractured, the splint or cast cannot maintain reduction properly, and while union will probably occur, the recovery will be prolonged and deformity likely. Nonunion of metacarpal bones can occur when splints are used for three or four fractured bones.

INTERNAL FIXATION
Internal fixation is used for comminuted single metacarpal fractures or in animals in whom three or four bones are fractured. In multiple bone fractures the fixation can be used for all fractured bones or for metacarpals II and V only (Fig. 26-1). In the latter case it is assumed that by rigidly fixing bones II and V, bones III and IV will align and become stable enough to unite.

Internal fixation may be accomplished with small plates (Fig. 26-2), intramedullary pins or wires, or orthopaedic wire used with intramedullary fixations. Intramedullary pins are introduced dorsal to the metacarpophalangeal joint and driven proximally. The exposed pin must be bent carefully in order not to interfere with joint function. Coaptation is often necessary following surgery, since the small diameter of the pins used for fixation may allow bending during weight bearing. Coaptation should be used until there is radiographic evidence of bony union.

FIG. 26-1 Dorsopalmar (A) radiograph demonstrates complete fracture of metacarpal bones II, III, IV, and V in an immature dog. Dorsopalmar (B) and medial-lateral (C) radiographs demonstrate union 5 weeks following intramedullary fixation of metacarpal bones II and V

FIG. 26-2 Dorsopalmar (A) and medial-lateral (B) radiographs demonstrate a complete fracture of metacarpal bone V in a racing greyhound. Dorsopalmar (C) and medial-lateral (D) radiographs demonstrate bony union 2 months following fixation using a seven hole semitubular bone plate. (Courtesy of Dr. Jon Dee)
COMPLICATIONS
Any method of fixation, open or closed, may fail and result in nonunion. Most metacarpal nonunions are painful and require subsequent surgery.

Proliferative callus associated with union or nonunion may incorporate flexor or extensor tendons and result in digital malfunction. This latter problem may also be painful. Overall, metacarpal fractures are treated very successfully and uneventfully. Most animals have excellent results and return to normal.

LUXATION OF METACARPOPHALANGEAL JOINTS
Luxation of the metacarpophalangeal joint is rare. Most dislocations occur in a palmar direction, resulting in the entire digit being held more prominently dorsal. Clinically the animal presents with pain, discomfort, and obvious deformity. Owing to the three other normal digits the dog may bear some weight but will be lame. Radiography confirms the luxation (Fig. 26-3).

Treatment of metacarpophalangeal luxation is difficult. Some dogs will return to near normal quickly and walk on the luxated joint, which is ideal, since most luxations treated by closed reduction tend to recur and are not properly immobilized in a splint or cast. Surgical repair of the torn capsule or ligaments is possible but difficult.(1) Internal fixation of the joint with a small pin, transfixation pin, or orthopaedic wire reconstruction results in perceptible abnormality to the animal and lameness. Arthrodesis of the joint is probably the most reasonable approach. If all else fails to make the animal comfortable, digital amputation is indicated (Chapter 48).

* Dee JF: Personal communication, 1981.

FRACTURES OF PHALANGES
Most phalangeal fractures are single and occur when the paw is stepped on.

CLINICAL PRESENTATION
Most animals are capable of walking but demonstrate considerable lameness. Palpation will reveal a warm, swollen, painful digit. Crepitus may or may not be present.

Radiography is helpful in determining how to treat the fracture, since it can clearly demonstrate the shape of the fracture. It is often necessary to separate the affected digit and radiograph it independently to avoid superimposition of the other phalanges.

REDUCTION AND FIXATION
EXTERNAL FIXATION
Most phalangeal fractures are aligned manually and immobilized in a splint or cast. Although most fractures heal, it must be remembered that it is very difficult to immobilize all the involved joints, especially when the animal is weight bearing. Therefore, delayed unions and proliferative callus are common (Fig. 26-4).
INTERNAL FIXATION
Occasionally, owing to the size of the animal or the shape of a fracture, internal fixation may be desired. Oblique fractures are fixed using cortical interfragmentary lag screws or orthopaedic wire sutures. If intramedullary fixation is desired, the pins must be inserted in such a way as not to interfere with normal joint motion. Small plates are occasionally used (Fig. 26-5). Internal fixation in phalangeal fractures uses very small implants; therefore, postoperative external fixation for 4 to 6 weeks is still necessary.

FIG. 26-5 Medial-lateral radiograph demonstrates use of a three hole bone plate for fixation of a fracture of the first phalanx in a racing greyhound. (Courtesy of Dr. Jon Dee)

COMPLICATIONS
As with metacarpal fractures, nonunions or proliferative callus may result in pain to the animal or in incorporation of flexor tendons. Most animals, however, have excellent results with external fixation of phalangeal fractures and experience no complications.

INTERPHALANGEAL JOINT LUXATIONS
Luxation of the proximal or distal interphalangeal joints is rare and when it occurs tends to be in racing greyhounds or field trial dogs.

CLINICAL PRESENTATION
In most instances the joint luxates dorsally and results in a very prominent "knocked-up" appearance. Palpation demonstrates a swollen, painful joint and the obvious deformity of the luxation. Dogs will favor the foot but bear weight. Radiographs are used to confirm that no fractures are present (Figs. 26-6 and 26-7).

FIG. 26-6 Dorsopalmar (A) and medial-lateral (B.) radiographs demonstrate palmar and lateral dislocation of the proximal interphalangeal joint in digit III of a racing greyhound. (Courtesy of Dr. Jon Dee)
REDUCTION AND FIXATION
CLOSED REDUCTION AND FIXATION
Closed reduction with splints or casts fails. It is impossible to properly maintain the joint in a reduced position. Nonathletic animals may adapt and walk well with the luxation.

OPEN REDUCTION AND FIXATION
Attempts at internal fixation using wires have been made; however, most are unsuccessful. Attempts to repair torn capsule or collateral ligaments have been reported,(2) but such procedures are difficult. The treatment of choice is interphalangeal arthrodesis. The joint must be aligned carefully to allow normal position. Even this procedure often fails under stress, with weight bearing causing a high rate of metal failure. Amputation of the affected digit is often the only successful method of treatment.

COMPLICATIONS
The main complication of interphalangeal joint luxation is fixation failure. In an athletic dog amputation is best. Pet animals have a good prognosis even if no treatment is given. Most dogs will continue to favor the limb but will walk and function at a near normal level.

REFERENCES
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