Fractures and Dislocations Associated with Racing Greyhound

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- Accessory Carpal Fractures
- Metacarpal-Metatarsal Fractures
- Central Tarsal Fractures
- Calcaneal Fractures
- Triads of the Tarsus
- Second Tarsal Fractures
- Acetabular Fractures

Fractures and dislocations of the racing greyhound can be of any type, but certain injuries are more common. Many of these injuries are rare in other breeds. The following compilation is from a small animal practice in south Florida. Although a few puppies are seen, most of the greyhounds treated are adult racing dogs. Injuries have been seen in the following frequencies:

**COMMON INJURIES**
- Accessory carpal fractures
- Metacarpal (metatarsal) fractures
- P1-P2 instability
- P2-P3 instability
- Central tarsal fractures
- P1, P2, or P3 fractures
- 4th tarsal fractures

**OCCASIONAL INJURIES**
- Radial and/or ulnar fractures
- Sesamoid fractures
- Metacarpal (metatarsal)-phalangeal instability
- Calcaneal fractures
- Third tarsal fractures (to common)
- Malleolar fractures (to rare)
- Plantar proximal intertarsal subluxation

**RARE INJURIES**
- Scapular fractures
- Humeral fractures
- Elbow fractures
- Styloid fractures
- Radial carpal fractures
- Small chips of numbered carpal bones
- Acetabular fractures
- Ischial fractures
Femoral fractures
Tibial fractures
Talar fractures
2nd tarsal subluxations
Dorsal proximal intertarsal subluxations
Plantar tarsometatarsal subluxations

In summary, it can be stated that the fractures that are common to the racing greyhound occur primarily through indirect forces, while those injuries that occur in companion animals are usually a result of direct trauma. When direct forces injure the greyhound, it is generally due to a spill, hitting the wall, or hitting the catch curtain.

The best success in greyhound practice is "a return to form," that is, the injury does not hinder the patient in later races. Less favorable is "a return to win," although the "win" may be in a lower caliber race or smaller track with smaller purses. Thus, a grade A (top grade) might drop down to grade D (lowest grade), and still win a race, albeit at a lower grade. The lowest form of success would be to "return to racing," which means the dog comes in third or fourth, at least paying its way. Complete failure is to lose money for the owner by not racing again. Some patients are operated, however, with the understanding that they are going to be retired for breeding stock.

We use the following terms when we predict a dog's ability to return to racing:

Excellent 90%-100%
Good 75%-90%
Fair 60%-75%
Guarded 40%-60%
Poor <40%

Initially, we used tourniquets routinely to aid in hemostasis; however, we have found them unnecessary in acute fractures. They make some reductions more difficult because they increase the tension on the flexor tendons, thereby distracting bone fragments. Tourniquets are still used for chronic fractures and arthrodesis. Skin retraction is usually obtained by multiple stay sutures, which help provide hemostasis.

ACCESSORY CARPAL FRACTURES
Fractures of the accessory carpal bone in the racing greyhound are relatively common owing to the stresses of racing. The injury, which more commonly affects the right leg, is due to hyperextension of the carpus at speed.

FIG. 35-1 Extra-articular avulsion fracture of the accessory carpal bone in a 21/2-year-old female greyhound.

FIG. 35-2 Distal avulsion fracture of the accessory carpal bone in a 2-year-old male greyhound: (A) preoperative radiograph; (B) following chip removal.

Two primary injuries are seen: a proximal avulsion strain at the insertions of the flexor carpi ulnaris on the accessory carpal bone (Fig. 35-1), and a distal avulsion sprain at the attachment of the intercarpal ligaments to the base of the accessory carpal bone (Fig. 35-2). The distal ligaments of the accessory carpal bone attach on the distal portion of the "basilar enlargement" and insert on the ulnar carpal bone. One must realize that the proximal chip is extra-articular, while the distal chip is
invariably intra-articular. Very rarely one will see a distal avulsion sprain from the origin of the abductor digiti quinti (Fig. 35-3).

In the past, it was thought that accessory carpal avulsions failed to heal because the abductor digiti quinti muscle kept the fragments distracted. In our experience most distal accessory carpal fractures fail to heal because they are intra-articular and because they are distracted by their distal ligamentous attachments, not by any attachments to the abductor digiti quinti. We agree with Hickman, that there is no need to resect the abductor digiti quinti muscle in the treatment of accessory carpal fractures. This muscle may be cut if the surgeon needs additional exposure of the chip, although this has been uncommon in our experience.

Although the fracture of the accessory carpal bone is acute, the rapid disappearance of soft tissue swelling and apparent improvement with rest usually cause the trainer to postpone presentation of the patient until the injury is chronic. The typical injured patient has been rested 6 to 8 weeks and appears sound but when raced again becomes lame or performs below expectation.

The patient with a proximal chip has moderate palmar carpal swelling and pain on extension; the patient with a distal chip has less swelling and has pain on flexion. Distal chips are more common and usually larger than proximal chips. Rarely, the fracture may divide the bone into nearly equal sections. Lateral radiographs in full extension are diagnostic. Occasionally the flexor carpi ulnaris will avulse from the accessory carpal and one will see only small amounts of "bone dust" to confirm the proximal avulsion. Careful palpation and critical viewing of detail radiographs will permit diagnosis of the lesion.

Surgery is straightforward to remove the chip. Distal chips are approached by a palmar-lateral incision that begins proximal and dorsal to the insertion of the flexor carpi ulnaris on the accessory carpal bone and extends distally to end on the lateral aspect of the base of metacarpal V. The abductor digiti quinti muscle is retracted in a palmar direction, while the lateral accessory carpal-metacarpal ligament is retracted dorsally. Visibility is limited. Gelpi retractors aid exposure greatly. Careful sharp dissection is needed to free the chip from its distal ligamentous attachment to the ulnar carpal bone while avoiding injury to the adjacent branch of the ulnar nerve and caudal interosseous artery.

In certain cases, the chip may be large enough to be reduced with an interfragmentary screw. It is too early to tell if this method will become an acceptable or preferred alternative to chip removal. Screw fixation may be the only method of repair that is feasible for the rare fracture that almost halves the accessory carpal bone.

Torn flexor carpi ulnaris tendons and proximal chip avulsions are approached through a palmar or palmar lateral incision. After the chip is removed, primary tendon repair may be accomplished with nonabsorbable suture if sufficient tags remain to hold sutures. Gannon has passed a suture around the accessory carpal bone to reattach the flexor carpi ulnaris. He has also drilled a hole in the accessory carpal bone to accommodate a suture but cautions that the hole must be small or fracture may occur through the hole.

Postoperative care consists of temporary support followed by a prolonged period (minimum 3 months) of gradually increasing activity (nonracing). Premature return to full use will risk additional damage to the carpus, while excessive joint immobilization risks decreased range of motion.

The prognosis decreases as chronicity increases as a result of degenerative joint disease. Conservative treatment is unrewarding. Some dogs with a proximal chip will return to racing after an extended rest. A distal chip usually results in early retirement if surgery is not performed. Early surgical intervention warrants a fair to good prognosis. If the dog is less than 2/2-years-old, the prognosis is good; if older, the prognosis is fair and if the lesion has been present more than 3 months, the prognosis is poor.

Many trainers postpone physical and radiographic examination by a veterinarian because they assume the injury is "just a
sprain"; initially it does mimic a flexor carpi ulnaris strain or sprain of the flexor retinaculum. It behooves the veterinary practitioner to educate the trainer to the benefits of early examination of these carpal "sprains."

METACARPAL-METATARSAL FRACTURES
Metacarpal-metatarsal fractures occur in the young dog who runs a very fast race or in the unfit dog started prematurely. The fact that the race is run on a circular track, in a counterclockwise direction, exacerbates the stresses of racing. These increased stresses are substantiated by the locations of metacarpal-metatarsal injuries: they occur most frequently on the "rail" side of the affected foot, specifically metacarpal V of the left foot, metacarpal II of the right foot, and metatarsal III of the right foot. If the left metacarpal V is amputated at the metacarpophalangeal joint, the fourth metacarpal bone must strengthen to protect itself from fatigue fractures. These stress fractures usually occur at the approximate junction of the proximal and middle one-third of the metacarpal or metatarsal bones (near the attachment of the interosseous muscles).

In our practice, patients with fatigue fractures present as three main types:

Type I. The patient presents with a history of "drifting," or running wide on the turns with some loss of speed on the straights. Clinically the dog may be lame after the race and the following day. Pain can be elicited by deep digital palpation approximately at the junction of the proximal one-fourth to one-third and the distal three-fourths to two-thirds of the affected bone. Radiographically, increased endosteal and cortical thickening may be evident, and increased radiodensity of the medullary canal is seen (Fig. 35-4). Treatment consists of rest followed by a restricted exercise regime to allow the stressed bone to gradually strengthen.

Type II. The clinical signs are increased in severity. A hairline fissure fracture may be seen radiographically with no displacement. Detail films are very helpful in the diagnosis of the above types (Fig. 35-5). Treatment consists of coaptation, and the rate of healing is slow.

Type III. An acute non-weight-bearing lameness with extensive metacarpal (metatarsal) swelling is demonstrated. Radiographically, a complete fracture with palmar (plantar) displacement of the distal fragment is seen. Many of these fractures are comminuted (Fig. 35-6, A and B).

Depending upon the amount of displacement or comminution, the following methods are used:

Coaptation
Lag screw fixation with coaptation
One fourth tubular neutralization plate with lag screws through the comminution; coaptation for 3 to 4 weeks (Fig. 35-6, C and D)

FIG. 35-5 Hairline fissure fracture of metatarsal III at the junction of the proximal one-third and middle one-third: (A) dorsal-plantar view; (B) medial-lateral view.

FIG. 35-6 Comminuted fracture of metatarsal 111 with plantar displacement of the distal fragment in a 2/2-year-old female greyhound: (A) medial-lateral view; (B) dorsal-plantar view. (C, D) Radiographs demonstrate the fracture repaired with an eight-hole one-fourth tubular plate using 2.7-mm and 2 mm cortical screws.
CENTRAL TARSAL FRACTURES
The central tarsal fracture is one of the most devastating fractures of the racing greyhound unless satisfactory surgical repair is achieved. These fractures have been classified into the following types according to their radiographic and surgical appearance:

I. Dorsal slab fracture\textsuperscript{1} nondisplaced
II. Dorsal slab fracture-displaced
III. Large displaced medial fragment without a dorsal slab fracture
IV. Dorsal slab fracture with a medial slab fracture
V. Comminuted fractures

Diagnosis of type I and II fractures is by appreciation of point pain over the central tarsal area upon digital pressure and by detail radiography. Clinically the patient is nonweight-bearing and has minimal soft tissue swelling. Historically type I fractures have been overlooked by the inexperienced observer even with detail radiography (Fig. 35-7, A). A high index of suspicion is required for its detection. Type I (Fig. 35-8) and type II (Fig. 35-9) fractures are repaired with a 2.7-mm cortical screw that is lagged and countersunk. They are seen frequently and their prognosis is excellent. If they are only coapted externally, they have a less favorable prognosis (Fig. 35-7, B)

![FIG. 35-7 (A) Type I central tarsal fracture with joint effusion and avulsion of the intertarsal ligament between the central and third tarsal bones in a 2/2-year-old male greyhound. (B) Nonunion of the central tarsal bone following six weeks of coaptation. Hypertrophic bone and degenerative joint disease are also present.](image)

![FIG. 35-8 (A) A nondisplaced dorsal slab fracture (type I) of the central tarsal bone in a 3-year-old female greyhound. (B) Radiograph 7 weeks after reduction and fixation using a simple interfragmentary screw.](image)

![FIG. 35-9 (A) Type II central tarsal fracture in a 1-year-old male greyhound, (B) Postoperative radiograph immediately following reduction and fixation using a single interfragmentary screw.](image)

Although rare, type III fractures are more readily apparent on physical and radiographic examination. Surgical correction is by interfragmentary compression using a 3.5-mm cortical or 4-mm canoston screw in a lag fashion (Fig. 35-10). Prognosis is excellent.

![FIG. 35-10 (A) Type II central tarsal bone fracture with a large medially displaced fragment of the central tarsal bone. (B) Postoperative radiograph immediately following reduction and fixation with a single lag screw.](image)

Type IV fractures are classified by appearance as having two major displaced fragments, although it is not uncommon to have comminuted chips posteriorly. Surgical repair is by a countersunk 4mm canoston screw to reduce the medial fragment...
followed by a 2.7-mm cortical screw in the anterior fragment placed in a lag fashion and carefully countersunk. The medial-lateral screw is placed distally to obtain the best purchase in the fourth tarsal bone. A 4-mm cancellous screw is used instead of overdriving a 3.5-mm cortical screw to minimize loss of bone by driving (the 3.5-mm screw has a thread of 3.5 mm while the 4-mm screw has a core diameter of only 2.3 mm, a saving of 1.2 mm of bone). This smaller core reduces the likelihood of the medial-lateral screw being hit when placing the cranial-caudal 2.7-mm screw.

In addition, the 4-mm cancellous screw is used because it has more thread area, an advantage since a large number of type IV central tarsal fractures have an associated fracture of the fourth tarsal bone. Prognosis of type IV central tarsal fractures is good for a return to racing.

Caution should be used when countersinking and seating the cranial-caudal screw, since this fragment is very thin and subject to fracture through the screw hole (Fig. 35-11).

FIG. 35-11 (A, B) Type IV central tarsal bone fracture with extensive soft tissue swelling and concomitant varus deformity in a 2 year old female greyhound. (C, D) Radiograph 7 months after reduction and fixation with two lag screws.

Type V fractures are usually externally coapted or internally fixed so that the animal can be used for breeding. Racing prognosis is poor (Fig. 35-12).

FIG. 35-12 (A, B) Severely comminuted type V central tarsal bone and a comminuted calcaneal fracture in a 3-year-old female greyhound. (C, D) Radiographs 14 weeks after reduction and fixation using a tension band ware. Because the dog was intended to be used for breeding purposes, only the repair of the calcaneal fracture was undertaken.

To date, screws have routinely been left in place in over 300 cases, and no screws have broken postoperatively as a result of racing.

Fourth tarsal fractures are usually associated with at least a type IV or greater central tarsal fracture. Repair is aimed at restoring the medial buttress, which is the central tarsal bone, thereby indirectly stabilizing the fourth tarsal (Fig. 35-13). In severe fractures of the fourth tarsal bone, the repair is augmented by placing an additional 4-mm cancellous screw in a medial-lateral direction through the second and third tarsal bones into the distal portion of the fourth. The prognosis is guarded depending on the amount of shortening or comminution of the fourth (Fig. 35-14).

FIG. 35-13 (A, B) Compression fracture of the fourth tarsal bone secondary to a severe central tarsal bone fracture in a 3-year-old male greyhound. An associated avulsion fracture of the metatarsal V is present. (C, D) Radiographs taken immediately after surgery demonstrate indirect reduction and fixation of fourth tarsal bone fracture using lag screws.
CALCANEAL FRACTURES

Calcaneal shaft fractures are usually associated with central tarsal fractures. The most common types are transverse comminuted fracture of the shaft of the calcaneus (Fig. 35-12, A and B) and lateral vertical slab into the distal articular surface (Fig. 35-15). It is simpler to repair the central tarsal fracture before repairing the calcaneal fracture.

Fracture of the calcaneal shaft is repaired using pins and a figure-of-eight tension band wire (Fig. 35-12, C and D). Kirschner wires and small cortical screws are used to maintain reduction of any small fragments. An axially placed Steinmann pin with a figure-of-eight tension band wire through the base of the calcaneus is used to establish longitudinal stability while counteracting the distracting forces of the calcaneal tendon. The wire is always placed first. If the pin is seated first, the drill invariably hits it when placing the hole for the wire. Prognosis for a return to racing is guarded.

An injury that may be unique to the racing greyhound is the lateral vertical slab (sagittal) fracture of the calcaneus that extends into the calcaneoquartal joint (the joint between the calcaneus and fourth tarsal bone). It is usually associated with a central tarsal fracture (Fig. 35-15)

A third type of calcaneal fracture that does not involve the shaft is an avulsion of the plantar ligament from the base of the calcaneus (Fig. 35-16, A). This avulsion is repaired by arthrodesis with cancellous grafting of the calcaneoquartal joint. This joint forms the lateral part of the obsolete "proximal intertarsal joint." Stabilization is achieved by using a Steinmann pin and figure-of-eight wire (Fig. 35-16, B and C). Prognosis is guarded.

Although calcaneal fractures have been repaired by plate fixation, in our experience this has been unnecessary. A plantar lateral approach is used to place interfragmentary, screws.

Postoperative care of calcaneal fractures of the racing greyhound consists of external coaptation for approximately 6 to 8 weeks. This prolonged external support is believed to be necessary because of the following factors:
The fractures are associated secondarily with a severe central tarsal fracture (type IV or V). The patient is a large, active, athletic dog. One must protect the soft tissue injuries associated with these fractures. The trainers tend to return the unsplinted patient to training prematurely.

**TRIADS OF THE TARSUS**
The following groups of fractures have been seen in association:

(Most Common)
Central, Fourth, Metatarsal IV
Central, Fourth, Talus
Central, Fourth, Calcaneus
Central, Metatarsal V, Calcaneus

All of these fractures have a central tarsal fracture as a component. Repair of the avulsion fracture of metatarsal V has not required internal fixation when associated with these triads of the tarsus (Fig. 35-13).

Metatarsal V fractures are invariably associated with type IV or greater central tarsal fractures.

Internal fixation, when used for repair of intra-articular tarsal fractures (other than tarsocrural), is performed primarily to achieve precise anatomical reduction and only secondarily to achieve early weight bearing. Although early passive motion is highly desirable, early weight bearing is hazardous. Therefore repairs that are often dependent upon one or two screws are often externally coapted for 6 to 8 weeks with a heavily padded Mason metasplint.

Unlike many articular fractures, loss of joint motion is not as much a problem as is loss of "bone space" or joint collapse with a resultant angular deformity and loss of function.

Third tarsal fractures usually present as a mild lameness with the dog weight bearing but with point pain over the dorsal aspect of the third tarsal bone (Fig. 35-17A, and B). Occasionally a chronic fracture of the third tarsal bone will not produce pain or palpation and can be determined only radiographically. Unlike central tarsal fractures, many third tarsal fractures present as chronic injuries with no readily apparent lameness. The dorsal slab of these chronic fractures usually has become osteoporotic with an associated peristeal reaction. Third tarsal fractures are usually solitary lesions with minimal displacement. Fixation is by a 2.7-mm cortical screw seated in lag fashion (Fig. 35-17, C and D) or by a 4-mm cancerous screw. Countersinking is done carefully to avoid splitting the fragment. The use of the 4-mm cancerous screw is being reevaluated, since two screws have fractured at the thread-shank junction while being placed. The 4-mm screw has been preferred because it does not need to be overdrilled and it has a larger head to compress the slab fracture. Prognosis is excellent if operated upon early but only fair to good if the injury is chronic.

**SECOND TARSAL FRACTURES**
Fractures or dislocations of the second tarsal are extremely rare but when seen are associated with the more severe central tarsal fractures (Fig. 35-14) or with a solitary third tarsal fracture (Fig.35-17). Dislocations are reduced and maintained with fixation screws. Fractures are treated similarly if the fragments will permit the use of the screws.

**ACETABULAR FRACTURES**
Acetabular fractures are acute injuries of young dogs that present with reduced weight bearing with the affected limb held in abduction. In our experience, they are usually associated with indirect trauma, unlike acetabular fractures in other breeds.
Cannon, however, has seen acetabular fractures associated primarily with direct trauma. On physical examination they will usually show pain on flexion and extension of the coxofemoral joint. On occasion digital pressure on the sacrotuberous ligament will elicit a pain response. In addition the dog will usually resist backward wheelbarrowing on the hind legs and will fall or be in great pain. The fracture is usually in the posterior one-third of the acetabulum or in the anterior ischium. Few acetabular fractures have been repaired and documented as a result of the following:

The condition is rare.
Most cases are young, unproven dogs.
The limited number of cases makes it difficult to determine an accurate prognosis for the owner.
Although the surgical repair is straightforward, namely, bone plating, insufficient data are available to estimate how many dogs will go on to win races as opposed to how many dogs will be acceptable as companion animals.

REFERENCES


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