Fracture of the Small Tarsal Bones and Luxation of the Tarsal Joints in Horses*

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ABSTRACT: Fractures of the small tarsal bones are uncommon and result from considerably different causes despite their anatomic proximity. Fractures of the fused first and second tarsal bones and fourth tarsal bone are very rare and are most often observed in association with luxation of tarsal joints and concurrent fracture of other tarsal bones or fracture of the fourth metatarsal bone, respectively. Internal fixation via lag screw application of third and central tarsal bone fractures results in a good prognosis for return to athletic performance if surgery is performed early. Collapse and/or fracture of the third or central tarsal bone occur(s) in foals with immature tarsal bones and may best be prevented by restricted exercise. Luxation of the equine tarsus requires substantial force and can occur in all four tarsal joints. Radiography allows assessment of the severity of the luxation and detection of concurrent fractures of the small tarsal bones. Stressed views under general anesthesia may be required to confirm suspected, spontaneously reduced luxation. Successfully managed cases have been described for both tarsocrural joint luxation and luxation of the distal joint rows.

Precise diagnosis and appropriate treatment of traumatic tarsal injuries can be difficult because of nonspecific clinical signs and the complex radiographic appearance of the tarsal joints. A thorough physical examination and knowledge of the pertinent anatomy are required to accurately detect injuries in the distal tarsus. This article reviews fracture of the small tarsal bones and luxation of the tarsal joints.

FRACTURES OF THE SMALL TARSAL BONES

The small tarsal bones comprise the central tarsal bone in the intermediate row, the fused first and second tarsal bones, the third tarsal bone, and the fourth tarsal bone in the distal row. Unlike the other small tarsal bones, which are flattened or narrow, the fourth tarsal bone is cuboidal and occupies both the distal

and intermediate row because of its greater depth (Figure 1). The fused first and second tarsal bones are relatively small and lie predominantly behind the third tarsal bone (Figure 2). Fractures of the small tarsal bones are uncommon. Despite their anatomic proximity, fractures of the various small tarsal bones result from considerably different causes.

### Fused First and Second Tarsal Bones

Fractures of the fused first and second tarsal bones are very rare. Two reports described this type of fracture in association with luxation or subluxation of the tarsometatarsal or talocentral (proximal intertarsal) joints. The fracture is usually detected radiographically in association with fractures of other tarsal bones and collapse of the distal row of the tarsus. Fragments may be removed through open surgical reduction of the luxation.

### Third and Central Tarsal Bones

Slab fractures of the third or central tarsal bones are more common, occurring almost exclusively in racehorses or other competitive horses during strenuous exercise. Although they are evidently of traumatic origin, one author believes they actually represent stress fractures of diseased bone resulting from accumulated repetitive trauma. Wedge-shaped appearance of the dorsolateral aspect of the third tarsal bone on a dorsomedial–plantarolateral oblique (DMPLO) radiographic view has inconsistently been associated with fracture of this bone. Another hypothesis is that fractures of the third tarsal bone result from premature inward rotation of this bone during the second half of the stride resulting from preexisting ligamentous damage between the small tarsal bones. Under axial loading, the exposed dorsal lip of the third tarsal bone may then be compressed between the central tarsal bone and the dorsal margin of the third metatarsal bone, resulting in fracture.

Bilateral pathologic fracture or collapse of the third and/or central tarsal bones has been reported in foals with immature bone secondary to premature birth or twin pregnancies. Excessive loading of immature small tarsal bones may result in valgus deformities and/or failure of the third and/or central tarsal bones. Radiographic and ultrasonographic monitoring of tarsal bone ossification have been proposed.
in immature foals before subjecting the tarsus to weight bearing (e.g., pasture turnout). Diagnosis of slab fractures of the third tarsal bone or central tarsal bone can be considerably difficult. Acute onset of severe lameness is usually observed; however, initial lameness often diminishes substantially over the first 1 or 2 weeks after injury. Tarsocrural joint effusion is inconsistently observed with central tarsal bone fractures. Other clinical findings include soft tissue swelling over the dorsodistal aspect of the hock, local heat, and a painful response to digital pressure over the fracture. Most horses resent flexion of the tarsus.

Radiographic confirmation of a central or third tarsal bone fracture may be challenging because the fragments are often only minimally displaced and a fracture line may not be evident on standard projections. Serial oblique radiographs, taken at various angles, or repeat films at a later date may be necessary to confirm a suspected fracture. In acute nondisplaced fractures with no evident fracture line, repeat radiographs should be obtained no sooner than 10 days after the incident to allow visualization of periosteal proliferation and bone resorption. Nuclear scintigraphy may be particularly useful to localize a problem before a fracture becomes radiographically visible (Figure 3). Computed tomography has also been used to define fracture planes in comminuted fractures. Ultrasonography may be used to detect small nondisplaced or reattached fragments in marginal fractures. However, ultrasonography appears to be of limited use for evaluating the articular cartilage in the distal tarsal joints.

Early diagnosis and treatment of central and third tarsal bone fractures are imperative. Development of secondary degenerative joint disease (DJD) of the distal tarsal joints can be minimized once the condition is recognized and treatment is initiated.

Collapse or fracture of immature third or central tarsal bones in foals is usually identified by physical examination and radiography. Affected foals often present with a “curby appearance” (bump on the plantar aspect of the tarsus) and sometimes with an associated angular limb deformity.
Slab fractures of the central tarsal bone (Figure 4) usually occur at the dorsomedial aspect of the bone, whereas third tarsal bone fractures most often involve the lateral or dorsolateral aspect\(^2,4,8\) (Figure 5). Both fracture types are best treated with lag-screw fixation via stab incisions using one or two cortical screws, provided the fracture plane can be assessed.\(^2,4,8\) Small fracture fragments may be reduced using smaller implants, such as 3.5-mm cannulated screws\(^19\) (Figure 6). Localization and definition of intertarsal and tarsometatarsal joints and the lateral and medial border of the fragment by percutaneous hypodermic needle insertion allow precise screw placement. Horses are stall confined for 8 to 10 weeks postoperatively, followed by hand walking for another month. Prognosis for return to athletic function is generally good if surgery is performed early.\(^2,4\)

Conservative therapy for third and central tarsal bone fractures historically results in poor athletic outcome because of progressive fragment displacement, advanced DJD, and the potential for partial joint arthrodesis.\(^2,4,8,9\) However, a recent study established a more favorable prognosis for conservative treatment. Ten of 14 standardbreds and two of six Thoroughbreds with fractures of the third or central tarsal bone successfully returned to racing following prolonged stall rest.\(^20\)

Collapse of immature tarsal bones in foals is best prevented and treated by restricted exercise. Hindlimb sleeve casts supporting the tarsus and exposing the foot to allow weight bearing and prevent flexor tendon laxity may be applied. If the limb can be maintained in reasonable alignment and the distal tarsal joints fuse, foals may become sound.\(^18\) Foals with pathologic fractures or collapse greater than 30% apparently have a very poor prognosis.\(^19\)

Fourth Tarsal Bone

Fourth tarsal bone fractures are rare and usually combined with fractures of the proximal aspect of the fourth metatarsal bone. This fracture configuration results from external impact trauma when a horse is kicked by another horse or kicks a solid object.\(^2,21\) Fourth tarsal bone fractures are frequently open, resulting in contamination and infection of bone fragments. Septic arthritis of the tarsometatarsal and intertarsal joints may also result.\(^2\) Therefore, traumatic laceration on the distolateral aspect of the tarsus warrants thorough radiographic examination. Because fracture of the fourth tarsal bone is almost exclusively observed in combination with fractures of the proximal aspect of the fourth metatarsal bone, particular attention should also be paid to the latter during radiographic examination.

Treatment of open fourth tarsal and metatarsal fractures consists of debridement of bone fragments and devitalized soft tissues and systemic medication with broad-spectrum antibiotics. Affected tarsometatarsal and intertarsal joints should be thoroughly lavaged with sterile lactated Ringer’s solution.\(^2\) Comminuted fractures of the fourth tarsal bone are usually left open to heal after debridement. Return to soundness following conservative therapy of a solitary fracture of the fourth tarsal bone has been reported in a draft horse.\(^21\)
LUXATION OF THE TARSAL JOINTS

Luxation of the equine tarsus can occur in all four tarsal joints, but, to our knowledge, no luxations of the centrodistal (distal intertarsal) joint have been reported in the literature. We observed one case associated with fractures of the fused first and second, third, and fourth tarsal bones in our clinic (Figure 7). However, this condition seems to be extremely rare, and the centrodistal joint seems to be additionally stabilized by the fourth tarsal bone and, to some extent, the fused first and second tarsal bones.

Luxation of the tarsocrural joint requires a major traumatic event and is most often observed in association with partial disruption of the collateral ligaments and avulsion of a large malleolar fragment. Falls, trapping of the leg under or through solid obstacles, and injuries associated with trapping of a limb in a hole have been described as contributing causes. Interdigitation of the tibial cochlea with the trochlear ridges of the talus and joint stability provided by collateral ligaments are most likely responsible for the infrequent occurrence of tarsocrural joint luxation. Luxation of the distal tarsal joints may be observed after the same traumatic events that cause tarsocrural joint luxation. Additional causes include kicks by other horses, kicking a solid object (i.e., wall of the stall), or being hit by a vehicle. One case has been observed following a Wamberg tenectomy procedure for treating bone spavin. Affected animals usually exhibit non–weight-bearing lameness and swelling, which may vary from moderate to severe. Crepitus may be elicited, and some horses may present with angular deformity of the limb distal to the luxated joint. Diagnosis is based on radiographic examination, which localizes and allows assessment of the severity of the luxation. Concurrent tarsal bone fractures, especially of the fused first and second tarsal bones, can also be determined. Stressed views under general anesthesia are indicated to confirm suspected, spontaneously reduced tarsal joint luxations. Ultrasonography may be used to evaluate the ligamental support structures for tears and ruptures supporting previous trauma.

Persistent luxations and subluxations of the tarsus are generally reduced under general anesthesia. Muscle relaxants or neuromuscular blockade and mechanical traction devices may also be needed to correctly reduce the luxated joint. Luxations of the talocentral (proximal intertarsal) and tarsometatarsal joints are most often associated with disruption of some collateral ligaments and tarsal and metatarsal bone fractures. Some authors suggest surgical arthrodesis of the distal tarsal joints as the best treatment option in tarsometatarsal and talocentral joint luxations. Three treatment options for the management of talocentral and tarsometatarsal joint luxation have been proposed, depending on injury location and concurrent lesions, such as tarsal bone fractures and ligament and soft tissue damage. These include closed reduction and cast immobilization; open curettage of the articular surface of the affected joint, reduction and closure, and cast immobilization; and open curettage, internal fixation, and cast immobilization. One report describes successful management of luxations of the tarsometatarsal or talocentral joint in three ponies and three horses with reduction and cast application only. Following reduction of distal tarsal joint luxations, the limb is usually maintained in a cast for 6 to 8 weeks. Tarsocrural joint luxations seem to be more easily reducible if the collateral ligaments of one side are completely disrupted. After reduction, the limb is maintained in a cast for 4 to 6 weeks. Postluxation sequelae after reduction include periarticular fibrosis, enthesisophyte formation, and DJD of the tarsocrural joint. The prognosis after tarsocrural joint luxation has been reported to be guarded to poor. Although some successfully managed cases have been described, this condition has been considered an indication for euthanasia.
REFERENCES


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1. The small tarsal bones include the
   a. central, fused first and second, third, and fourth tarsal bones.
   b. talus and fused first and second tarsal bones.
   c. central, third, and fourth tarsal bones.
   d. all of the above

2. Which of the following statements concerning the small tarsal bones is true?
   a. The third tarsal bone has a cuboidal shape and occupies both the distal and intermediate row of tarsal bones because of its greater depth.
   b. The fused first and second tarsal bones are relatively small and lie predominantly behind the central tarsal bone.
   c. Despite their anatomic proximity, fractures of the various small tarsal bones result from considerably different causes.
   d. all of the above

3. Slab fractures of the central or third tarsal bone occur almost exclusively in
   a. racehorses and other competitive horses during strenuous exercise.
   b. draft horses.
   c. miniature horses.
   d. foals younger than 6 months of age.
4. Which of the following statements concerning central or third tarsal bone fractures is true?
   a. Development of secondary DJD of the tarsocrural joint can be minimized if the fracture is diagnosed and treated early.
   b. Radiographic detection of fractures may be challenging because they are often minimally displaced and a fracture line may not be evident on standard radiographs.
   c. Tarsocrural joint effusion is inconsistently observed in third tarsal bone fractures.
   d. all of the above

c. Tarsocrural joint luxation is usually associated with fracture of the calcaneus.
d. all of the above

10. ____________ may develop after reduction of tarsocrural joint luxation.
   a. Periarticular fibrosis
   b. Enthesiophyte formation
   c. DJD of the tarsocrural joint
   d. all of the above