Splint bone fractures in the horse

Michelle A. Jackson, Dr. med. vet., Dipl. ECVS

Vetsuisse Faculty University of Zurich, Equine Department, Zurich, Switzerland

mjackson@vetclinics.uzh.ch

I. Introduction

Fractures at the vestigial metacarpal and metatarsal bones, which are commonly referred to as splint bones, can occur anywhere along the bones and are very common in horses of all ages.[1] These bones are predisposed to injury because of their anatomic location, the nature of the horse and equine management practices. Kicks from other horses are probably the most important cause of splint bone fractures[2], but fractures may also occur spontaneously during exercise. Splint bone fractures can be open or closed, simple or comminuted, and localised in the proximal, middle or distal part of the bone. Injuries such as kicks or falls often result in open fractures of the proximal splint bones. Once a splint bone fracture has been diagnosed, the structures close to the bone including the suspensory ligament, proximal sesamoid bones and cannon bone (metacarpal III [McIII], metatarsal III [MtIII]) must be examined carefully. The lameness varies from moderate to severe; it is usually severe in horses with open proximal fractures and moderate in those with distal fractures. The interval between the injury and the time of presentation also profoundly affects the severity of lameness. In addition to lameness, affected horses also have an open wound near the splint bone. The degree of swelling, pain and heat is directly related to the extent of soft tissue damage. The size of the wound caused by external trauma varies. Radiographs are required to confirm the diagnosis and to rule out other complications. It is very important to take several views and the proximal articulation should always be included. Ultrasonography is essential for the assessment of the suspensory ligament. Computed tomography, if available, may be in difficult cases valuable for a definitive diagnosis. Complications, including nonunion, osteomyelitis and the formation of a sequestrum or excessive callus are common when the fracture is not treated properly. Involvement of the cannon bone affects the prognosis negatively.

II. Anatomical considerations

The splint bones are also called vestigial or second/fourth metacarpal or metatarsal bones. Strong collateral ligaments attach to the proximal part of the splint bones. The metacarpal/metatarsal interosseus ligament differs substantially among horses and may start to ossify at an early age. A firm fascia covers the tendons in the proximal region of the metacarpus and is attached to the splint bones. A band-like structure extends distally from the distal end of the splint bone toward the proximal sesamoid bone [3].

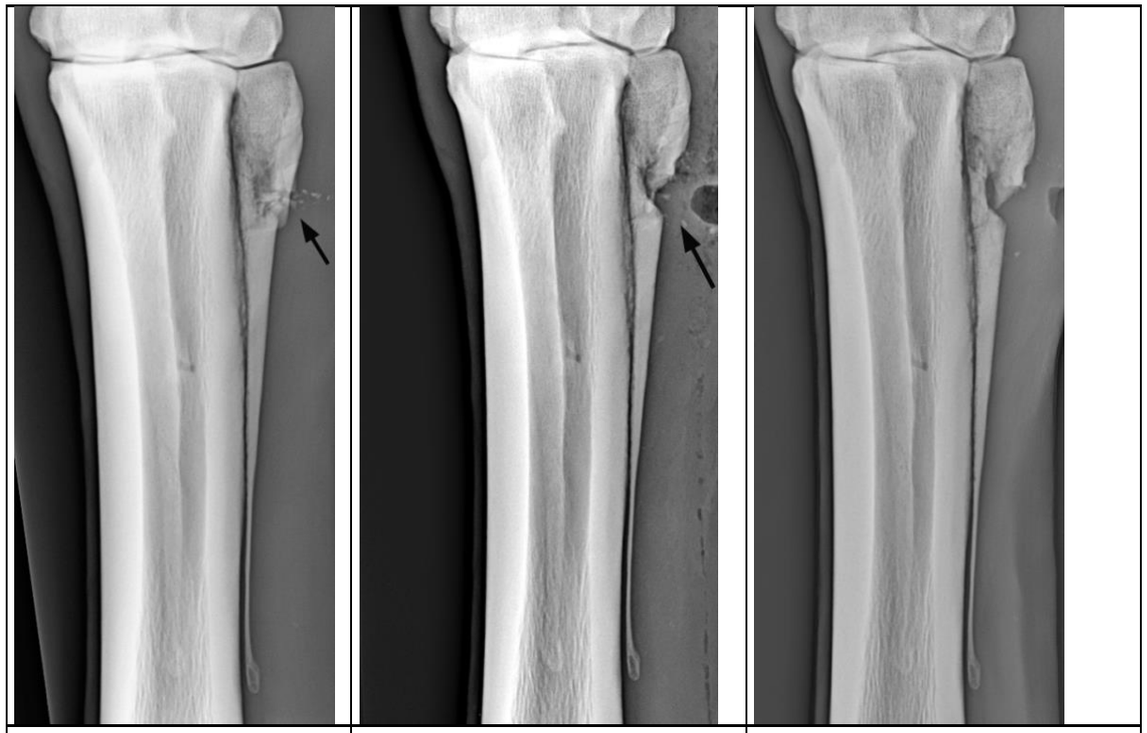
III. Classification of splint bone fractures

Splint bone fractures are usually classified as proximal, mid-body or distal according to their location [1]. Alternatively, they have been classified as proximal or distal, depending on whether they occur in the proximal or distal half of the splint bone [4].

IV. Proximal splint bone fractures

Proximal splint bone fractures are usually the result of a kick from another horse and therefore are usually open fractures. The cannon bone and the region of the articulation with the carpal bones are carefully examined for fractures or fissures. The articulation between the splint bone and the carpal bone deserves special attention. The splint bones, especially the medial ones, are loaded axially. The attachment of the collateral ligaments exerts tension on the proximal aspect of the splint bones. Therefore, after removal of the distal aspect of a splint bone, the remaining proximal stump may dislocate, which can result in significant lameness and, eventually, degenerative joint disease. Removal of a splint bone fragment distal to the fracture is controversial. Some authors believe that surgical removal of the distal splint bone fragment including removal of the callus is the treatment of choice for proximal fractures. Others think that removal is indicated only when the distal fragment is not firmly attached to the cannon bone by the interosseus ligament**. It is generally accepted that no more than the distal two thirds of the splint bone should be removed.** In cases in which the distal fragment is larger than two thirds of the entire splint bone, an internal fixation using a small plate is advised to maintain axial support of the proximal part of the bone. Screws may engage only the splint bone or include the near cortex of the cannon bone. The fusion of the splint bone with the cannon bone results in joint stability; however, this is not ideal from a physiological standpoint because it eliminates normal movement within the joint and between the splint bone and the cannon bone.

1. Conservative Treatment:
Although many authors suggest surgical fixation of open proximal splint bone fractures in an attempt to minimise complications and residual chronic lameness, surgery is not always necessary. In one report, 12 of 14 horses with open comminuted splint bone fractures returned to athletic function after conservative therapy [5]. In another study, healing occurred in the majority of horses that were treated with only wound debridement and no additional stabilisation or splint bone removal [1]. **Aggressive surgical management including debridement, lavage, temporary installation of a drain, pressure bandaging and antibiotic therapy under sedation and local anaesthesia, has a very good prognosis and is recommended, particularly for open fractures.** Radiographic re-evaluation should be done 2 and 4 weeks later. If the wound has healed and the radiographs show that the splint bone is stable and the fracture is healing, no further treatment is necessary [1]. Nevertheless, one should be aware that complications, such as excessive callus and exostosis formation, are not uncommon and may lead to prolonged convalescence.



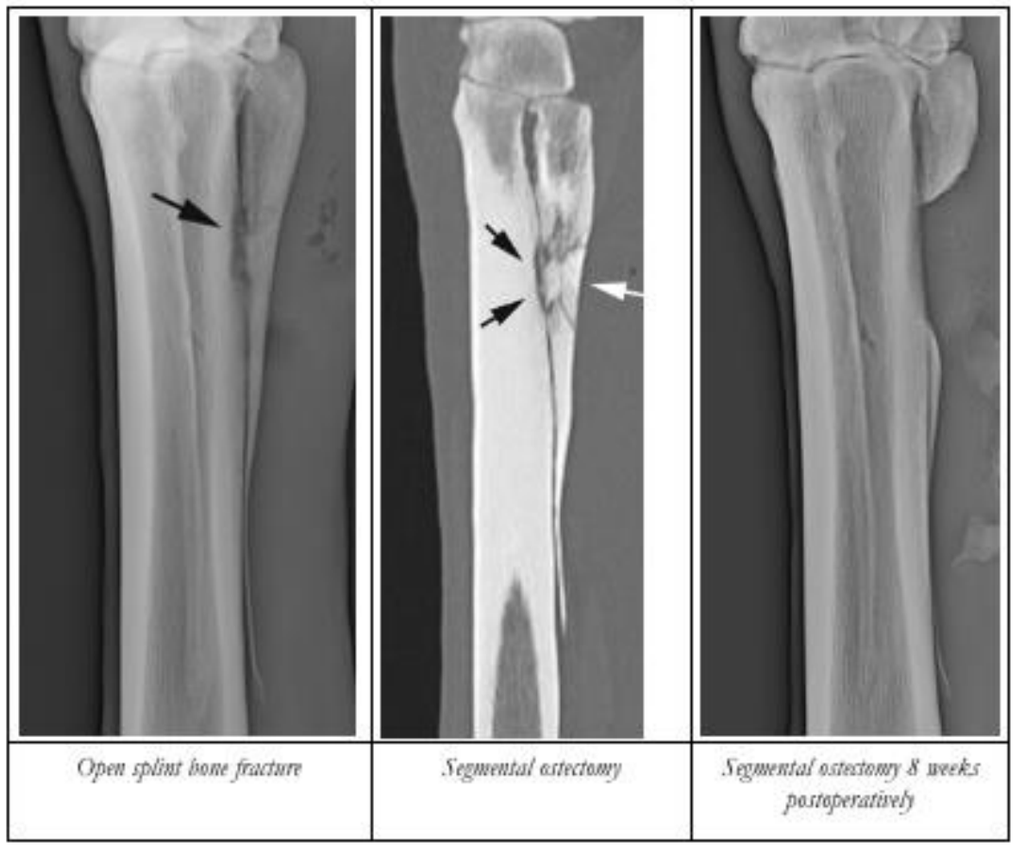
Open splint bone fracture | *Healing after 7 weeks*

2. Fixation
If proximal splint bone fractures are not displaced, fixation is not necessary. If fixation is deemed necessary and feasible, the fracture should be stabilised with screws or plates. However, one should always bear in mind that implants have a high risk of infection, particularly if the original injury was caused by external trauma. **Therefore, the use of metallic implants should be reserved for cases in which there is a high probability of luxation or subluxation of the proximal splint bone fragment.** The preferred technique for internal fixation is a plate in which the screws only engage the splint bone. A 3.5 mm (narrow) DCP or LCP, semi-tubular plate or reconstruction plate are appropriate in most cases.

Closed, proximal splint bone fracture | *Fixation with a 3.5mm LCP plate*

Screw fixation alone is generally associated with a relatively high rate of technical failure, and when the splint bone is fixed to the cannon bone, horses often remain lame.

3. Segmental ostectomy
Removal or fixation of the splint bone can always be carried out later if conservative treatment fails. In some cases, a segmental ostectomy can be undertaken in horses with complicated fractures composed of multiple small fragments [6].



Open splint bone fracture | *Segmental ostectomy* | *Segmental ostectomy 8 weeks postoperatively*

4. Complete removal of the splint bone
Baxter (1992) recommended complete removal of the affected splint bone, rather than internal fixation, in cases in which infection and sequestration occur after conservative treatment [7]. However, complications after complete removal of a splint bone are common.

V. Mid-body fractures

Mid-body fractures should be managed surgically with removal of the distal fragment of the splint bone, removal of the callus and excision of the distal most aspect (1 cm) of the remaining proximal fragment. The latter should be achieved by oblique transection with an oscillating saw to avoid microfissures, which can occur when an osteotome is used. Before closure of the wound, all fragments should be removed and the wound flushed thoroughly. In open fractures, a drain is placed in the wound for 3-4 days; the wound normally heals on its own after drain removal. This treatment assures quick recovery of the horse and return to previous use. Complications after surgical management are rare and include the development of periosteal proliferative changes at the distal aspect of the amputated splint bone, which leads to a longer convalescence. Exostosis of the involved splint bone and/or cannon bone, or sesamoiditis are other possible complications, which can also occur after conservative treatment. Old fractures with minimal callus formation and good healing can be managed conservatively. Conservative treatment is often chosen for financial reasons. The outcome may be good, although healing takes longer and there may be excessive callus formation. The latter can lead to secondary suspensory desmitis, and some cases require surgical removal of the fragment later on. Callus formation usually begins after 2-4 weeks and, if no complications occur, it spontaneously disappears 16-24 weeks later, depending on the fracture type and the individual fracture healing potential. Another possible complication of conservative treatment is nonunion, which most likely is the result of continuous intermittent traction exerted by the collateral ligaments.

Mid-body fracture | *After surgery* | *Typical mid-body fracture*

VI. Distal fractures

Fractures of the distal third of the splint bone are usually simple and occur most often at the **narrowest part** of the bone or immediately distal to the attachment of the interosseus ligament. Distal fractures are very common and can result from external or internal trauma. Internal trauma, especially in the forelimb, occurs secondary to excessive stress with extension of the carpus during exercise or after internal trauma attributable to concurrent suspensory desmitis and loss of pliability of the suspensory ligament. Distal fractures are often **associated with suspensory desmitis.** Because suspensory desmitis can result in chronic lameness, it should be taken seriously. It is recommended that horses receive stall rest for 2 or 3 months followed by a carefully monitored exercise program.
Although distal fractures can be treated conservatively, surgical removal of the distal fragment under general anaesthesia improves the prognosis; alternatively, the fragment may be removed in the standing horse using local anaesthesia [4].

Typical distal fracture | *Distal splint bone fracture*

VII. Prognosis

The prognosis of splint bone fractures depends primarily on the location, type and age of the fracture, but also on the involvement of tendons, soft tissues and the cannon bone. If treated properly, the prognosis is good. It is critical that the clinician be alert and quickly identify fractures and infection, so that appropriate therapeutic measures can be implemented to improve the chances of the patient returning to its intended use.

VIII. Complications

Complications of splint bone fractures are not uncommon and callus formation at the distal end of the proximal fragment may occur. Moreover, splint bone fractures can be further complicated by the development of osteitis, osteomyelitis and/or bone sequestra. Complications such as nonunion of the splint bone fracture, luxation of the tarsometatarsal joint after complete splint bone removal, cannon bone fracture or luxation of the proximal splint bone stump may occur.

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