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## KEY FACTS

- Maximal fetlock extension during fatigue loading of the limb may result in tensile forces that exceed the biomechanical limit of the proximal sesamoid bones, resulting in fractures.
- Studies indicate that training strengthens soft-tissue components so that the weakest part of the unit becomes the proximal sesamoid bones.
- Sesamoiditis is diagnosed radiographically as the presence of increased size and number of vascular foramina in the proximal portion of the bone.

# Proximal Sesamoid Bone Fractures in Horses

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**ABSTRACT:** The proximal sesamoid bones are encased within the elastic suspensory ligament proximally and the nonelastic distal sesamoidean ligaments distally on the palmar/plantar surface of the fetlock, collectively forming the suspensory apparatus. This system functions as an energy-storing device in horses and minimizes hyperextension of the fetlock during the stance phase of the stride. Exercise fatigues the proximal portion of the suspensory apparatus, and fetlock extension may become maximal such that the tensile forces exerted exceed the biomechanical tolerance of the structures, leading to failure of the bone or soft tissues. It appears that training strengthens the suspensory ligament so that the weakest component of the apparatus becomes the proximal sesamoid bones. Chronic sesamoiditis has also been implicated as a factor in the development of proximal sesamoid bone fractures owing to changes in the material properties of the bone. Studies of the microvasculature of the proximal sesamoid bones have demonstrated that the bones have a substantial intraosseous vascular supply through multiple perforating vessels. The degree of lameness, pain upon manipulation, and synovial effusion present with proximal sesamoid fractures are highly variable. Radiographic studies of the affected limb are diagnostic for a fractured sesamoid bone. Treatment and prognosis vary depending on the type of fracture and extent of concurrent soft-tissue injuries.

Fractures of the proximal sesamoid bones account for a substantial percentage of distal limb injuries that occur in racehorses. Musculoskeletal injuries accounted for more than 80% of all injuries resulting in fatalities at race-tracks in California during a 2-year period.<sup>1</sup> Of the fatalities caused by musculoskeletal injuries, 85% were associated with appendicular fractures and 50% of these fractures involved the proximal sesamoid bones.<sup>1</sup>

## ANATOMY, BIOMECHANICS, AND PATHOPHYSIOLOGY OF INJURY

The proximal sesamoid bones are paired bony structures that provide stability to the suspensory apparatus as it courses over the palmar/plantar surface of the fetlock by acting as a lever arm for the suspensory apparatus. The dorsal surface of each bone is covered with hyaline cartilage and comprises a portion of the palmar/plantar surface of the metacarpal/metatarsophalangeal joint (fetlock).

The intersesamoidean ligament attaches to the axial surface of each sesamoid bone and allows both bones to function as a single unit during fetlock motion. The medial and lateral branches of the suspensory ligament insert on the apical and abaxial surface of each proximal sesamoid bone. The long (straight), cruciate, short, and oblique sesamoidean ligaments (distal sesamoidean ligaments) attach to the basilar surface of each sesamoid and anchor them to the proximal palmar/plantar surface of the proximal phalanx.<sup>2,3</sup> Therefore, the proximal sesamoid bones are encased within the elastic suspensory ligament proximally and the nonelastic distal sesamoidean ligaments distally on the palmar/plantar surface of the fetlock.<sup>4</sup>

The suspensory apparatus functions as an energy-storing device in horses. The suspensory apparatus is loaded in tension during the stance phase of the stride to minimize hyperextension of the fetlock. This stored energy is released late in the stance phase of the stride to assist in limb propulsion. During limb loading, tensile forces are transmitted through the suspensory ligament, proximal sesamoid bones, and distal sesamoidean ligaments. These tensile forces are distributed among the ligaments of the suspensory apparatus on the palmar/plantar aspect of the fetlock during joint extension.<sup>2</sup> When the superficial and deep digital flexor muscles become fatigued during strenuous exercise, their musculotendinous units provide less elastic support to the distal limb. When this occurs, fetlock extension may become maximal and the tensile forces exerted on the proximal sesamoid bones may exceed the biomechanical tolerance of the structure, leading to failure of the bone.<sup>5</sup>

The effect of training on the strength of the suspensory apparatus has been investigated.<sup>6</sup> The single load to failure of the suspensory apparatus from each limb of freshly euthanized horses was determined *in vitro*. A biomechanical comparison was made between horses that were in training and those that were not to determine if training increased the strength of the suspensory apparatus or any of its components. In 83% of horses in training, the suspensory apparatus failed through the proximal sesamoid bone. In horses that were not trained, the suspensory apparatus failed by midbody tearing or proximal avulsion of the suspensory ligament from its attachment to the metacarpus/tarsus. The authors concluded that training strengthens the suspensory ligament sufficiently so that the weakest part of the apparatus becomes the proximal sesamoid bones.<sup>6</sup>

Chronic sesamoiditis has been implicated as a potential factor in the development of proximal sesamoid bone fractures owing to changes in the material properties of the bone.<sup>7</sup> Sesamoiditis has been described as per-

ioistitis and osteitis affecting the abaxial surface of the proximal sesamoid bone at the attachment of the suspensory ligament.<sup>7</sup> Histologic changes are consistent with an enthesiopathy.<sup>8</sup> Repetitive trauma may result in minor tearing of the suspensory attachment to the proximal sesamoid bones, causing the reported inflammatory changes.<sup>9</sup> Clinically, sesamoiditis is diagnosed when lameness examination findings localize the source of lameness to the fetlock and there are radiographic changes consistent with sesamoiditis,<sup>10</sup> including the presence of prominent intraosseous vascular channels and sclerosis on the abaxial or basilar portions of the proximal sesamoid bones.<sup>7,10</sup> Vascular channels are considered normal if inapparent or small and well defined. In one report, the size of the channels increased and the radiographic detail decreased proportionally to the duration of the lameness.<sup>7</sup> However, in a serial radiographic investigation of 71 young standardbreds in training over a 1-year period, horses that developed a proximal sesamoid bone fracture did not have radiographic signs consistent with sesamoiditis.<sup>11</sup> These results partially support the *in vitro* study suggesting that the suspensory ligament gains strength from training and that sesamoid bone fractures are an acute single-event type of injury rather than the result of accumulated microtrauma.<sup>6</sup>

Investigations of the microvasculature of the proximal sesamoid bones have demonstrated that the bones have a substantial intraosseous vascular supply, but as a short bone they lack a nutrient artery and are instead supplied by multiple smaller perforating vessels.<sup>12</sup> These perforating vessels are derived from branches of the medial and lateral palmar digital arteries that enter the proximal sesamoid bones on their nonarticular, abaxial surface near the insertion of the suspensory ligament. There is a limited vascular supply at the proximal and distal ligamentous attachments to the bone.<sup>12</sup> This study appeared to support the hypothesis that the linear, radiolucent areas actually represent vascular channels that will enlarge and increase in number with sesamoiditis or training.<sup>12</sup>

A study that evaluated the remodeling response to training in young thoroughbred racehorses indicated that the apical portion of the proximal sesamoid bone has the highest porosity and the most biomechanically uniform characteristics (lowest anisotropy) of any other region of the sesamoid bone.<sup>13</sup> The increased number of vascular channels normally present in the proximal portion of the sesamoid bone may contribute to the increased porosity in this area.<sup>12</sup> Since proximal sesamoid fractures occur in horses that have a normal radiographic appearance of the bones, these vascular channels may predispose the bone to fracture via a stress ris-

## BOX 1 Fracture Types

Proximal sesamoid bone fractures are classified according to the location and orientation of the fracture:

- |           |           |                    |
|-----------|-----------|--------------------|
| ■ Apical  | ■ Basilar | ■ Sagittal (axial) |
| ■ Midbody | ■ Abaxial | ■ Comminuted       |

er effect.<sup>11</sup> This appears to be further supported by the fact that over 90% of proximal sesamoid bone fractures occur in the apical portion of the bone, which appears to be the most vascularized and porous.<sup>5</sup> However, this theory fails to account for the variety of other fracture patterns that frequently occur and why horses that have marked radiographic changes consistent with sesamoiditis infrequently sustain a proximal sesamoid bone fracture.

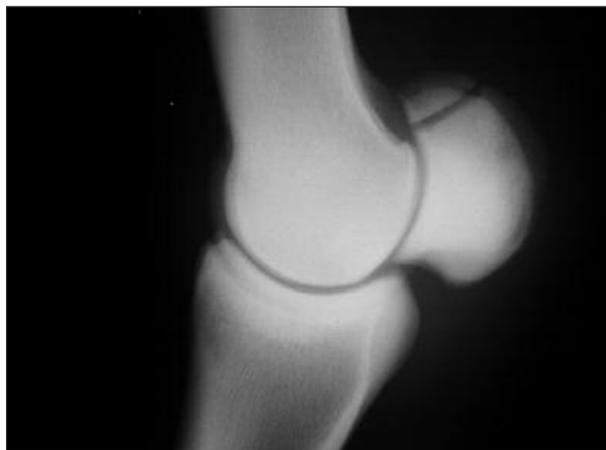
Nonunion or malunion can be a sequela to proximal sesamoid bone fractures and negatively impact the prognosis for future athletic performance.<sup>10</sup> Nonunion or malunion has been attributed to a sparse blood supply to the bone,<sup>4,14</sup> which is contradictory to the findings of other studies regarding the rich vascular supply of the proximal sesamoids.<sup>12</sup> It has been hypothesized that the fracture itself may disrupt the blood supply to the bone<sup>12</sup> or that constant motion at the fracture line during weight bearing results in poor fracture healing. In addition, the proximal sesamoid bones lack a periosteal covering, which has been implicated in poor fracture healing.<sup>15</sup>

### FRACTURE TYPES (BOX 1)

#### Apical Fractures

Apical fractures occur in the proximal one third of the sesamoid bone and are often articular (Figure 1).<sup>4,15,16</sup> As mentioned, these fractures are by far the most common type of sesamoid bone fracture.<sup>17</sup> In standardbreds, the lateral sesamoid of a hindlimb is most commonly affected.<sup>15</sup> Usually less than 25% of the abaxial border where the suspensory ligament attaches is affected. The larger the fragment, the more extensive the disruption of the suspensory ligament attachment. Distraction of the apical fragment is directly related to fragment size and the amount of suspensory ligament damage.

Clinical signs associated with apical sesamoid bone fractures include joint effusion if the fracture has an articular component, pain elicited during fetlock flexion, and moderate to severe lameness. Pain can often be elicited by applying pressure to the apical portion of



**Figure 1**—Lateral-to-medial radiographic projection of an apical proximal sesamoid bone fracture.

the affected sesamoid.<sup>10</sup> Radiographs are diagnostic in acute cases. In chronic cases, the correlation between radiographic and clinical findings is challenging and further diagnostics, including perineural anesthesia or nuclear scintigraphy, may be necessary. Chronic nonunion fractures can cause a variable degree of lameness.<sup>2</sup> Ultrasonographic evaluation of the suspensory ligament is critical to identify concurrent suspensory ligament desmitis that may adversely affect the prognosis for athletic soundness.<sup>18</sup>

#### Treatment

Optimal treatment for apical fractures entails prompt surgical removal. Early and aggressive therapy provides the quickest return to training, minimizes complications, and improves the prognosis for return to the previous level of athletic performance.<sup>4,10,15</sup> Arthrotomy and arthroscopy are commonly used techniques.

An arthrotomy is performed through the ipsilateral palmar/plantar pouch of the fetlock. The arthrotomy incision is made over the fragment, the joint is flexed, and self-retaining retractors are used to provide adequate exposure. Sharp but gentle dissection of the fragment from the attachments of the suspensory ligament minimizes disruption of the suspensory apparatus. Arthroscopy offers the advantages of complete examination of the palmar/plantar aspect of the fetlock joint and smaller incisions and may reduce formation of restrictive periarticular fibrosis following surgery.<sup>2,17</sup> The arthroscope is placed in the palmar/plantar pouch either ipsilateral or contralateral to the fragment. Instruments that can be used to remove the fragment include a rosette knife, tendon-splitting knife, meniscal knife, arthroscopic scalpel, and sharp periosteal elevator.<sup>17,19</sup> Technical expertise is necessary for atraumatic removal

with the arthroscope; therefore, arthroscopic removal is best reserved for experienced arthroscopic surgeons and for smaller fragments. Because of the few complications encountered with an arthrotomy of the palmar/plantar pouch and the minimal postoperative fibrosis that develops at that site, some authors feel that an arthrotomy is the preferred method for removal of small apical fragments.<sup>2</sup>

Recently, the use of electrocautery for the arthroscopic removal of apical fragments was described.<sup>20</sup> The arthroscopic approach to the fragment is either ipsilateral or contralateral in the palmar/plantar pouch. The use of electrocautery to sever the attachments of the suspensory ligament improves the ease and accuracy of dissection and provides immediate and complete hemostasis.<sup>20</sup> The thermal effect of cautery on the suspensory ligament has not been investigated.

### Outcome

The prognosis for soundness and athletic prognosis decreases with larger fragments owing to the amount of soft-tissue disruption.<sup>2</sup> However, in one retrospective study the dimensions of the apical fragment and degree of suspensory ligament damage did not affect outcome.<sup>21</sup> Retrospective studies in standardbred racehorses with apical proximal sesamoid bone fractures have shown that the prognosis for return to successful racing increased if the fragment was removed within 30 days of the injury and if the horse had raced prior to injury.<sup>15,18</sup> Injuries involving the forelimb may have a worse prognosis compared with injuries involving the hindlimb; however, surgical treatment did not positively or negatively impact career earnings, number of starts, or order of finish score of the horse when preinjury performance values were compared with postsurgical performance values.<sup>15</sup>

### Midbody Fractures

Midbody fractures are transverse and occur more frequently in younger horses.<sup>22,23</sup> In thoroughbreds, the medial proximal sesamoid bone of the right forelimb is the most commonly affected. In standardbreds, the proximal sesamoid bone of the left hindlimb is most commonly affected.<sup>22</sup> The fracture usually divides the bone into two approximately equal-sized proximal and distal fragments. However, midbody fractures can be further subdivided into proximal, middle, and distal midbody configurations in a horizontal or oblique plane.<sup>4,22</sup> Conservative management of these fractures results in an unfavorable outcome for performance as fracture healing usually results in a nonunion or fibrous union with persistent pain from the resulting instability of the joint.<sup>2,4,22</sup>

Clinically, these fractures are associated with an acute onset of severe lameness with considerable soft-tissue swelling and fetlock joint effusion. The clinical appearance and radiographic examination are diagnostic (Figures 2A and 2B).

### Treatment

Surgical repair of midbody fractures is recommended to enhance fetlock stability and improve the prognosis for future athletic performance. Careful evaluation of the supporting soft-tissue structures of the fetlock is imperative prior to surgery. The condition of the skin, neurovascular structures, and suspensory apparatus may affect the decision to perform surgery, timing of the surgery, technique used, and prognosis. Surgical repair can be achieved by either lag-screw fixation or circumferential wiring.<sup>22-24</sup> Autogenous cancellous bone graft application in the fracture line is recommended when repairing these fractures. Autogenous cancellous bone grafts alone have been used with some success and will promote osseous union in basilar and transverse proximal sesamoid fractures.<sup>10,25,26</sup>

Lag-screw fixation should provide adequate compression of the proximal and distal fragments so as to neutralize the distractive forces of the suspensory ligament and fetlock joint on the fragments during weight bearing. When combined with an autogenous cancellous bone graft, fracture healing is enhanced.<sup>22</sup> The base of the proximal sesamoid bone can be approached through an S-shaped incision starting proximally through the palmar pouch and extending distally to the base of the sesamoid.<sup>2</sup> This single incision will expose the articular surface of the sesamoid (to facilitate debridement and reduction of the fracture) and the base of the sesamoid (for lag-screw placement). Alternatively, two incisions can be used to achieve the same goal: one directly into the palmar/plantar pouch and the other at the base of the sesamoids. Flexing the fetlock facilitates reduction of the fragment. A tourniquet can be used to control hemorrhage but may interfere with the delivery of perioperative antibiotics to the surgical field during surgery. Performing the surgery with the horse in dorsal recumbency will reduce hemorrhage if a tourniquet is not used. Fixation of midbody fractures is attained by using a single 4.5-mm or paired 3.5-mm fully threaded cortical bone screws inserted in lag fashion from the base toward the apex of the sesamoid (Figure 2C). Proximal midbody fractures can also be repaired using one to three 3.5-mm fully threaded cortical bone screws inserted in lag fashion from the apex toward the base of the proximal sesamoid bone. The use of a sesamoid guide clamp or bone reduction forceps will facilitate accurate drilling and proper screw placement. Alternatively, a



**Figure 2A**—Extreme distraction of fracture fragments.

**Figure 2**—Lateral-to-medial radiographic projections of mid-body proximal sesamoid bone fractures.

2.0-mm drill bit can be positioned under radiographic or fluoroscopic guidance as a marker to ensure proper positioning and alignment before drilling the glide (4.5-mm) and thread (3.2-mm) holes for the 4.5-mm screw. If a cancellous bone graft is used, it should be placed in the fracture bed prior to tightening of the screw(s). A half limb cast or trauma boot is applied for recovery and removed within the first 3 to 7 days after surgery.<sup>2,17</sup> Some surgeons prefer to have the limb in a cast for 2 to 4 weeks after surgery.<sup>17</sup>

Circumferential wiring of the proximal sesamoid bone involves placing an 18-gauge wire in a frontal plane proximal and distal to the fracture and encasing the bone with a circumferential loop of wire.<sup>23</sup> The use of a larger wire (1.25-mm diameter) has been reported.<sup>17,27</sup> The fracture is approached through a palmar/plantar pouch arthrotomy to expose the articular surface and body of the sesamoid. The fracture bed is debrided, and the fracture is reduced by flexing the joint and maintained in reduction by using bone-reduction forceps. A second incision is made into the digital tendon sheath through the annular ligament to expose the flexor tendons, the intersesamoidean ligament, and the plantar/palmar aspect of the fracture. A 16-gauge needle is placed at the base of the proximal sesamoid from the abaxial to axial surface through the distal sesamoidean ligament. A 2.0-mm drill bit is used to drill a hole in the apex of the sesamoid bone in an abaxial to axial direction, and a separate 16-gauge needle is placed in the drill hole in the same plane. Using the needles as a guide, a length of 18-gauge orthopedic wire is first passed abaxially to axially through the distal needle in to the intersesamoidean space. The wire is tunneled proximally along the axial surface of the



**Figure 2B**—Fetlock in a flexed position.



**Figure 2C**—Fracture repaired with a 4.5-mm fully threaded cortical bone screw inserted in lag fashion.

sesamoid to the proximal needle. The wire is then passed through the proximal needle in an axial to abaxial direction. The needles are removed and the wire tightened on the abaxial surface of the sesamoid bone to compress the fracture. An autogenous cancellous bone graft can be incorporated in the repair.<sup>2</sup>

### Outcome

Retrospective studies of both techniques have been performed.<sup>22,23</sup> In a retrospective study of 25 horses with proximal sesamoid midbody fractures repaired by lag-screw compression, 9 of 12 (75%) standardbreds and 5 of 8 (63%) thoroughbreds returned to racing. As a group, the standardbreds had a mean decrease in average earnings per start and number of starts following surgery. Of the thoroughbreds that raced after surgery, two horses with preinjury starts raced and won and two performed at a lower class.<sup>22</sup> Although there was a preponderance of



**Figure 3**—Lateral-to-medial radiographic projection of a basilar proximal sesamoid bone fracture.

forelimb fractures in thoroughbreds and hindlimb fractures in standardbreds in this study, there was no difference in limb involved, age, gender, duration of injury, or which sesamoid bone was fractured between horses that raced or did not race after surgery.<sup>22</sup> Eleven of 15 (73%) horses in which circumferential wiring alone was used for repair of a midbody sesamoid fracture returned to athletic use.<sup>23</sup> Five (33%) performed at a similar or improved level of performance than before surgery.<sup>23</sup>

An *in vitro* comparison of circumferential wiring and lag-screw fixation showed that the initial strength of repair in a single load-to-failure model is greater for circumferential wiring than for lag-screw fixation.<sup>24</sup> However, the clinical implication of this finding is unknown as cycling of the implants, particularly wire, is known to weaken fixation devices during healing. In another *in vitro* study comparing fixation techniques for midbody proximal sesamoid bone fractures, the authors did not find that one method of repair was superior.<sup>27</sup>

### Basilar Fractures

Basilar fractures occur in the distal one third of the sesamoid bone; most are articular (Figure 3). These fractures occur more commonly in thoroughbreds than standardbreds. The right fore medial proximal sesamoid bone is most often affected.<sup>28</sup>

Clinical signs are similar to those of midbody fractures. Radiographs (including oblique views obtained during weight bearing with the beam at 20° in a proximal to distal direction) image the basilar surface adequately.<sup>29</sup>

### Treatment

Removal of small fragments can be performed via arthrotomy or arthroscopy of the palmar/plantar pouch

of the fetlock.<sup>2</sup> The attachments of the distal sesamoidean ligaments need to be dissected from the basilar and abaxial aspects of the fragment, and this is more readily accomplished while the joint is held in flexion during surgery. Arthroscopy is less traumatic in that the collateral ligaments of the fetlock do not need to be incised as is often done when arthrotomy is used. Nonarticular fragments that are imbedded in the distal sesamoidean ligaments can be treated conservatively to allow these ligaments to heal. Chronic pain from sesamoidean ligament desmitis or posterior capsulitis may necessitate removal of the fragment. This can be accomplished using an extraarticular approach.<sup>2</sup>

### Outcome

The prognosis for athletic use after conservative management is consistently poor.<sup>10</sup> Surgical management may improve the prognosis for athletes, but the prognosis remains guarded for athletic use in most cases.<sup>10,30,31</sup>

A retrospective study of 57 horses with basilar sesamoidean fractures (49 thoroughbreds, 7 standardbreds, and 1 quarter horse) showed that 59% returned to racing regardless of treatment.<sup>28</sup> Horses with smaller, non-displaced fractures performed better than horses with large or displaced fractures; 73% of horses that had the fragment removed surgically returned to racing (57% of which dropped in class), whereas only 48% of horses in which the fragment was not removed returned to racing (87% of which dropped in class). These results support the surgical removal of basilar fragments. Horses treated surgically were more likely to have a longer convalescent period, indicating a willingness of the owners to spend the time and money on what they perceived as quality racehorses.<sup>28</sup>

A recent retrospective study of 26 basilar sesamoidean fractures in which the fracture fragment was removed arthroscopically was undertaken to determine whether fracture size was associated with the outcome. This study, however, did not associate either fragment size or presence of associated articular disease with outcome but provided a fair prognosis, with 50% of the horses involved returning to racing.<sup>32</sup>

### Comminuted Proximal Sesamoid Fractures

Comminuted proximal sesamoid fractures are often associated with fetlock breakdown injuries (Figure 4).<sup>2</sup> If the fracture is biaxial, distraction becomes more prominent with hyperextension after the injury has occurred. Neurovascular and soft-tissue trauma with these injuries is usually extensive and warrants the use of a Kimzey leg saver splint (Kimzey Welding Works, Woodland, CA) or a dorsal splint as a first-aid device in order to minimize further damage.



**Figure 4**—Lateral-to-medial radiographic projection of a comminuted proximal sesamoid bone fracture showing multiple fracture fragments.

Clinical signs include a non-weight-bearing lameness and marked soft-tissue swelling, synovial joint effusion, and crepitation upon palpation or flexion. Attempts at weight bearing result in hyperextension of the fetlock joint.

### **Treatment**

Although these fractures may be treated conservatively, managing this type of injury in a cast or splint usually results in an unacceptable outcome. The considerable discomfort experienced by these horses during coaptation can lead to contralateral limb laminitis and breakdown. Pastern subluxation of the injured leg is a common sequela to these injuries due to disruption of the suspensory apparatus. Fetlock arthrodesis is indicated for this type of injury to return the animal to pasture or breeding soundness.<sup>2</sup>

### **Outcome**

Comminuted fractures of the sesamoid bones have been described in foals younger than 2 months of age after they exercised to exhaustion while trying to keep up with their dams.<sup>33</sup> Of the 18 foals studied, only 3 raced, 1 of which was treated surgically.

### **Abaxial Fractures**

Abaxial fractures involve the axial ridge of the proximal sesamoid bone, include the insertion of the suspensory ligament, and are usually nonarticular (Figure 5).<sup>16</sup> Palmar/plantar proximal to palmar/plantar distal projections at 60° (skyline) from horizontal highlight the abaxial margin of the sesamoid bone nearest to the cas-



**Figure 5**—Dorsoplantar radiographic projection of an abaxial proximal sesamoid bone fracture.

sette.<sup>19,29</sup> It is critical to determine if the fracture is articular because articular fracture fragments should be removed surgically to improve prognosis for athletic use.

Horses with articular fractures have more synovial effusion and pain when flexing or palpating the fetlock than do those with nonarticular fractures.<sup>2</sup>

### **Treatment**

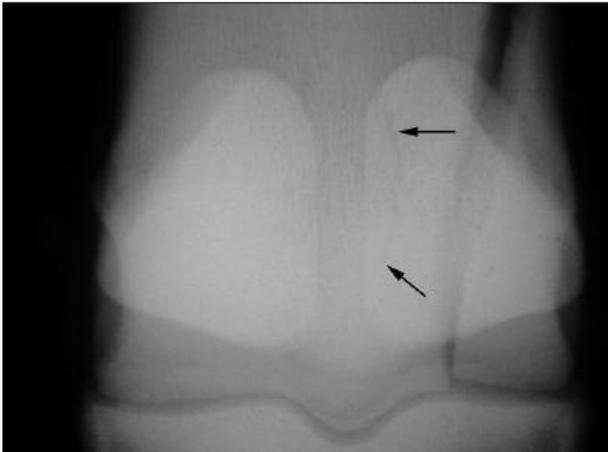
Abaxial fracture fragments are removed in a similar fashion to apical fractures, using an arthrotomy or arthroscopy.<sup>19,31</sup>

### **Outcome**

In a retrospective study of 47 abaxial sesamoid bone fractures that had an articular fragment surgically removed, 25 of 35 (71%) horses returned to racing. However, only 16 of these 25 (64%) returned to the same class or higher. Therefore, it appears that horses with abaxial sesamoid fractures treated surgically have a favorable prognosis for return to racing but only a fair prognosis to return to the same racing class after the injury.<sup>31</sup>

### **Sagittal (Axial) Fractures**

Sagittal (axial) fractures are uncommon and usually occur in association with lateral condylar fractures of the third metacarpal bone (Figure 6).<sup>4,34</sup> Rotation of the condyles during hyperextension increases the strain on the palmar axial support of the sesamoid bones, which may lead to a sagittal fracture or intersesamoidean ligament rupture.<sup>34</sup>



**Figure 6**—Dorsoplantar radiographic projection of a sagittal (axial) proximal sesamoid bone fracture (arrows) with an associated lateral condylar fracture.

### Treatment

Repair of this type of sesamoid fracture has not been reported. Horses with this type of injury that had only the condylar fracture repaired had a poor prognosis for return to racing due to damage to the intersesamoidean ligament and concurrent injury to the articular surface of the sesamoid bone.<sup>34</sup>

### Outcome

Four horses with sagittal fractures of the proximal sesamoid bone were all lame at followup.<sup>34</sup>

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### ARTICLE #5 CE TEST

The article you have read qualifies for 1.5 contact hours of Continuing Education Credit from the Auburn University College of Veterinary Medicine. Choose the best answer to each of the following questions; then mark your answers on the postage-paid envelope inserted in *Compendium*.

1. Which surface(s) of the proximal sesamoid bone is covered with hyaline cartilage?
  - a. palmar/plantar
  - b. dorsal
  - c. axial
  - d. b and c
2. The medial and lateral branches of the suspensory ligament attach on the
  - a. apical surface only.
  - b. apical and abaxial surfaces.
  - c. abaxial surface only.
  - d. apical, axial, and abaxial surfaces.
3. Which of the following statements regarding the suspensory apparatus is false?
  - a. In untrained horses, the suspensory apparatus fails by tearing or avulsion of the suspensory ligament.
  - b. The suspensory ligament fails through the proximal sesamoid bone in most horses in training.
  - c. In older horses, it is most likely that the proximal sesamoid bone will fracture in suspensory apparatus failure.
  - d. Training strengthens the suspensory ligament so that the weakest part of the apparatus becomes the proximal sesamoid bones.
4. Which of the following statements regarding sesamoiditis is true?
  - a. Sesamoiditis has been described as periostitis and osteitis affecting the abaxial surface of the proximal sesamoid bone where the suspensory ligament inserts.
  - b. Clinically, sesamoiditis is diagnosed when lameness is localized to the fetlock without radiographic changes indicative of sesamoiditis.
  - c. Vascular channels in the proximal sesamoid bone are prominent, enlarged, and poorly defined in normal horses.
  - d. Vascular channel size decreases and radiographic sharpness increases proportionally to the duration of lameness.
5. Which of the following statements regarding the sesamoid bones is false?
  - a. The proximal sesamoid bones have a predominant nutrient artery.
  - b. Linear radiolucent areas in the apical and abaxial portion of the sesamoid bone represent vascular channels.
  - c. The proximal sesamoid bones are supplied by multiple perforating vessels.
  - d. The blood supply to the proximal and ligamentous attachments to the bone is limited.
6. Apical fractures have the best prognosis when
  - a. treatment is delayed to allow inflammation to decrease prior to surgical removal.
  - b. surgical removal of the apical fragment is elected over conservative therapy.
  - c. prompt surgical removal, within 30 days after injury, is the elected treatment.
  - d. the apical fragments are large and removal is easier.
7. Which of the following statements regarding midbody fractures is false?
  - a. Midbody fractures are transverse and occur more frequently in younger horses.
  - b. Conservative outcome usually provides a poor prognosis for performance.
  - c. An in vitro comparison of repair techniques showed that the initial strength of repair in a single-load-to-failure model is greater for lag-screw fixation than for transfixation wiring.
  - d. Healing is enhanced by the use of an autogenous cancellous bone graft in surgery.
8. Which of the following statements regarding basilar fractures is true?
  - a. Prognosis for athletic use after conservative management is good.

- b. Surgical management will not improve the prognosis for soundness.
  - c. Arthrotomy for fragment removal will compromise the collateral ligaments.
  - d. Nonarticular fragments must be treated surgically.
9. Which of the following statements regarding abaxial fractures is false?
- a. They are usually nonarticular.
  - b. It is critical to determine whether the fracture is articular as articular fragments should be removed.
  - c. Articular fragments do not present with effusion of the joint.
  - d. Surgical removal will provide a good prognosis for return to racing.
10. Sagittal fractures
- a. are relatively common.
  - b. usually occur simultaneously with lateral condylar fractures.
  - c. have a good prognosis for return to racing despite the condylar fracture.
  - d. occur during hyperflexion of the fetlock joint.