Saving Grace

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Introduction

Equine central tarsal bone fractures are extensively described in the literature yet are often reported as being uncommon[1-11]. These fractures most frequently involve equine athletes participating in racing sports with Standardbreds and Thoroughbreds overrepresented[1-11, 14]. Cases involving non-racehorses are sporadically reported and rare[8,10-11].

Clinical signs associated with equine central tarsal bone fractures are usually vague and require a lameness exam to localize the lesion. Affected horses may present with moderate to severe hindlimb lameness[11]. These horses may exhibit other clinical signs such as noticeable joint effusion in the region of the hock and pain upon manual palpation of the distal row of tarsal bones[3,6,11]. During lameness evaluation, the patient's hindlimb lameness may become noticeably worse after flexing the hock, holding this position for 60 seconds, then allowing the horse to trot off. However, a positive hock flexion test result is not specific for hock pain since the fetlock, stifle, and hip joints are flexed as well[12]. Anesthetic nerve blocks are frequently used to localize the to the region of the tarsus, but can not isolate specifically to the central tarsal bone[11].

Advanced diagnostic imaging is required to identify central tarsal bone fractures since they can be challenging to diagnose radiographically[3-10,13]. Lateromedial or slightly oblique views are preferred for identifying these fractures on radiographs[3,13]. However, non-displaced or minimally displaced central tarsal bone fractures can be hidden due to the superimposition of nearby anatomy[13]. Therefore, computed tomography and nuclear scintigraphy are frequently utilized as additional forms of diagnostic imaging to achieve a definitive diagnosis by locating these lesions and ruling out other conditions[13]. Nuclear scintigraphy is useful in identifying the location of a traumatic lesion, but it cannot be used to differentiate between trauma and osteoarthritis[13]. The best modality for imaging bone trauma is computed tomography; however,

it is recommended to use radiographs in conjunction with it due to the decrease in spatial resolution[13].

Signalment, History, and Presentation

On September 18th, 2019, an 8-year-old Quarter Horse mare presented to the Equine Surgery service at Mississippi State University College of Veterinary Medicine (MSU-CVM) for further evaluation of a possible third tarsal fracture in her right hock that had previously been investigated by her primary veterinarian.

Prior to presentation, this mare was an accomplished athlete that traveled across the country to participate in cutting horse competitions. Over the course of the summer of 2019, she had become noticeably lame, which led to presentation with her primary veterinarian. During her lameness exam, she blocked out with approximately 50% improvement in a proximal suspensory block. In addition, she continued to improve when her peroneal nerve was blocked out. Therefore, it was proven that her lameness was isolated to the hock and proximal suspensory area. At this time, she was treated with hock injections (with a steroid); however, she was still not performance sound. In order to further investigate the cause of her lameness, an ultrasound was performed on her right suspensory ligament and she was treated with ProStride (autologous protein solution derived from platelet rich plasma), extracorporeal shockwave therapy, and rehabilitation exercises. Unfortunately, she remained lame. At this time, her primary veterinarian completed radiographs, which showed a possible third tarsal bone fracture with a lytic area in the third tarsal bone as well.

On presentation, she was bright, alert, and responsive. She weighed 1045 lbs (474 kg) with a body condition score of 5/9 (4-5 out of 9 are ideal). Her temperature, pulse, and respiratory rate were within normal limits. Her lungs and heart auscultated normally, with no

crackles, wheezes, murmurs, or arrhythmias appreciated. Gastrointestinal motility was normal in all four quadrants and no digital pulses were appreciated. The remainder of her physical exam was unremarkable.

Diagnostic Examination

During presentation, a brief lameness exam was completed to re-evaluate the patient's gait. She was observed at the walk and trot in both a straight line and on a circle. At this point, she was determined to have a grade 3/5 lameness on her right hindlimb, characterized by being consistently lame at the trot under all circumstances.

On September 19th, the mare was placed under general anesthesia to have computed tomography images taken of both hindlimbs. On the left tarsus, periarticular osteophyte formation was noted on the dorsomedial aspect of the central tarsal bone and the dorsal aspect of the third tarsal bone. In addition, there was sclerosis of the subchondral bone on the dorsal third of the central and third tarsal bones. The findings suggest that She has degenerative osteoarthrosis of the proximal intertarsal joint.

In images taken of the right tarsus, an irregularly marginated, thin, curvilinear, hypoattenuating defect was present within the dorsodistal aspect of the central tarsal bone, which communicates with the distal intertarsal joint. In addition, enthetic new bone and periarticular osteophyte formation were noted to be irregularly marginated on the of the dorsal borders of the central and third tarsal bones. Multiple variably sized and shaped hypoattenuating defects were present within the articular surface and subchondral bone of the central tarsal bone. Once again, sclerosis was present on the central and third tarsal bones. However, it was observed in the subchondral bone of the dorsal 1/3 to1/2 of these bones. These findings suggest that she has degenerative osteoarthrosis of the distal intertarsal joint and central tarsal bone. In addition, the

curvilinear hypoattenuating defect within the dorsal aspect of the central tarsal bone can be interpreted as a chronic chip/slab fracture.

Pathophysiology

Central tarsal bone fractures are more often reported to occur in a slab fashion, where the fracture line is within the frontal plane and involves the proximal intertarsal and distal intertarsal joints[6]. Previously, these fractures were suggested to be more prevalent in the left hindlimb[5,6]. However, more recent research has determined that they occur equally in either limb with no side predilection noted[15]. Presentation of bilateral tarsal slab fractures have been reported in the literature as well[6].

The exact pathogenesis of central tarsal bone slab fractures has been reported as being "somewhat speculative" with multiple mechanisms proposed in the literature over the years[3,6,9-10,14-16]. These mechanisms have focused on the idea that these fractures either occur due to a severe compressive force[16] or a combination of repetitive forces[3] acting upon the central tarsal bone. Most of the recent literature describes central tarsal bone slab fractures similarly to a stress fracture years.

Exercise and other times of cyclical loading of the bone results in microdamage which stimulates a remodeling response[17]. The remodeling response consists of the removal of bone from one location and the replacement of bone at the same location [17]. During the resorption phase, bone is more porous and less stiff which increases strain within the bone resulting in more microdamage[17]. This cycle leads to the formation of areas of intense cortical remodeling, which are associated with fracture lines[17]. Ultimately, repeated events of strenuous exercise result in adaptive remodeling of the bone, but the bone will reach a threshold where it can no longer withstand these forces, resulting in the formation of a fracture line.

Treatment and Management

On September 20th, the patient underwent lag screw fixation of her right central tarsal bone and chemical arthrodesis of her right distal intertarsal joint. She was anesthetized and placed in left lateral recumbency. The plantar-lateral and plantar-medial aspect of the right tarsus was clipped, sterilely prepared, and draped. In order to ensure proper placement of the screw, multiple one inch, 18-gauge needles were inserted to serve as landmarks for joint spaces on the right hock. Pre-operative radiographs were taken to assess the positioning of the needles.

A small 1.5 cm incision was made over the lateral aspect of the central tarsal bone was made with a No. 10 scalpel blade. A 3.2 mm thread hole was drilled into the central tarsal bone, placement was confirmed radiographically, the area was measured and a 32 mm 4.5 screw was placed in a straight lateral to medial approach positioning the fragment to the central tarsal bone. Radiographs were taken to ensure proper placement of the lag screw. Then, the incision was closed in a single cruciate pattern using 2-0 PDS suture.

The head of the lateral and medial splint bones were sterilely palpated, and 1 inch, 22 gage needles were inserted into the joint distally and dorsomedially over the head of the lateral and medial splint bone until they were seated within the distal intertarsal joint. Sterile radio-opaque contrast medium was injected into the joint. The syringe was removed, and the needle was left in the joint. Radiographs were taken immediately after injection of the contrast. No communication was identified between the distal intertarsal and tarsometatarsal or tibiotarsal joints. Approximately 10 ml of 90% ethyl alcohol was injected through a needle into the tarsometatarsal joint. The needle was removed from the joint, and the region was covered with a sterile bandage and Elastikon. The patient recovered from anesthesia without any problems and returned to her stall once she was able to stand and walk on her own.

Case Outcome

After surgery, the patient was kept on stall rest to allow her lower hock joint to fuse and her central tarsal bone fracture to continue healing. During this time, she received Uniprim antibiotic powder (sulfadiazine and trimethoprim) and flunixin (non-steroidal anti-inflammatory) every twelve hours orally. Initially, she did well and experienced no problems during the post-operative period. However, she developed antibiotic induced colitis approximately 5 days after surgery.

On September 25th, the patient was noted to have an increased temperature of 101.8^{o} F at 8am, which progressed to 103.1 F at noon. Blood was collected and submitted for a complete blood count and a chemistry panel. These diagnostic tests showed a lymphopenia, eosinophilia, slightly elevated glucose, and slightly decreased calcium. She remained febrile but did not show any signs of sweating, which lead to the completion of an anhidrosis test. She was positive for both epinephrine dilutions (1:1000 and 1:10000) and therefore determined to not be anhidrotic.

On the morning of September 26th, the mare stopped receiving Uniprim and began chloramphenicol instead. That afternoon, she exhibited signs of colic with a dull mentation. She was intubated with a nasogastric tube, given 6 liters of water with 3.5 liters of reflux produced. A rectal examination was completed after the administration of 1 ml of xylazine and 7 mls of Buscopan. Loose, watery manure was present in the colon and no obvious impactions were appreciated. All other structures that were palpated were within normal limits. Finally, an abdominal ultrasound was performed and revealed a moderate amount of fluid and ingesta within the colon. In addition, the lining of the intestines appeared to be of normal size and thickness on ultrasound. Prior to returning to her stall, she received one pound of BioSponge via nasogastric tube and blood was submitted for a follow up complete blood cell count. Her bloodwork

demonstrated a leukopenia (characterized by a lymphopenia and neutropenia) and elevated fibrinogen levels. To rule out small strongyle migration as the cause of her clinical signs, she was dewormed with Quest Plus (2% moxidectin and 12.5% praziquantel) given orally. Ultimately, it was presumed that her colitis was antibiotic induced due to the administration of beta-lactams causing an overgrowth of *Clostridium dificile* within the large bowel. This episode of colitis was determined to have resolved on September 28th, but She remained in hospital until October 7th.

At discharge, treatment recommendations were primarily focused on exercise restriction/rehabilitation and monitoring. Owners were instructed to keep her confined in a stall for thirty days. After this time, the mare could be turned out into a small paddock for four weeks, then she could gradually return to exercise. While she was confined in her stall, this patient's physical rehabilitation plan included hand walking for ten minutes twice daily with an increase in five minutes duration to be added weekly. The goal was to have her walking for twenty minutes twice a day before she was turned out into a small paddock for four weeks and returned to exercise. During her restriction and rehabilitation, she was to be monitored for any signs of colic, pain, or lameness.

In May 2020, the mare returned to MSU-CVM for breeding management and embryo flushing with the theriogenology service. At the time, she was reported to be doing well at home and no signs of illness or lameness noted.

Conclusion

While Thoroughbreds and Standardbreds involved in racing are most often reported to experience central tarsal slab fractures, other equine athletes such as cutting horses and barrel racers are still at risk for developing this condition during their career. The various repetitive forces involved in these activities lead to continuous stress placed upon the bones and eventually

a fracture if the bone experiences an overwhelming amount of force in a previously remodeled area. Physical and lameness examinations are not typically enough to definitively diagnose central tarsal bone fractures and it may be difficult to visualize the fracture on radiographs. Advanced imaging modalities such as computed tomography and bone scintigraphy are useful in locating the fracture and ruling out other conditions. Treatment involves conservative management or surgery (either the placement of a lag screw or the removal of bone depending on the fragment).

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