Diagnosis of Conditions of the Fetlock

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Introduction

The metacarpophalangeal (MCP) and metatarsophalangeal (MTP) joints (fetlock joint) are high range motion joints that bear substantial loads during performance. The fetlock is a complex joint even though it moves predominantly in a sagittal plane. This joint has a relatively small surface area which may increase the susceptibility of this joint to injury. The front and hind fetlock joints are almost identical anatomically but due to the different functions of the front and hind limbs these joints may manifest different types of injuries. Understandably, this joint has the largest number of unique traumatic and degenerative lesions affecting any joint.

The entire body weight is borne through the fetlock of the lead leg when a horse is cantering or galloping. The elastic suspensory apparatus is designed to resist loads and limit extension of the fetlock. Increasing loads can produce hyperextension (or dorisiflexion) which can produce compression (impact) injuries of the dorsal aspect of the joint and tension injuries of the flexor tendons and suspensory apparatus of the palmar/plantar aspect of the joint. Asymmetric load bearing of the limb can increase the contribution of the suspensory ligament branches and collateral ligaments in resisting hyperextension of the fetlock joint and may predispose these structures to injury as well. It should come as no surprise that synovitis, capsulitis and/or osteoarthritis of the fetlock joint is consistently ranked as one of the most common causes of lameness in all categories of sport horses.

A careful and complete examination of the limb is necessary to indicate the fetlock is a clinical problem. Radiology, ultrasonography, nuclear scintigraphy and more recently magnetic resonance imaging can be utilized to image the fetlock. While the radiographic examination of the fetlock(s) provides useful information about the bones of the fetlock joint it needs to be performed correctly and with the understanding that it provides little definitive information about the soft tissues that surround the joint. Sonographic examination is necessary to evaluate the soft tissue structures that surround the joint. Radiography and ultrasonography should be considered ideal complementary imaging tools for the diagnosis of musculoskeletal of joints in the horse.

Radiographic Examination

The fetlock joint is easily imaged because of its size and absence of overlying soft tissue structures. However this technology reflects a three-dimensional structure is projected in a two-dimensional plate and has a lack of differentiation of the soft tissues. It is also important to remember that a considerable amount of bone loss is necessary (up to
30 to 50%) before it can be identified on radiography. The fetlock must be evaluated with a minimum of five views; the lateromedial (LM), flexed lateromedial (flexed LM), dorsoproximal palmarodistal (D30Pr-PaDi), dorsolateral palmaromedial oblique (D45L-PaMO) and the dorsomedial palmarolateral oblique (D45M-PaLO). Special oblique views can be performed to highlight specific areas that may have been seen on the screening radiographs or other imaging modalities. The radiographic views should be aligned with the limb which may be a different angle from aligning with the horse.

**Lateromedial and flexed lateromedial views**

A rough guideline for the lateromedial view is to use the bulbs of the heel to direct the primary beam. The condyles of the third metacarpal (metatarsal) bone and the proximal sesamoid bones should be superimposed and the metacarpophalangeal joint space easily visualized. Subchondral bone and adjacent trabecular bone in the condyles of MC III and MT III should be clearly identifiable. On flexed lateromedial views the articular surfaces of the proximal sesamoid bones and the dorsal aspect of the sagittal ridge should be identifiable.

**Dorsal 30° proximal-palmar (plantar) view**

The proximal sesamoid bones should be situated proximal to the metacarpophalangeal joint space to visualize bone changes that might be present in the subchondral bone. The borders of the proximal sesamoid bones should also be identifiable in their superimposed position over the distal aspect of MC III and MT III. The medial sesamoid has a more convex peripheral abaxial margin than the lateral sesamoid demonstrated in this view.

**Dorsal 45° medial-palmaro (plantaro) lateral and dorsal 45° lateral-palmaro (plantaro) medial oblique views**

The extensor process on the proximal phalanx should be easily identified. The base of the sesamoid bones should not be superimposed over the proximal palmar process of P1 and the peripheral border of the sesamoid bones should be visible.

Other views have gained popularity when trying to image specific areas of the fetlock joint. The metacarpal/tarsal condyle may need to be examined which requires special 125° or flexed DP oblique projections. Special horizontal oblique views (downward angel of 15-20 degree) may also be necessary to elaborate and accurately identify osteochondral fragments located in the dorsal or palmar/plantar aspect of the joint.

**Ultrasonographic Examination of the Fetlock**

High-resolution linear array transducers are necessary for the musculoskeletal examination of the fetlock joint. Diagnostic ultrasound provides an excellent means to image the soft tissues not seen with radiographs as well as providing detailed information about cartilage and subchondral bone. Most structures of interest in the fetlock lie superficial, just under the skin and subcutaneous tissue necessitating a variable focus high frequency linear probe such as a 10-14 MHz and a standoff. Sonographic examination of the fetlock joint requires examining the dorsal, medial, lateral and palmar/plantar aspects of the joint. Arthrosonography carries the distinct advantage of allowing the dynamic
evaluation of the soft tissue and osseous structures in the standing and flexed positions of the joint.

In the dorsal aspect of the fetlock joint, the sound beam travels from the transducer through the skin, subcutaneous tissue, extensor tendon(s), subtendinous bursa, fibrous joint capsule, synovial fluid, cartilage and ends at the subchondral bone surface. In the transverse plan, the subchondral surface is smoothly undulating with a pronounced midsagittal ridge. The cartilage covering should be uniform as should the subchondral surface. The cartilage is thicker (.8 mm) more proximally than distally (.4 mm). Osteochondral fragmentation and osteochondrosis lesions will manifest a break in this continuity of the subchondral surface creating an irregular joint surface. The front limb has the two extensor tendons passing over the metacarpal condyles; the lateral digital extensor tendon over the lateral condyle and the dorsal digital extensor tendon over the medial condyle. The dorsal digital tendon is larger giving the appearance of more soft tissue overlying the medial condyle. This should not be mistaken for swelling of this area when compared to the lateral condyle. The examination should include evaluating the cartilage and subchondral surfaces of the weight bearing surfaces of the flexed fetlock by flexing the limb while placing the transducer on the dorsal surface of the joint. By utilizing range of motion it is also possible to evaluate the accessibility and mobility of osteochondral fragments of the dorsal and palmar/plantar aspect of the joint.

The palmar/plantar aspect of the joint has the flexor tendons, proximal sesamoid bones, intersesamoidean ligament, the digital flexor tendon sheath and the anular ligament. Any fetlock lameness necessitates that the suspensory apparatus be carefully evaluated with particular attention paid to the suspensory branches and their attachments to the sesamoid. The oblique sesamoidean ligaments, being the functional continuation of the suspensory apparatus, should also be evaluated distal to the sesamoid bones and can be seen by continuing distal over the lateral aspect of the sesamoid just as done when evaluating the suspensory branches. Changes in the contour of the sesamoid bones may indicate damage of these structures that will need to be confirmed radiographically. Apical and abaxial sesamoid fractures should be assessed as to the extent and degree of suspensory ligament involvement as this can significantly influences the prognosis and helps determine the accessibility of the fragment to surgical removal.

The lateral/medial aspect of the joint should be evaluated for the collateral ligaments of the fetlock joint. Each collateral ligament is composed of a thin superficial bundle and a thicker deep bundle. These bundles are oriented at different angles to each other and therefore cannot be assessed together but must be examined independently because the beam angle must be at 90° to the fiber pattern of the structure of interest. Therefore, when the beam angle is 90° to superficial bundle then the beam angle is incorrect for the deep bundle making this bundle appear hypoechoic. The affected collateral ligament must be carefully measured (cross sectional area) and compared to the opposite ligament on the same limb and the same ligament in the opposite limb both on transverse and longitudinal sections. These measurements should be as close to the exact same level as possible. The contour of the distal abaxial surface of the canon bone should appear the same. The author places these structures on split screen and tries to create the appearance of mirror images to better assess the size and shape of both structures. Denoix has stated that the superficial bundle of the collateral ligaments should be examined with the limb flexed. In the author’s experience, size and shape changes of the superficial
collateral ligament have been readily apparent when the limb is examined in the standing position.

**Scintigraphic Examination of the Fetlock**

Nuclear scintigraphy has become routinely utilized in the horse for detection of orthopedic disease. A radiopharmaceutical is injected into the intravenous system and is distributed throughout the body. Technetium pertechnetate is bound to a pharmaceutical called methylene diphosphonate (MDP). Methylene diphosphonate binds to osteoblasts that are actively remodeling bone. By doing this, the radioactive Technetium is deposited at the site of osteoblastic activity and as the radioactive material decays, it emits a gamma ray. This gamma radiation escapes the body for external detection and measurement by a scintillation camera. The camera detects the gamma radiation and a dedicated computer creates an image of radiation distribution. This makes scintigraphy an especially valuable tool to diagnose early orthopedic injury. Musculoskeletal scans are divided into vascular phase, pool phase and bone phase (first pass, soft tissue and osseous). An area of increased uptake of radiopharmaceutical can indicate active inflammation in pool phase images and bone modeling in bone phase images. The metabolic rate of bone significantly influences the uptake of the radiopharmaceutical during the osseous phase making younger animals in training ideal candidates for scintigraphy. Older mature animals that have minimal bone turnover and are not actively training are poor candidates. In the appropriate candidate nuclear imaging of bone disease is very sensitive at detecting bone modeling but is less specific at defining the specific site of involvement. To assist with localization of lesion(s) the scans should be acquired in two planes (lateral and dorsopalmar) and should be compared to the paired opposite fetlock. The main drawback to nuclear medicine is that the images generated are very sensitive for disease, but not very specific. It is difficult to know the clinical importance of the lesions identified or whether these lesions are acute or chronic. Active bone remodeling after an incomplete stress fracture can persist for up to 2-3 years after the injury. Also, perineural and intra-articular anesthesia can cause increased vascularity to the regions injected and provide false positive results for several days after the procedure.

Scintigraphy examinations must always be combined with radiographic and ultrasonographic evaluation. The indications for nuclear scintigraphy in the horse with fetlock lameness include: when there is localization of pain to the fetlock region but no radiographic or ultrasonographic evidence of a problem; an acute onset of lameness thought due to a fracture but without radiographic evidence of a fracture; intermittent lameness that cannot be reproduced to perform anesthesia of the fetlock region; lameness in several limbs making local anesthesia interpretation difficult and finally in the assessment of the significance of equivocal radiographic abnormalities. Again, increased radionuclide uptake does not always equate with clinical significance emphasizing that interpretation of nuclear scintigraphic images without reference to the clinical examination and other imaging results can be potentially misleading.

The normal pattern of RU in the fetlock joints has higher RU at the proximal region of P1 and a significantly lower activity within the MCIII condyles. The hind limbs have a broader profile incorporating the MTIII condyles and the proximal aspect of P1 with a more generalized RU across the MTP. Mild RU of the MCIII in the dorsal view may be a normal scintigraphic finding in horses in active race training.
Computed Tomography of the Fetlock

A detailed CT description of the normal MCP joint has not been published. Computed tomography can detect more subtle density differences than radiography making it a much more sensitive tool to evaluate boney disease. Cross sectional imaging allows visualization of the bones of the distal limb in much more detail than with conventional radiography. CT uses a rotating X-ray beam to penetrate body tissues and generates multiple slice tomographs which can be utilized to develop three-dimensional rendering of the area of interest. Newer 8-16 multi-slice CTs are able to acquire the study in minutes allowing the clinician to read the study develop a strategy for repair of a fracture and perform surgery within the same anesthetic period. Multi-planar reformatting can yield better anatomic orientation of an area and provide for more sensitive detection and characterization of disease extension. CT is more sensitive detecting changes of bone contour and has proven to be particularly useful in the evaluation of stress-induced bone remodeling, focal bone lesions, and defining fracture configuration prior to fracture repair. However, CT requires general anesthesia to acquire the images or sequences. The fetlock is ideal for CT evaluation because of the complex anatomic arrangement with the superimposition of the sesamoid bones and the distal MC3 and proximal P1 significantly compromises image interpretation. However the soft tissue detail in CT is deficient when compared to MRI. The use of intravascular contrast agents can possibly enhance the soft tissue detail of this area (like as has been reported in the foot) but not comparable to the soft tissue detail obtained with MRI.

Magnetic Resonance Imaging of the Fetlock

The fetlock region is more accessible than the foot for imaging using radiography, ultrasonography, nuclear scintigraphy, arthroscopy, and endoscopy, thus the indications for MRI are fewer than in the foot. MRI is used when the abnormalities found with other imaging modalities cannot entirely be associated with the degree of lameness. The normal MRI anatomy of the equine MCP joint has been described using a low-field and a high-field magnet. A recent report has described the MRI findings of 40 horses seen at NCSU over the last 5 years. See below.

Arthroscopic Examination of the Fetlock

Arthroscopy enables direct visualization of the joint structures which include the synovial membrane and associated villi, articular cartilage and intraarticular ligaments. Therefore, arthroscopy can be used both for therapeutic and diagnostic purposes. In the equine fetlock joint, either a dorsal or a palmar/plantar approach can be used, depending on the procedure to be performed. However, a complete arthroscopic examination of the entire articular surface of P1 and the MCIII/MTIII condyles is not possible. The dorsal approach allows the visualization of only the dorsal articular margin of P1 and the dorsal aspect of the articular surface of the MCIII/MTIII condyles. The palmar/plantar approach permits visualization of the metacarpal- or metatarsosesamoidean joint although the access to the palmar/plantar fetlock region is rather limited. During the arthroscopic removal additional lesions such as wear lines, full-thickness cartilage fibrillation, cartilage erosion (articular surface of the distal MCIII/MTIII, proximal sesamoid bones,
proximal aspect of P1), synovial proliferation in the area of the fragment and chronic proliferative synovitis can be detected.

Discussion

Lameness originating from the fetlock occurs commonly in performance horses of all breeds for variety of reasons. Radiology and ultrasonography can enhance the equine practitioner’s ability to accurately diagnose and manage many of these fetlock joint-related problems. Even now, diagnostic ultrasonography is vastly underutilized in the clinical assessment of joint problems in horses. While these imaging tools are commonly at the clinician’s disposal the selective use of other advanced imaging modalities such as nuclear scintigraphy, computed tomography and MRI are sometimes needed to diagnose some types of fetlock joint disease. In the past, arthroscopy was considered the gold standards for diagnostic evaluation of the intraarticular aspects of most equine joints. In the fetlock joint nuclear scintigraphy has been especially helpful in assess the young actively training/racing thoroughbred or standardbred horse with stress induced bone remodeling of the metacarpus/metatarsus but has been unrewarding in the mature performance horse. Currently, magnetic resonance imaging is proving to be the gold standard to evaluate the joints of the distal limb.

MRI FEATURES OF METACARPO(TARSO)PHALANGEAL REGION LAMENESS IN 40 HORSES

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Abstract

Lameness originating from the metacarpo(tarso)phalangeal (MP) joint significantly affects the use and athletic competitiveness of a horse. The identification of the cause of lameness originating from the MP joint can be challenging, given the limitations of radiography, ultrasonography and nuclear scintigraphy. Our purpose was to describe the injury types and incidence in magnetic resonance (MR) imaging studies from 40 horses with lameness attributable to the MP joint region where it was not possible to reach a definitive diagnosis using other imaging modalities. Horses were examined in a 1.5 T Magnet (Siemens Medical Solutions) under general anesthesia. The frequency of occurrence of MR lesions was subchondral bone injury (19), straight or oblique distal sesamoidean desmitis (13), articular cartilage injury and osteoarthritis (8), suspensory branch desmitis (8), osteochondral fragmentation (7), proximal sesamoid bone injury (7), intersesamoidean desmitis (4), deep digital flexor tendonitis (4), collateral desmitis (3), superficial digital flexor tendonitis (2), enostosis-like lesions of the proximal phalanx or metacarpus (2), desmitis of the palmar annular ligament (1), desmitis of the proximal digital annular ligament (1) and dystrophic calcification of the lateral digital extensor tendon (1).

Twenty-five horses had multiple MR abnormalities. MR imaging provided information that was complementary to radiography, ultrasonography and nuclear scintigraphy and that allowed for a more comprehensive evaluation of all structures in the MP joint region and an accurate diagnosis in all 40 horses.
References
