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Radiology and Ultrasonography of the Equine Foot

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It stands to reason that because the foot is one of the, if not the, most common source of lameness or area of concern that it is also the most common site for radiographic evaluation. Lameness is one of several indications for radiographic evaluation of the foot. Taking radiographs of the feet is a very common recommendation or request made during the prepurchase examination. In the absence of lameness detailed radiographic evaluation of the horse’s foot exhibiting poor conformation, imbalance or abnormal patterns of growth is very useful in guiding the veterinarian in the treatment for the prevention of lameness. Radiographic evaluation of a horse’s foot also gives tremendous insight into the relationship between the structures of the foot and the digit in guiding the farrier in proper trimming and shoe placement.

The information gained from a radiographic study is only as good as the quality of the radiographs (“garbage in, garbage out”). It is imperative that the veterinarian invest in quality equipment, become proficient at operating the equipment and take the time and effort to set up technique charts and perform quality radiographic studies. Radiographic evaluation of the horse’s limb does not replace the need for a detailed physical examination, lameness evaluation, and diagnostic analgesia. There are a number of preplanning questions that need to be asked before performing foot radiographs: 1) What is the purpose of the study, 2) What do I expect to gain from the study, and 3) What information do I need to obtain from the study? The answers to those questions will guide in planning the study with regard to what views to take and what type of technique should be used.

Equipment

Digital radiography (DR) has become commonplace in equine practice. Although expensive, the advantages over film/screen radiography and demand for digital radiography is making it a worthwhile investment. The advantages of DR over film/screen radiography include improved image quality, digital postprocessing, and improved archiving. There is tremendous exposure latitude with DR vs. plain film radiography resulting in far fewer retakes and radiation exposure. With a single image you also have the ability to adjust window/level settings (brightness and contrast) improving the detection of darker, lighter, and low contrast structures. Once captured, processed, and saved the images can be archived electronically eliminating the need for film storage. The ability to transmit the images quickly for the purpose of consultation, second opinions and prepurchase examinations allows the practitioner to practice more efficiently and better serve the client. That said, digital technology is not necessarily the tell all, and high quality conventional radiographs are satisfactorily diagnostic for many purposes. Digital radiography has allowed identification and more accurate diagnosis of some lesions in the foot that were otherwise impossible to visualize or suspect at best. It has also introduced questions about the significance of observation not previously possible.
With conventional film/screen radiography it is important to establish standard technique charts taking into consideration the view to be taken, what information is to be obtained from the particular view and the size of the foot. Because the same degree of detail and contrast is not as obvious on conventional film, establishing multiple techniques for each view is necessary to visualize and evaluate soft and osseous tissues.

Additional equipment required to obtain quality radiographs include positioning blocks and appropriate markers. There are commercial positioning blocks and stands available for equine practice that aid in standardizing focal distance, foot placement and alignment of the x-ray beam. Wood blocks of the appropriate size and height work well; commercial blocks are available but they are also simple to fabricate to the practitioners desired specifications. A variation to the standard flat block is one that the author uses and is composed of two independent circular blocks connected in such a way which allows rotation of the two halves. This works well for horses that exhibit conformational faults such as a toe-in or toe-out conformation. When the foot is placed on the block the rotation of the block allows the foot to position itself influenced by the horse’s conformation thereby alleviating the possibility of positional artifacts such as joint space asymmetry (Fig. 1). When designing or purchasing a positioning block it is important to take into consideration the height of the block and the x-ray machine used. Proper positioning will be discussed in later sections. It is also useful if the block contains some sort of metallic marker which will aid in accurately identifying the ground surface of the foot which simplifies foot measurements.

![Figure 1. Rotating positioning block. A, Note copper metal insert used for identification of weight-bearing surface. B, Rotation of the block allows for accurate placement of the limb due to variations in conformation.](image)

### Preparation and Positioning of the Foot

If the horse is shod, acquiring owner permission to remove the shoes is important. This of course is dependent on the type of study that is to be performed and the information needed from the study. Performing radiographs with the shoes in place can be useful when consulting with the farrier. The shoe allows accurate identification of the weight bearing surface and the position of the shoe in relationship with the hoof capsule and distal phalanx. This simplifies evaluation of breakover, sole depth and balance of the foot. If a source of lameness has been localized to the foot, removal of the shoes may be necessary in order to obtain the additional views necessary to
fully evaluate the foot. Appropriate shoe removal technique is a skill that the veterinarian should be able to perform. The owner may request that the foot be prepared by the farrier, or the veterinarian can request that the owner’s farrier prepare the foot before performing a radiographic study.

The foot should be thoroughly cleansed with a stiff brush and soap and water if necessary. Once the gross debris is removed the outer wall and the sole should be evaluated for any frog overgrowth or flaky sole that can be removed to reduce artifact. Any flakiness or accumulations on the outer wall can be removed with either a rasp or a sanding block. Once the foot is prepared, packing the sulci (Play-Doh® or appropriate putty material) reduces the likelihood of radiographic artifact due to air in the sulci. Even careful packing does not eliminate all gas artifacts. Placing the foot in a water bath is effective in displacing trapped gas and “cleaning up” the image (Fig. 2). The vessel that is used should have a flat bottom preferably without molded supporting ridges. The water depth should be at a level just proximal to the heel bulbs. Keeping the level to a minimum will help reduce the reluctance of the horse to keep the foot placed and reduce radiographic scatter. It is also recommended that the cassette or digital sensor be placed in a plastic protective cover (trash bag) prior to placement of the foot. When using film-screen radiography when shooting in a water bath, it is necessary to increase the radiographic technique by doubling the time. The water also causes significant scatter causing some fogging of the image, but this does not preclude accurate evaluation of the distal phalanx.

![Figure 2. Foot preparation for radiographic study. A, Right front foot has been properly prepared for imaging. B, Bottom of the foot has been packed with Play-Doh which displaces trapped gas and alleviates gas artifact on radiographic image. C, Foot is placed in a water bath resulting in displacement of gas in areas that traditional packing sometimes fails to displace.](image)

Positioning is the key to obtaining quality informative and diagnostics radiographs. Proper positioning involves positioning of the horse and the limb of interest, positioning of the foot on the appropriate block, and positioning of the x-ray machine.

The horse should be placed on a firm level footing with the limbs squarely beneath them whenever possible. Having a level surface for the horse to stand allows more accurate placement of the x-ray machine in the same plane for the lateral to medial and horizontal dorsal to palmar/plantar projections. Depending on the height of the positioning block, height adjustments can easily made by placing the machine on spacers of the appropriate thickness to bring the beam to the desired height (Fig. 3). Light sedation is often necessary and can help maintain positioning.
through the study. Regardless of whether a unilateral or bilateral study is being performed both feet should be placed on blocks of equal height off the ground. Correct positioning reduces the likelihood of artifactual changes to the joint space that might otherwise be interpreted as joint asymmetry and foot imbalance.

![Figure 3. Proper x-ray machine placement and beam orientation for shooting Horizontal D-P projection. Foot and machine are in the same plane and beam is centered at a sight 1.5-2cm proximal to the weight-bearing surface.]

**X-Ray Beam Orientation**

Distortion of the radiographic image occurs if the x-ray beam is not perpendicular to the radiographic cassette or sensor unit. Distortion to the horizontal projections (lateral-medial, dorsal-palmar/plantar) will result in asymmetry within the image and inaccurate evaluation of the image and radiographic measurements. Magnification increases as the distance of the cassette or sensor unit to the object increases. This can be minimized with proper placement of the foot on the positioning blocks. There is more image distortion of the dorsal–palmar/plantar radiograph due to the angle of the pastern. Placing the cassette parallel with the pastern will create distortion which is unacceptable. The slight magnification produced with this view is acceptable and does not make a significant change to the interpretation of the image. A palmar/plantar-dorsal projection can be taken to reduce magnification but it is not necessary and can be unsafe to personnel and equipment.

Focal-film distance should be kept constant for all projections. Changes in the focal-film distance will alter the exposure of the image assuming the exposure settings are held constant.

The following table is a guideline as to the recommended radiographic views that should be taken depending on the type of study to be performed and the anticipated information that should be gained from the study. These are only guidelines, recommendations will vary and the need for additional views can be added based on the individual case the preferences of the practitioner and the assessment of the previous views.
### Views

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### Lateral-Medial (L-M)

The lateral-medial (L-M) view is performed with the horse standing squarely with each foot on a position block of equal height. Focal-film distance usually ranges between 24”-28” and will vary with the specific film-screen combination and technique chart that is developed. It is important to be consistent and once the technique is established the focal-film distance remain constant. The L-M beam alignment is a line parallel to the bulbs of the heels. The beam is centered at a point halfway between the toe and the heels and 1.5-2cm proximal to the weight-bearing surface (Fig. 4).3,4 This beam alignment will produce a film that the medial and lateral solar margins and pal-

![Figure 4. Lateral to Medial projection (L-M). A/B, the beam orientation is perpendicular to the dorsal-palmar plane of the foot. Parallel alignment with the heel bulbs is useful in proper alignment of the x-ray machine. The beam is centered at a point halfway between the toe and the heels and 1.5-2cm proximal to the weight-bearing surface. C, shoe placement and point of break over can be evaluated with L-M projection shot with the shoe on.](image-url)
mar processes of the distal phalanx are perfectly superimposed on one another allowing for accurate evaluation of the balance of the foot. This projection is useful in evaluating breakover, shoe placement, and quantitatively evaluating the foot by acquiring multiple measurements such as sole depth, palmar angles, dorsal hoof wall angles, and the dorsal hoof width (H-L Zone, Redden). Rigid metallic markers are often used to identify the true border of the dorsal wall; however, accurate identification of the wall length is often difficult. Running a 2mm bead of Barium paste (can be easily stored in and applied from a 60 ml syringe) directly over the dorsal median hoof wall extending from the coronary band to the tip of the toe allows for accurate identification of the wall border, toe length and appreciation of multiple angles of the dorsal hoof wall (Fig. 5). If the navicular bone is the prime area of interest, the x-ray beam should be centered at a point halfway between the dorsal and palmar coronary band, and approx-

Figure 5. Placement of radiopaque marker on the dorsal hoof wall, apex of the frog and the coronary band allows for accurate identification of those sites and evaluation of the foot.

imately 1cm distal to the coronary band. For the distal interphalangeal joint, the x-ray beam is centered on the coronary band at the junction of the dorsal and middle 1/3 of the coronary band. Frequent radiographic abnormalities seen in this projection include changes in the dorsopalmar balance of the foot as represented by changes in the angle of the solar margin of the distal phalanx (normal 3-6°) and disproportionate distribution of foot mass in relation to the center of rotation, changes to the solar margin in horses with pedal osteitis, small focal irregularities at the insertions of the deep digital flexor tendon and the distal sesamoidean impar ligament, and osteophyte or enthesiophyte formation associated with the DIP joint. Some clinicians also consider this projection to be sensitive in the identification of navicular disease, as a well positioned lateral-medial projection focused on the navicular bone allows for evaluation of all borders of the bone and the changes to the medullary cavity (Fig. 6).
Horizontal Dorsal-Palmar (HD-P)

This view is also performed with the horse standing squarely on two positioning blocks with the foot placed towards the back of the block. The cassette is placed on the palmar surface perpendicular to the floor. The focal-film distance remains constant. The beam orientation is parallel to the dorsal-palmar long axis of the foot on the median plane of the foot. As with the L–M projection the x-ray beam is centered 1.5-2 cm above the weight bearing surface of the foot. It is this projection where the dynamic rotary block may add additional accuracy to the interpretation of the image; alleviating artifact due to conformation or foot placement. This projection allows evaluation of medial to lateral balance of the foot with observation and measurement of the medial and lateral wall length and angle. Placement of a small dot of barium paste or some alternative radio-opaque marker at the hairline on the medial and lateral coronet may help in accurate identification of the proximal most extent of the medial and lateral coronet. It also allows inspection of the proximal and distal interphalangeal joint symmetry. Medial to lateral imbalance of the foot can only be seen in this projection and appears as an asymmetry or narrowing at the medial or lateral aspect of the joint. Fractures of the distal phalanx and navicular bone may also be seen in this projection (Fig. 7).

Dorsoproximal-(45°)-Palmarodistal Oblique (DP-45-PDO)

The dorsoproximal-45°-palmarodistal oblique view is performed with the horse standing squarely on a positioning tunnel. This projection is also described as being performed in the non-weight bearing limb with an assortment of different positioning blocks, e.g. navicular block.
Figure 7. Horizontal Dorsal to Palmar projection (HD-P). A, the beam orientation is parallel to the dorsal-palmar, sagittal plane of the foot. As with the L–M projection the x-ray beam is centered 1.5-2 cm above the weight bearing surface of the foot. B, placement of a radio-opaque marker on the medial and lateral coronary band helps in accurate identification and measurement of the wall. C, imaging with the shoe in place helps to evaluate shoe placement and medial-lateral balance.

It is not critical that both feet be placed on similar tunnels. The beam orientation is parallel with the dorsal-palmar, median plane of the foot. The beam is also oriented in a dorsoproximal to palmarodistal direction, 45° to the weight-bearing surface and the long axis of the limb. The beam is centered 1 cm distal to the coronary band (Fig. 8). This projection allows inspection of the solar border of the distal phalanx. Changes to the solar border of the distal phalanx can vary considerably. Resorption of the solar border can be secondary to aseptic or septic inflammation or neoplasia. Aseptic osteitis may present with focal resorption with a smooth rim of sclerosis whereas septic osteitis will exhibit an irregular moth eaten area with bony sequestration. Osteitis may also cause a widening of the radiating vascular channels. Most distal phalanx fractures are best identified with this projection. Additional potential changes that should be evaluated include sclerosis or lysis at the insertion of the collateral ligaments within the fossae located at the lateral and medial articular margins of the distal interphalangeal joint, navicular fractures, and changes in the DIP joint space.4

Figure 8. Dorsoproximal-45°-Palmarodistal Oblique projection (DP-45-PDO). A, The beam orientation is parallel with the dorsal-palmar, sagittal plane of the foot. The beam is aimed in a proximodorsal to palmarodistal direction, 45° to the weight-bearing surface and the long axis of the limb. The beam should be centered on the dorsal coronary band or 1 cm distal. B, gas artifact is obvious through the sulci of the unpacked foot. C, traditional packing alleviates the majority of artifact however packing artifact can still be present. D, use of the water bath displaces all gas and packing artifact.
**ProximoDorsal-60°-DistoPalmar/Plantar (DP-60-PDO)**

PD-60°-DPO projection is shot with an increased technique also with the horse standing squarely with the foot of interest on a positioning tunnel. The purpose of this projection is evaluation of the navicular bone. Because of the narrow area of interest the beam should be collimated lightly so that it is just enough to cover the navicular bone. The beam orientation is similar to that of the 45° projection except for the beam angle is increased to 60° from the weight-bearing surface or 30° from the long axis of the limb. The beam should be centered at a position 1 cm proximal to the coronary band in the median plane of the foot. This technique results in penetration of the overlying middle and distal phalanx and improved detail of the proximal, distal and lateral borders of the navicular bone as well as the medullary cavity. (Fig. 9) There is debate regarding the normal acceptable shape and size of the navicular bone and its contribution to a diagnosis of navicular disease. Numerous studies have attempted to correlate navicular changes to a diagnosis of navicular disease. A radiographic grading system has been formulated to more accurately and objectively classify these changes and correlate them to clinical lameness. The changes that correlate strongly with lameness include large medullary lucencies, medullary sclerosis, and bony remodeling at the proximal border. Although difficult to identify, fragmentation of the distal border at the junction of the horizontal border and the medial and lateral oblique angles of the bone should be evaluated. Navicular bone fractures are also identified in this projection. Gas artifact from poorly prepared sulci can be mistaken for fracture lines; but artifactual lines will project beyond the margins of the bone. Repacking the foot should be attempted or, as preferred by this author, using a water bath to completely displace any gas artifact.

![Figure 9. ProximoDorsal-60°-DistoPalmar projection (PD-60°-DPO). A, The beam orientation is similar to that of the 45° projection except for the beam angle is increased to 60° from the weight-bearing surface. The beam should be targeted at a position 1 cm proximal to the coronary band in the axial plane of the foot. (B, unpacked; C, packed with Play-doh; D, foot in a water path).](image)
ProximoPalmar-DistoPalmar (Flexor Tangential) (PP-PDO)

This projection is performed with the foot placed on a positioning tunnel with the limb of interest positioned palmar to the mid-stance position. This results in increased dorsiflexion of the DIP joint and extension of the metacarpal phalangeal joint, thereby “opening” the back of the foot and pastern. The focal–film distance is usually limited by the abdomen of the horse. The x-ray beam is oriented in the palmaroproximal to palmarodistal angle with the beam following the angle of the palmar surface of the pastern and centered directly in the divot formed between the collateral cartilages. This projection allows evaluation of the flexor surface, flexor cortex, and axial portion of the medullary cavity of the navicular bone as well as the palmar processes of the distal phalanx (Fig. 10). Common radiographic abnormalities of the palmar processes include irregular bony margins consistent with pedal osteitis, and fractures. This projection is most useful for evaluation of the navicular bone. The most significant radiographic changes include poor corticomedullary definition, medullary sclerosis, and changes to the contour of the flexor surface.4

Figure 10. A, The x-ray beam is oriented in the proximopalmar to distopalmar angle with the beam following the angle of the palmar surface of the pastern and centered directly in the divot formed by the heel bulbs. (B, packed with Play-doh; C, foot in water bath)

Additional views of the foot are often indicated based on physical examination, lameness examination, and survey films. Horizontal beam oblique projections can be performed to look at the dorsal medial and dorsal lateral surfaces of the coffin bone (Fig. 11).5 The beam orientation is similar to that of the horizontal beam projections except that it is oriented in either a dorsolateral to palmaromedial or dorsomedial to palmarolateral direction. The lateral borders of the navicular bone and palmar eminences of the coffin bone can also be more extensively evaluated. Dorsoproximal oblique views allow for more accurate evaluation of the palmar processes and particularly for identification of abaxial distal phalangeal fractures.7,10 These projections are performed with the horse staining squarely and positioned on positioning tunnels. The x-ray beam is oriented in a dorsolateral proximal-(45°)-palmaromedial distal oblique (DLP-45-PMDO)
or dorsomedial proximal-(45°)-palmarolateral distal oblique (DMP-45-PLDO) direction. The beam is centered on a point just distal to the coronary band and between the lateral quarter and heel. The obliquity of the beam off lateral can be altered which will allow visualization of different aspects of the DIP articular margins and lateral margins of the navicular bone (Fig. 12).

**Ultrasound of the Equine Foot**

Complete ultrasonographic evaluation of the equine foot is limited by the keratinized hoof capsule. There are, however, numerous approaches and structures that can be imaged ultrasonographically: 1) dorsal approach for inspection of the DIP joint and collateral ligaments of the DIP joint; 2) palmar approach for inspection of the DDFT, suspensory ligament of the navicular apparatus, palmar proximal pouch of the navicular bursa, the proximal border of the navicular bone, and the palmar aspect of the DIP joint; and 3) transcuneal approach for inspection of the digital cushion, DDFT, distal sesamoidean impar ligament, navicular bone, and navicular bursa. A systematic approach to the exam should be followed. Many horses will require light sedation to reduce movement of the foot which will improve image acquisition and reduce the time required to scan. The transcuneal approach can also be used to confirm needle placement for intrabursal injections for lameness evaluation or treatment of foot disease.
Figure 12. Dorsolateral Proximal-(45°)-Palmaromedial Distal Oblique (DLP-45-PMDO) Projection. A, The x-ray beam is oriented in a dorsolateral proximal-(45°)-palmaromedial distal oblique (DLP-45-PMDO) or dorsomedial proximal-(45°)-palmarolateral distal oblique (DMP-45-PLDO) direction. The beam is centered on a point just distal to the coronary band and between the lateral quarter and heel. The obliquity of the beam off lateral can be altered which will allow visualization of different aspects of the DIP articular margins and lateral margins of the navicular bone. (B, packed with Play-doh; C, foot in water bath)

**Dorsal Approach**

The hair is clipped circumferentially from the level of the mid pastern to the coronary band. The pastern is cleaned with warm water and a mild soap (an alcohol rub down can be used but it does not result in as thorough of a cleaning) and then a liberal coating of coupling gel applied, in the direction of the hair. A 7.5-13 MHz linear array transducer with a narrow footprint works well for this approach. Starting on the dorsal surface with the probe oriented in the longitudinal plane, the extensor process can be viewed along with the dorsal aspect of the DIPJ lying deep to the extensor tendon (Fig. 13). Sliding the probe either lateral or medial will bring the origin of the collateral ligaments into view at the 10:00 and 2:00 o’clock positions. A useful bony landmark is a depression in the distal middle phalanx, the collateral fossa. The ligaments are normally oval in shape and have a diffuse echogenicity and fiber pattern similar to other ligaments and tendons (Fig. 14). There can be variation in the cross sectional area (CSA) of these ligaments (normal, 0.62cm²) so it is important to compare ligaments in the same foot as well as the opposite limb. In the longitudinal plane, the origin of the ligament is imaged with the probe oriented perpendicular to the wt-bearing surface. The insertion of these ligaments can be very difficult to image and are rarely interpreted.

Figure 13. Dorsal Approach. Transducer is placed on the dorsal distal sagittal pastern. The distal second phalanx is depicted by the large arrow; the extensor process is depicted by the small arrow; the extensor tendon is depicted by the double arrow. The distal interphalangeal joint is the hypoechoic region located between the extensor process and the distal middle phalanx.
Figure 14. Dorsal Approach. Transducer is placed on the dorsolateral or dorsomedial coronary band. A, Transverse image of the lateral collateral ligament of the distal interphalangeal joint lying within the collateral fossa. B, Longitudinal image of the collateral ligament at its origin on the distal middle phalanx, proximal is to the left.

Palmar Approach

Preparation for this approach is similar to that of the dorsal approach. Because of the distal location and the small contact surface between the collateral cartilages a 5-10 MHz microconvex linear array transducer is necessary. This approach can be performed in either the wt-bearing or non-wt-bearing position. With the transducer placed directly between the collateral cartilages in the transverse plane the DDFT appears as a bilobed structure measuring 7-12mm in thickness and 15-23mm in width. In the longitudinal plane the fiber pattern quickly becomes hypoechoic due to the inability to maintain a perpendicular transducer orientation with the tendon (Fig. 15).

Directing the transducer toward the toe and deep to the DDFT the suspensory ligament of the navicular bone can be visualized. It is border dorsally by the middle phalanx and distally by the navicular bone. The proximal rim of the navicular bone can also be seen with this approach deep to the suspensory ligament; the surface is smooth and convex. The navicular bursa is located on the palmaroproximal aspect of the proximal rim of the navicular bone and is normally anechoic in appearance (Fig. 16).
Figure 16. Palmar Approach. Transducer is held in the sagittal longitudinal orientation and angled slightly distal. The proximal border of the navicular bone is depicted by the large arrow; the palmar distal articular surface of the middle phalanx is depicted by the small arrow; the suspensory ligament of the navicular bone is depicted by the double arrow. Note the proximopalmar recess of the distal interphalangeal joint immediately palmar to the middle phalanx.

**Transcuneal Approach**

For the transcuneal approach, foot preparation is important otherwise image acquisition is very unreliable. In most average sized horses, removal of the superficial layer of frog exposing soft spongy frog is all that is necessary to assure image acquisition. Use of a sharp hoof knife will assure clean removal of material leaving a smooth flat surface. In large feet or feet that are dry additional preparation may be necessary. Once the frog is removed, soaking the foot in a warm foot bath or moist foot bandage will soften the frog and improve ultrasound penetration. Thirty minutes to several hours of soaking may be required depending on the hydration of the foot. The foot is held by the ultrasonographer or an assistant; supporting the foot in a hoof stand cradle works well. A 7.5-10 MHz linear array transducer or 5-10 MHz microconvex linear array transducer can be used with the transcuneal approach. Depending on the width and depth of the frog and the microconvex, probe is often necessary for image acquisition in the transverse plane. Placing the transducer on the frog in the median or paramedian plane, the digital cushion is visualized superficially. The DDFT can be visualized from the palmar aspect of the frog as it traverses the flexor surface of the navicular bone extending distally to its insertion adjacent to the semilunar line on the distal phalanx. The tendon at this level is hypoechoic in appearance due to the fibrocartilage content and the divergent orientation of the fibers as they course to their insertion. A fiber pattern can be visualized in the distal fibrous portion of the tendon. The solar margin of the tendon should be well delineated and linear; normal tendon thickness at this level is 4-6mm. In the absence of navicular bursa effusion it is difficult to discern the separation of the bursa, flexor surface fibrocartilage of the navicular bone and the fibrocartilage portion of the DDFT. A small hypo-anechoic area can occasionally be seen at the distal aspect of the navicular bone deep to the DDFT and superficial to the origin of the distal sesamoidean impar ligament which represents the distal recess of the navicular bursa. The distal sesamoidean impar ligament can be imaged from its origin to its insertion, deep to the DDFT and bordered dorsally...
by the oblique margin of the distal phalanx (normal thickness, 2-3.2mm). The flexor surface of the navicular bone can be imaged from the proximal border to the distal border and appears as a smooth convex hyperechoic line (Fig. 17). The transcuneal approach should also be scanned in the transverse plane. As mentioned before it is occasionally necessary to use a microconvex transducer although adequate contact can be obtained over the palmar three quarters of the frog using a linear transducer with a narrow footprint. As a point of reference, with the transducer placed in trans in the middle third of the frog, two hyperechoic lines can be imaged, one superficial and one deep, as the transducer is moved dorsally. The more superficial line represents the flexor surface of the navicular bone. As the image slides off the distal border of the navicular bone the deeper hyperechoic line comes into view and represents the solar surface of the distal phalanx; superficial to this border is the distal sesamoidean impar ligament (Fig. 18).
Conclusions

Imaging of the equine foot has made tremendous advancements in the past 10-12 years allowing us to understand its normal anatomy and how it relates to lameness; however, for the practitioner radiography of the foot remains the most practical, economical and informative imaging modality in the field. Having said that, the quality of the information gained from a radiograph is only as good as the quality of the radiograph itself. Using high quality equipment, maintaining that equipment, and mastering radiographic technique and image acquisition is imperative to obtaining quality information. Depending on the information desired out of a radiographic study a limited number of views are required. Based on the information gained from the standard study and the clinical presentation of the case there are numerous other specialty views and techniques that can be performed to gain additional information. As stated previously, a detailed lameness examination is also required to guide the practitioner in deciding what radiographic views should be taken. Radiography is also very useful in more thorough evaluation of the sound horse’s foot for consultation with the farrier with respect to trimming and shoeing protocols. Although digital radiography has improved the ability to visualize and evaluate some of the soft tissue structures within the foot there remains great limitations to imaging most soft tissue structures within the foot. Ultrasound can decrease those limitations by allowing evaluation of such structures as portion of the impar distal sesamoidean ligament, deep digital flexor tendon, the navicular bone, and the collateral ligament of the distal interphalangeal joint. Image acquisition can be challenging. High quality equipment, proper probe selection, and foot preparation are important in acquiring quality images, particularly with the transcuneal approach.

References


**Additional Reading**


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