DIFFERENT ANGLE ON DIAGNOSTIC IMAGING OF EQUINE PEDAL CASES

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Categories: Vets

Date: July 19, 2010

Russell Parker, Martin Weaver explain that traditional radiography continues to have a key role in these cases, and offer tips on imaging techniques and ways to avoid errors

LAMENESS originating from the foot is common in horses, but it can frequently present a diagnostic and therapeutic challenge for equine clinicians.

Equine foot imaging is complicated by the hoof capsule and complex anatomy within, and a number of imaging modalities may be employed.

Compounding this problem is the often non-specific response to perineural and intra-articular diagnostic analgesia (Schumacher et al, 2000).

Advances in diagnostic imaging have led to the wider availability of nuclear scintigraphy, magnetic resonance imaging and computed tomography, all of which may be useful for diagnosing foot lameness.

However, more traditional techniques are often sufficient to provide a diagnosis at a much lower cost and inconvenience to the owner and animal. Radiographic examination is most commonly employed for:

• lameness localised to the foot by clinical examination or using diagnostic analgesia;
• laminitis;
• penetrating wounds; and
• pre-purchase examinations.

Clinical examination

Although slightly outside the remit of this article, a good clinical examination is essential and, therefore, worthy of mention.

The hoof is a specialised structure that can alter its growth in response to stress; close inspection of the foot can be invaluable during the lameness investigation and for the early detection of potential lameness, such as that required at pre-purchase examination. The clinician should adequately clean the foot before visual examination, palpation, hoof tester application and distal limb flexion.

Radiography

• Radiographic technique

Radiography is the most commonly employed imaging modality in practice, and good-quality radiographs are obtainable with portable equipment. Increasing numbers of equine practices are acquiring computed (CR) or digital radiography (DR) systems, allowing instant evaluation of radiographs. However, sound technique is still required.

Conventional film radiography will also provide high-quality diagnostic images. Veterinarians will often be asked to take radiographs at a client’s yard, and a few basic requirements can drastically improve the efficiency and value of the examination, including a hard, level surface, a compliant or sedated animal, an area out of direct sunlight (so the collimated light beam can be seen) and an experienced assistant.

With any radiographic examination, safety procedures – as detailed in the Ionising Radiations Regulations 1999 – must be adhered to (which means ensuring adequate protective clothing for personnel), with the aim of minimising staff exposure to radiation. Minor radiographic changes are often clinically significant and, therefore, good-quality radiographs are essential. The shoe should be removed and the foot cleaned and pared if necessary, particularly in the frog region. Areas where the hoof is under-run or dirty will result in artefacts, which are a common cause of misdiagnosis and should be pared out. A full set of foot radiographs includes lateromedial, dorsopalmar, dorsoproximal– palmarodistal oblique (upright pedal; DPr-PaDiO) and palmaroproximal-palmarodistal oblique (“skyline”; PaPr-PaDiO) views, but further views may be required, depending on the suspected pathology.
• **Lateromedial view**

The lateromedial view is obtained while the foot is weight bearing, and raised on a block so that a horizontal beam can be collimated just distal to the coronary band. Alternatively, some clinics may have a raised platform the horse can stand on.

In laminitis cases, a radioopaque marker may be placed on the dorsal hoof wall, ending proximally at the coronary band to allow assessment of distal phalangeal rotation or sinking.

The beam should be centred on the distal interphalangeal (coffin) joint (DIPJ), which is 1.0cm distal to the coronary band, halfway between the heel bulbs and dorsal hoof wall (see Figures 1a and 1b).

Due to the palmar location of the navicular bone, a separate view – centred slightly more palmar – may be necessary to obtain a true lateromedial projection and thus allow evaluation of the palmar surface of this bone.

– **Useful tip.** Dorsopalmar/plantar obliquity can be avoided by placing a straight object on both heel bulbs, and aligning the beam with it.

• **Dorsopalmar view**

Dorsopalmar views (Figure 2) can be used to assess mediolateral balance, but the horse must be evenly weight-bearing and any findings should be confirmed visually. Severe mediolateral imbalance may be identified radiographically by measuring the width of the DIPJ, the angle of the hoof capsule and the distance of the third phalanx (P3) to the weight-bearing surface, and comparing the values medially and laterally. Ossification of the lateral cartilages is best identified on this view, but is usually clinically insignificant. New bone formation on the proximal aspect of the navicular bone may also be detected – this can be associated with the insertion of the collateral sesamoidean ligaments (enthesiophytes), DIPJ capsule (osteophytes) or both.

• **Upright pedal view (DPr-PaDiO)**

The upright pedal view is best obtained using a horizontal beam with the toe resting on a wooden block; this produces less distortion than the alternative weight-bearing D65° Pr-PaDiO projection. Two views should be obtained.

For assessment of P3 and white lines, the sole should be placed flat against the cassette, with the horizontal beam centred on the coronary band and collimated to include the entire hoof capsule (see Figure 3a). Lower exposures are necessary to prevent over-exposure of P3.

Navicular assessment requires the dorsal hoof wall to be vertical or slightly angled forward towards the machine by 50. The beam is centred 1.0cm proximal to the coronary band, and collimated...
tightly to the navicular bone (see Figure 3b); higher exposures are required for this projection. Packing the frog cleft and sulci is recommended to reduce gas lucencies, which can complicate interpretation.

– **Useful tips.** A “navicular block” with an angled groove or wedge can help with positioning the upright navicular view. Do not position the foot too far under or in front of the horse; under or overflexion of the fetlock will superimpose the navicular bone over the DIPJ.

• **Skyline (PaPr-PaDiO) view of the navicular bone**

This view (Figures 4a and 4b) is especially useful for assessing the palmar cortex of the bone, and subtle changes may first be apparent on this view.

The cassette is protected by a cassette tunnel, and the horse should be weight-bearing on the tunnel, with the limb positioned caudally to the contralateral one. Correctly positioning the limb and angulation of the beam is vital to obtain good-quality “skyline” radiographs, and will depend on the conformation of the horse. The beam should be parallel to the palmar aspect of the navicular bone, which is usually 40° to 50° to the horizontal. Take care to avoid medial or lateral obliquity, which will superimpose the wings of the distal phalanx over the navicular bone. Packing the frog is necessary with this projection.

– **Useful tips.** Horses with low heel conformation will require a lower-angle beam; those with “boxy” feet need a more vertical beam. Careful preparation of the tip of the frog is needed to reduce artefacts superimposed on the navicular bone.

• **Further projections**

Some further projections may aid the diagnosis of certain conditions. Dorsal 45° lateral-palmaromedial oblique or dorsal 45° medial-palmarolateral oblique flexed views may be taken with the horse weight-bearing on the cassette, or with the leg up and the sole adjacent to the cassette. It is most useful when a fracture of the palmar/plantar processes of the distal phalanx is suspected, which may not be obvious on the conventional upright pedal view (see Figures 5a and 5b). Weight-bearing oblique projections (DLPMO/ DMPLO) allow evaluation of the dorsolateral and dorsomedial aspects of the distal phalanx, including the insertion sites of the collateral ligaments of the DIPJ. They may be of benefit in severe “seedy toe” cases or suspected keratomas.

**Common errors**

• **Foot preparation**

Poor foot preparation and inadequate foot paring or packing, particularly the frog clefts, can lead to air artefacts that could be mistaken for fractures (see Figure 6).
• Incorrect foot positioning

Most views require the foot to be properly positioned, such that superimposition is minimised. Superimposition complicates interpretation.

• Incomplete views

Financial or client pressures can lead to an incomplete series being taken or the shoes left on, both of which can cause embarrassment if pathology is missed.

• Not examining the whole radiograph

Radiographs are often taken with the expectation of finding a specific condition, and if that condition is noted, there is a tendency to stop looking further. Diagnostic analgesia will affect a number of structures within the foot, all of which should be evaluated (see Figure 7a, Figure 7b).

Common radiographic findings

• Laminitis

Radiography remains an integral part of assessing and monitoring laminitis. Quantitative analysis of radiographs may help to establish a laminitis prognosis (Cripps and Eustace, 1999). For this reason, good-quality lateromedial radiographs are vital (see Figure 8). The proximal placement of the dorsal wall marker is important, as over-estimation of the “founder” distance can lead to a false diagnosis of P3 sinking; in some chronic cases, the coronary band is wide and the true junction is hard to assess.

• Coffin joint

Osteoarthritis of the DIPJ is not uncommon, and features include osteophyte formation at the extensor process of P3 and the navicular bone’s dorsoproximal aspect. Considerable variation may be seen in the appearance of the extensor process (see Figure 9a, Figure 9b, Figure 9c), including fragmentation – which can vary in clinical significance. A good lateromedial view is essential for proper joint evaluation. Clinically significant lesions should respond positively to intra-articular analgesia.

The DIPJ should be evaluated in all projections in which it is seen; some conditions (such as cystic lesions) may only be seen on a dorsopalmar or upright navicular projection, and may easily be missed.

• Navicular bone
Navicular bone pathology may be identified on a number of views, and good-quality radiographs are vital.

A review of radiological interpretation of the navicular bone comprehensively described pathological and normal findings (Dyson, 2008). Significant changes include remodelling the proximal border of the navicular bone, increased number and variation in shape of the distal border synovial invaginations in the distal border, fractures and some distal border fragments (see Figures 10 and 11).

• Pedal bone

Fractures of P3 vary greatly, and some are easily missed. Other common conditions include keratomas, which will often produce a well-defined area of bone resorption (see Figure 12). Pedal osteitis is a general term describing inflammation of the distal phalanx, and may be infectious or inflammatory. However, it frequently reflects past pathology.

• Penetrating injuries

Penetrating wounds are a common occurrence and may be life threatening, depending on their location and the structures involved.

Synoviocentesis and the use of contrast radiography can be helpful to confirm the involvement of synovial sepsis (see Figure 13).

References


Further reading
