The Hoof in Focus: Practical Radiography for Farriers and Veterinarians

Jon Olijnyk, BVM&S, MVR (Research), MANZCVS (LA & SA Rad), AFHEA
ECVDI Resident in Veterinary Diagnostic Imaging
Swedish University of Agricultural Sciences

SLU

For discussion:

1. Why radiograph the hoof?
2. Basic radiographic principles.
3. Radiographic anatomy of the foot.
4. What are radiographs good for?
5. What are radiographs bad at?
6. When should you move to more advanced imaging?

Why Radiograph the Hoof?

1. To identify the source of lameness.
2. To guide veterinarians and farriers in the prevention of lameness.
3. In a pre-purchase scenario to identify previous and existing disease.

- Radiographic evaluation of the foot does not replace a detailed physical and lameness examination.

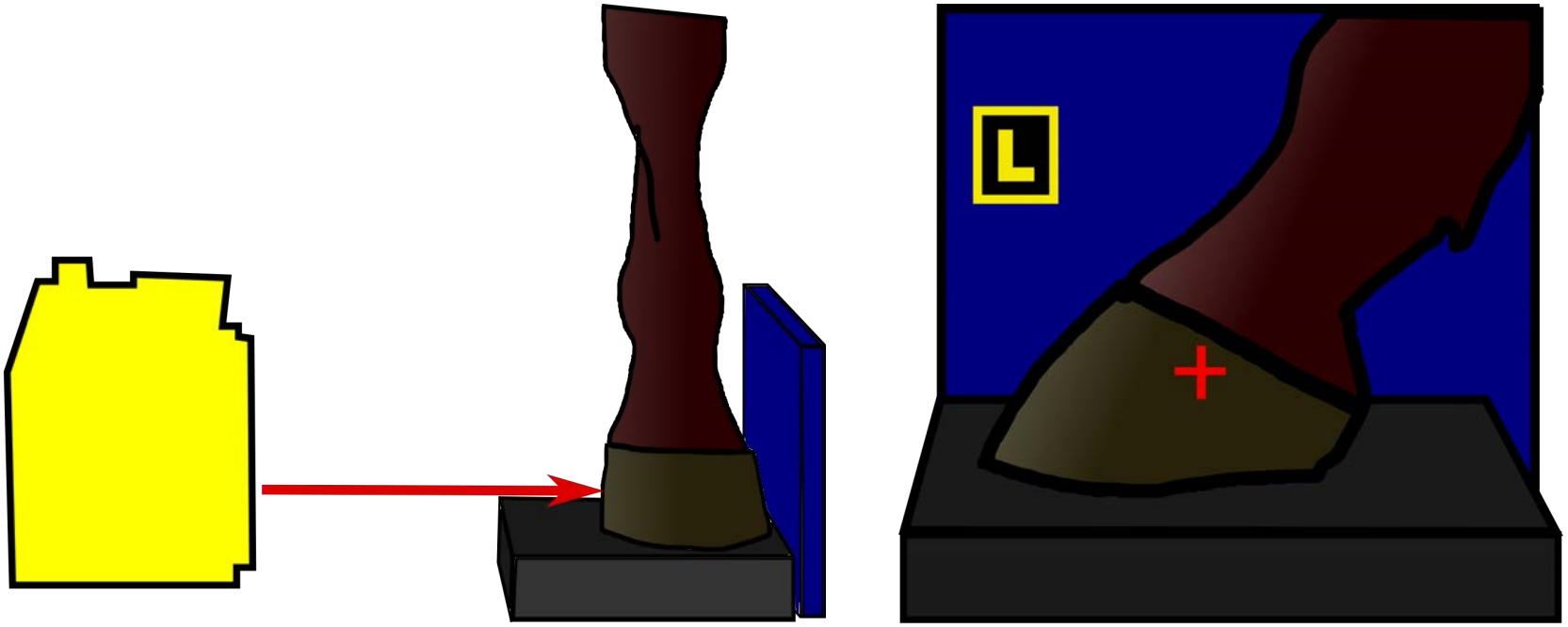
Why Radiograph the Hoof?

- Radiographs are typically considered a ”first line” imaging modality.
  - They are relatively inexpensive – most of the time.
  - They are quick to perform.
  - They can be acquired on-site.

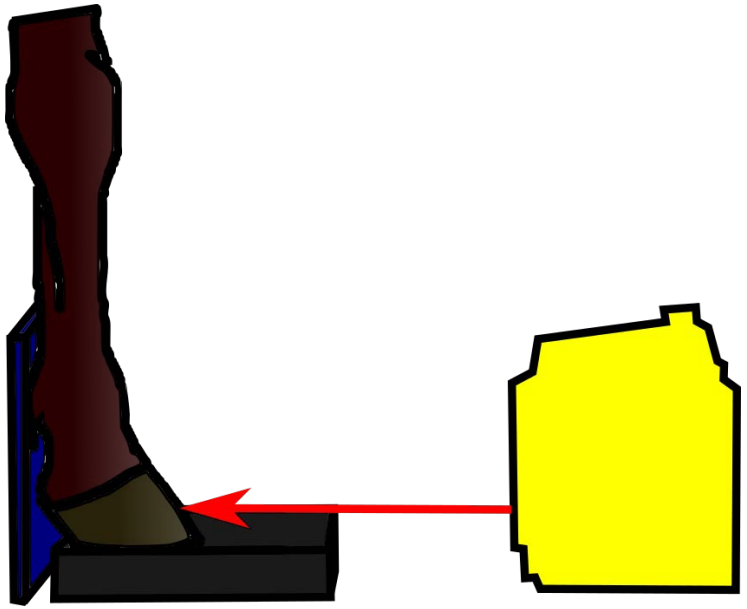
- Radiographs have some of the highest spatial resolution.
  - Physically small findings are more easily identified.

Basic Principles – Preparing the Foot

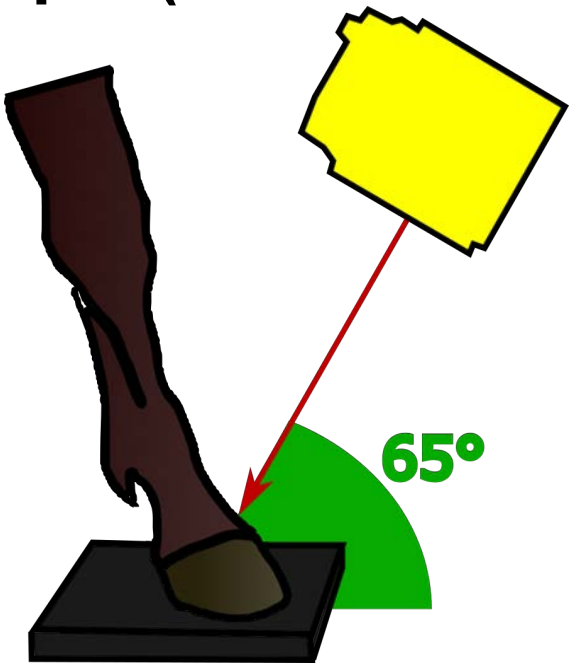
Basic Principles – Lateromedial (LM) Projection

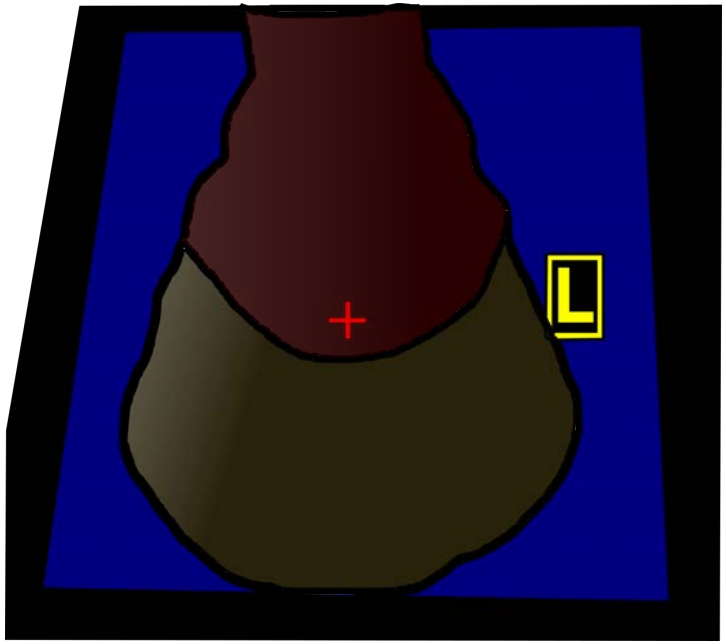


Basic Principles – Dorsopalmar (DPa) Projection

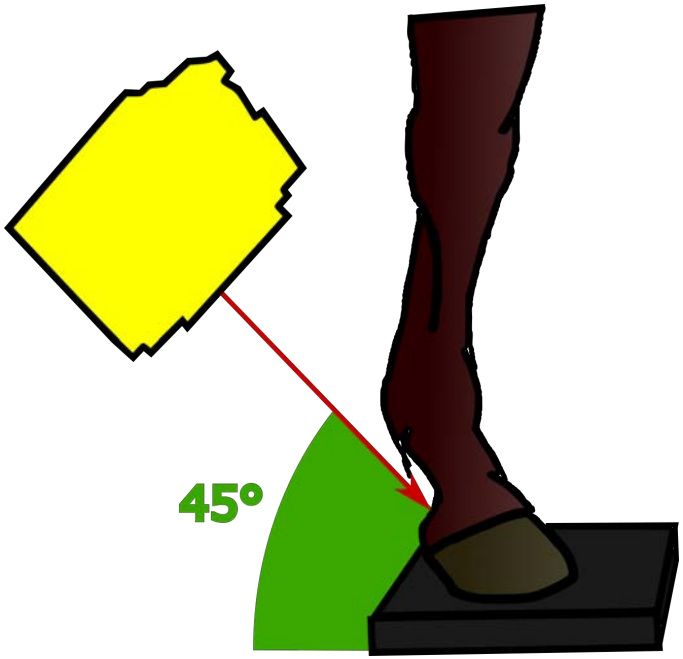


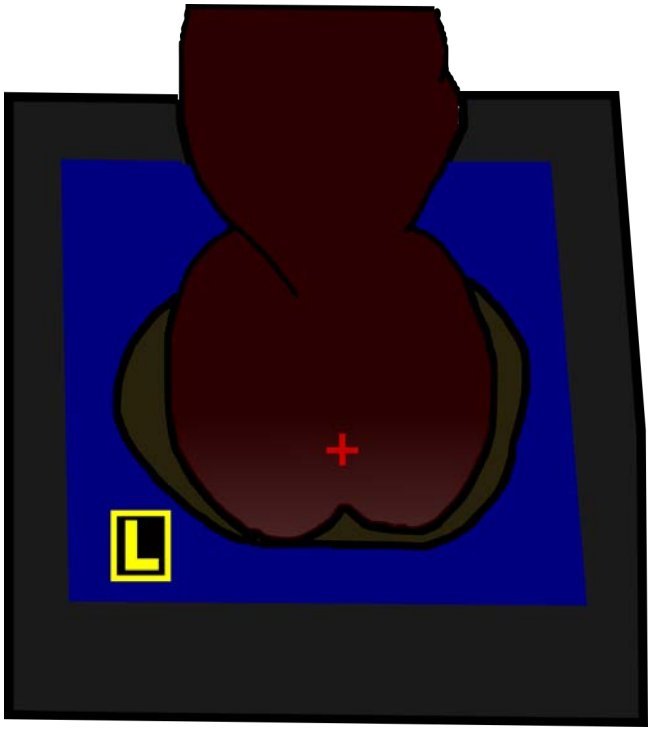
Basic Principles – Dorsoproximal-palmarodistal Oblique (D65Pr-PaDiO) Projection





Basic Principles – Palmaroproximal-palmarodistal Oblique (Pa45Pr-PaDiO) Projection



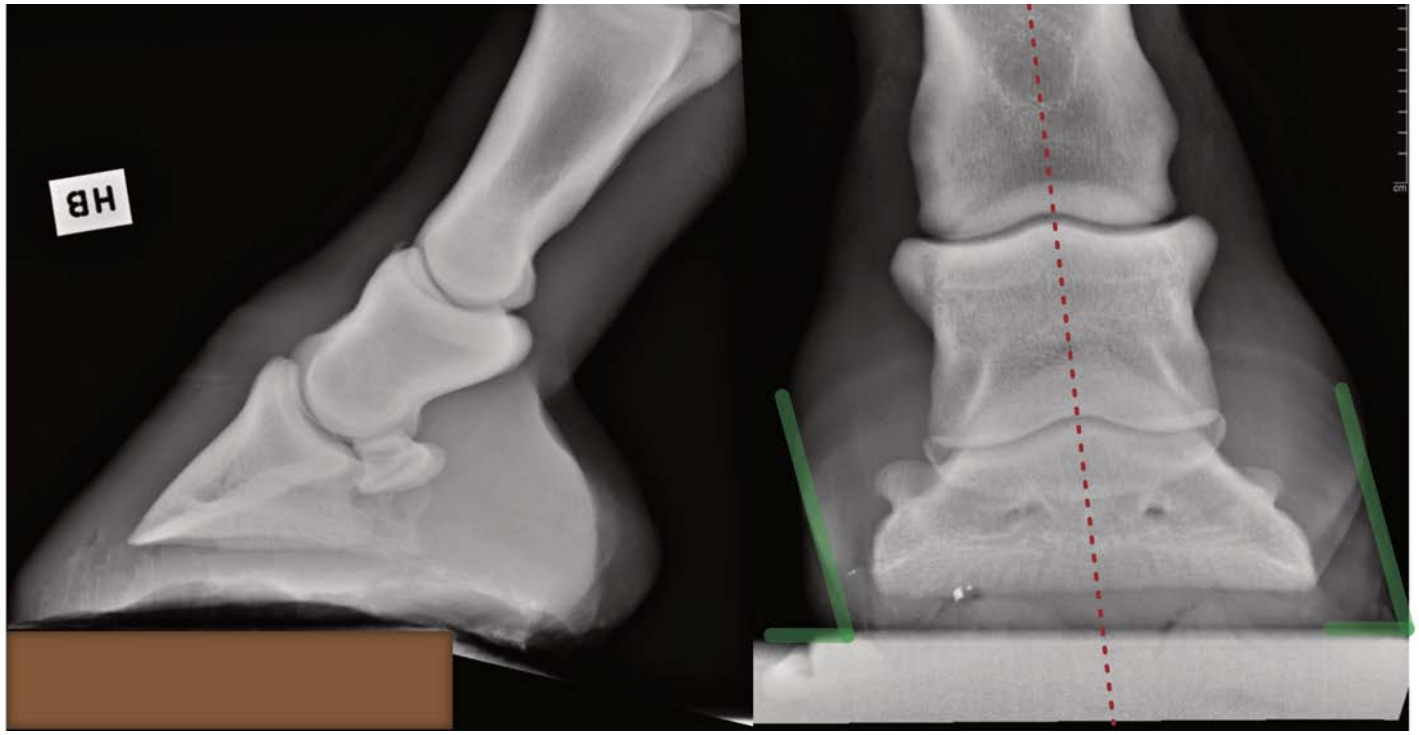


Basic Principles - Markers

Basic Principles – Are Markers Important?

- Bowkett-Pritchard, C. et al. (2025)
  - Markers were associated with **unacceptable repeatability** of measurements.
- Grundman, I. N. M. et al. (2014)
  - *”We were able to see the dorsal hoof wall surface well by adjusting image brightness/contrast.”*
- Sellke, L. et al. (2025)
  - *”Landmark definition is crucial … radio-opaque markers should be used.”*
- Mullard, J. et al. (2020)
  - *“It was considered unnecessary to place a radiodense marker on the dorsal aspect of the hoof wall.”*

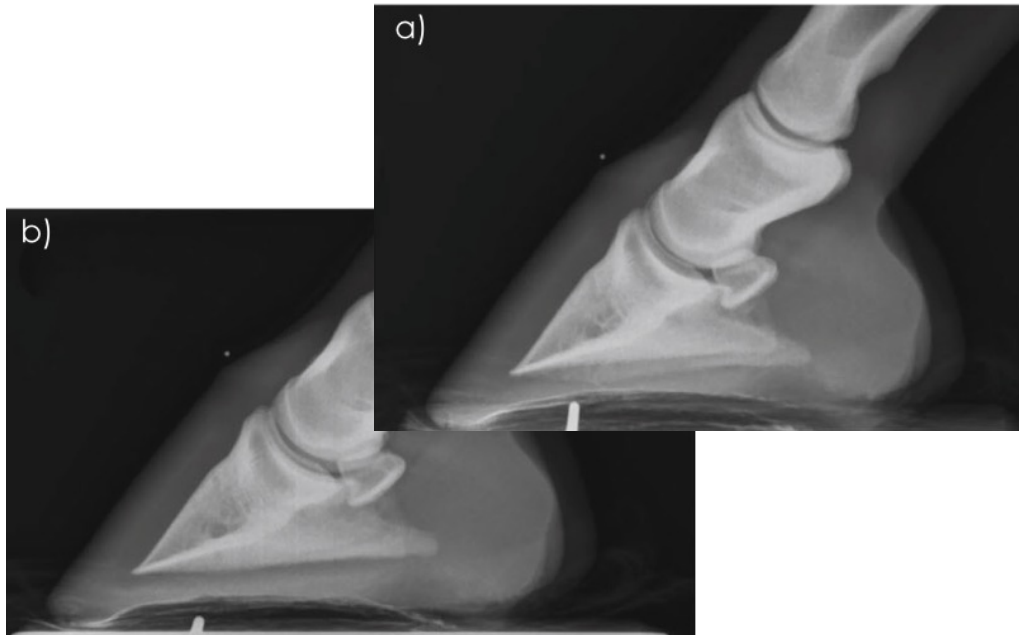
The Importance of Repeatable Technique



The Importance of Repeatable Technique

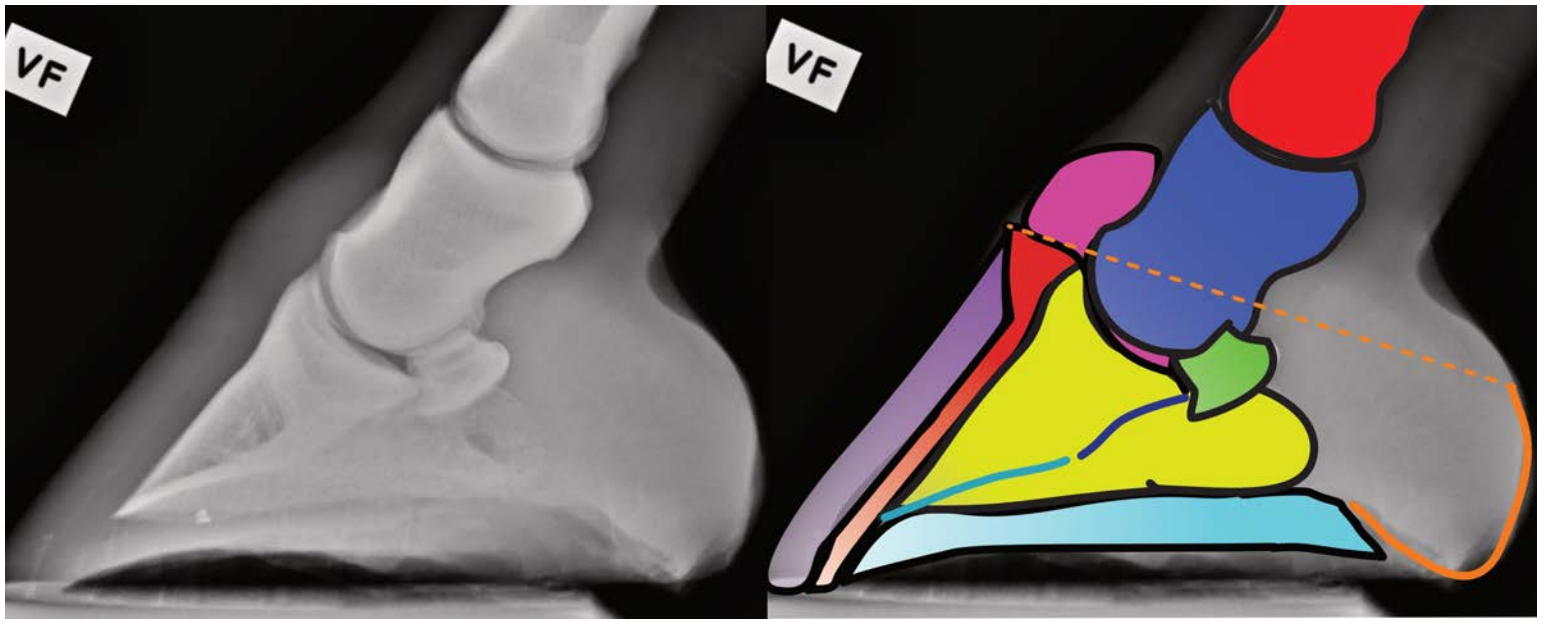
Fig 3: Lateromedial projection with the beam centred at the coronary band (a) and hoof–ground interface (b). Note the lack of superimposition of the palmar processes of the distal phalanx with the beam centred at the coronary band.

- Staples, E. et al. (2022)
  - Positioning of x-ray beam centring.
- Tacchio, G et al. (2002)
  - Rotation of the limb and SID effect measurements.
  - Particularly angles.
- Pauwells, F et al. (2017) & Joostens, Z et al. (2018)
  - Stance affects lateromedial balance.



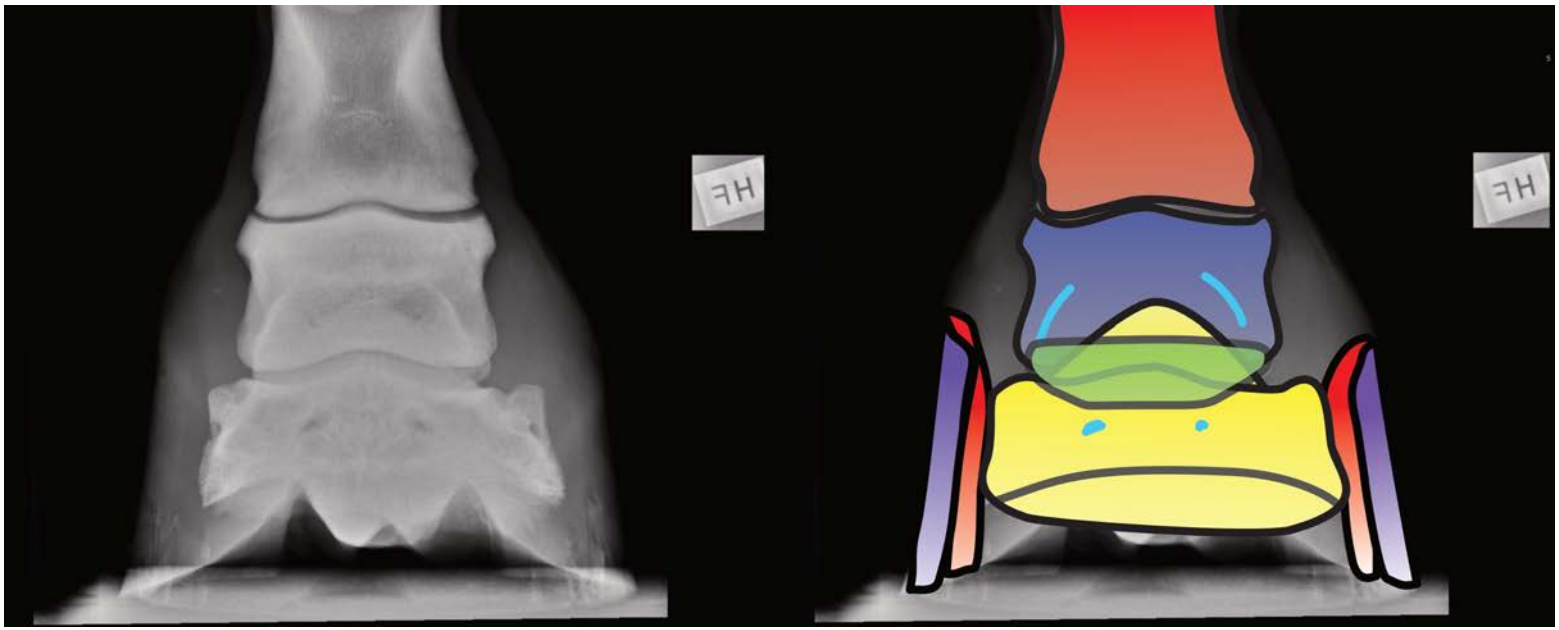
Radiographic Anatomy of the Foot

Lateromedial (LM) projecion



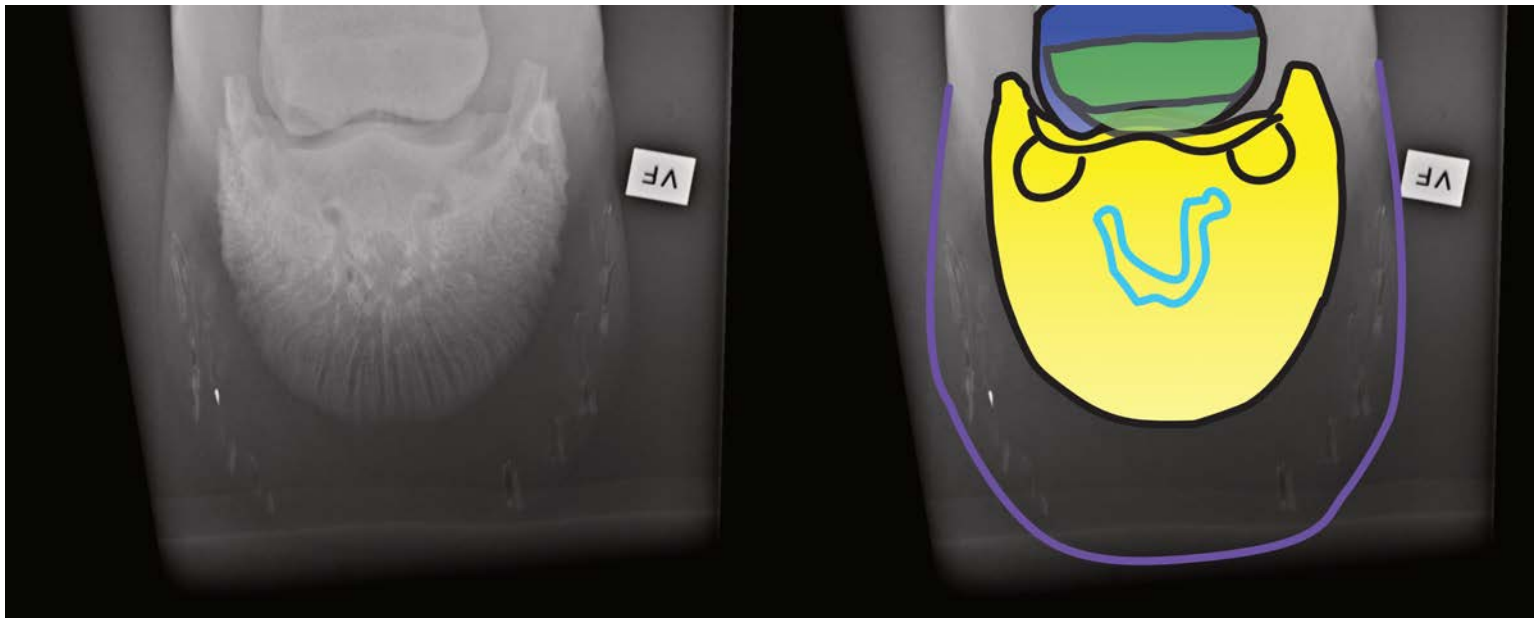
Radiographic Anatomy of the Foot

Dorsopalmar (Dpa) Projection



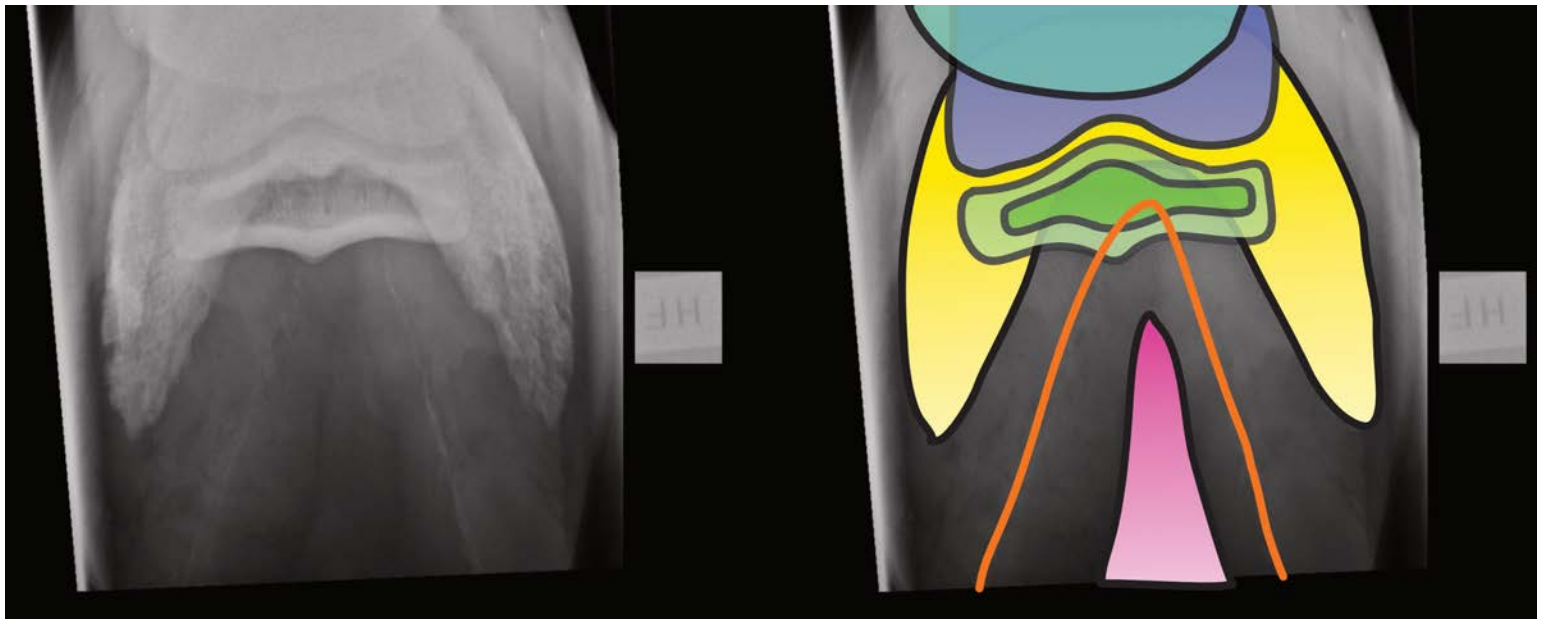
Radiographic Anatomy of the Foot

Dorsoproximal-palmarodistal oblique (DPr-PaDiO) Projection



Radiographic Anatomy of the Foot

Palmaroproximal – palmarodistal oblique (PaPr-PaDiO) Projection

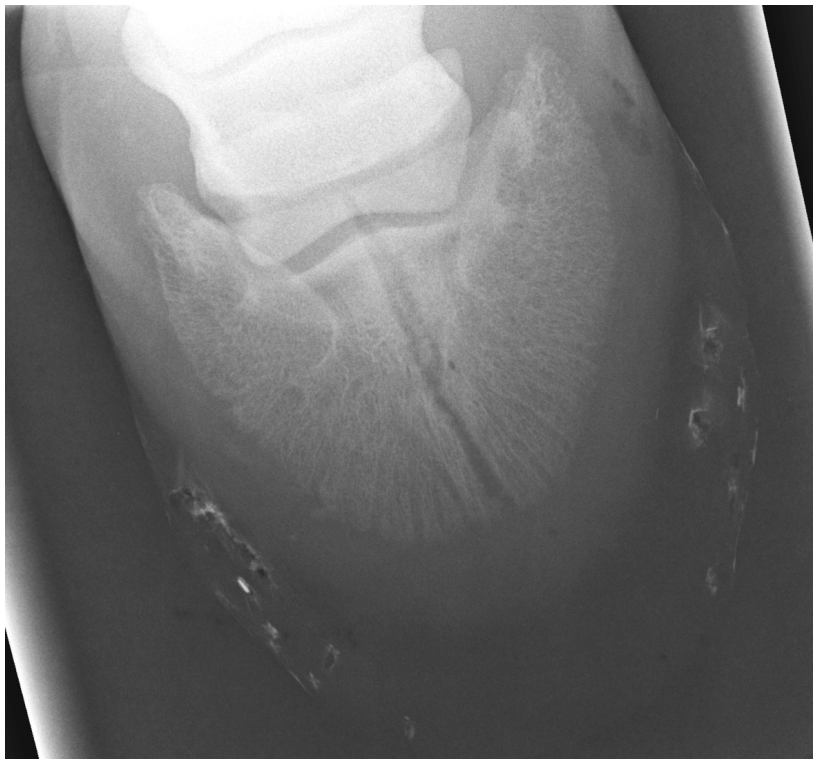


What are Radiographs Good For?

Simple Fractures

- Agreement between Radiographs and CT (Crijns, C.P. et al. 2014):
  - Excellent for identifying the bone involved.
  - Good for identifying: displacement, articular involvement, comminution of the fracture.

- Same sensitivity as MRI for identifying palmar process fractures in foals. (Kaneps, A.J. et al. 1995)



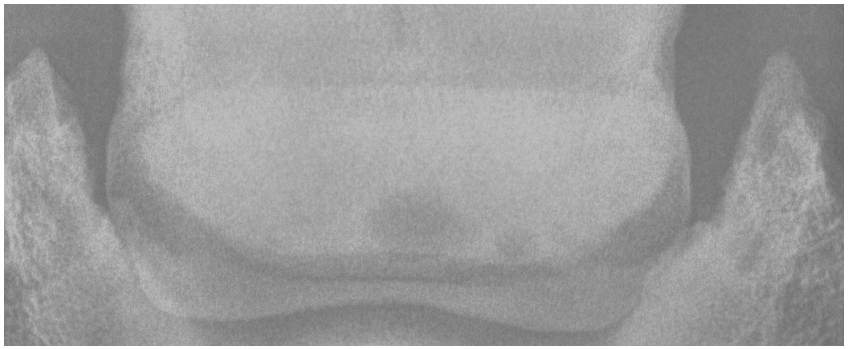
Simple Fractures – Fairburn, A. J. et al. (2022)

Diagnosis of plantar process fractures.

- 82% sensitive
- 100% specific

Osseous Cyst-Like Lesions

- Moderate agreement between radiographs and MRI for the presence of cystic lesions in the distal limb. (Sönnichsen, N., et al. 2023)
- Radiographs were 74% sensitive and 78% specific. (Sönnichsen, N. et al. 2023)
- 90% of all osseous cyst-like lesions involving the distal border of the distal sesamoid bone were identified radiographically (Biggi, M. et al. 2010)



Use of Positive Contrast Radiography to Identify Synovial Involvement – Bryant H. A. (2019)

- High specificity (86%) and moderate sensitivity (59%).
  - A negative result is not reassuring.

- ”Positive contrast radiography should be undertaken in combination with other tests, such as arthocentesis…for the correct diagnosis to be obtained.”

Predicting Soft Tissue Lesions – de Zani, D. et al (2016)

Some evidence that there is mild correlation between:

- Thickened palmar compact bone of the distal sesamoid bone and deep digital flexor tendonitis and collateral sesamoidean desmitis.
- Relative sole thickness, palmar angle were correlated with collateral ligament desmitis.

Preventing lameness? – Clements, P.E. et al. (2020)

- A 1° negative plantar angle was strongly associated with lameness.
  - 43% of cases involved the medial femorotibial joint.
  - 19% of cases involved the tarsometatarsal joint.
  - 13% of cases involved the origin of the suspensory ligament.
- ”Whether hind foot imbalance is the cause or a consequence of the upper hindlimb lameness is unknown.”

What is there conflicting evidence about?

Radiographic Measurements.

- Sellke, L. et al (2020)

Total of:

- 80 distances
- 24 angles
- 34 ratios
- 16 other

In Favour of Measuring Distances from Radiographs

- **No difference** in measurements between radiograph and caliper. (Tachhio, G. et al. 2002, Goulet, C. et al. 2015)

- **Good to excellent reliability** of measurements of mid-dorsal hoof wall thickness and distal phalanx length respectively (Mullard, J. 2020)

- **No difference** between MR and radiography for 13 of 36 measurements of hoof wall thickness. (Grundmann, I. N. M. et al. 2015)

Against Measuring Distances from Radiographs

- **Unaccounted for differences** in distance measured between radiographs and CT. (Sellke et al. 2026)
- **Limited agreement** between radiographic and MRI distances. (Bowkett-Pritchard, C. et al. 2025)
- **Unacceptable interobserver agreement** of nearly all radiographic measurements. (Olijnyk, J. et al. 2025)
- 95% of measurements of the distal phalanx length **vary by up to 1cm**. (Tacchio, G. et al. 2002)

Ratios of Measurements

- ”… the proportion-adjusted lengths were nearly identical to the magnification-corrected (lengths)” (Linford, R. et al. 1993)

- ”Improper to use single parameter for the assessment of balance… (ratios) should be used.” (Tacchio, G. et al. 2002)

Ratios of Measurements

- Excellent agreement and very accurate (95% sensitivity and 95% specificity) for diagnosing acute laminitis. (Skelton, G. et al. 2025)

- Ratios of the hoof wall thickness had excellent interobserver agreement. (Olijnyk, J. et al. 2025)

What are Radiographs Bad at?

Navicular Bone Lesions
– Can we agree on what is important?

- Considerable variation in the classification of navicular lesions between observers. (Groth, A.M. et al. 2009)

- Considerable variation in the level of concern for navicular bone lesions amongst veterinarians. (Esselman, A.M. et al. 2024)

Navicular Bone Lesions – Can we accurately identify lesions?

- More lesions identified on CT. (Claehoudt, S. et al. 2012)
- 40% sensitivity for identification of distal border fragments compared to MRI. (Biggi, M. et al. 2010)
- Increased sensitivity to flexor cortical lesions when multiple PaPr-PaDiO projections used. (Johnson, S. A. et al. 2016)

Complex Fractures - Crijns, C. P. et al. 2014

- CT more commonly identified fractures of the distal limb.

- CT more commonly correctly described fracture orientation and fracture width.

Foreign Bodies - Ogden N.K.E. et al (2020)

- CT more accurately detects foreign bodies than radiography.

- Metallic, glass and slate foreign bodies identifiable on radiographs.

Subchondral Bone Injuries - Lesca, H. et al. (2022)

”advanced imaging modalities such as MRI and CT (are) superior to routine radiography for the diagnosis of subchondral bone injury of the distal limb.”

Soft Tissue Lesions

- Lawson, J. S. et al. (2012)
  - Poor agreement regarding the severity of joint distension for the DIP joint.
- Sampson, S. N. et al. (2008)
  - Multiple soft tissue lesions identified in horses with lameness localised to foot with no radiographic changes.
  - 50% of horses had effusion of the DIPJ.
  - 44% had effusion of the NB.
  - 44% had pathologic change within the DDFT.
  - 33% had pathologic changes within the DSB.

When Should you Move to More Advanced Imaging?

- Persistent lameness that can be localised to the foot but normal radiographs.
- Suspected soft tissue lesion.
- Complex fractures.
- For surgical planning.

`


SLU
SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE