


Equine Acute Injuries: When Imaging is Critical for Success

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Who am I?

- Native Coloradan
- Colorado State DVM 2011
- Mid-Atlantic Equine Medical Center Intern 2011-2012
- OSU Equine Surgery Resident 2012-2015
- ACVS 2016
- ACVECC 2017
- OSU faculty since 2015-current (now Associate Professor)
- Clinical Skills Educator 2023-current



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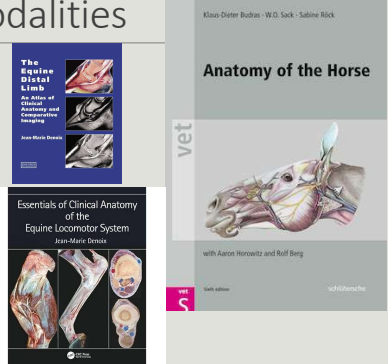
Many common acute injuries we see on emergency



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Diagnostic Imaging Modalities

- Eyes!
 - Good knowledge of anatomy
 - Don't be afraid to look it up!
- Radiographs
- CT
- Ultrasound
- MRI
- Nuclear Scintigraphy
- Endoscopy



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Radiographs

X-rays produced in a generator is directed towards a detector (the plate)
 Digital radiography (computed or flat-panel detectors) has replaced screen-film radiography

Attenuation of x-ray energy by differing body tissues results in the diagnostic image on the detector

Energy of x-rays (Peak kilovoltage or KVP) and number of x-rays (proportional to milliampere-second or mAs) can be manipulated by the image acquirer

Pros

- First line imaging test
- Can be performed on-farm
- Most images can be acquired in the standing horse
- Relatively low cost

Cons

- 2-dimensional imaging can make areas with complex anatomy difficult to interpret
- Inherent danger to image acquirers
- Thicker regions require specialized equipment (stronger generators)
- Foreign bodies must be metallic to visualize

From Threll, 2018 pg 111

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When do I radiograph an acute distal limb injury?

- Lame
- Suspect instability
- Critical structures present deep to wound
- Exposed bone
- Contrast radiography for synovial involvement

Image from: De Panafieu, J. B. (2007). *Evolution*. Seven Stories Press.

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Computed Tomography (CT)

Standing or general

Also uses tissue differences in x-ray attenuation for image acquisition

Three-dimensional imaging achieved by taking circumferential sections of an anatomical area of interest termed a "slice"

- Better contrast resolution than radiographs
- Compromised spatial resolution versus radiographs

From Manso-Diaz et al, 2021

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Ultrasound

- Piezoelectric crystals generate high-frequency sound waves when electrically stimulated
- Sound waves penetrate tissue and reflect back to the transducer, with absorption of sound by some substances, e.g. bone
- Sound wave interaction is tissue-dependent "acoustic impedance"


From Blaivas et Adhikari, 2019

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In field vs. in hospital: transducer



Curvilinear Transducer
[2-6.4 MHz], 30 cm depth
Transabdominal cattle, horses, small ruminants, camelids, large dogs



High-frequency linear transducer
[6-14 MHz], 10 cm depth
Equine tendons, small animal abdomen, neurovascular applications




Linear transducer
[5-8 MHz], 18 cm depth
Bovine and equine reproduction, tendons

To optimize image quality:

- Use the highest frequency transducer that penetrates to the area of interest
- Focus in middle of area of interest
- Use appropriate contact media
- Clip?
- Use the smallest depth of field on the display screen

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Ultrasound



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Magnetic Resonance Imaging (MRI)

Signals are generated from relaxation of hydrogen protons subjected to a strong magnetic field and excited by a radiofrequency pulse

T1 relaxation: release of energy from protons into surrounding molecular environment
 T2 relaxation: energy transfer between protons
 T2* decay: energy loss due to heterogeneity within magnetic field (increased in areas with hemorrhage or metal)

Descriptions adapted from Pease and Nelson, 2019

CT vs MRI

CT

- Superior resolution of osseous structures
- Faster
- Usually cheaper

MRI

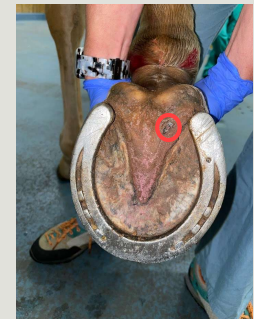
- Superior resolution of soft-tissue structures
- Able to detect fluid within bone

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Case 1: Max

6-year old Barrel horse gelding

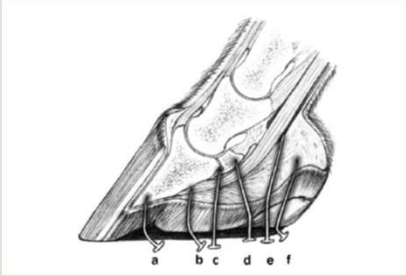
- Sound when he was turned out to pasture
- Non-weight bearing lame 1 hour later right hind



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GA1

Critical structures of the hoof

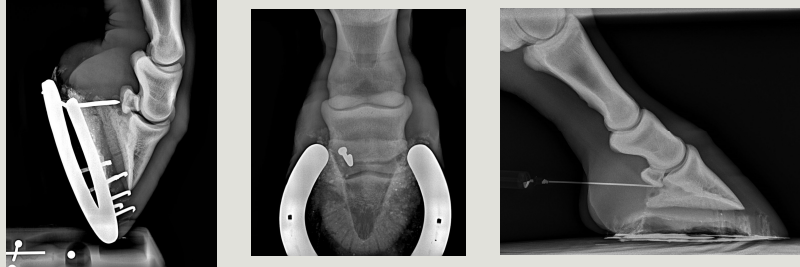


a: distal phalanx of the toe
 b: insertion of the DDFT
 c: DDFT/navicular/distal interphalangeal joint
 d: DDFT/navicular/navicular bursa
 e: hoof cushion/DDFT/flexor tendon sheath
 f: hoof cushion

From: Furst and Lischer, in Auer and Stick 2019

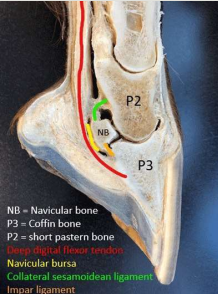
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Radiograph



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Surgical Procedure and Outcome



NB = Navicular bone
 P3 = Coffin bone
 P2 = short pastern bone
 DDFT = deep digital flexor tendon
 Navicular bursa
 Collateral sesamoidean ligament
 Impar ligament

<https://vetmed.illinois.edu/2020/09/11/navicular-syndrome/>

Navicular bursoscopy and lavage

- Immediately comfortable on recovery from anesthesia

Parenteral antibiotics and monitoring in-hospital

- Stayed comfortable

Rapid identification of critical structure allowed for rapid return to work

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Case 2: Harvey



14 year old TWH gelding

- Sustained laceration sometime during the night before
- Otherwise healthy

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Initial Plan




24 hours packed with 7.2% saline soaked 4x4's

*not Harvey

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Sequestrum development

- Loss of periosteum causes death of 1/3 superficial cortex
- Not radiographically apparent for 2-4 weeks after injury
- Associated with lameness/sensitivity to palpation
- Radiographic signs of sequestrum:
 - cloaca
 - involucrum
 - sequestrum



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Case History and Initial Outcome


Sequestrectomy
 Bandaging and stall rest until wound healed
 Slow return to work

*video courtesy Dr. Sushmitha Durgam

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Case 3: Livy

Did you know? 

3 month old Knabstrupper filly 

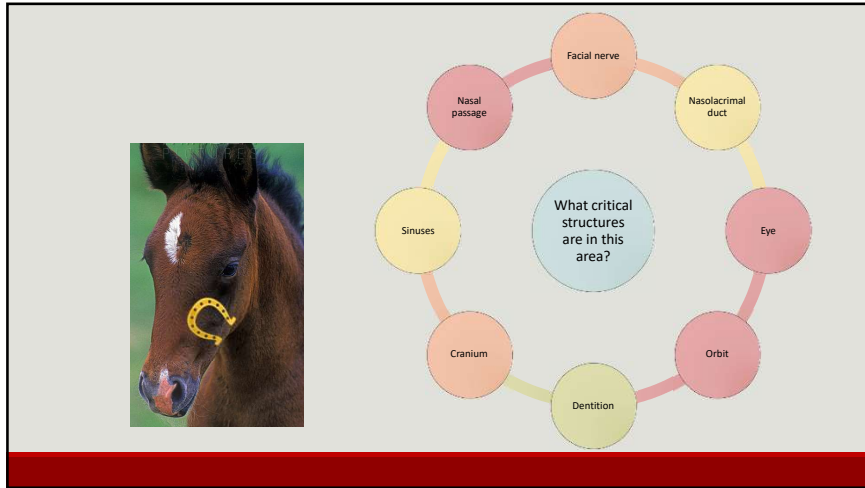
Spotted horses were bred for Danish nobility dating back to the 17th century

The original "Tiger horses" were lost, but the Knabstrupper breed was created based on a quality mare called Flaebe in 1812

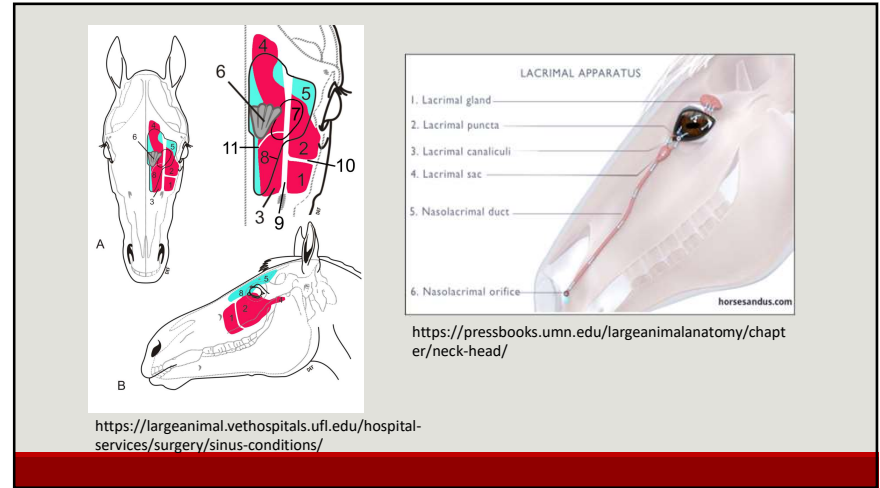
Good performance is required for the breed over color characteristics

*not Livy

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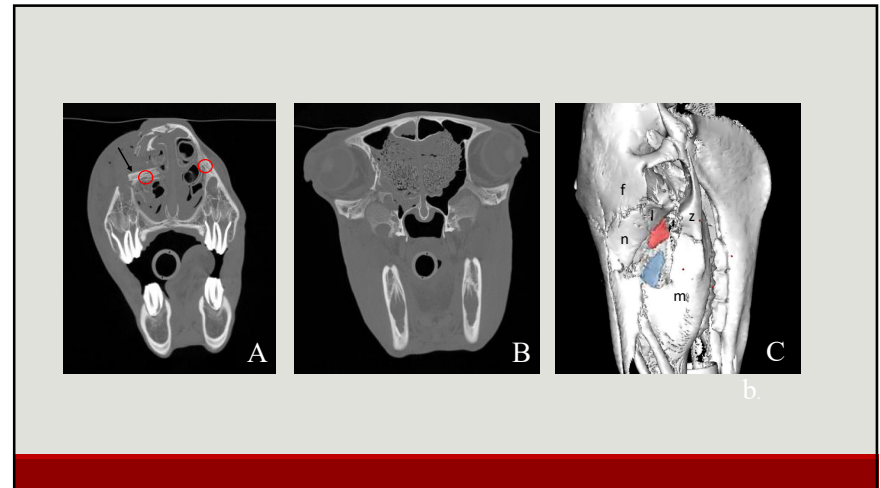
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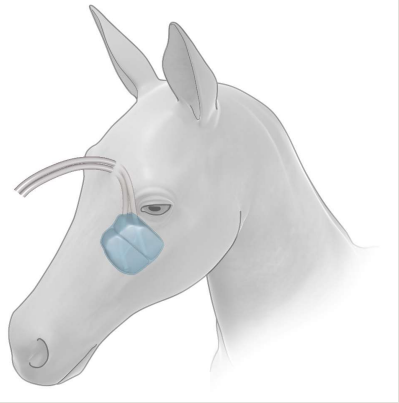
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Case Report WILEY

Intranasal bolus of traumatic maxillary sinus fractures by using Foley catheter balloons in two foals


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Veterinary Surgery, 2020;49:1215-1261



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Outcome




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Case 4: Ladybug

16 year old Quarter Horse


- Presented for draining tract along right maxillary bone several months duration



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Ultrasound: Utility

- Difficult modality to use in acute wounds due to presence of gas
- Good for non-opaque foreign bodies
- Ultrasound > Radiographs for evaluating pneumothorax in chest wounds



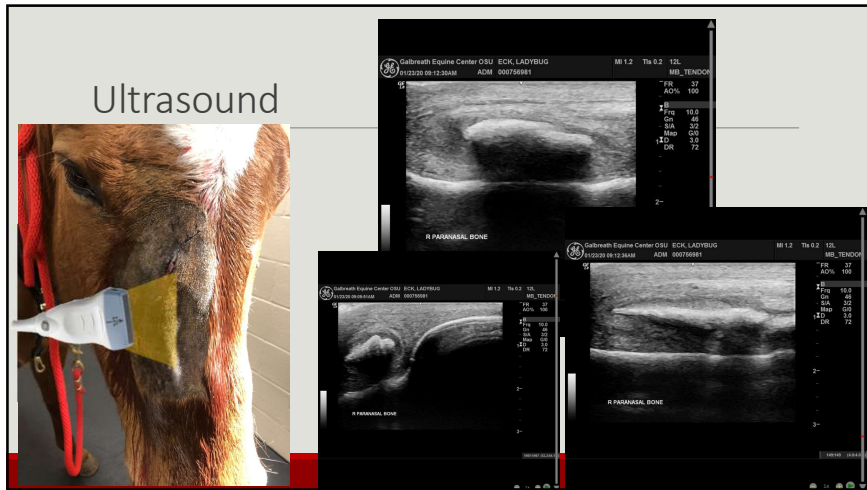
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Recheck

Medications

- Exceed (Ceftiofur Crystalline Free Acid) 15ml (3 grams) intramuscularly was administered at the time of foreign body removal

Exercise Restriction

Ladybug should be kept in a stall until Monday 1/27/2020 after her drain is removed. She may return to regular turnout and exercise after drain removal.

Monitoring


Please watch for difficulty breathing or eating. Also, please monitor for signs of infection (increased drainage from the wound, heat, and increased pain), facial rubbing, suture break down, and drain displacement. Vetwrap has been placed around Ladybug's halter to protect it from irritation of her drain and incision sites.

Drain care

Please continue to monitor Ladybug's drain. Should the drain dislodge before removal on Monday there is no need to have it replaced. Vaseline has been placed under the incision on Ladybug's face to help keep wound drainage from causing skin irritation.

Suture Removal


Please have Dr. X remove the proximal site sutures 12-14 days after discharge (Feb 4-6) and recheck the wound.



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Case 5: Moon

- Case courtesy of Dr. Sushmitha Durgam
- 18 yo Appaloosa gelding
- Originally sustained laceration to the cranial aspect of right hind coronary band
- Wood foreign body removed from wound
- Received joint lavage and IV antibiotics after coffin joint confirmed involved. Discharged sound
- Lameness recurred 3 weeks later, became non-weightbearing
- Coffin joint arthrocentesis on representation readily communicated with wound

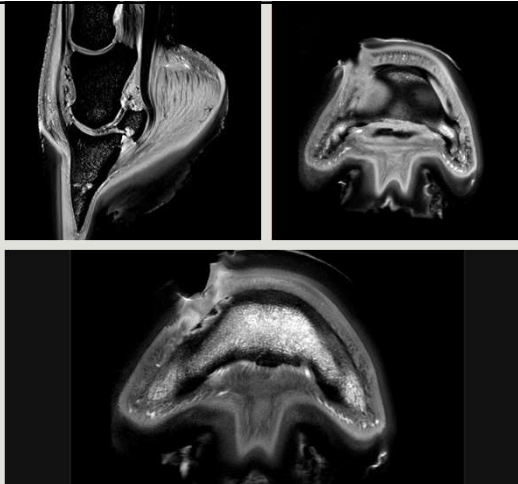


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Moon Imaging

Diagnostic Findings and Procedures:
Magnetic resonance imaging (MRI) of the right hind foot was pursued on 1/4/2021. A brief summary of the findings include, moderate amounts of fibrin accumulation was present in the dorsal and plantar pouches of the coffin joint, injury to the lateral collateral ligament of the coffin joint and, a bony sequestrum to the dorsal lateral aspect of P3 were noted.

Given these findings, arthroscopic lavage of the right hind coffin joint was repeated on 1/4/21. At surgery, there was marked fibrin accumulation within the dorsal and plantar pouches. The fibrin was removed, the wound was debrided, and the joint was lavaged thoroughly. The hoof wall was resected further and the sequestrum was removed and the underlying P3 was debrided. Postoperatively, Moon was managed with amikacin and ceftazidime regional limb perfusions and systemic penicillin and gentamicin for 7 days. Then, Moon was transitioned to chloramphenicol.



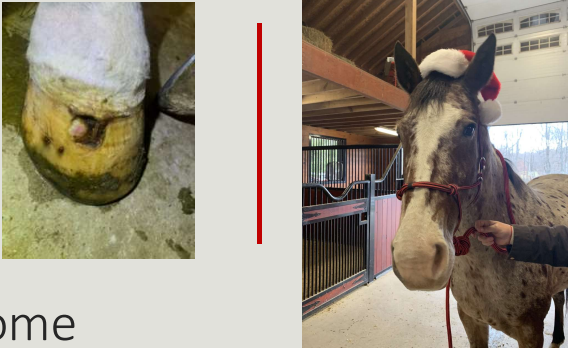
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Surgical Procedure

ARTHROSCOPY AND FURTHER HOOF WALL RESECTION

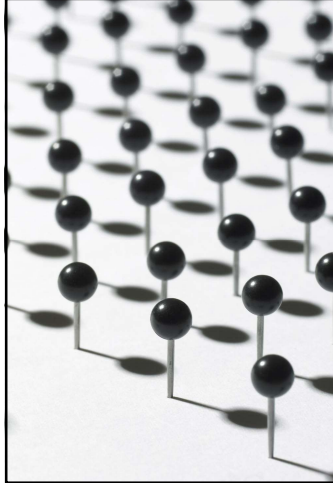


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Outcome

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Questions?
Remember to **download the CE certificate** in the handouts panel of the webinar control panel.
NOTE: CE certificate not available for watching the recording.

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