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BEVA Congress 2015
9th-12th September, Liverpool, UK

www.pferdeklinik-aschheim.de
MRI of Equine Stifle Injuries:

– A Review of the first 100 clinical cases –

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Declaration

- No sources of funding
- No conflict of interest
- No any other conflicts
Purpose of this talk

• Describe a routine technique for equine stifle MRI

• Report on pathologic MRI-Findings

• Compare MRI-Findings to traditional diagnostics

• Outline therapeutic consequences based on MRI
INTRODUCTION
Introduction – Anatomy

• Equine stifle diseases are common
  – Complex joint – bone and soft tissue pathology
Introduction – *Diagnostics*

- Traditional diagnostics
  - Radiographs\(^1\)
  - Ultrasonography\(^2\)
  - Scintigraphy\(^1\), CT\(^3\)
  - Diagnostic arthroscopy\(^2\)

- ... Despite that – exact diagnosis can be frustrating ...

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Introduction – *Diagnostics*
Introduction

• Problem
  – Frequently, problem was localized by intraarticular block
  – But negative on current imaging techniques ...

• Current solution
  – Arthroscopic exploration as „Gold Standard“ ....
Introduction

• However ..... Arthroscopy was also fruitless ..... 
  – So what now ...?
  – *No diagnosis – Which treatment ...? What’s the prognosis?*

• Current solution
  – Human medicine = MRI
  – Equine surgery = mainly arthroscopy\(^1\)

  – Equine Hospital Aschheim = MRI\(^2-5\)

\(^1\)Barrett B, EVJ 2012; \(^2\)Waselau M, ECVS 2014; \(^3\)Waselau M, ACVS 2014; \(^4\)Waselau M, Equitana 2015; \(^5\)Waselau M, ECVS 2015
Introduction

- Equine Hospital Aschheim – Equine Diagnostic Center Munich
  - Munich, Germany
  - MRI-Scans since 2011
  - Head, +/- Neck
  - Distal foot
  - Carpi, shoulder
  - Tarsi and stifles ...
MATERIALS & METHODS
MRI – *Technique*

*Custom-made MRI-Table with rotating MRI-Scanner*
MRI – Examination

GA, dorsal recumbency, rotating MRI-Scanner
MRI – Scanning Protocol

• MRI – Sequences „Equine Hospital Aschheim“
  – T1 (1mm) = Cartilage, subchondral bone
  – T2 (4mm) = Ligament, tendons, menisci
  – PD (4mm) = Ligament, tendons, menisci, cartilage
  – SHARC (1,3mm) = Cartilage
  – STIR (4mm) = Bone
  – X-Bone (4mm) = Subchondral bone

• 3 planes
  – Frontal, sagittal and axial; T1 / SHARC 3D-Rekonstruktion
MRI – Scanning Protocol

• MRI – Sequences „Equine Hospital Aschheim“
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• 3 planes
  – Frontal, sagittal and axial; T1 / SHARC 3D-Rekonstruktion
MRI – 3 planes

STIR – Sagittal
PD - Axial
T1 - Dorsal
MRI – Review of Images

• **MRI – Scans were reviewed by**
  – Diplomate ACVR and/or
  – Diplomate ACVS

• **MRI findings retrospectively compared to**
  – Ultrasonography, radiographs
  – +/- A-Copy
MRI – What horses were scanned?

- Inclusion criteria
  - Lameness was localized to stifle joint
  - Negative on ultrasonography and/or
  - Negative on radiographs and/or
  - A-Copy
MRI – *What parameters recorded?*

- **General parameters**
  - Age, breed, gender, anesthesia time
  -Saved in medical records

- **Pathology**
  - Bone pathology
  - Soft tissue pathology (menisci, cruciates and cartilage)
  - Concurrent lesions
MRI – *Classification of parameters*

- **Pathology – classification**
  - Meniscopathy  ➔ Tear / Degeneration
  - Cruciate ligaments  ➔ Tear / Degeneration
  - Chondropathy  ➔ Erosion
  - Concurrent lesions  ➔ Frequency
RESULTS
Results – General parameters

• Patients
  – Number: 100 horses
  – Age: 10.8 years (1-27)
  – Gender: 37% Mares, 50% Geldings, 13% Stallions
  – Breeds: different breeds – representative hospital popul.
  – Bilateral stifle scans: 5%

• Anesthesia time
  – 65min (40-87min)
Results – **Overview on Pathology**

- **Bone lesions**
  - Bone edema/bruises
  - Fissures
  - (Subchondral) bone cysts

- **Soft tissue lesions**
  - Synovitis / Fibrinous adhesions
  - Articular cartilage defects
  - Cruciate / collateral / mensicotibial desmitis
  - Meniscal tears / degenerations
BONE
PATHOLOGY
MRI – Bone Edema

STIR

STIR

STIR
MRI – Bone Fissures

T1

STIR

T1
MRI – Bone Fissures
MRI – **Tibial Cysts**

**T1**

**STIR**

**STIR**
MRI – Femoral Condyle Cysts
MRI – *Femoral Condyle Cysts*
SOFT TISSUE PATHOLOGY
MRT – CRUCIATE DESMOPATHIES
MRI – Normal Cranial Cruciate

PD – sagittal
MRI – Cranial Cruciate Desmopathy

- Degeneration & Tear
- Tear
- Partial Tear
- Degeneration
MRI – Normal Caudal Cruciate
MRI – *Caudal Cruciate Desmopathy*
MRI – CHONDROPATHIES
MRI – Normal Cartilage
MRI – *Cartilage Defects*

Multiple cartilage defects, Subchondral sclerosis and remodelling
MRI – MENISCOPATHIES
MRI – Normal Menisci

PD – Signal Intensity
MRI – Meniscopathy

Tear

Tear

Tear lateral menisci
Results – Meniscopathies

• Incidence
  – 95%

• Location
  – 47% medial
  – 45% lateral
  – 19.5% medial and lateral
Results – Meniscopathies

• Medial
  – Tears = 58%
  – Degenerations = 39%

• Lateral
  – Tears = 14%
  – Degenerations = 86%

• Medial & lateral
  – Tears = 7%
  – Degenerations = 13%
Results – *Concurrent Pathology*

- **Menisco- and Cruciate Desmopathy** = 43%
  - Medial meniscopathy
    - = 47% *Cranial Cruciate Desmopathy*
    - = 31% *Caudal Cruciate Desmopathy*
  - Lateral meniscopathy
    - = 51% *Cranial Cruciate Desmopathy*
    - = 29% *Caudal Cruciate Desmopathy*
Results – Concurrent Pathology

• Menisco- and Chondropathy = 66%
  – Medial femoral condyle > lateral femoral condyle
  – Femoral chondropathy >>> tibia >> patella
Results – *Retrospective evaluation of*

- **Radiographs**
  - Bone edema not / Fissure unreliably detected
  - Rads = 50% change in bone density ...

- **Ultrasonography, A-Copy**
  - Incidence and extent of menisco-, cruciate ligament desmo- and chondropathy were underestimated
Results – *MRI and treatment*

- **Conservative Therapy**
  - 61% of all lesions surgically inaccessible
  - I.A. & system. Medication

- Mild-moderate
  - Orthobiologics >>>>> Anti-inflammatories
  - Orthobiologics (PRP >>> stem cells; Pentosansulphate; PSGAG etc.)

- Severe
  - Anti-inflammatory >> Orthobiologics
  - Bisphosphonates (TILDREN®)
Results – *MRI and treatment*

- **Surgical – A-Copy**
  - 39% of all lesions surgically accessible
  - Surgical revision & lavage
  - Concurrent I.A. / I.L. orthobiologics
    - PRP >> stem cells
  - Superficial menisco- & cruciate pathology confirmed
  - Meniscus degeneration and extent of cruciate desmopathy unreliably confirmed
Results – MRI based A-Copy
Results – MRI based A-Copy

Waselau, M. Arthroscopic exploration of the equine stifle – advantages and limitations in respect to MRI-findings. The 7th Edition of MRI in Veterinary Medicine, Tuscany, November 2014;
Waselau, M. Magnetic resonance Imaging of meniscal, cruciate ligament and cartilage pathology - 76 clinical cases. ECVS, Berlin, July 2015
Results – MRI and Rehabilitation

Rehabilitation in counter-current swimming pool
DISCUSSION
Discussion – **Technique**

• **Scanning procedure**
  – Straight forward and save protocol
  – Can be routinely performed on all horses independent on age, breed and gender

• **Bone structures and soft tissue pathology**
  – Completely/torously portrayed
  – Higher sensitivity than traditional imaging modalities
  – Similar to reports from human literature\(^1\)

\(^1\)Hayashi D. *Curr Rheumatol Rep*. 2014 Jan;16(1):391
Discussion – Pathology

• Location
  – Central, submeniscal, plantar, extraarticular ...
  – Intrastructural, insertional desmopathies etc.

• Relevance
  – Poorly detectable on traditional imaging
  – Frequently inaccessible and complex pathology
  – May explain overall low therapeutic success rates in past
Discussion – Pathology

• Bone pathology – acute lesions ...
  – Bone bruises >>> other pathology
  – Acute pain – i.a. anesthesia less specific ...
  – Different pathophysiology ...?

• Soft tissue pathology – chronic lesions ...
  – Wide variety
  – Complex pathology

1Hayashi D. Curr Rheumato1 Rep. 2014 Jan;16(1):391
Discussion – *Soft tissue pathology*

• **Meniscopathy** – higher than previously reported
  – Medial = tear ...; Lateral = degeneration ...
  – Complex joint biomechanics ? -> *ex vivo* studies ...

• **Cruciates** – Cranial desmopathy higher than caudal
  – Similar in humans\(^1\)
  – Complex joint biomechanics ? -> *ex vivo* studies ...

\(^1\) Sri-Ram *K. Bone Joint J.* 2013 Jan;95-B(1):59-64
Discussion – *Concurrent pathology*

- Concurrent pathology – high
  - Menisco-, cruciate desmo- and chondropathy
  - Similar to reports in other species\(^1\)
    - May reflect chronicity of pathology
    - May reflect complex joint biomechanics?
    - \(\rightarrow\) requires *ex vivo* studies ...

- Indication for a „Snowball effect“ ... ?

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\(^1\) *Hulse D. Vet Surg. 2010 Apr;39(3):350-4*
Discussion – *Concurrent pathology*

- Repetative Trauma
- Cartilage Damage
- Bone Edema
- Meniscal lesions / cruciate stress
- Pain and Inflammation
- Abnormal weight bearing

„*Snowball Effect?*“
Discussion – MRI and Tx

• > 50% of lesions inaccessible → conservative Tx ...
  – May explain frustrating A-Copy results in the past
  – A-Copy avoided = change in Tx

• < than 50% of lesions accessible → A-Copy
  – Modified surgical approach = influence on Tx
Discussion – *MRI and Costs*

**Advantages**
- More detailed and global view on stifle pathology
- „Hit 5 birds with one stone“

**Financial considerations**
- Information gained within 60min less expensive than months of diagnostic therapy
- Diagnosed-based treatment
Conclusion – *Stifle MRI* ...

(1) save & routine for all horses

(2) deliniated all bone and soft tissue pathology

(3) confirmed co-existence of pathology

(4) revealed that soft tissue pathology is highly underestimated
Conclusion – *Stifle MRI* ...

(5) has a prognostic value

(6) is an excellent pre-OP diagnostic tool

(7) influenced / changed treatment

(5) may develop in „Gold Standard“ for diagnosis
Finally – *Some practical aspects* ...

- **I.A. Anesthesia**
  - 60% improvement considered positive ...
  - +/- dorsal pouches blocked
  - ... Plantar lesions? Bone edema?

- **A-Copy**
  - Positive = suspect concurrent lesions ...
  - Negativ = consider MRI for further evaluation
    = Three Counties Equine Hospital

- **MRI + A-Copy** =
  - Global view on stifle pathology
  - May be „Goldstandard“ for Dx & Tx
Questions and/or suggestions?

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