Subchondral Bone Injury in the Equine Fetlock

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Fetlock Joint
- Heavily loaded, high-motion joint
- Risk of injury in all performance horses, especially horses performing at max speeds
- Hyperextension
  - Proximal dorsal P1 compresses dorsal MC/MT III
  - High compressive forces distal palmar/plantar MC/MT III
  - Tension & bending forces on PSBs

Repetitive Cyclic Stress
- Sub-maximal loads
- Stress = Magnitude x Frequency

Training the Skeletal System
- Adaptive training with skeletal modeling and remodeling
- 36 cycles/day required to train bone
  - Too many miles can be damaging
- Limit on rate of repair of bone
  - Overtraining can overwhelm system
- Wolff's Law
  - Bone is laid down where strength is needed and removed where strength is unnecessary

Pathophysiology
- Trabecular thickening & sclerosis
- Ischemic injury to osteocytes
- Osteocyte necrosis & microfractures in subchondral bone
- Collapse of subchondral plate
- Cartilage degeneration
- Failure occurs in absence of adequate repair
Osseous / Osteochondral Injury

- Subchondral bone injury (SBI)
- Cumulative stress induced bone injury (CSBI)
- Maladaptive repetitive osseous stress syndrome (MROSS)
- Distal cannon bone bruising
- Palmar/plantar osteochondral disease (POD)

Subchondral Bone Injury

- Distal palmar/plantar MC/MT III
  - Linear or crescent-shaped lucencies
- Central weight-bearing areas of proximal P1

- Racehorses: Repetitive overloading
- Non-racehorses: Single overload injury

Clinical signs

**Racehorses**
- Poor performance
- Variable lameness
  - Often more than 1 limb affected
- Short, choppy gaits
- Joint effusion, heat, positive response to flexion often absent or very subtle

**Sport Horses**
- Variable lameness
- Joint effusion, heat, positive response to flexion may be present

3 year old Thoroughbred filly

Courtesy: Dr. Elizabeth Davidson
3 year old Thoroughbred filly

LH plantar metatarsal block

Diagnosis
- Diagnostic analgesia
- Radiography
- Advanced imaging
- Arthroscopy

Diagnostic Analgesia
- Intra-articular analgesia **inconsistent**
- Metacarpal/metatarsal nerve blocks
- +/- Low-4 point
- +/- High-4 point

Radiography
- Minimum set includes: DP, flexed DP, lateral, flexed lateral, obliques (+/- 25-30° down-angle obliques)
  - Often unremarkable
**Oblique Views**

**Nuclear Scintigraphy**
- Increased sensitivity
- DP, lateral, & flexed lateral images

**3 year old TB with SBI**

**Normal 2 year old TB**

**MRI Findings**
- Low signal intensity in condyles on T1- and T2-weight images
  - Chronic, sclerotic bone
- Often focal high signal intensity within this area on STIR sequences
  - Bone edema, necrosis, hemorrhage, granulation tissue

**Computed Tomography**

**Robotic CT**
2 year old TB colt
- Poor performance
- Short, choppy gait all 4

8 year old TB gelding
- Progressive LF lameness

8 year old TB gelding
- 1 year later

3 year old TB with mild SBI

Courtesy: Dr. Julie Engles
1 year old TB with moderate-severe SBE

12 year old Warmblood mare
- RF lameness, blocks to fetlock

16 year old Warmblood gelding
- LH lameness
### Treatment

- **REST**
  - TB: 3-4 months of small paddock turnout
  - STB: 6 weeks rest, re-evaluate lameness
    - No lameness = Slow return to training
    - Lameness = 2-3 months rest
- Anti-inflammatories
- Aspirin (17mg/kg BID), isoxsuprine (400mg BID)
  - Not very useful
- Intra-articular injections
  - Rarely beneficial if no OA
- Bisphosphonates
- Surgery

### Bisphosphonates

- Two phosphate (PO(OH)₂) groups linked by a central carbon
- High affinity for hydroxyapatite
- Induce apoptosis in osteoclasts

#### Human medicine: Disorders with bone fragility
- Osteoporosis, bone metastasis, Paget’s disease of bone, osteogenesis imperfecta

![Bisphosphonate Structure]

### Types of Bisphosphonates

- **Non-N-containing**
  - Tiludronate, clodronate
  - Replace terminal pyrophosphate of ATP → osteoclasts undergo apoptosis
- **N-containing**
  - Zoledronate, risendronate, ibandronate, pamidronate, alendronate
  - Block HMG-CoA-reductase pathway → disrupts intra-cellular protein trafficking → decreased osteoclast survival and function of “ruffled border”

### Side Effects in Humans

- Osteonecrosis of the jaw
- Atrial fibrillation
- "Bisphosphonate fractures” → Femoral diaphysis and sub-trochanteric region
- Half-life of BPs ~ 10 years

### Veterinary Bisphosphonates

- Tiludronate (Tildren™) and clodronate (OsPhos™)
- Licensed for navicular disease only
- Distal tarsal OA (Lough et al., 2003)
- Zoledronate being investigated
  - May have chondroprotective effect?

#### What about subchondral bone injuries??
- Inhibiting osteoclasts may be contraindicated in subchondral bone injury

### Surgery

- Drilling
  - Stimulate vascular ingrowth & remodeling
- Screw placement
  - Drilling effects + stabilize microfractures to facilitate healing?
- Arthroscopy
  - Usually low-yield due to location of inaccessible location of lesions
EQUINE radiopharmaceutical uptake of the MCPJ/MTPJ being insidious onset with a lack of radiographic changes, that are unable to repair the damage as they train. MCPJ/MTPJ arthritis, and condylar fracture in horses age accumulates and has been associated with lameness, stress remodeling, in the distal portion of MC3/MT3. 4–7

Conclusions and Clinical Relevance
- Horses in previous studies were not raced before and after injury, 31% (14/45) had an increase in racing class, 31% (14/45) had a decrease in racing class, and 38% (17/45) had no change in racing class.
- Thoroughbred racehorses with CSBI in the distal portion of MC3/MT3 are ascribed a guarded to poor prognosis, as only 40% to 50% of horses return to previous levels of work.
- 54% of horses with CSBI in these studies raced before and after injury, 31% (14/45) had an increase in racing class, 31% (14/45) had a decrease in racing class, and 38% (17/45) had no change in racing class.

Prognosis
- Depends on where horse is in disease spectrum
- Subchondral bone injury — Posttraumatic osteoarthritis (PTOA)
- Subchondral bone injury can resolve with adequate rest
- PTOA is progressive

Summary
- Subchondral bone injury incredibly common in racehorses & common in sport horses
- Early diagnosis challenging but key!
- Few medical interventions...REST is most important
- Surgical intervention may help some

Mean age 3.2 years
- 95% (52/55) horses with CSBI returned to racing
- No significant difference in post-injury total earning compared with total earning before
- Median time to first start = 194 days

Questions?