Soft Tissue Injuries, Where Do We Start?

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  - Jennifer Barrett, DVM, PhD, DACVS
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  - Arthrex
  - EmCyte
  - Harvest
  - MediVet
  - PulseVet
  - CRT

- Consultant for Harvest, Scil, EVROST, ReCellerate, CRT, Vetra
Objectives:

• Soft tissue forelimb conditions as a common cause of non-responsive lameness

• New conditions not well described

• Previously described conditions with new treatment options
  • Anatomy
  • Clinical presentation
  • Physical exam findings
  • Diagnostic findings
  • Treatment options
Soap box:

• You need a definitive diagnosis

• What shoulder structure are you rehabbing

• Medial shoulder syndrome
  • Subscapularis
  • Medial glenohumeral ligament
  • Cranial joint capsule
  • Labrum
Shoulder Pearls

- A lot of conditions “look like a shoulder”…
  - Brachial plexus mass
  - Caudal cervical disease (root signature)
  - Elbow disease
  - Osteosarcoma
  - Panosteitis

- Combination disease
  - SHELBOW

- Rehab is crucial

- Dog and human shoulder vastly different
Shoulder Pearls

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- Dog and human shoulder are vastly different
Shoulder Pearls

• “The structural and biomechanical characteristics of the joints of quadrupedal animals are too different to be useful as a model for human shoulder injury”…..

Sager M, et al., Comp Med 2009
Fly ball
Supraspinatus Tendinopathy

- ‘Open diagnoses’ of unilateral forelimb lameness
- Non-responsive to rest and NSAIDs
- Worse with exercise and heavy activity
Supraspinatus Tendinopathy - 327 Cases

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Debra Canapp, DVM, CVA, CCRT, DACVSMR

Pat Gavin, DVM, PhD, DACVR
Location

ST327

n=327
**Signalment**

Age Range: 8 months to 14 years
Average Age – 6.5 years (median - 6 years)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Population</th>
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</thead>
<tbody>
<tr>
<td>Female</td>
<td>122</td>
</tr>
<tr>
<td>Male</td>
<td>144</td>
</tr>
</tbody>
</table>

n=327

ST327
Occupation

- Agility – 58.1%
- Breeding – 1%
- Dock Diving – 1%
- Field Trial – 2.5%
- Flyball – 1%
- Herding – 3%
- Hunting – 0.5%
- Obedience – 4.9%
- Police K-9 – 0.5%
- Racing (Retired) – 0.5%
- Rally – 1.4%
- Show – 2%
- Working Stock – 0.5%

Companion – 60.6%
Sport/Performance – 39.4%

n=327
Supraspinatus Tendinopathy

Anatomy

- Supraspinous fossa to the greater tubercle
- Active stabilizer of the shoulder
- Extension of the shoulder and advancement of the limb
- Stabilize and prevent collapse of the shoulder
- Active during 65% to 80% of stance phase
Supraspinatus Tendinopathy
Physical Examination

- Examine while standing
  - Symmetry of supraspinatus muscles

- Decreased forelimb circumference
  - Tape measure
  - Compare to contralateral

- Decreased shoulder flexion
  - Goniometer
  - 54°-59° (AJVR, 2002)
  - Compare to contralateral
Supraspinatus Tendinopathy
Physical Examination

• Examine unsedated

• Subtle changes
  • Pupils dilate
  • Licking
  • Breathing pattern

• Pain on flexion of shoulder

• Pain on direct palpation of tendon and point of insertion
Objective
Gait Analysis

Temporal-spatial gait analysis
Light V, et al. AJVR. 2010
Supraspinatus Tendinopathy

Diagnostics - Radiographs
Supraspinatus Tendinopathy
Diagnostics - Radiographs
Supraspinatus Tendinopathy
Diagnostics - Radiographs
Supraspinatus Tendinopathy
Diagnostics - Radiographs
Supraspinatus Tendinopathy

Greater tubercle of humerus
Joint Capsule
Biceps tendon
Supraspinatus tendon
Mixed Echogenicity representing tendinopathy
Supraspinatus Tendinopathy Diagnostics - Ultrasound

"Core lesion"
Supraspinatus Tendinopathy
Diagnostic Ultrasound

LONGITUDINAL VIEW

R SUPRA = 0.50CM²

Mixed echogenicity

L supra enlarged
Musculoskeletal Ultrasound
Objective Grading Scale

- Quantitative Ultrasound Shoulder Pathology Rating Scale (USPRS)
- Modified (USPRS)
- ST Cross-Sectional Area at a Standardized Level
- Canapp D, Barrett J, Ibrahim V

0 = Normal fibrillar pattern and echogenicity
1 = Mild loss of fibrillar pattern and/or echogenicity
2 = Moderate loss of fibrillar pattern and/or echogenicity
3 = Calcified area of tendon
4 = Clear tear partial thickness
5 = Clear tear full thickness
Supraspinatus Tendinopathy
Diagnostics - CT

supraspinatus

**

Jordan
Supraspinatus Tendinopathy Diagnostics - MRI

- STIR sagittal sequence revealing increased signal intensity (inflammation) at supraspinatus insertion on greater tubercle
Supraspinatus Tendinopathy Diagnostics - MRI

- STIR transverse image revealing a proliferative inflammatory nodule of the supraspinatus tendon causing flattening of the biceps tendon.
Supraspinatus Tendinopathy
Diagnostics - Arthroscopy
Supraspinatus Tendinopathy
Diagnostics - Arthroscopy

L shoulder & Leibow scope
Supraspinatus Tendinopathy

Cause of Injury

- Hitting the ground, fly ball box, agility contacts, etc., on an outstretched forelimb

- Impinging when reaching forward and hitting the box or contacts

- Slipping- overstretching of the muscle/overuse

- Quick turns and repetitive eccentric contractions

- Concentric contractions in lengthened positions
Tendinopathy, as opposed to tendinitis or tendinosis, is the best generic descriptive term for the clinical conditions in and around tendons arising from overuse

- Require lengthy management
- Patients often respond poorly to treatments
Supraspinatus Tendinopathy

- **Cause of injury:**
  - Overuse activity demonstrated in animal models
  - Mechanical properties of tendon deteriorated
    - Decreased modulus of elasticity
    - Decreased maximum stress of failure

J Shoulder Elbow Surg, 2000
Supraspinatus Tendinopathy

• With repetitive trauma at the insertion site a proliferative nodule develops

• Classic inflammatory changes are not seen

• Dysfunctional repair response

• Chronically calcification occurs without necrosis or inflammation

J Shoulder Elbow Surg, 2000

Hulse, D
Supraspinatus Tendinopathy

Treatments

• Previous Reports:
  • Surgical debridement & release (JAVMA, 1990, 2005; Vet Record, 1996)
    • Treated calcifying tendinopathy
    • Chronic cases
    • Mineralization reformed in all operated dogs (JAAHA, 2000)
    • Stabilizer of the shoulder

• Extracorporeal shock wave therapy (Vet Record, 2003)
  • Two dogs
  • Treated calcifying tendinopathy
  • Chronic cases
Supraspinatus Tendinopathy Rehabilitation Therapy

• Manual therapy

• Modalities

• Therapeutic home exercise program

• Hydrotherapy

• Strengthening techniques
  • Isometric exercises

• End stage eccentric exercises
  • Trotting and walking down hills

Phys Ther, 2004
J Orthop Sports Phys Ther, 1994
Lasers Surg Med, 2005
Previous Failed Treatments

**Population**

- NSAIDs: 74.6%
- Rehabilitation Therapy: 40.8%
- IA Injection: 2.6%

n=311
Treatment

Supraspinatus Tendinopathy

- Rehabilitation Therapy: 47.1%
- Regenerative Medicine Therapy: 35.5%
- No Treatment: 17.4%

n=327
Supraspinatus Tendinopathy
Regenerative Medicine

- Stem Cells (cultured adipose derived progenitor cells)
  - Contribute to generating new tissue
  - Chemotactic for progenitor cells
  - Supply growth factors
  - Make extracellular matrix
  - Angiogenesis
  - Anti-apoptosis
  - Anti-inflammatory
  - Anti-fibrotic

- Platelet Rich Plasma (PRP)
  - Positive effects on angiogenesis and extracellular matrix remodeling
  - Stem cell recruitment and chemotaxis
  - Cell proliferation and differentiation
  - Potent source of growth factors important in regenerative process
  - Fibrin for matrix / scaffold
Response to ADPC/PRP Therapy

- Resolved: 90%
- Improved: 10%

*10 dogs did not present for final evaluation
Supraspinatus Tendinopathy Retraining

- Improve / correct
- performance technique
- Warm up
- Stretching after warm-up and performance
- Cool down
- Swimmers turn

J Orthop Sports Phys Ther, 1994
J Strength Cond Res, 2005
Medial Shoulder Instability

“Medial Shoulder Syndrome”

- Many have no lameness, just a shortened stride or step length
  - Missing contacts
  - Knocking bars
  - Taking wide sweeping turns
  - Pulling out of weaves

- ‘Open diagnoses’ of unilateral forelimb lameness

- Non-responsive to rest and NSAIDs

- Worse with exercise and heavy activity
Medial Shoulder Syndrome Anatomy

- Medial glenohumeral ligament (MGL)
  - Passive stabilizer
- Joint capsule
- Subscapularis tendon
  - Arises in subscapular fossa and inserts on the minor tubercle
  - Adduct and extend shoulder, aids in maintaining flexion
Medial Shoulder Instability

• Joint capsule and glenohumeral ligaments (MGL) play a large role in shoulder stability

• Bardet reported 69% of dogs with chronic forelimb lameness had pathology of MGL

• Pathology of the MGL was the most common form of shoulder instability in adult dogs

Bardet JF, JAAHA 1998
Medial Shoulder Syndrome
Physical Examination

- PE: Discomfort and spasm on abduction of shoulder and increased angle

Abduction angle test:

- Awake
- Standing
- Goniometer
- Elbow and shoulder extension abduct forelimb

- Normal angles: $32^\circ +/-$
- Instability: $53^\circ +/-$
- Compare to contralateral shoulder

Medial Shoulder Syndrome Diagnostics

**Radiography:**
- Typically within normal limits
- May see mineralization of supraspinatus or biceps in chronic conditions

**MRI:**
- May identify concurrent tendinopathies
- Unable to detect dynamic lesions
- MRI arthrograms are showing promise

**Arthroscopy:**
- Gold standard for diagnosis in canine patients
Medial Shoulder Syndrome Diagnostics

**Arthroscopy:**
- Direct observation of all major intra-articular structures with magnification
- “Dynamic” evaluation of tissues during range-of-motion tests
- “Palpation” of intra-articular structures using arthroscopic instrumentation
- Minimally invasive
- Serves as a diagnostic and therapeutic tool
Medial Shoulder Syndrome

Diagnostics

a. Glenoid
b. Glenohumeral lig.
c. Subscapularis ten.
d. Humeral head
Medial Shoulder Syndrome
Diagnostics

Arthroscopy
• Laxity, disruption, and/or rupture of:
• Subscapularis tendon
Medial Shoulder Syndrome
Cause of Injury

Suspected to be repeated strain and sprain injuries

- Repetitive microtrauma secondary to vigorous activity
- Longitudinal stretching or tearing of muscle fibers, tendons, and ligaments
- Over stretching or overuse leads to degeneration
- Lowering tensile strength predisposes to rupture

- Concurrent tendinopathies of passive stabilizers of shoulder
  - Supraspinatus
  - Biceps
- In humans, tendons provide barrier against translation

J Shoulder and Elbow Surg, 2001
Medial Shoulder Syndrome Treatment

Mild instability:

- 35° to 45° abduction angles
- Minimal pathology arthroscopically (inflammation but not disrupted or torn)
- Conservative management and Rehabilitation therapy
- Shoulder support system (hobbles)
- 2 to 4 month recovery
Medial Shoulder Syndrome Treatment

Moderate instability:

- 45° to 65° abduction angles
- Moderate pathology arthroscopically (disruption and fraying of tissues)
- Arthroscopic radiofrequency (RF) treatment and/or imbrication
- Stripping, or spotting techniques
- Monopolar RF generator (Vulcan TAC)
- Default 25W and 70°C

Post-operative shoulder support:
- Hobbles 2 to 3 months
- Rehabilitation therapy
- 3-4 month recovery
Medial Shoulder Syndrome
Treatment
Medial Shoulder Instability Treatment

Severe instability:

- Uncommon; 65° to 90° abduction angles
- Severe pathology arthroscopically (complete rupture of tissues)
- Reconstruction of the medial compartment by direct tissue reapposition and synthetic capsulorrhaphy
Medial Shoulder Syndrome Treatment

Severe instability:

- > 65° abduction angles
- Disruption and tearing of tissues
- Arthroscopic imbrication and reconstruction
  - Number 2 fiber wire
  - Bone anchors
  - TightRope
- Post-operative shoulder support
  - Slings 2 weeks
  - Hobbles 2 to 3 months
- Rehabilitation therapy
- 4 to 6 month recovery
Medial Shoulder Syndrome
Regenerative Medicine

Stem Cell Therapy (Adipose derived progenitor cells) with ACS:

• Moderate to severe cases +/- arthroscopic treatment (RF or TightRope)

• Collection from falciform

• Processed by Marion duPont
  • Cultured over 2 weeks (4-5 million mesenchymal cells)

• Follow-up
  • Pre and post objective gait analysis
  • Second look arthroscopy
  • Synovial fluid / cytokine analysis

“Buyer”
MSS : Pre -SCT

“Buyer”
Medial Shoulder Syndrome
Post-op Hobbles
Medial Shoulder Syndrome
Post-op Management

Pain management:

- NO NSAIDs
  - Want to stimulate inflammatory response
- Tramadol or Codeine
- Glucosamine and Chondroitin Sulfate
- LASER therapy
  - digits, carpus, elbow
- Acupuncture
Medial Shoulder Syndrome
Rehabilitation Therapy

• Very regimented and gradual program

• Hobbles x 3 months

• Manual therapy

• Modalities

• Therapeutic exercise and strengthening program
  • Peanuts, parastanding, handstands, walking on hills, wobble board, cavaletti, Under water treadmill therapy
Medial Shoulder Syndrome

Return to Sport

• Gradual introduction of loads on tissues encourages remodeling and gain in strength

• Agility
  • Low Straight Line Jumps
  • Wide Sweeping Turns
  • Tunnels
  • Dog Walk and Teeter
  • A Frame and Contacts

• Return to sport – competition 5-6 months
  • Recheck after re-training and before competition
Medial Shoulder Instability
Return to Sport - “Buyer”

“Buyer”- 6 months post SCT
Iliopsoas Strain

- ‘Open diagnoses’ of unilateral hind limb lameness
- Non-responsive to rest and NSAIDs
- Worse with exercise and heavy activity
Iliopsoas Strain Anatomy

- Iliopsoas fusion of
  - Psoas major
  - iliacus
- Lumbar vertebrae and ilium to lesser trochanter
- Flexion of hip
- Flexion of vertebral column
- When femur in fixed position
Iliopsoas Strain
Physical Examination

• Pain on extension and abduction of hip
• Pain and spasm on direct palpation of myotendinous unit and point of insertion
• Trigger points
• Hyperirritable spots
• Decreased hind limb circumference
Iliopsoas Strain
Physical Examination
Iliopsoas Strain
Physical Examination
Iliopsoas Strain
Physical Examination
Iliopsoas Strain
Diagnostics

Radiography
VCOT, 2005
Iliopsoas Strain Diagnostics

- Transverse CT Scan
- Left iliopsoas muscle asymmetric
- Thinning of dorsolateral portion of left iliopsoas
- Region of hypodensity confirming strain

CT Scan

VCOT, 2005
Iliopsoas Strain Diagnostics

- MR images of pelvis in dorsal sections
- T-1 weighted following contrast
- Hyperintense bright signal identifies strain injury of the tendon of the iliopsoas

VCOT, 2005
Iliopsoas Strain Diagnostics
Iliopsoas Strain Diagnostics
Iliosoas Strain
Cause of Injury
Iliopsoas Strain
Cause of Injury

• Acute, stretch-induced muscle injury

• Active eccentric muscle contraction
  • Muscle is activated during stretch
  • Slipping into splay-legged position
  • Repeated strain injury from jumping over hurdles
  • Aggressive agility work

• Overstretching of the muscle or an overuse

• Cause of injury:
  • Not uncommon to find other concurrent orthopedic conditions
    • CCL insufficiency
    • Hip dysplasia
Iliopsoas Strain
Rehabilitation Therapy

- Manual therapy
- Laser therapy
- Muscle relaxants
- Stretching and strengthening techniques
- End stage eccentric exercises
- Active concentric, non-resistance activity
- Active, resistance activity
- Controlled activity and return to sport as previously described
- Phonophoresis-nonresponsive to initial rehab program

Complete resolution:

- Rehabilitation therapy 63%
- Rest and NSAIDs 33%
  - VCOT, 2005
Iliopsoas Strain
Regenerative Medicine

• For patients that fail to respond to rehab or continue to recur

• Adipose derived progenitor cells-PRP combination; ACP, etc under ultrasound guidance

• Entered back into rehab program
  • Manual therapy
  • Laser therapy
Conclusions:

- Start thinking soft tissues
- Use objective measures during your PE
- Perform orthopedic exam standing and unsedated
- When it comes to diagnostics and treatments think outside the box
  - Msk Ultrasound
  - Arthroscopy
- These same conditions being identified in ordinary dogs
- Infantile stages of understanding these conditions, diagnostic modalities, and treatments
- Need more objective controlled rehabilitation studies
- Evidence based medicine
Questions?
Thank You!