ATHLETES: OVERUSE INJURIES VERY COMMON

- Muscle
- Joints
- Tendon
- Ligament
- Bone

How is this Relevant to My Practice?

- High performance athletes get similar injuries as 'regular' people… but:
  - More of them, & at a younger age
  - More commonly imaged
  - Secondary gain involved
- All the cases here are high performance athletes – but most injuries are conventional
- Exceptions
  - Some weird sport-specific patterns of stress and other injuries
  - Acute injuries as opposed to overuse

MUSCLE / SOFT TISSUE INJURY

- Overuse
  - DOMS
- Acute injury
  - Tendon
  - Myotendinous junction
  - Muscle belly

Delayed Onset Muscle Soreness (DOMS)

- All athletes are susceptible if they change training regimen
- Athletes tend to work out intensely – leads to muscle injury
- Rarely imaged (“no pain no gain”)
  - Weightlifting / aerobic exercise
  - 24hr later – soreness
  - Can be severe, even look like a tear
DOMS: Lateral gastrocnemius
Finding can be subtle, even with T2 and fat sat

Acute Muscle Injury
• Direct → muscle belly, esp quadriceps
  - esp rugby, football
• Indirect → myotendinous junction
  - eccentric contraction
  - sudden acceleration / deceleration

Acute Injury – Myotendinous Unit
• Myotendinous Junction
  - ‘weak link’ of normal myotendinous complex
  - Common place for injury
  - Most common mechanism: eccentric contraction
    (muscle lengthens and contracts at the same time)

Gastrocnemius tear: “V” sign

Professional football player
Quadriiceps hematoma
Muscle belly injury
Hit with helmet

High T1 = blood

Grade 1 Muscle Strain
• Ill-defined edema

Weishaupt D, JCAT 2001; 25:677
Professional baseball player
Grade 1 strain
Sartorius m.

Grade 2 Muscle Strain
AKA “Partial Tear”

Marathon Runner
Quadratus Femoris Strain

Small Grade 2 Strain – NFL Player

Grade 3 Muscle Strain

Grade 3 Strain
Rectus femoris

Gd can help identify subtle muscle injury

• Complete tear
  – Fluid, blood common
  – Retraction – balled up muscle may be perceived as a mass
  – Degree of dysfunction varies
    • Hamstrings, rectus femoris, tibialis anterior – loss has little effect on ADL performance
Sportsman’s Hernia

- Adductor avulsion
- Pubic symphysis capsule injury
- Groin pain medially
- Actually a ‘grab bag’ of diagnoses
  - Adductor injury
  - Pubic symphysis inj
  - Rectus abdominis strain
  - actual hernia

Sportsman’s Hernia

- Rectus abdominis strain

Chronic Injury
Marathon Runner

- Bone resorption
- Loss of cortex

Looks like clavicular osteolysis

Corresponding MRI

Clavicular Osteolysis

- Edema only / predominantly at distal clavicle
- Classic in Weightlifters

Other Muscle Pathology

- Dysfunction related to nerve impingement
- Compartment syndrome
Radial Tunnel Syndrome

Elbow nerve impingement syndromes
- Many types
- Etiology
  - Muscle hypertrophy (wt lifters)
  - Upper extremity endurance athletes (esp tennis)

T2 FSE fatsat

Compartment Syndrome

- Confined fascial compartment
  - Lower leg > thigh
  - Most common: anterior compartment
- Acute and chronic forms
  - Acute: tibial fx, hematoma, vascular injury, infection
  - Chronic: Muscle hypertrophy / overexertion
- Increased compartmental pressure (>30mm Hg)
- Decreased bloodflow into compartment
  - Clinical: pain/swelling, weakness, decreased sensation
- Late: Muscle infarction

Chronic Exercise-induced Compartment Syndrome

Gd can help show subtle variations in muscle vascularity

Bursitis

Professional Ballet dancer

Also note stress fx of sesamoid

Adventitial Bursitis

TENDONS
TENDON PATHOPHYSIOLOGY

- **Degeneration**
  - Primary (overuse injury)
  - Direct frictional effect
- **Hypovascular-critical zone**
  - Tendons without sheaths are susceptible
  - Achilles, biceps, cuff, etc.
  - Between myotendinous joint and insertion
- 'Normal tendons don’t tear'

Example of friction: Distal biceps
Mechanical pronation leads to impingement between radius and ulna.

TENDINOSIS

- Thickening, increased signal (T1, PD, T2)

![Distal biceps](esp in weightlifters)

TENDON TEAR

COMPLETE TEAR: USUALLY ASSOCIATED WITH RETRACTION
- e.g., biceps: retracts, bulging muscle (‘popeye’ arm)

LATERAL EPICONDYLITIS

Adjacent marrow edema
- Chronic, severe, refractory cases
- Especially in racquet / club sports
- Lateral = tennis elbow

Muscle edema (esp ECR brevis)

MEDIAL EPICONDYLITIS

- “Golfer’s elbow”

IMPINGEMENT

Rotator Cuff
Tendinosis and Tear

- Lateral acromial downslope:
  - Predisposes to impingement
  - Esp. common in overhead throwing sports
Undersurface Partial Thickness Tear

--Impingement is nearly always involved
--Underlying degeneration
--"Acute tear" extremely uncommon

Professional basketball player

Tendinosis

Hypoxic Degeneration

Lesions at the "watershed zone"

Tendinosis

Mucoid Degeneration

Lesions at the "watershed zone"

Tendinosis

Painful Enthesopathy

Edematous spur => high likelihood of sx

Professional basketball player

Patellar Tendinosis / Tear

Tendinosis / Tear

Pro Basketball Player
Iliotibial Band Friction Syndrome
*Long Distance Runner*

Delayed Union of Apophyses

Avulsive Stress Ischial Apophysis
*Gymnast*

Medial Apophysis Stress

Old Osgood-Schlatter

*Extensor mechanism pathology*
*AKA “Jumper’s knee”*
*Esp. common in basketball*
JOINTS

Cartilage Lesions
Microfracture – NBA Player
Medial compartment symptoms prevent play.

S/P MICROFRACTURE
7 MONTH FOLLOW-UP
Playing without symptoms

13 MONTHS LATER
Recurrent symptoms

OSTEOCHONDRAL LESIONS
Panner’s disease
Esp. in adolescent pitchers
Chronic osteochondral injury of capitellum
Underlying focus of AVN

OSTEOCHONDRAL LESION OF THE TALUS
Esp. in basketball
35 month follow up
-interval detachment of fragment
OCD KNEE
*Detached*

OCD phalanx
*Ballet Dancer*

Plicas and Bodies

Professional Baseball Player
*Synovitis in Elbow*

Posterolateral Elbow Plica

POSTERIOR SPURS, INTRA-ARTICULAR BODIES
*Baseball Pitcher*
Joint Impingement and Instability

ANKLE JOINT
Impingement

Anterior impingement:
large spurs limit dorsiflexion
-esp in soccer, kicking sports

Anterolateral Impingement
“meniscus syndrome”
-following tear of lateral ligaments
-scar tissue forms in recess
-leads to impingement, cartilage erosion, pain

Posterior Impingement
“Os Trigonum Syndrome”
-big os
-fluid at interval
-cystic change

Hip Impingement
Basketball Player

Posterior Labral Tear
Chronic Unidirectional Posterior Instability
Subluxation
Chronic Multidirectional Instability
Combined Anterior and Posterior Instability

ANTERIOR DISLOCATION

POSTERIOR CAPSULAR OSSIFICATION
“BENNETT LESION”

Capsular Injury

“Turf Toe”

Football players
-esp. due to artificial turf
-Tear of plantar plate 1st MTP
-Often acute on chronic

Soccer – capsular injury superomedial

DORSAL HOOD INJURY
Boxer

LIGAMENTS
FASCIA
**ELBOW**

**MCL INJURY**
- **NORMAL**
- **CHRONIC INJURY**
- MCL partial tear “T sign”

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**Flexor tendon pulley injury**
- Esp. common in rock climbers

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**PLANTAR FASCITIS**
- Esp. in runners
- Acute on chronic

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**Plantar Fascia Tear**

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**Medial Tibial Stress Syndrome**
- AKA “shin splints”
- Avulsive injury medial tibial myofascial attachment
- Running, overuse
- Fascial or periosteal edema along anteromedial tibia
- Occasional marrow edema
- Most common: normal MRI

Anderson MW. Radiology 1997; 207:1826
**Stress Fracture**

- **Fatigue:** ‘people in fatigues’
  - Normal bone undergoing abnormal stress
  - Young people
- **Insufficiency**
  - Abnormal bone (eg, osteoporotic), normal stresses
  - Older population

**Etiology of Stress Fracture**

- During early phase of a new activity, muscle steadily increases strength
- Bone must undergo a phase of osteoclastic resorption first

“*At risk period*”

**Stress Response**

- No linear component

**Stress Fracture**

- Atypical locations: periostitis may be mistaken for tumor

**Stress Fracture**

- Late – Propagation across shaft
Stress Fracture

Late - Thick periostitis

Tibial Stress Fracture
Multiple Foci

Classic in runners

Classic Fatigue Fracture
2nd Metatarsal Shaft

18 year old male Persistent pain in hip History of recent increase in activity

Fatigue fracture

Atypical Sports-specific Locations

Olecranon stress in gymnast
GYMNAST WITH DISTAL RADIAL / ULNAR PHYSEAL STRESS Bilaterally

Capitate stress Gymnast

STRESS RESPONSE Ballerina

Humeral stress pitcher

Stress forearm in female softball player

Stress femur nba
Sesamoiditis
-Hyperemia likely due to chronic repetitive injury
-Prob along spectrum of stress, AVN
-Sesamoid high on T2, surrounding ST edema
-Mostly preserved T1 signal

AVN Sesamoid
Likely an end stage of stress

AVN metacarpal head (post op)
Pro boxer
-Dynamic Gd demonstrates viability of remaining bone

QUESTIONS?