Disclosures

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Co-founder & Stockholder: Imagen Technologies
Special Considerations of the Throwing Athlete

- Chronically remodeled capsule yields plastic deformation
- Distinctly different MRI appearance from non-throwing athlete who sustains anterior translational episode
- Capsular stretch, partial rotator cuff tears, cartilage wear
- Glenoid adaptation is dependent on the position, duration and altered GH mechanics
24 year-old professional athlete with fall in abduction: pre-arthrogram
Post-arthrogram
Lateral avulsion of posterior capsule in a 16 year-old
12 year-old pitcher with acute pop and pain
Superior labral tears: features of chronicity
21 year-old pitcher with acute injury
21 year-old pitcher with acute injury
Those pesky latissimus tears...
ABER view: necessary?
Rotator cuff overload in the skeletally immature athlete
9 year-old pitcher with pain and weakness
11 year-old pitcher with internal impingement
13 year-old with chronic Little League shoulder and features of internal impingement
30 year-old pitcher with internal impingement
Glenoid dysplasia and posterior instability
27 year-old pro baseball player: F/U post stabilization with re-injury
27 year-old pro baseball player: F/U post stabilization with re-injury: note the progressive cartilage loss
16 year-old baseball player with rotator cuff tendinosis, labral fraying and OCD glenoid: which is clinically most relevant?
22 year-old professional BB player with periscapular pain
Shoulder MRI with ZTE: Bone analysis
Breighner et al, Radiology 2018;286:960-966

- ZTE MRI samples signal from short T2 species (like cortical bone)
- Amenable to 3D modeling

- Shoulder – quantitative 34 shoulders
  - 2 Readers (blinded)
  - Measured glenoid vault depth, Bankart and Hill-Sachs lesions
  - ICC (0.74 – 1.00) indicated strong inter-observer agreement
  - Bland-Altman analysis indicated little intermodal (ZTE vs CT) bias (< 1mm) in linear distance metrics with K values from 0.62-1.00
Imaging the Throwing Athlete

- Chronic repetitive microtrauma and excessive load leads to plastic deformation of collagen in tendons, capsule and ligaments
- NOT just “dye leakage” or black and white but degree of remodeling (shades of gray)
- Acute on chronic injury: understanding the baseline pathology that is adaptive to (over)use
- High resolution scanning: cartilage sensitive, water sensitive obviates intra-articular contrast, no gap between slices!; Elbow coronal ≤1.8mm
Medial Collateral Ligament

- **Anterior bundle:**
  - composed of anterior and posterior bands
  - Anterior band is primary restraint to valgus load
    - Injury most significant @ 60º/90º flexion
  - Taut in elbow extension
  - Posterior band is secondary restraint
    - Injury most severe @ 120º flexion
18 year-old woman with valgus injury during softball
MRI of the Throwing Elbow

- Valgus overload during acceleration stage of arm swing
- MCL tears: plastic deformation with superimposed partial thickness tears
  - Assess degree of remodeling
- Flexor/pronator tendinosis and/or tear
- Valgus extension overload
  - posteromedial impingement
- Cartilage status
  - trochlea, olecranon (high contact pressures)
  - RC joint (end stage)
- Ulnar neuropathy
Acute high grade partial tear MCL in a 20 year-old pitcher
19 year-old pitcher with acute on chronic PT MCL with old bony avulsion
17 year-old pitcher with 6 months of ulnar side pain with recent exacerbation
19 year-old with acute elbow pain; pitching since age 9

Acute on chronic MCL tear at humerus and posteromedial impingement
19 year-old with acute elbow pain; pitching since age 9
Ulnar neuritis in a pitcher
Professional pitcher two years following MCL reconstruction

INTACT
Re-tear MCL graft
20 year-old 2 years after MCLR with pain after pitching
15 year-old baseball player with posterior elbow pain
Same patient:
18 yrs. old
Follow up in 2014 with decreased stress reaction but persistent sclerosis

2016: finally healing!
Radial Head Fractures with ZTE MRI
23 year-old pitcher with severe elbow pain
Upper extremity injuries in throwing athletes

- Use high resolution scanning (1.5T or 3T; slice ≤ 1.8mm)
- Fat suppression is your bone scan
- Filter the small stuff!
- Use sequences to accentuate gray scale in remodeled collagen of tendons and ligaments
- Cartilage-sensitive imaging always essential
- Understanding of altered biomechanics: glenoid adaptation is dependent on the type of sport, duration and altered GH mechanics
- Chronic plastic deformation is more common than acute tear