MRI imaging of pediatric and adolescent shoulder injuries

J. Herman Kan, M.D.
Section chief, musculoskeletal radiology
Edward B. Singleton Department of Pediatric Radiology
Texas Children’s Hospital
Outline

• Cartilage imaging
  - Labral and chondrolabral anatomy

• Mimics for labral tears

• Shoulder injuries with pediatric perspectives
  - Anterior shoulder dislocation, GIRD, rotator cuff pathology, little league shoulder
Shoulder imaging after trauma

- Most frequent injuries in the children and adolescence: fractures about the humerus and clavicle

Radiographs

- Use of MRI limited to:
  - When radiographs are normal
  - MRI (non-arthrographic) when there are no mechanical symptoms
  - MR arthrography when there are mechanical symptoms
Cartilage imaging
Normal MR findings in children - cartilage

- Epiphyseal and articular cartilage
- 2 yo
- Epiphyseal pre-ossification hyperdensities
- 4 yo
Normal MR findings in children-cartilage

- Decreased epiphyseal cartilage component

- 2 yo
- 14 yo
Chondral anatomy well seen with intra-articular contrast

- 13 yo

• T1 FS

• T2 FS
T1 FS after arthrography better at identifying chondral injuries

• 16 yo delaminating chondral injury of the glenoid
Bare area of the glenoid (vs chondral injury?)

• 2% incidence

• Centrally located

• Smooth margins or central divot

• Felt to be an subclinical acquired lesion since it is not seen in children under 10 years of age

1 Kim et al Pediatr Radiol 2010
Bare area of the glenoid

- 14 yo
Sometimes may be a central divot, or smooth taper
May also be seen on the humeral side as well

• 16 yo
Labral and glenolabral pathology

• Normal shape of the labrum

• Normal chondrolabral junction

• Chondrolabral edema/degeneration

• Chondrolabral tears versus intrasubstance tears
Normal labral shape

- Triangular (64% anteriorly, 47% posteriorly)
- Round (17% anteriorly, 33% posteriorly)
- Other: notched, cleaved

Park et al AJR 2000
Labral shape

• Triangular (64% anteriorly, 47% posteriorly)

Park et al AJR 2000

16 yo
Labral shape

• Triangular (64% anteriorly, 47% posteriorly)

• Round (17% anteriorly, 33% posteriorly)
Labral shape

• Triangular (64% anteriorly, 47% posteriorly)

• Round (17% anteriorly, 33% posteriorly)

• Other: notched (3% of normal labra), cleaved

However, likely sequelae related to prior labral injury/degeneration
Chondrolabral junction

- Normal chondrolabral junction

- Junctional chondrolabral edema/degeneration

17 yo
• Junctional chondrolabral edema/degeneration

• Chondrolabral tear
• Chondrolabral tear

• Chondrolabral tear with intralabral cyst
Should be differentiated from intra-substance labral tears

- Chondrolabral tear
- Intra-substance tear
Normal labral spaces and structures that should not be confused with labral tears

• Superior labral recess

• Superior labral sulcus

• Hyaline cartilage undercutting at the chondrolabral junction

• Sublabral foramen

• Buford complex
Superior sublabral recess

- Small recess underneath superior labrum

- Felt to be a normal variant although some feel it is related to degenerative tearing since it is rare in younger patients
Superior sublabral recess
Hyaline cartilage undercutting
Superior sublabral recess vs sulcus

- **Sulcus**: space between biceps and superior labrum
- **Recess**: between chondrolabral junction
Should be differentiated from SLAP injuries

- Recess
- SLAP
- SLAP with extension into long head biceps
Sublabral foramen

• 11% of normal shoulders

• Anterosuperior quadrant

• May be continuous with a superior sublabral recess
Sublabral foramen

• Above 3:00

• Below 3:00
Buford Complex

• 1.5% of normal shoulders

• Absent anterior superior labrum and thickened, cord-like middle glenohumeral ligament
Buford Complex

• 15 yo

Normal anteroinf labrum
Selected shoulder pathology with pediatric perspectives

- Anterior shoulder dislocation
- GIRD
- Pediatric rotator cuff pathology
- Little league shoulder
Anterior shoulder dislocation

• Usually related to direct injury during contact sports

• First time dislocation usually in second decade of life

• Younger the age of first time dislocation, the higher incidence of additional future dislocations
Hills-Sachs fracture

14 yo
Hill-Sachs fracture

- The deeper the notch, the higher incidence of recurrent dislocation

17 yo

Ito et al J Shoulder elbow Surg 2000
Hill-Sachs fractures should only be made on first 2-3 cephalad slices

• 16 yo. Normal spherical head. Normal greater troch-posterior shaft junction flattening
Bankart injuries

• Osseous vs non-osseous (soft tissue)
  - For osseous Bankarts, if there is greater than 25% surface loss, higher incidence of recurrent shoulder dislocation

• Displaced vs nondisplaced

• Presence/absence of chondral injury
Displaced osseous Bankart

- 17 yo
Nondisplaced soft tissue Bankart

• 18 yo
Nondisplaced soft tissue Bankart with cartilage injury

• 18 yo
What the surgeon needs to know for Bankart injuries

• Osseous vs non-osseous (soft tissue)
  - Glenoid bone loss (>25% associated with recurrent dislocation)

• Displaced vs nondisplaced

• Presence/absence of chondral injury
Glenohumeral internal rotation deficit (GIRD)

• Occurs with repetitive overhead motion with excessive external rotation and abduction (swimmers, baseball players)

• Leads to posterior capsular injury, posterior labral tears, SLAP injuries, and tearing of the posterior fibers of the supraspinatus
GIRD

• 18 yo posterior labral tear with posterolateral humeral head cysts
GIRD

• 17 yo posterior labral tear with posterolateral humeral head cysts
Pediatric rotator cuff pathology

• Rare in children

• In one study, 12% of children 10-18 year old had rotator cuff injuries, with 36% having concurrent labral pathology\(^1\)

• MR arthrography has sensitivity 44%, and specificity of 87% to diagnose partial rotator cuff tears in children\(^2\)

15 year old with tendinopathy of the infraspinatus with posterior labral tear
15 yo rim rent tear
Tendinopathy vs tear?

- Tendinopathy
- Tear
Little League Shoulder

• Chronic SH 1 stress fracture

• 11-14 years of age; boys

• Overuse injury related to rotational torqueing generated during the acceleration phase of overhead throwing

Comparison views are usually sufficient.

- 13 year old
MR demonstrates physeal edema

13 year old
Summary

• MR arthrography for most patients who undergo shoulder imaging

• Reviewed normal labral variants and pathology

• Covered selected shoulder pathology from pediatric perspective
  - Anterior shoulder dislocation, GIRD, rotator cuff pathology, and little league shoulder