Excellent Overview

Musculoskeletal Imaging in Physical Therapist Practice

What do you suspect? ACJ Separation

In an AP View the normal joint space is 0.3-0.8 cm and the normal coracoclavicular distance is 1.0-1.3 cm

ACJ Grading

<table>
<thead>
<tr>
<th>Deformity</th>
<th>Ligaments</th>
<th>Instability</th>
<th>Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Minor</td>
<td>None</td>
<td>No</td>
</tr>
<tr>
<td>Type II</td>
<td>Minor step-deformity</td>
<td>Complete AC</td>
<td>Palpable gapping</td>
</tr>
<tr>
<td>Type III</td>
<td>Piano key deformity</td>
<td>Complete AC/CC</td>
<td>Visible gapping</td>
</tr>
<tr>
<td>Type IV</td>
<td>Clavicle displaced</td>
<td>Complete AC/CC</td>
<td>Trap/deltoid tear</td>
</tr>
<tr>
<td>Type V</td>
<td>CC space &lt; 100-300%</td>
<td>Complete AC/CC</td>
<td>Significant trap/deltoid tearing</td>
</tr>
<tr>
<td>Type VI</td>
<td>Inferior dislocation of clavicle</td>
<td>Complete AC/CC</td>
<td>Frequently locked under conjoined tendon</td>
</tr>
</tbody>
</table>

PT Scope of Practice

- Recognize the need for imaging
- Provide rationale and location for imaging to radiologist
- Appreciate the accuracy of imaging (false positives/negatives) and the periodic lack of correlation between pathoanatomy and clinical presentation (spine)

Clavicular Fracture

Non-Displaced

Displaced

Greenstick
What is this?

3-part Proximal Humeral Fracture involving the surgical neck, greater tubercle, and lesser tubercle

Neer Classification

Neer Fracture Classification Parameters

- Displaced means that any of the four major segments is displaced more than 1 centimeter or angulated more than 1 degree
  - Humeral head
  - Humeral shaft - surgical neck
  - Greater Tuberosity
  - Lesser Tuberosity

Proximal Humeral Fracture

What is this?

Os acromiale

- Results from the failure of the acromial secondary centers of ossification to fuse which normally occurs at about 18-20 years of age

Os Acromiale

- The appearance is a normal variant than can be mistaken for a fracture on an axillary lateral view.
- The reported prevalence of this condition has ranged from 1-15% in the general population. The finding is present bilaterally in approximately 62% of the cases.
Hill Sach’s Lesion

MRI and X-ray (above) of a Hill-Sachs lesion - an impaction fracture on the posterolateral margin of the humeral head.

Acromial Morphology

Transccapular Lateral Y view

Type II

Acromion Morphology

Lateral Sagittal View

Type III – hooked
Type II – curved
Type I - flat

Acromial Morphology - AP View

Normal
Type B – excessive down sloping

Acromion Morphology

Frontal Plane Orientation

0°-10° TYPE A
>10° TYPE B
What is this? Posterior Humeroulnar Dislocation

Complete Perched

What is this? Radial Head Fracture

Mason-Johnson Classification of Radial head and neck fractures

I Nondisplaced (<2 mm)
II Minimally displaced (>2-3 mm) with depression, angulation, impaction, or involving >30% of radial head
III Comminuted and displaced
IV Radial head fractures associated with dislocation of the elbow

Distal Radius Fracture – “Colles”

Boxer Fracture – Fractured neck of 4 or 5th metacarpal

- Metacarpal head tilts in volar direction causing hyperextended MCP
- Metacarpal head angulates and rotates
What is this?

**Scaphoid Fracture**

Traumatic snuffbox pain should be treated as a scaphoid fracture for at least 2-3 weeks.

What is this?

**Spondylolisthesis – “scotty dog” broken collar**

Pars Defect

Superior facet (ear)

Transverse process (nose)

Pars articularis (neck)

Vertebral Body

Inferior Facet (front leg)

Lamina (body)

Thoracic Compression Fracture

Dens Fracture

These are two reformatted CT images of the cervical spine. The green arrows point to a transverse fracture of the base of the dens (odontoid) (Type II). The red arrow points to the same fracture in a sagittal reformatted image. The dens is displaced slightly posteriorly on the body of C2.
Clay Shoveler’s Fracture
An avulsion of the spinous process of the lower cervical vertebrae, classically at C7.

Canadian C-Spine Rules
SN = .99
SP = .45
Implementation of the Canadian C-Spine Rule led to a significant decrease (12%) in imaging without injuries being missed or patient morbidity. Widespread implementation of this rule could lead to reduced healthcare costs and more efficient patient flow in busy emergency departments. Stiell IG, et al, Spine, 2009

What is this?

Hip Osteoarthritis
Figure 1
Figure 2

Femoral Stress Fracture
Femoral neck stress fx on MRI

More obvious ...
Bone Scan
What is this?

Slipped Capital Femoral Epiphysis

Femoral head slips in a posteromedial direction on the femoral neck

Klein's Line on Radiograph

Legg Calves Perthes - coxa plana

Avascular necrosis resulting in a flattening of the femoral head

Patellofemoral Imaging

Merchant (sunrise or skyline) View

Sulcus Angle

- Sulcus angle representing the femoral condylar depth
- Normal = 138° ± 6°
Lateral Patellofemoral Angle

Abnormal patellar tilt in transverse plane orientation
Lines should diverge laterally

Congruence Angle

frontal plane orientation

Bisect Offset

GE > GF
GE = GF

Increased % of patellar width is lateral to the midline – laterally displaced patella

Method used to measure medial and lateral displacement. Determined by a line connecting the posterior femoral condyles (AB) and then projecting a perpendicular line anteriorly through the deepest portion of the trochlear groove (CD) to a point where it bisected the patellar width line (EF) (GF). The bisect offset is reported as the % of the patellar width lateral to the midline.

Patella Alta

Normal
Patellar Alta

Ratio of P:PT = 1:0
More than 20% variation is abnormal

See anything of concern?

Standing bilateral AP view:
note the superiorly displaced right patella secondary to a patellar tendon rupture

MRI of a Patellar Tendon Rupture

Orange arrow:
gap between inferior pole and patellar tendon

White arrow:
distracted patellar tendon fibers

Johnson SD, et al, JOSPT, 2009
What is this structure?

Color enhanced torn ACL on MRI

Normal ACL

The solid black band is the ACL

Complete ACL rupture

The disruption of ligament makes it appear medium-light grey; compare to normal ACL views.

Complete ACL rupture

Midsubstance disruption outlined in yellow

Osteochondral Bruising

• Common consequence of an acute ACL tear
• Extent of damage is quite influential in the speed of non-operative or post-surgical recovery

MRI image of knee with a small geographic bone bruise in the weight-bearing lateral femoral condyle and an extensive bruise of the lateral tibial plateau in association with an ACL rupture.

What is this structure?

PCL

Posterior Cruciate Ligament on MRI

This color enhanced MRI shows a PCL tear (right side). The non-enhanced image (left) shows the torn PCL as printed after the scan

Ottawa Knee Fracture Rule

An x-ray is indicated if any of the following are present within the first 7 days:
1. Patient age ≥ 65
2. Isolated tenderness of the patella
3. Tenderness at the head of the fibula
4. Inability to flex the knee 90°
5. Inability to immediately bear weight for 4 steps (regardless of limping)

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<th>Specificity (95% CI)</th>
<th>+LR</th>
<th>-LR</th>
</tr>
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<tbody>
<tr>
<td>98.5 (93-100)</td>
<td>49 (43-51)</td>
<td>1.93</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Validation from the pooled data of 6 high quality diagnostic studies revealed the following accuracy.
Pittsburgh Knee Fracture Rule

- Mechanism of injury is a blunt trauma or fall
- Patient age < 12 or > 55
- Inability to walk 4 weight-bearing steps in the emergency room

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<tr>
<td>99 (94-100)</td>
<td>60 (56-64)</td>
<td>2.48</td>
<td>0.02</td>
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Validation from the pooled data of 6 high quality diagnostic studies revealed the following accuracy.

What is this?

Jones Diaphyseal Fracture of the 5th metatarsal

Hallux Abductovalgus – “Bunion”

- Metatarsophalangeal hallux valgus angle (HVA) representing the lateral deviation of the 1st phalanx
  - should be < 15°
- Intermetatarsal angle (IMA) should be < 9°

Do you see malalignment? Where?

Lisfranc Fracture-Dislocation

The bases of all of the metatarsals have dislocated and there is a fracture at the base of the 2nd metatarsal.

What do you see on this MRI?

Osteochondral Fracture/Defect of the Medial Talar Dome

Os Trigonum

Posterior Impingement Syndrome

MRI X-ray
Achilles Tendon Tear

Sagittal View of the Ankle to evaluate the Achilles Tendon. The mixed signal intensity in the Achilles Tendon represents tendon tear.

Do you see the avulsion fracture on the left? What is the avulsion fracture on the right?

Undisplaced medial malleolar fracture — could there be a missed proximal fibular or syndesmotic injury?

Undisplaced fracture at the base of the 5th met.

Ottawa Ankle Fracture Rules

Excellent screening tool because of its high sensitivity and very low negative likelihood ratio

Rule
1. Inability to WB 4 steps
2. Localized tenderness in any of 4 spots

http://www.learningradiology.com/toc/tocorgansystems/tocbone.htm

http://rad.usuhs.edu/medpix/