Lower Extremity Ultrasound with MRI Correlation

Jon A. Jacobson, M.D.
Professor of Radiology
Director, Division of Musculoskeletal Radiology
University of Michigan

Disclosures:
- Consultant: Bioclinica
- Advisory Board: Philips
- Book Royalties: Elsevier

Note: all images from the textbook Fundamentals of Musculoskeletal Ultrasound are copyrighted by Elsevier Inc.

Outline
- Hip
  - Effusion
  - Trochanteric pain syndrome
  - Iliopsoas snapping
- Knee
  - Joint effusion and extensor mechanism
  - Baker cyst
- Ankle and Foot
  - Achilles and peroneal tendons
  - Ligaments

Hip: anterior recess
- Anterior and posterior layers
  - Fibrous tissue + minute layer of synovium
  - Hyperechoic
  - Each 2 - 4 mm thick

Hip Effusion:
- Separation of anterior and posterior layers
- Capsule distention at femoral neck > 7 mm or difference of 1 mm from opposite side
- Extension & abduction improves visualization
- Do not internally rotate hip: capsule thickens

Radiology 1999; 210:499
Scand J Rheumatol 1989; 18:113
Acta Radiologica 1997; 38:967
Hip Joint: septic effusion

Long Axis

Hip Labrum

- Normal:
  - Hyperechoic, triangular
- Degeneration: hypoechoic
- Tear:
  - Anechoic cleft
    - Most common anterior
  - Possible paralabral cyst
  - Sensitivity 82%, specificity 60%*

Labral Tear and Paralabral Cyst

Courtesy of D. Fessell, Ann Arbor, MI

Trochanteric Pain Syndrome:

- Most commonly caused by gluteus minimus and medius tendon abnormalities¹
- Trochanteric bursitis: uncommon
  - 20% of symptomatic patients²
  - Not actually inflamed³
  - Not associated with pain⁴

¹Eur Rad 2007; 17:1772
²Long SS et al. AJR 2012; 201:1882
³Clin Rheumatol 2008; 14:82
⁴Skateal Radiol 2008; 37:903

Outline

- Hip
  - Effusion
  - Trochanteric pain syndrome
    - Iliopsoas snapping
- Knee
  - Joint effusion and extensor mechanism
  - Baker cyst
- Ankle and Foot
  - Achilles and peroneal tendons
  - Ligaments

Greater Trochanter

Pfirrmann et al. Radiology 2001; 221:469
**Greater Trochanter**

- AF: anterior facet
- LF: lateral facet
- PF: posterior facet

**Trochanteric Bursitis**

- Transverse
- Coronal

**Gluteal Tendon Pathology:**

- Tendinosis: hypoechoic, no defects
- Partial tear: anechoic clefts
- Complete tear: discontinuous tendon
- >2 mm depth cortical irregularity is associated with tendon tear
  - Positive predictive value = 90% (x-ray)*

*Steinert et al. Radiology 2010; 257:754

**Gluteus Minimus and Medius: Long Axis**

>2 mm cortical irregularity (x-ray) = 90% positive predictive value for gluteus tendon tear

Steinert et al. Radiology 2010; 257:754
Calcific Tendinosis: Gluteus Medius

Outline
• Hip
  – Effusion
  – Trochanteric pain syndrome
  – Iliopsoas snapping
• Knee
  – Joint effusion and extensor mechanism
  – Baker cyst
• Ankle and Foot
  – Achilles and peroneal tendons
  – Ligaments

Snapping Hip Syndrome
• Painful snap with hip motion
• Intraarticular
• Extraarticular:
  – Anterior: iliopsoas tendon
  – Lateral: iliobibial tract or gluteus maximus

Snapping Hip Syndrome: iliopsoas
• Image long axis to inguinal ligament superior to femoral head
• Extension of flexed abducted and externally rotated hip
• Abrupt movement of iliopsoas as iliacus muscle interposed between tendon and bone moves

Deslandes et al. AJR 2008; 190:578

Snapping Hip Syndrome: iliopsoas

Iliopsoas Complex

Red: psoas major
Orange: medial iliacus fibers
Purple: lateral iliacus fibers

Iliopsoas Bursa:

• Hip joint communication in 10%
  – Increased with hip joint pathology
• May extend cephalad into abdomen
• May be mistaken for abscess:
  – Look for hip joint communication

Radiology 1995; 197:853

Outline

• Hip
  – Effusion
  – Trochanteric pain syndrome
  – Iliopsoas snapping
• Knee
  – Joint effusion and extensor mechanism
  – Baker cyst
• Ankle and Foot
  – Achilles and peroneal tendons
  – Ligaments

Joint Effusion

• Suprapatellar recess
  – Superior
    • Prefemoral & quadriceps fat pad separation
    • Distends with partial knee flexion
  – Medial and lateral to patella
    • Distends with knee extension
    • Transducer pressure displaces joint effusion

Suprapatellar Recess and Gutters

Joint Effusion: sagittal plane

Sagittal T2w

Joint Effusion: transverse plane

Transverse

Joint Effusion: knee extension

Quad

Patella

Femur

Quadriceps Tendon: tendinosis

Patella

Femur

Long Axis

Quadriceps Tendon: Partial Tears

Rectus Femoris Tear (1 layer)

Vasti Tear (2 layers)

Quadriceps Tendon: full-thickness tear

Patella

Long Axis

Sagittal PDw
Patellar Tendinosis:
- Jumper’s knee
- Hypoechoic swelling
- Mucoid degeneration, possible interstitial tearing
- Hyperemia: neovascularity
- No inflammatory cells

Radiology 1996; 200:821

Outline
- Hip
  - Effusion
  - Trochanteric pain syndrome
  - Iliopsoas snapping
- Knee
  - Joint effusion and extensor mechanism
  - Baker cyst
- Ankle and Foot
  - Achilles and peroneal tendons
  - Ligaments
**Baker Cyst:**

- Semimembranosus-medial gastrocnemius bursa
- 50% over age of 50 have communication with knee joint
- Cyst communication to posterior knee between SM-MG tendons required

AJR 2001; 176:373
One of the many causes for ankle injury

Outline

• Hip
  – Effusion
  – Trochanteric pain syndrome
  – Iliopsoas snapping
• Knee
  – Joint effusion and extensor mechanism
  – Baker cyst
• Ankle and Foot
  – Achilles and peroneal tendons
  – Ligaments

Achilles Tendon:

• 2 – 6 cm proximal to insertion
  – Tendinosis
  – Full-thickness tear
• Calcaneal attachment
  – Tendinosis, tear
  – Haglund Syndrome

Tendinosis: Achilles

Longitudinal

Power Doppler

Achilles Tendon: partial-thickness tear

Achilles Tendon: full-thickness tear

Long Axis

Sagittal T2w

Courtesy of Jon Halperin, San Diego
Achilles FTT + Intact Plantaris

Achilles Tendon: *dynamic imaging*

Achilles Tendon: *healing tear*

Longitudinal split: peroneus brevis

Peroneal Tendon Subluxation:
- Abnormal movement may only occur dynamically
- Predisposes to peroneal tendon tears
  - Longitudinal split of peroneus brevis
- US: examine with dorsiflexion / eversion
  - 100% accurate diagnosis with US

Neustadter et al. AJR 2004; 183:985
Peroneal Retinaculum

Peroneal Subluxation: dynamic imaging

Posterior
Anterior

Transverse

Dislocation: peroneus brevis & longus

Anterior
Posterior

Short axis

Intrasheath Subluxation

- Abnormal snapping of peroneal tendons
- No lateral displacement, intact retinaculum
- Associations:
  - Convex posterior fibula in 92%
  - Tendon tear in 86%
  - Low lying peroneus brevis muscle in 71%

Outline

- Hip
  - Effusion
  - Trochanteric pain syndrome
  - Iliopsoas snapping
- Knee
  - Joint effusion and extensor mechanism
  - Baker cyst
- Ankle and Foot
  - Achilles and peroneal tendons
  - Ligaments
Technique: lateral
- Anterior talofibular
- Calcaneofibular
- Posterior talofibular
- Anterior tibiofibular
- Posterior tibiofibular

Anterior Talofibular Ligament
- Long Axis

Calcaneofibular Ligament
- Long Axis

Anterior Inferior Tibiofibular Ligament
- Long Axis

Anterior Talofibular Ligament Tear
- Axial T1w + gado

Anterior Talofibular Ligament Tear
- Patient #1
- Patient #2
- Patient #3
Calcaneofibular Ligament Tear

Anterior Inferior Tibiofibular Ligament Tear

Ligament Tear:
- Anterior inferior tibiofibular ligament:
  - Look for interosseous membrane tear if absent lower fibular fracture
  - Maisonneuve fracture

Maisonneuve Fracture

Deltoid Ligament Tear

Take Home Points
- Hip: bursitis is very uncommon
- Knee effusion:
  - Suprapatellar and medial/lateral recesses
- Extensor mechanism: dynamic evaluation
- Baker cyst: must see neck to diagnose
- Achilles: dynamic imaging
- Peroneal: dynamic, subluxation
See www.jacobsonmskus.com for syllabus and other educational material
Twitter handle: @jacobson