Hip Ultrasound

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

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Outline:
• Sonographic technique
• Normal anatomy
• Common pathology

Sonographic Technique: hip and thigh
• Anterior:
  – Hip joint
  – Anterior hip muscles, iliopectineal bursa
  – Consider: symphysis pubis, inguinal hernia
• Lateral: gluteal tendons, bursae
• Medial: adductors
• Posterior: hamstring

Sonographic Technique: Hip
• Anterior
  – Hip joint
  – Anterior musculature
  – Snapping iliopsoas
  – Iliopsoas bursa
  – Lateral femoral cutaneous nerve
• Transducers:
  – 10 – 12 MHz linear
  – <10 MHz curvilinear if needed

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

Radiology 1999; 210:499
Hip: anterior recess

Hip Joint

Iliopsoas Complex

Lateral Femoral Cutaneous Nerve

Sonographic Technique: Hip

Greater Trochanter: gluteal tendons

- Sensory: anterolateral thigh
- Variable course:
  - 62% medial, 27% superficial, 11% lateral to ASIS
- Variable branching
- Superficial to sartorius
  - Lateral fat triangle

- Greater trochanter
- Gluteal tendons
- Bursae
- Snapping hip

- Transducers:
  - 10 – 12 MHz linear
  - <10 MHz curvilinear if needed

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


Rudin D et al. JBJ 2016; 98:561
Gluteus Medius: Long Axis

Sonographic Technique: Hip
- **Posterior**
  - Piriformis
  - Superior gemellus
  - Obturator internus
  - Inferior gemellus
  - Obturator externus
  - Quadratus femoris
  - Sciatic nerve

Sonographic Technique: thigh
- Standardized sequence
  - Anterior: quadriceps femoris
  - Medial: adductors
  - Posterior: hamstrings
- Focused examination
- Transducers:
  - <10 MHz curvilinear (ensure global evaluation)
  - 10 – 15 MHz linear

Piriformis
- Technique:
  - Low frequency curvilinear transducer
  - Axial plane
  - Move transducer inferior to SI joint
  - Angle transducer; inferior and lateral
  - Rotate hip internally: movement of tendon

Sonographic technique: thigh

- **Anterior**
  - Rectus femoris
  - Vastus intermedius
  - Vastus lateralis
  - Vastus medialis
- **Transducers:**
  - 10 – 12 MHz linear
  - <10 MHz curvilinear if needed

From: Netter's Atlas of Human Anatomy

Quads: rectus femoris and vastus intermedius

Quadriceps Femoris: vastus medialis

Quadriceps Femoris: vastus lateralis

Quadriceps Muscles: transverse
Quadriceps Muscles: longitudinal

Sonographic technique: thigh

- Medial
  - Adductors
  - Sartorius
  - Gracilis
- Transducers:
  - 10 – 12 MHz linear
  - <10 MHz curvilinear if needed

Medial Thigh: Sartorius

Sartorius Tendon

Medial Thigh: Adductors
Adductors

Long Axis
Short Axis

Mnemonic: aLaBaM

White arrows: Ant and Post Branches Obturator Nerve

Medial Thigh: Gracilis

Saphenous Nerve

• Largest cutaneous branch of the femoral nerve
• Travels beneath sartorius:
  – Moves anterior to posterior
  – Over gracilis tendon
• Infrapatellar branch: thru sartorius
• Subcutaneous: great saphenous vein

Saphenous Nerve

Sonographic Technique: Thigh

• Posterior:
  – Semimembranosus
  – Semitendinosus
  – Biceps femoris
    • Long and short heads
  – Sciatic nerve
• Transducers:
  – 10 – 12 MHz linear
  – <10 MHz curvilinear if needed

Posterior Thigh: anatomy

From: Netter’s Atlas of Human Anatomy
Proximal Hamstring: gluteal fold

Note: Conjoined semitendinosus (ST) and biceps femoris long head (BF) tendon (yellow arrow), semimembranosus (SM) (blue arrow), and sciatic nerve in a triangle configuration. “Toggle transducer to eliminate anisotropy.”

Proximal Hamstring: gluteal fold to ischial tuberosity

Note: Semimembranosus tendon (yellow arrow) moving medial to lateral.

Proximal hamstring: at ischial tuberosity

Conjoined ST-BF and SM tendons only seen together in long axis when they cross over distal to tuberosity.

Posterior Thigh: longitudinal

Sciatic Nerve

Hamstring Origin

Pathology:
- Joint abnormalities
- Bursal pathology
- Muscle and tendon injury
- Snapping hip syndrome
- Miscellaneous pathology
**Hip Effusion:**

- Separation of anterior and posterior layers\(^1\)
- Capsule distention at femoral neck > 7 mm or difference of 1 mm from opposite side\(^2\)
- Extension & abduction improves visualization\(^3\)
- Do not internally rotate hip: capsule thickens

\(^1\)Radiology 1999; 210:449
\(^2\)Scand J Rheumatology 1989; 18:113
\(^3\)Acta Radiologica 1997; 38:667

**Hip Effusion: misconception**

- It is incorrect to assume that joint fluid may not be seen anterior due to gravity
- Native hip: joint fluid distributes around femoral neck
- In no cases was fluid only seen posterior
- Exception: after hip surgery

Moss et al. Radiology 1998; 208:43

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**Hip Joint: septic effusion**

**Hip Joint: aseptic effusion**

**Pitfall: capsule thickening**

- Internal rotation of hip:
  - Anterior hip capsule
  - Thicker, convex anterior
Hip Effusion:
- Cannot predict infection by ultrasound
- Negative power color Doppler does not exclude infection*
- Guided aspiration

* AJR 1998; 206:731

Joint Injection
- Anterior recess
- In plane
- Transducer:
  - Parallel to femoral neck
  - Consider curvilinear
- Needle: distal to proximal
- 97% accuracy¹

¹Smith J. J Ultrasound Med 2009; 28:329

Joint Injection
- Femoral neck target
- Preferred over aiming for femoral head
- Allows higher injection volumes
- Less extra-articular contrast


Pigmented Villonodular Synovitis
- Head erosion

Juvenile Idiopathic Arthritis
- Normal: hyperechoic, triangular
- Degeneration: hypoechoic
- Tear: anterior
  - Anechoic cleft
  - Sensitivity 82%, specificity 60%, accuracy 80%*


Hip Labrum
- Normal:
  - Hyperechoic, triangular
- Degeneration: hypoechoic
- Tear: anterior
  - Anechoic cleft
  - Sensitivity 82%, specificity 60%, accuracy 80%*
Labral Tear and Paralabral Cyst

- Associated with labral tear
  - Full-thickness or detachment
- Anechoic to hypoechoic
- Multilocular

Paralabral Cyst

- Ultrasound-guided aspiration
- 18 – 20 gauge spinal needle
- Steroid injection

Femoroacetabular Impingement

- Pincer-type: deep acetabulum
- Cam-type
  - Broad irregular femoral neck
  - Possible cortical irregularity at US
- Associated with anterior labrum tear
- Consider dynamic evaluation

FAI: Ultrasound

- Ultrasound can demonstrate a bony protuberance and non-spherical head associated with CAM FAI
- Alpha angle measurements
  - Buck et al.: unreliable
  - Lerch et al.: strong correlation with MRI

Radiology 2005; 236:588

**Total Hip Arthroplasty:**
- Metal components demonstrate posterior reverberation.
- Artifact occurs deep to prosthesis away from fluid collection (unlike MRI, CT).

**Hip Arthroplasty:**
- Ultrasound cannot differentiate small effusion from post-op change.
- Suspect infection:
  - Pseudocapsule > 3.2 mm: suspect infection.
  - Extra-articular fluid collection.
  - Not visualized with arthrography if non-communication.

1. Weybright PN et al. AJR 2003; 181:215
2. AJR 1994; 163:381

**Teaching Point:**
Always screen soft tissues about an arthroplasty prior to fluoroscopic joint aspiration.

**Metal-on-Metal Arthroplasty: pseudotumor**

**Pathology:**
- Joint abnormalities
- Bursal pathology
- Muscle and tendon injury
- Snapping hip syndrome
- Miscellaneous pathology
Trochanteric Pain Syndrome:
- Most commonly caused by gluteus minimus and medius tendon abnormalities\(^1\)
- Trochanteric bursitis: uncommon\(^2\)
  - 20% of symptomatic patients\(^2\)
  - Not actually inflamed\(^3\)
  - Not associated with pain\(^4\)

\(^1\) Kong A et al. Eur Radiol 2007; 17:1772
\(^2\) Long SB et al. AJR 2011; 201:1083
\(^3\) Sylva F et al. Clin Rheumatol 2008; 14:52
\(^4\) Blankenhauer DG et al. Skeletal Radiol 2008; 37:303

Trochanteric Bursal Fluid + Glut Min Tear
- Posterior
- Anterior
- Axial

Trochanteric Bursitis: Septic
- Note posterior location of bursa

Trochanteric Bursitis: Lupus

Trochanteric Bursa: infection + gas
- Greater Trochanter

Trochanteric Region Bursae
- Trochanteric: deep to gluteus maximus
- Subgluteus medius
- Subgluteus minimus
- Axial or coronal plane
**Iliopsoas Bursa**

- Hip joint communication in 10%:
  - Increased with hip joint pathology
  - After joint replacement
- May extend cephalad into abdomen
- May be mistaken for psoas abscess
  - Look for hip joint communication

Radiology 1995; 197:853

**Iliopsoas Bursal Fluid**

- Axial
- T1w post-gadolinium

**Iliopsoas Bursa**

- Oblique-axial plane:
  - Superior to femoral head
  - Lateral to medial
  - Inject between tendon, ilium
- Pain relief = successful iliopsoas surgical release

**Ischial or ischiogluteal Bursa**

- Uncommon
- "Weaver’s Bottom"
- Between ischial tuberosity and gluteus maximus

**Pathology:**

- Joint abnormalities
- Bursal pathology
- **Muscle and tendon injury**
- Snapping hip syndrome
- Miscellaneous pathology

**Muscle and Tendon Injury**

- **Tear:**
  - Anechoic or hypoechoic defect
  - Partial-thickness tear
  - Full-thickness tear: retraction
- **Tendinosis:**
  - Hypoechoic, enlarged
  - No inflammation (not tendinitis)
Tendinosis: Gluteus Medius

AF LF SPF LF

Tendinosis: Gluteus Minimus

AF LF AF

Calcific Tendinosis: Gluteus Medius

AF LF LF

Tear: Gluteus Medius after THA

AF LF LF SPF AF

Tear: Gluteus Minimus

AF LF AF

>2 mm cortical irregularity depth (x-ray) = 96% positive predictive value for gluteus tendon tear
Steinert et al. Radiology 2010; 257:754

Post-operative: Gluteus Medius

Long Axis Short Axis
Semimembranosus: tendinosis

Conjoined Biceps Femoris-Semitendinosus: tendinosis

Conjoined BF-ST Tendon: partial tear

Semimembranosus Tear

Hamstring: complete tear with retraction

Biceps Femoris: remote tear
**Ischiofemoral Impingement**

- External impingement
- Narrowed space between ischial tuberosity and femur
- Associations:
  - Coxa valga
  - Variations in bone anatomy
  - Hip and pelvis instability
  - Abductor / adductor muscle imbalance


**Ischiofemoral Impingement: MRI criteria**

- Narrowed ischiofemoral space:
  - 15 mm or less
  - 77% sens, 81% spec, 78% accurate
- Narrowed quadriceps femoris muscle space
  - 10 mm or less
  - 79% sens, 74% spec, 77% accurate
- Abnormal signal of quadriceps femoris muscle
- Seen in 9% of asymptomatic individuals


**Sports Hernia?**

- A non-anatomic, non-diagnostic term attributed to many cause of groin pain
  - Tears or attenuation of inguinal structures
  - Bulge posterior wall of inguinal canal
  - Obturator nerve entrapment
  - Common aponeurosis abnormality:
    - Rectus abdominis and adductors tendons
  - Associated: pubic symphyseal instability, FAI

Omar IM et al. Radiographics 2008; 28:1415
Garvey JFW et al. Hernia 2010; 14:17
Hopkins JN et al. JBJS Reviews 2017; 5:1
Rectus Abdominis + Adductor: "Sports Hernia"

Note: common aponeurosis

From: RadioGraphics 2008; 28:1415

Rectus Abdominis / Adductor Tendinosis: "Sports Hernia"

Complete Tear: adductor longus

Proximal Distal

Long Axis

Rectus Femoris: anatomy

Aponeurosis Tear (Indirect Head): Rectus Femoris

Short Axis Long Axis

Author: Joe Lemire, Hemisphere Magazine, Feb. 2015
Aponeurosis Tear (Indirect Head):
Rectus Femoris

Partial Tear: rectus femoris

Calcific Tendinosis: rectus femoris

Calcific Tendinosis
- Ultrasound-guided lavage and aspiration
- 20 gauge spinal needle

Rectus Femoris Injury

Rectus Femoris Tear: full tear, pseudomass
**Rectus Femoris Tear: full tear, pseudomass**

**Pathology:**
- Joint abnormalities
- Bursal pathology
- Muscle and tendon injury
- Snapping hip syndrome
- Miscellaneous pathology

**Snapping Hip Syndrome**
- Painful snap with hip motion
- Intraarticular
- Extraarticular:
  - Anterior: iliopsoas tendon
  - Lateral: iliobial 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

**Iliopsoas Complex**


From: Deslandes et al. AJR 2008; 190:576
**Snapping Hip: lateral**

- Transverse over greater trochanter
- Hip external rotation / flexion
- Abrupt motion of iliotibial tract or gluteus maximus over greater trochanter

**Pathology:**

- Joint abnormalities
- Bursal pathology
- Muscle and tendon injury
- Snapping hip syndrome
- Miscellaneous pathology

**Lymph Node: malignant**

- Gray scale:
  - Absent echogenic hilum
  - Narrow hilum with thick cortex
  - Round shape (not oval)
- Power Doppler:
  - Dense vascularity
  - Spotted, mixed, or peripheral (not hilar)
  - High resistance

Radiology 1992; 183:215

**Lymph Node: Non-Hodgkins lymphoma**

**Recurrent Undifferentiated Pleomorphic Sarcoma**

Femur

Transverse  Longitudinal
**Soft Tissue Metastasis: lung**

**Pseudohypertrophy**
- Thigh: tensor fascia lata
- Denervation: spine, chronic
- Pseudomass appearance:
  - Enlarged muscle
  - Fat infiltration

**Polymyositis: sartorius**

**Transection Neuroma: sciatic**

**Meralgia Paresthetica**
- Sensory: anterolateral thigh
- Hypoechoic enlargement
- Ultrasound-guided steroid injection

**Take-home points: hip**
- Joint effusion: anterior hip recess
- Greater trochanteric pain syndrome:
  - Gluteal tendon abnormality, not bursitis
- Tendon tendinosis: know bone footprints
- Snapping hip syndrome: dynamic evaluation
  - Iliopsoas
  - Iliotibial tract / gluteus maximus
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