Introduction to Musculoskeletal Ultrasound

Levon N. Nazarian, M.D.
Professor of Radiology
Thomas Jefferson University Hospital

Disclosures

• None relevant to this presentation

Educational Objectives

• Following the presentation, participant should be able to:
  - Discuss the general applications for US in the MSK system
  - Identify the appearance of normal MSK structures on US
  - Identify common MSK pathologies seen on US

Why Musculoskeletal US vs. MRI?

• Lower cost
• Few technical limitations
• Real time dynamic studies and interventions
• Contralateral comparisons
• Better patient acceptance

Why Musculoskeletal US?

• Better spatial resolution than MRI
• 150 microns (at 10 MHz) vs. 450 microns (shoulder MRI)
• Like shining a flashlight on the abnormality

Two Views of Jefferson
MRI of Achilles Tendon

Longitudinal Achilles Tendon

Musculoskeletal Ultrasound Technique

- High frequency linear transducers
- 10 MHz or higher; 5 MHz if needed for body habitus or deeper structures such as hip joint
- Compound imaging
- Have an anatomic reference handy: www.essr.org

Musculoskeletal Ultrasound Technique

- Contralateral side for comparison
  - Helps differentiate normal from abnormal
  - Beware of bilateral pathology, especially where one side is asymptomatic
Contralateral Comparison

Learn Normal US Appearances

- Tendons
- Muscles
- Joints
- Bursae
- Peripheral Nerves

Normal Tendon Histology

Longitudinal Achilles Tendon

Transverse Achilles Tendon

Normal Anterior Tibial Tendon
**Tendons**

- **Anisotropy**
  - Property of all tendons
  - Occurs when US beam not 90°
  - Do not confuse with pathology
  - Solution: “heel to toe” transducer to produce 90° angle

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**Anisotropic Achilles Insertion**

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**Ankle Tendon Anisotropy**

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**Importance of Linear Transducer**

- Linear 7 MHz
- Curved 8 MHz

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**Complete Achilles Rupture**
Partial Achilles Tendon Tear

Rotator Cuff
Normal US appearance

Full Thickness Tear of Supraspinatus Tendon

Partial Articular Surface RC Tear

Tendinosis
- Disorganized collagen fibers
- Increase in mucoid ground substance
- Random neovascularization
- Focal necrosis
- Fibrocartilaginous metaplasia
- Calcification
- Interstitial tearing

Tendinosis
- Thickened, heterogeneous tendon
- Nodular hypoechoic areas
- Calcification
- Interstitial splits
- Increased Doppler flow (variable)
Insertional Achilles Tendinosis

Gluteus Medius Tendinosis

Calcific Tendinosis, Supraspinatus

Calcific Tendinosis, Subscapularis

Severe Patellar Tendinosis

Severe Patellar Tendinosis
**Tendon Sheaths**

- Hypoechoic halo around tendons
- May contain a small amount of fluid
- Achilles has no sheath: hyper echoic paratenon

**Tenosynovitis**

**Joints**

- Anatomy specific to the body part being examined
- Learn best acoustic window to see effusions for each joint

**PTT Tenosynovitis**

**Joints**

- Hip: anteriorly deep to joint capsule
- Knee: hypoechoic band between the suprapatellar fat pads
- Shoulder: posteriorly at the level of glenoid labrum

**Hip Effusion**
Knee Joint: No Effusion

Kneecap (Patella)
Quad Tendon

Knee Effusion from OA

Knee Effusion: Extended Field of View

Posterior Shoulder Joint
Deltoid
Infraspinatus
Labrum

Joint Effusion

Ankle Joint
Talus
Ankle Joint Effusion

Tibia
Talus

Bursae

- Popliteal (Baker’s) cyst
- Iliopsoas
- Retrocalcaneal

Popliteal (Baker’s) Cyst
Anatomy

- Fluid in gastrocnemius - semimembranosus bursa (medial popliteal fossa)
- Communicates with joint: >50% of adults

Distended Iliopsoas Bursa

Retrocalcaneal Bursitis
Retrocalcaneal Bursitis

Muscles
- Hypoechoic muscle bundles separated by hyperechoic fibroadipose septa
- Longitudinal scans: “pennate” architecture, like veins in a leaf
- Transverse scans: “starry night” pattern
Normal Muscle: Longitudinal

Normal Muscle: Transverse

Muscle Anisotropy

Ruptured Medial Head of Gastrocnemius

Partial Tear of Medial Head of Gastrocnemius

Peripheral Nerves

- Well-seen internal structure
- Similar to tendons
  - Less tightly packed
  - Less anisotropy
- Fascicles separated and surrounded by epineurium

Soleus
Neurofibroma of Tibial Nerve

Ligaments
- Intermediate echogenicity
- Identified by the bones they connect

Anterior Talofibular Ligament

ATFL Sprain

Medial Elbow of Pitching Arm
Normal Ulnar Collateral Ligament

Valgus Stress on Elbow
Fibrocartilage
- Echogenic
- MRI is often test of choice
- US most helpful if positive
  - Labral tears
  - Meniscal tears

Hyaline Cartilage
- Lines articular surfaces
- Hypoechoic
- May mimic fluid
Hyaline Cartilage: Femoral Trochlear Notch

Knee Articular Cartilage Loss

Bone
- Brightly echogenic line with acoustic shadowing
- Don’t ignore: can provide information
  - Unsuspected stress fractures
  - Degenerative changes
  - Erosions from rheumatic disease or osteomyelitis

Persistent Shoulder Pain 6 Months After Car Accident

Rib Fracture Missed on Plain Film
Plain Film Correlation

Foreign Bodies

Foreign Bodies

Pain After ORIF of Humeral Fracture

Dynamic Examination

- Pathology may not be apparent at rest
- Use maneuvers to elicit
- Ask patient to reproduce symptoms

Softball Pitcher with Painful Click While Throwing

Rest

Stress
Peroneal Subluxation

Snapping Iliopsoas Tendon

68-year-old Senior Olympian With Posterior Foot and Ankle Pain
Multiple views of Achilles tendon

Area of Tenderness: Lateral Malleolus

Dx: Peroneus Brevis Split

Disadvantages of US vs. MRI

- Operator dependence
- Internal derangement of joints
- Bone marrow processes
  - Edema
  - Tumors
  - Fractures
- CNS and adult spine
Advantages of US vs. MRI

- Every patient can have an US: they prefer it!
- Superior resolution
- Contralateral comparison
- Real time dynamic studies
- US probe can be placed exactly where it hurts
- Doppler capability
- Interventions

Patient-Centered Imaging

- 28-year-old woman with intractable pain after femoral osteotomy for hip dysplasia
- Lost her job; on disability
- All imaging studies were unrevealing
- Flew here from Portland, OR
- Referring surgeon said patient was “a little crazy”

Asymptomatic Left Iliopsoas

Symptomatic Right Iliopsoas

Symptomatic Right Iliopsoas

Axial

Sagittal

Screw Head

Bone

Screw Threads