MSK US Exam Protocol Standardization

Kenneth Lee/Christina Hendricks/Drew Ross
Revised 11/20/2020

Standardized Diagnostic US Exams:

- Shoulder
- Elbow
- Wrist
- Fingers
- Hip
- Knee
- Ankle
- Foot (Morton's)
- Nerves
- Masses

Complete exams include

- Muscles, tendons, joints, and ligaments as indicated per protocol (*Adjacent joint MUST be imaged to bill a complete exam)*
- Long and Short axis views (*unless otherwise indicated per protocol*)
- Power or Color Doppler (PD)
- Extended field of view images as indicated
- Contralateral comparison if abnormal or as indicated per protocol

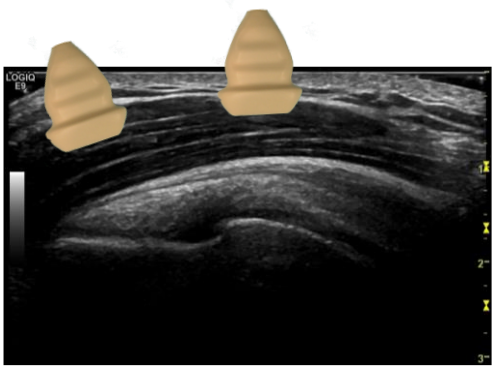
Charge a limited exam for foreign bodies, superficial lumps, as indicated by the protocol, or if only looking at one aspect of any of the protocols below…i.e. just biceps tendon.

UPPER EXTREMITY

- **Shoulder**
  - Long head biceps tendon (PD)
    - Dynamic- biceps tendon subluxation*
  - Subscapularis tendon (PD)
    - Cine Superior to Inferior: (*Long*)
  - Acromioclavicular (AC) joint (PD) (*Short to body*)
  - Supraspinatus tendon (SST) –Modified Crass position (PD)
    - Cine Long and Short
    - Additional images more proximal (*Long*)
  - Dynamic – SST/SASD bursa impingement (*Long*)**
  - Infraspinatus tendon (IST) – with arm crossed over chest (*Long*)
  - Posterior labrum and posterior shoulder joint (*Long*)
    - Dynamic of posterior shoulder/labrum/shoulder joint*
  - Spinoglenoid notch (*Short to body*)
  - SST muscle in fossa w/ contralateral comparison (*Short*)
    - Measurement
  - Extended field of view SST, scapular spine, & IST (*Short*)
  - Tear
    - Cine clip w/compression (best visualized imaging plane)

**Dynamic biceps tendon subluxation & posterior labrum: palm supinated, internal and external rotation*

***Dynamic impingement: abduct arm with thumb pointed toward the floor*



➢ Lateral Elbow

- Common extensor tendon (CET) (PD)
  - Contralateral comparison (*Long*)
    - Measurement
  - Dynamic-stretching CET (*Long*)*
- Radial collateral ligament (RCL) *Pronate hand*
- Radiocapitellar joint with dynamic stressing (*Long*)**

**Dynamic stretching of CET: Hand off the edge of table or sponge, pronate hand, make a fist, flex and extend at the wrist*

***Varus stress: Pronate hand, press affected side wrist into unaffected hand against resistance*

➢ Medial Elbow

- Common flexor tendon (CFT) (PD)
  - Contralateral comparison (*Long*)
    - Measurement
- Ulnar collateral ligament (UCL)
- Ulnar nerve
  - Measurements- AP thickest portion in cubital tunnel (*Short*)
    - Contralateral comparison in same location
  - Dynamic for subluxation/dislocation*
    - Have patient reproduce symptoms
- Ulnotrochlear joint with dynamic stressing (*Long*)**

**Dynamic Ulnar Nerve: Light pressure on posteromedial elbow, flex and extend at the elbow*

***Valgus stress: pt rolled decub on affected side & using unaffected hand to brace humerus against cart; apply pressure to affected side wrist, toward floor*

➢ Anterior Elbow

- Biceps tendon at insertion onto radial tuberosity (PD)
  - Cine prox-dist (*muscle belly -insertion*) (*Short*)
- Biceps muscle
- Brachialis tendon and muscle
- Anterior elbow joint
  - Distal humerus (*Short*)
  - Radiocapitellar joint (*Long*)
  - Ulnotrochlear joint (*Long*)
- Nerves – if applicable

Optional dynamic, questioning tear:

Elbow flexed at 90 degrees, probe long axis to humerus & distal biceps tendon, dynamic with supination/pronation of hand

➢ Posterior Elbow

- Triceps tendon (PD)
- Posterior elbow joint
- Loose body evaluation
- Ulnar nerve
  - Measurements- AP thickest portion in cubital tunnel (*Short*)
    - Contralateral comparison in same location
  - Dynamic for subluxation/dislocation*
    - Have patient reproduce symptoms

**Dynamic Ulnar Nerve: Light pressure on posteromedial elbow, flex and extend at the elbow*

➢ Wrist Volar (Tendons)

- Flexor tendons (PD)
  - Dynamic (*Long*)*
- Median Nerve
  - Measurements- circumferential area (*Short*)
    - In carpal tunnel (level of scaphoid and pisiform)
    - Over pronator quadratus
    - Contralateral comparison
      - In carpal tunnel or same location/level as largest measurement on affected side
  - Flexor retinaculum (*Short to body*)
- Radiocarpal joint (*Long to body*)

**Dynamic: flexion/extension of fingers; DIP dynamic for FDP; PIP dynamic for FDS*

➢ Wrist Dorsal (Tendons/Compartments)

- Extensor tendons (*single or multiple compartments*) (PD)
  - Dynamic (*Long*)*
- Radiocarpal joint (*Long to body*)
- Scapholunate and Lunotriquetral Ligaments (*Short to body*)

**Dynamic: flexion/extension of fingers*

➢ Wrist De Quervain's (1st Compartment)

- Abductor pollicis longus (APL) tendon
  - Prox-Dist (PD)
  - Dynamic*
- Extensor pollicis brevis (EPB) tendon
  - Prox-Dist (PD)
  - Dynamic**
- Compartments 2-6 (*Short*) (PD)- *1-2 images*
- Radiocarpal joint (*Long to body*)

**Dynamic APL: abduction & adduction of thumb*

***Dynamic EPB: flexion & extension of thumb*

➢ Wrist Extensor Carpi Ulnaris Subluxation

- Extensor carpi ulnaris (ECU) Tendon (PD)
- Dynamic ECU snapping/subluxation (*Short*)*
  - Have patient reproduce snapping
- Contralateral comparison (*Short*)
- Contralateral comparison w/dynamic (*Short*)*
- Distal radioulnar joint (DRUJ) (*Short*)

**Dynamic ECU: Light pressure ECU w/in grove; supination and pronation*

➢ Wrist Synovitis

- Volar
  - Radiocarpal Joint (*Long to body*)
  - Distal Radioulnar Joint (*Short to body*)
- Ulnar Styloid (*Long to body*)
- Dorsal
  - Radial Carpal Recesses
    - Trapezium/Scaphoid/Radius (*Long to body*)
    - Capitate/ Lunate/Radius] (*Long to body*)
  - 4th and 6th Dorsal Compartments (*Short*)
- Index and Middle MCP and PIP Joints (*Long*); Volar or Dorsal)
- Power/Color Doppler all joints (Very light pressure on skin)
- Area of pain/swelling (if applicable)

Grading Synovial Hypertrophy

For synovial hypertrophy 0-3:

- 0 = normal
- 1 = synovial hypertrophy to level of metacarpal (fills the angle between bones without bulging over line linking bones)
- 2 = synovial hypertrophy with bulging over the line linking tops of periarticular bones (WITHOUT extension over diaphysis)
- 3 = Extension over diaphysis

PDI (Power Doppler): 0-3

- 0 = normal
- 1 = single vessel
- 2 = <0.5 area of synovium
- 3 = >0.5 area of synovium

➢ Fingers – assess at MCP, PIP, DIP joint on finger of interest

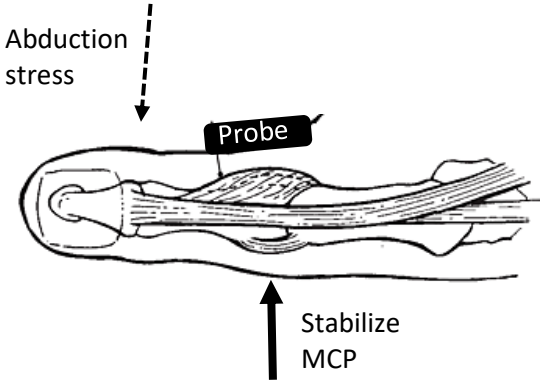
- Flexor tendon (PD) or Extensor tendons (PD) (whichever side is indicated)
- Dynamic imaging
- Volar plate (*Long*) (PD)
- Affected joint (PD)
- Comparison with adjacent or contralateral finger, if necessary
- Tear
  - Follow proximal to wrist to locate tear or measure opposing ends
  - Visualize stumps
  - Dynamic to demonstrate partial vs complete (*Long*)

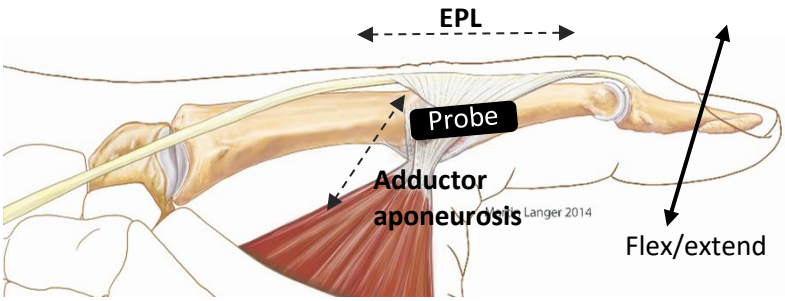
➢ Ulnar Collateral Ligament (UCL) (Thumb)

- UCL (MCP joint) (PD)
  - Contralateral comparison (*Long*)
  - Stress (*Long*) *
    - Contralateral comparison (*Long*)
- Extensor Pollicis Longus (EPL) and adductor aponeurosis
  - Dynamic (*Long*) **
    - Contralateral comparison (*Long*)

**Stabilize radial side of MCP joint while imaging over UCL in long axis; apply abduction stress at the interphalangeal joint*

***Image over UCL as EPL and adductor aponeurosis slide with flex/extend of the DIP*





LOWER EXTREMITY

- **Anterior Hip**
  - Iliopsoas tendon (PD)
    - Dynamic (*Short*)*
  - Iliopsoas bursa
  - Anterior hip joint (*Long*)
  - Anterior hip labrum (*Long*)

**Dynamic IP: flex and externally rotate hip; extend and internally rotate hip in one motion*

- **Lateral Hip *(Limited Study) Max flexion of 30°***
  - Gluteus maximus Tendon (PD)
  - Gluteus medius Tendon (PD)
  - Gluteus minimus Tendon (PD)
  - Extended field of view over greater trochanter (*Long*)
  - Greater trochanteric bursa (*Short*) PD
    - Dynamic clamshell*
  - If lateral hip snapping
    - Iliotibial (IT) band (*Long*)
    - Dynamic (*Short*)**

**Dynamic clamshell: slightly separate knees and bring back together*

***Dynamic IT Band: flexion/extension hip, clamshell, or let patient reproduce*

- **Posterior Hip (Hamstring) *(Limited Study)***
  - Conjoint tendon & proximal muscles (PD)
  - Semimembranosus tendon & proximal muscle (PD)
  - Contralateral comparison (*Long*)
    - Measurement of tendons near origin/thickest area
  - Sciatic nerve near hamstring tendons/muscles (*Short*)

Try low frequency linear or curved for Power Doppler imaging

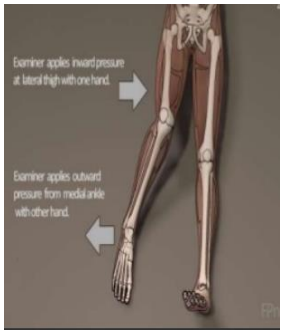
- **Anterior Knee *30° flexion***
  - Quad tendon (PD)
    - Dynamic (*Long*)*
    - Contralateral comparison
    - Measurement
      - Contralateral comparison
  - Patellar tendon (PD)
    - Dynamic (*Long*)*
    - Contralateral comparison
    - Measurement
      - Contralateral comparison
  - Hoffa's fat pad (PD) (*Long*)
  - Suprapatellar fat pad/joint (PD) (*Long*)
  - Joint effusion in suprapatellar region (PD)

**Dynamic Quad and Patellar tendon: flex and extend knee*

➢ Medial Knee

- Medial collateral ligament (MCL) (PD)
- Medial compartment joint space
  - Dynamic of meniscus (*Long*)*
- Pes anserine bursa
- Knee joint effusion (PD)

**Dynamic of Meniscus: use valgus stress by applying outward pressure to medial ankle while pt applies inward pressure to lateral thigh to stabilize leg*

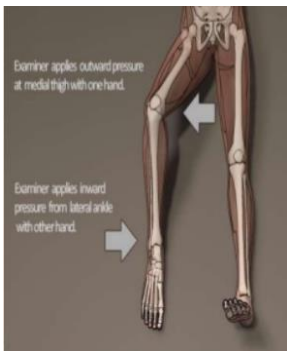


➢ Lateral Knee

- Iliotibial (IT) band (PD)
  - Dynamic- (*Short*)*
- Lateral collateral ligament (LCL)
- Biceps femoris tendon (PD)
- Lateral compartment joint space
  - Dynamic – (*Long*)**

**Dynamic IT band: flexion/extension of knee or let patient reproduce symptoms*

***Dynamic posterolateral corner joint space: use varus stress by applying inward pressure to the lateral ankle while pt applies outward pressure to medial thigh to stabilize leg*



➢ Posterior Knee *(Limited Study)*

- Baker's cyst (PD)
  - Measure
  - Demonstrate neck
- Origin of gastrocnemius muscles
- Posterior knee joint effusion (PD)
- Posterior cruciate ligament (PCL) (*Long*)

➢ Lateral Ankle

- Peroneus Longus tendon (PD)
  - Cine (*Short*)
- Peroneus Brevis tendon (PD)
  - Cine (*Short*)
- Longus & Brevis tendons
  - Dynamic (*Short*)*
- Joint effusion (*Long*) (PD)
- Anterior Talofibular ligament (*Long*) (stress maneuver for tear (dorsiflexion); PD)
- Anterior Tibiofibular ligament (*Long*) (stress maneuver for tear (plantarflexion); PD)
- Calcaneofibular ligament (*Long*) (stress maneuver for tear (dorsiflexion w/eversion); PD)

} Eval for sprains

**Dynamic peroneal tendon at the level of the retinaculum: subluxation test with eversion & circumduction*

➢ Medial Ankle

- Posterior tibial tendon (PD)
  - Cine (*Short*)- *try to include all 3 but PT most important*
- Flexor digitorum longus tendon (PD)
- Flexor hallucis longus tendon (PD)
- Tarsal tunnel/joint (*Short*)
- Medial joints (*Long to body*)
  - Medial malleolus, talus, sustentaculum tali, & flexor hallicus longus

➢ Anterior Ankle

- Anterior tibial tendon (PD)
  - Cine (*Short*)- *demonstrate all 3 tendons*
- Ext hallucis longus tendon (PD)
- Ext digitorum longus tendon (PD)
- Peroneus tertius (PD)
- Anterior tibiofibular ligament (*Long*) (PD)
- Ankle joint effusion (*Long*) (PD)

➢ Posterior Ankle (Achilles)

- Achilles tendon (PD)
  - Cine (*Short*)
  - Extended field of View (*Long*)
  - Contralateral comparison (*Long*)
    - Measurement AP
  - Dynamic Achilles (*Long*) *
- Complete tear
  - Measure gap
    - Neutral
    - Doriflexion
    - Plantarflexion
- Retrocalcaneal bursa (PD) (*Long*)
- Posterior ankle joint (*Long*)
- Plantar fascia (*Long*)
- Muscles
  - Interrogate areas of pain (PD)

**Dynamic Achilles: dorsiflexion and plantarflexion*

- **Foot (Plantar Fascia)**
  - Plantar fascia (PD)
    - Extended field of View (*Long*)
    - Contralateral comparison (*Long*)
      - Measurement
  - Achilles tendon/retrocalcaneal bursa *(Long)*
  - Posterior ankle joint *(Long)*

Try low frequency linear for Power Doppler imaging

- **Foot (Morton's) (*Long*)**
  - MTP joints
    - Plantar plate with dynamic dorsiflexion cine 2, 3 and 4 (PD if abnormal)
    - Flexor tendons
  - Interspaces with compression
    - Split screen if abnormal
    - Measure neuroma
  - If neuroma, Mulder's test (*Short*)

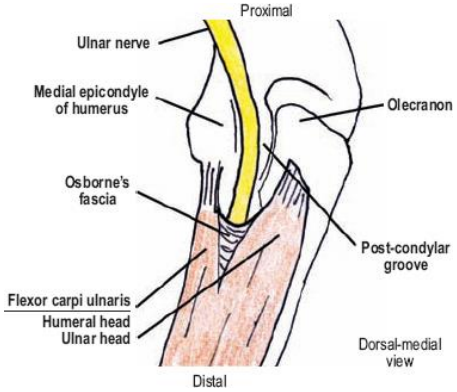
NERVES

- **Median Nerve**
  - Median nerve (PD)
    - Measurements- circumferential area (*Short*)
      - In carpal tunnel (level of scaphoid and pisiform)
      - Over pronator quadratus
      - Contralateral comparison
        - In carpal tunnel or same location as largest measurement on affected side
    - Flexor retinaculum (*Short to body*)
  - Radiocarpal joint (*Long to body*)

- **Ulnar Nerve (Elbow)**
  - Ulnar nerve (PD)*
    - Measurements- AP thickest portion in cubital tunnel (*Short*)
      - Contralateral comparison in same location
    - Dynamic for subluxation/dislocation**
      - Have patient reproduce symptoms
    - Distal at flexor carpi ulnaris origins
      - Between humeral and ulnar heads
  - Ulnotroclear joint *(Long)*

**Image through cubital tunnel (b/w medial epicondyle and olecranon)*

*** Dynamic Ulnar Nerve: Light pressure on posteromedial elbow, flex and extend at the elbow*



- **Ulnar Nerve (Wrist/Guyon's Canal)**
  - Ulnar nerve (PD)
    - Measurements- AP thickest portion w/in canal (*Short*)
      - Contralateral comparison in same location
  - Pisotriquetral joint (*Short to body*)

**Image proximal to distal volar wrist through Guyon's canal*

- **Common Peroneal Nerve (Posterolateral knee/fibula)**
  - Common peroneal nerve (PD)
    - Location
      - *From branch off the sciatic nerve, distally around fibular head to bifurcation*
      - *Follow superficial and deep branches a few cm distal to bifurcation (Short)*
    - Measurement (*Short*)
      - Contralateral comparison
    - Cine (*Short*)
      - From sciatic to bifurcation
  - Anterior compartment muscles (PD)
    - Atrophy and echogenicity changes due to innervation issues
  - Proximal tibiofibular joint (*Short to body*)

- **Other Nerve Mapping (*Limited study*)**
  - Radiologist discretion per exam
  - Bump/Neuroma bill as limited diagnostic

Masses*

- Mass evaluation
  - Long & Short Axis (PD)
  - Visualize bone deep to mass- at least 1 image
  - Cines
    - Compression
    - Sup-Inf and/or Med-Lat
  - Extended field of view to demonstrate nearest joint or bony landmark
  - May add Color Doppler as needed
  - May add Pulsed Doppler as needed
    - Add US Peripheral Doppler charge if rads dictate PW Doppler used

Off-hours: assign to READ POOL MSK CSC CT

*MSK Mass Evaluations:

- Ganglion vs pseudoaneurysm
- Mass that is found to be thrombophlebitis
- Mass vs vascular malformation
- Mass vs arterial clot
- Baker's vs popliteal aneurysm
- Baker's vs DVT
  - 2 orders:
    - Baker's: check with MSK
    - DVT: check with ABD
- If DVT order only and baker's is incidental- **check with ABD** (they can call MSK if needed)
- Mass to EVAL FOR thrombophlebitis- **check with ABD** as this may be a peripheral Doppler

NOTE: Guidelines for performing diagnostic exams on injection patients

- **Joint injections do not need a diagnostic unless requested – Injection only**

- Shoulder: Bursa, Tendon Sheath

Diagnostic w/Injection	Injection only
• No prior diagnostic ultrasound or MRI w/in 2 years • New injury • Recent surgery	• Prior diagnostic ultrasound or MRI w/in 2 years • No new injury • No recent surgery • **Glenohumeral/ AC/SC joint, ganglion and nerve injections do not need a diagnostic unless requested – Injection only**

- Elbow/Hand/Wrist: Bursa, Tendon Sheath, Tendon Origin/Insertion

Diagnostic w/Injection	Injection only
• No prior diagnostic ultrasound or MRI w/in 2 years • New injury • Recent surgery	• Prior diagnostic ultrasound or MRI w/in 2 years • No new injury • No recent surgery • **Joint, ganglion, and nerve injections do not need a diagnostic unless requested – Injection only**

- Hip: Iliopsoas Bursa

Diagnostic w/Injection	Injection only
• No prior diagnostic ultrasound w/in 2 years • New injury • Recent surgery • *Limited Dx + Injection if prior MRI ○ Dynamic	• Prior diagnostic ultrasound w/in 2 years • No new injury • No recent surgery

- Hip/Knee: Greater Trochanteric Bursa, Tendon Sheath, Tendon Origin/Insertion

Diagnostic w/Injection	Injection only
• No prior diagnostic ultrasound or MRI w/in 2 years • New injury • Recent surgery	• Prior diagnostic ultrasound or MRI w/in 2 years • No new injury • No recent surgery • **Joint, Baker's, ganglion, nerve, and fat pad injections do not need a diagnostic unless requested – Injection only**

- Foot/Ankle: Bursa, Tendon Sheath, Paratenon, Morton's

Diagnostic w/Injection	Injection only
• No prior diagnostic ultrasound or MRI w/in 2 years • New injury • Recent surgery	• Prior diagnostic ultrasound or MRI w/in 2 years • No new injury • No recent surgery • **Joint, ganglion, fat pad injections do not need a diagnostic unless requested – Injection only**

- Calcific Lavage
  - Image affected tendon (long/short/cine/PD) only to evaluate for tear and measure calcium unless full diagnostic indicated
  - Bill Calcific Lavage (R76924AY) and add Limited Extremity (Group both for Power Scribe)

- Limited vs complete
  - Limited studies are lump/bump/ganglion cyst checks that do not turn into detailed study OR protocols that don't include adjacent joint (indicated in protocols above)

****All protocols subject to changes by staff radiologist on case by case basis****