Musculoskeletal Ultrasound

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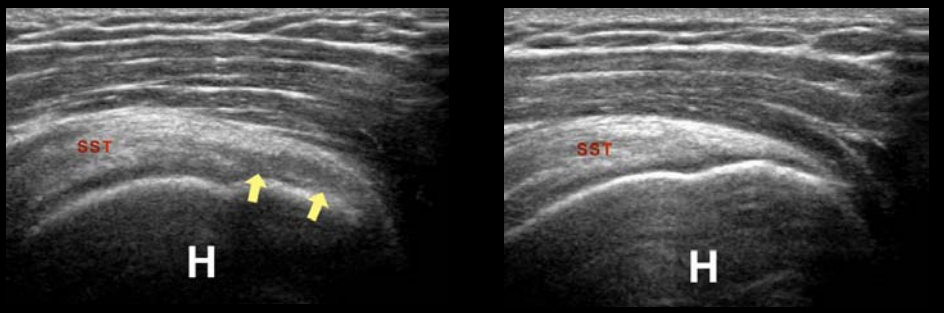


Longitudinal images of the supraspinatus tendon at the same location. What artifact is responsible for simulating the partial thickness articular surface tear on the left?

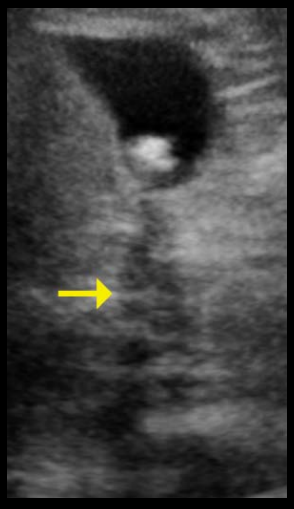
A. Anisotropy.
B. Shadowing.
C. Posterior acoustic enhancement.
D. Posterior reverberation.

Anistropy Artifact

- **What is anisotropy?**
  - When a tendon is imaged perpendicular to US beam, the characteristic hyperechoic fibrillar appearance is displayed
  - If the beam is angled as little as 5 degrees relative to long axis of the tendon, the normal hyperechoic appearance becomes hypoechoic
  - Affects tendons, ligaments, and to a lesser degree muscle
  - Can be used to advantage to identify tendons and ligaments surrounded by hyperechoic fat

Anistropy Artifact

- **Other artifacts:**
  - Shadowing
    - US beam is reflected, absorbed, or refracted
    - Anechoic area is created deep to the involved interface
    - Bone/calcification, foreign body, gas



Gallstone with shadow

Anistropy Artifact

- **Other artifacts:**
  - **Posterior acoustic enhancement**
    - Primarily occurs when imaging fluid
    - US beam is less attenuated compared with adjacent structures
    - Deep to the fluid, the soft tissue appears hyperechoic

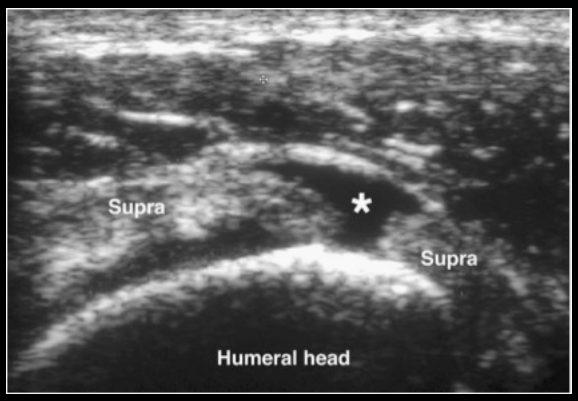
Olecranon bursitis with posterior acoustic enhancement

Anistropy Artifact

Adenomyomatosis

- **Other artifacts:**
  - **Posterior reverberation**
    - Occurs when surface of object is smooth or flat (bone for instance)
    - US beam reflects back and forth from smooth surface to transducer
    - Creates series of linear reflective echoes deep to the structure

Splenic cysts



Transverse Plane

What sign is helpful in identifying a partial thickness articular surface tear of the rotator cuff on US?:

A. Cartilage interface sign.
B. Concavity of superior surface.
C. Tendon swelling.
D. Arcuate sign.

Rotator Cuff Tear

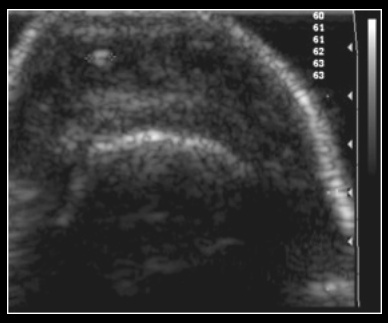
- **Findings of rotator cuff tear on US:**
  - Typically affects the supraspinatus tendon
  - SST tears may be associated with cortical irregularity of the greater tuberosity when chronic
  - May have glenohumeral joint effusion and/or increased fluid within the subacromial-subdeltoid bursa
  - Can be partial thickness (articular or bursal surface) or full thickness
  - Tears are typically anechoic or hyopechoic
  - Tendon thinning may be present
  - If a tear of the SST extends > 2.5 cm posterior from the rotator interval, the infraspinatus is involved

Rotator Cuff Tear

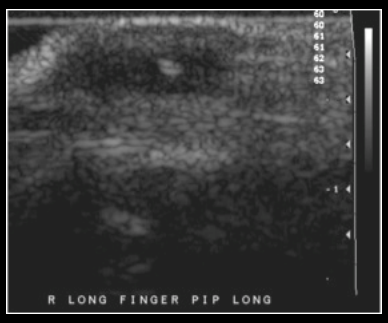
- **DDx for rotator cuff tear on US:**
  - Tendinosis
    - Degeneration of the tendon
    - Heterogenous, ill-defined, hypoechoic area within the tendon
    - Tendon may be swollen
  - Anisotropy

Rotator Cuff Tear

- **Cartilage-interface sign:**
  - There is a normal thin hyperechoic interface separating hyaline cartilage (hypoechoic) from tendon (hyperechoic)
  - This echogenic interface is accentuated with partial thickness articular surface tears of the RC



Transverse



Longitudinal

What may the echogenic focus be composed of in this patient status post persistent STS following recent fall into rose bush?

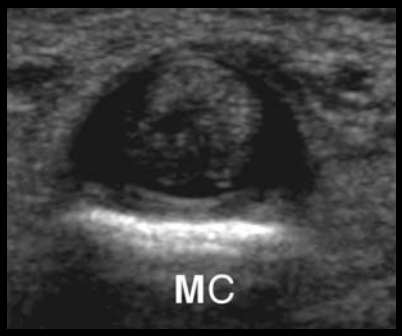
A. Plant material.
B. Glass.
C. Needle.
D. Nail.

Soft Tissue Foreign Body

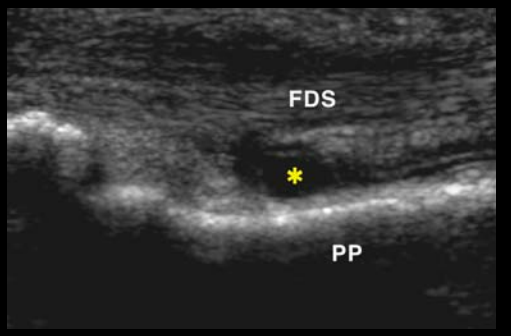
- **Findings of soft tissue foreign body on US:**
  - All ST FB's are initially echogenic, however plant material becomes more hypoechoid with time
    - US is most useful for FB's that are not radiopaque (wood, plastic)
  - ST FB will be most echogenic when US beam is perpendicular to the surface of the FB
  - Hypoechoic halo and hyperemia may be present, related to hemorrhage, granulation tissue, and abscess
  - May demonstrate shadowing and/or reverberation

Soft Tissue Foreign Body

- **DDx for soft tissue foreign body on US:**
  - Gas – either from prior attempted removal or less likely infection
  - Soft tissue mass



Transverse Metacarpal Level

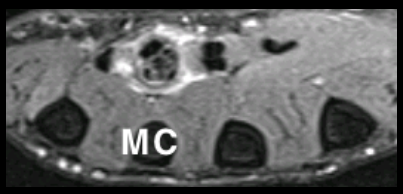


Long PP Level

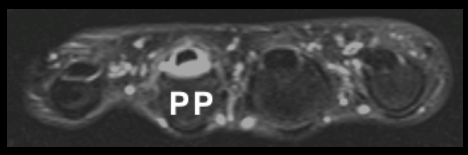
What is missing at the level of the yellow asterisk?

A. Flexor digitorum profundus.
B. Flexor digitorum superficialis.
C. Sagittal band.
D. Collateral ligament.

Does the MRI support your answer?



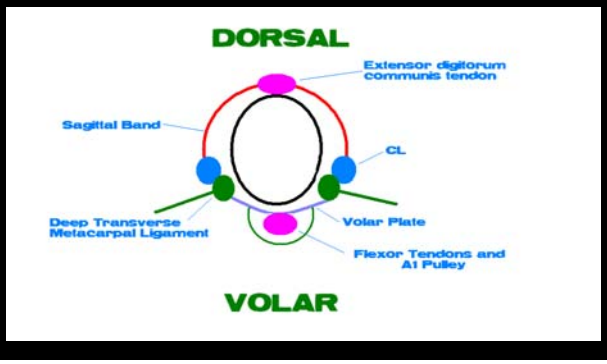
Axial T2 FS at Metacarpal



Axial T2 FS at Proximal Phalanx

Rupture of the Flexor Digitorum Profundus

- **Flexor tendon anatomy:**
  - Flexor digitorum superficialis (FDS) resides superficial to the flexor digitorum profundus (FDP)
  - FDS divides into two bundles, and then inserts onto the middle phalanx
  - FDP inserts onto the distal phalanx
  - Pulley system holds the flexor tendons onto the adjacent digit
    - Pulleys have an echogenic appearance at their respective locations

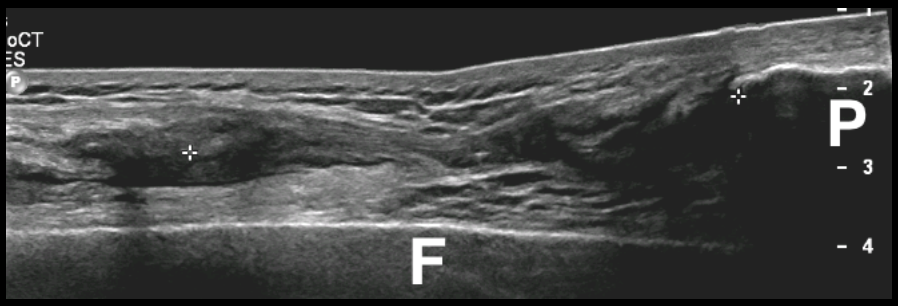


Rupture of the Flexor Digitorum Profundus

- **Flexor tendon abnormalities on US:**
  - Pathology of the tendon: Tenosynovitis, tendinosis, and tendon tear
    - Tenosynovitis - distention of synovial sheath around the tendon by simple fluid, complex fluid, or synovitis
    - Tendinosis – hypoechoic swelling without fiber disruption
    - Tendon tear – either partial or complete fiber disruption (dynamic imaging can be helpful to differentiate the two)

Rupture of the Flexor Digitorum Profundus

- **Pulley injury on US:**
  - The tendon becomes abnormally displaced from volar aspect of the phalanges → Bowstringing
  - Hypoechoic tissue resides between the phalanx and tendon
  - Hyperechoic pulley is not visualized
  - A2 pulley is located at the proximal phalanx



Long Image Distal Femur (F = femur; P = patella)

The structure ruptured in this image exhibits how many lamina when imaged in cross section?

A. 1
B. 2
C. 3
D. 4

Quadriceps Tendon Rupture

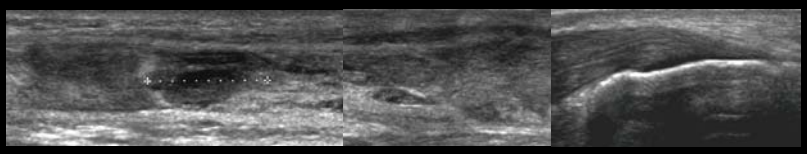
- **Quadriceps tendon anatomy:**
  - Composed of four individual muscles, creating a trilaminar appearance in cross section:
    - Rectus femoris
    - Vastus medialis and lateralis
    - Vastus intermedius

Quadriceps Tendon Rupture

- **Findings of quadriceps tendon tear:**
    - o Partial thickness tears are well defined hypo- or anechoic clefts within the tendon fibers
    - o Full thickness tears exhibit complete tendon disruption, tendon retraction, joint fluid tracking from suprapatellar recess through the defect, and buckling of the patellar tendon
    - o Dynamic imaging can be used to determine partial versus full thickness tear

Quadriceps Tendon Rupture

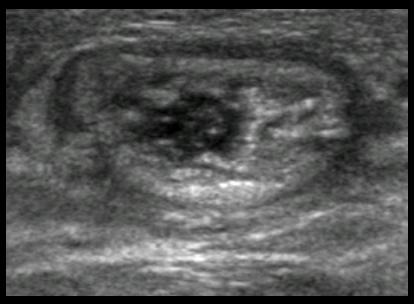
- **DDx for quadriceps tendon tear:**
    - o Tendinosis – hypoechoic and swollen without fiber discontinuity



Long Achilles Proximal to Distal

Imaging features above of the recently repaired Achilles tendon suggest:

A. Tendinosis.
B. Partial Tear.
C. Tendinosis plus partial tear.
D. Partial tear superimposed upon surgical repair.



Trans Proximal Achilles

Achilles Tendon Pathology

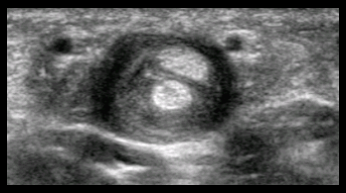
- **Achilles Tendon on US:**
  - o Best to image with patient prone
  - o The anterior margin of the normal Achilles is flat or concave, but never convex
  - o Injury usually occurs between 2-6 cm from the insertion, a poorly vascularized segment
- **US features of Achilles tendon tear:**
  - o Partial thickness tear – hypoechoic/anechoic cleft of fiber disruption
    - ▪ Thickening of the tendon with abnormal intrasubstance appearance can also signify partial tear
    - ▪ Neovascularity
  - o Full thickness tear – complete tendon fiber disruption with tendon retraction
    - ▪ Dynamic imaging may be useful to diagnose

Pre-op Sagittal T2 FS

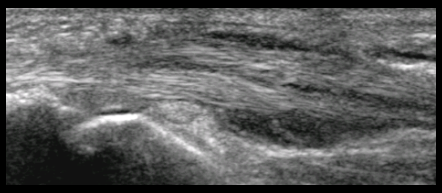
Achilles Tendon Pathology

- **Post-operative appearance of the Achilles tendon:**
  - o Heterogenous and hypoechoic with hyperechoic suture material
  - o Fiber continuity should be seen, however
- **DDx of Achilles tendon tear:**
  - o Paratenonitis – abnormal fluid about the tendon
  - o Tendinosis – hypoechoic fusiform swelling without fiber discontinuity; neovascularity
  - o Xanthoma deposition – range from focal hypoechoic nodules to a heterogenously hypoechoic swollen tendon

Pre-op Sagittal T2 FS



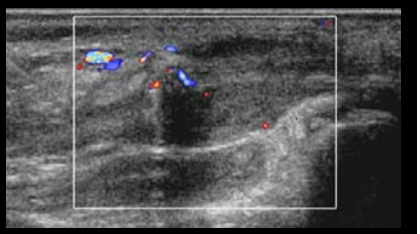
Trans Flexor Tendonds 3rd Finger



Long Flexor Tendons

In what clinical settings does this entity occur?:

A. Degenerative.
B. Traumatic.
C. Inflammatory (RA, infection, crystal deposition)
D. All of the above.



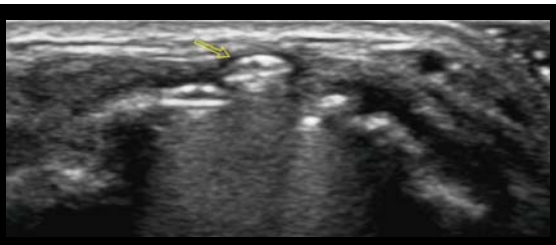
Color Doppler Long

Tenosynovitis of the Hand

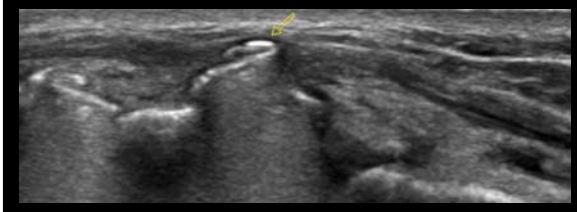
- **Findings of tenosynovitis involving the tendons of the hand:**
  - Distension of synovial sheath around the tendon
    - If anechoic, fluid is likely simple
    - If not anechoic, consider complex fluid versus synovitis
      - Compressibility, movement of internal echoes with transducer pressure, and lack of flow on color/power doppler suggest complex fluid

Tenosynovitis of the Hand

- **Specific forms of tenosynovitis about the wrist:**
  - de Quervain's tenosynovitis
    - Extensor pollicis brevis and abductor pollicis longus tendons (1st compartment)
    - Thickening of tissues around the involved tendons, hyperemia, tendinosis, and cortical irregularity at the radius



Trans US Wrist



Long US Wrist

The structure denoted by the yellow arrow has most likely disrupted the:

A. Flexor tendons.
B. Extensor tendons.
C. TFCC.
D. Scapholunate ligament.

Lateral Wrist

Frontal Wrist

Orthopaedic Hardware Impingement

- **What is orthopaedic hardware impingement?:**
  - Hardware protruding from the bone surface, causing irritation of the adjacent structures
  - US is not limited by metal artifact, and can assess local soft tissues during dynamic examination
- US appearance of orthopaedic hardware and impingement**:**
  - Hardware appears echogenic with posterior ring-down artifact
  - Pathologic changes of the regional soft tissues are seen with tenderness on dynamic examination at the site of protruding hardware
  - Protruding hardware can irritate ligaments, tendons, muscle, bursa, vessels, and nerves

Orthopaedic Hardware Impingement

- **Tendon findings:**
  - Hypoechoic and swollen
  - Tenosynovial fluid
  - Partial or complete tearing
  - Hyperemia
- **Muscle findings:**
  - Partial tearing
  - Hematoma
- **Nerve findings:**
  - Hypoechoic and swollen
  - Tingling and paresthesias with compression of the US probe

Orthopaedic Hardware Impingement

- **Vascular findings:**
  - Aneurysm/pseudoaneurysm (to and fro flow spectral waveform)
  - Thrombus (hyperechoic intraluminal material)

References

- Jacobson, Jon A. Fundamentals of Musculoskeletal Ultrasound. Saunders Elsevier, 2007.
- Guillin R, Botchu R, Bianchi S. Sonography of orthopedic hardware impingement of the extremities. J Ultrasound Med. 2012 Sep;31(9):1457-63.