Sonographic evaluation of the ligaments and tendons of the hands

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Introduction

• Ultrasound’s role in the evaluation of musculoskeletal abnormalities is steadily increasing. High spatial resolution and real time dynamic imaging make ultrasound a powerful tool for the evaluation of ligaments and tendons.

• Ultrasound has been shown to be both sensitive and accurate in its assessment of the ligaments and tendons of the hands.

• This exhibit will review both the normal sonographic appearance of the tendons and ligaments of the hand as well as some commonly encountered pathology.
Methods and Materials

• Normal anatomic sonographic images of the ligaments and tendons of the hand were obtained from control patients to demonstrate normal anatomy.

• The Picture Archive and Communication System (PACS) was searched for representative pathological cases involving the hand.

• Electronic medical records were reviewed to confirm the sonographic diagnosis.
Normal anatomy - Flexors

Digital arteries (DA); Lumbricals (L); Flexor digitorum profundus (FDP)
Flexor digitorum superficialis (FDS); Metacarpal (MC)
Normal Anatomy - Extensors and Ligaments

Greyscale short axis images of normal extensor tendon and adjacent sagittal bands in neutral (A), and flexed position (B). Extensor tendon (ET); Sagittal band (SB); Flexor tendons (FT); Metacarpal (M).

M- Metacarpal head; PP- Proximal phalanx

Flexor tendon rupture

- **Sonographic presentations:**
  - **Strain:** Hypoechoic thickening without fiber disruption.
  - **Partial tear:** Hypoechoic thickening with interruption of the normal fibrillary pattern. This can be difficult to discern from tendinosis.
  - **Complete tear:** Complete disruption of the tendon fibers with focal hypoechoic or anechoic area corresponding to the tear site.

- **Associated US findings:** Cortical avulsion, hematoma, herniated adjacent tissues in the defect, and proximal tendon retraction.

- **Etiologies:** Most commonly penetrating trauma. Also seen in blunt trauma and inflammatory conditions such as rheumatoid arthritis.

- **Dynamic evaluation:** Passive and active movement of the tendon can be helpful to differentiate between complete and partial thickness tears by demonstrating the presence or absence of contiguous fiber movement.

Greyscale ultrasound images of flexor digitorum profundus (t) in short axis (A) and long axis (B) show focal heterogeneity and thickening (representing hematoma) with associated fiber disruption (white arrows).
Tenosynovitis

Inflammation of the fluid filled sheath surrounding the tendon.

- **Sonographic presentation:** Hypoechoic or anechoic distension of the synovial sheath with or without associated increased vascularity.
  - **Simple fluid:** Hypoechoic or anechoic with no internal debris.
  - **Complex fluid:** Hypoechoic fluid with internal mobile low level echogenic debris. The sheath maintains its compressibility.

- **Associated US findings:** Peritendinous hyperemia, thickening of the tendon sheath, underlying tendinosis, and adjacent cortical erosion.

- **Etiologies:** Mechanical stress, trauma, infection, inflammation, and crystal deposition.

- **Dynamic evaluation:** Compression of sheath can differentiate complex fluid from synovial hypertrophy. In the case of synovial hypertrophy there will be loss of tendon sheath compressibility as well as associated internal vascularity on Doppler imaging.

Greyscale ultrasound images in short axis (A) and long axis (B) show predominately anechoic fluid (white arrows) surrounding the tendon (t).
Trigger finger

Inflammation and thickening of the annular pulley.

- **Sonographic presentations:** Focal thickening and hypoechogenicity of the annular pulley with associated hypervascularity.

- **Associated US findings:** Tendinosis, tenosynovitis.

- **Etiologies:** Most commonly idiopathic. Also seen in patients with inflammatory arthropathy, diabetes, mucopolysaccharidoses, and hypothyroidism.

- **Dynamic evaluation:** Passive and active movement of the tendon can be helpful to visualize abnormal movement and catching of the tendon as it passes through the thickened pulley.

Greyscale and power Doppler ultrasound images in short axis (A) and long axis (B) show irregular thickening and hypervascularity of the A2 pulley (thick white arrows). There is also thickening and hypoechogenicity of the flexor tendon (thin white arrows). Proximal phalanx (PP).
Ulnar collateral ligament tear

- **Sonographic presentation:** Disruption of the ligament fibers with associated focal hypoechoogenicity at the site of tear and possible fragment displacement.
  - If the adductor pollicis aponeurosis becomes interposed between the injured UCL and its insertion site at the base of the proximal phalanx it prevents spontaneous healing (Stener lesion) and surgical consultation should be sought.

- **Associated sonographic findings:** Bone avulsion, joint effusion, volar plate injury, Stener lesion.

- **Dynamic evaluation:** Valgus stress of the MCP joint to evaluate for joint laxity and help determine a partial from complete UCL tear.

Images from dynamic US without stress (C), and with stress (D) show gapping of the joint (thin white arrow), and fluid in the tear at the proximal phalanx attachment site (thick white arrow).

Greyscale ultrasound images in long axis of the UCL show a patient with a normal intact ligament (A) (arrow heads) and a patient with a focal hypoechoic tear (B) (thick white arrow). Note the normal position of the adductor pollicis aponeurosis (thin white arrows), MC, metacarpal; PP, proximal phalanx.
Stener lesion

Complete tear of the UCL with retraction and displacement of the disrupted proximal ligament fragment in relation to the adductor pollicis aponeurosis.

- **Sonographic appearance:** Complete tear of the UCL with a hypoechoic round mass proximal to the MCP joint representing the displaced proximal ligament fragment. The adductor pollicis aponeurosis may be interposed between the bone and retracted ligament.

- **Dynamic image:** Gentle valgus stress will show gapping of the joint with total fiber disruption. Additionally, passive flexion of the thumb IP joint can mobilize the overlying adductor pollicis aponeurosis (attached to EPL tendon) to differentiate it from the torn retracted UCL.

Greyscale (A) and color Doppler (B) ultrasound images in long axis of the UCL show a full thickness tear with proximal fragment displacement presenting as a hypoechoic mass (thick white arrow). The adductor pollicis aponeurosis (thin white arrows) appear to terminate at the retracted tendon fragment. MC, metacarpal; PP, proximal phalanx.
Sagittal band rupture

Range of sagittal band injuries include strain, partial tear, and complete tear. Complete tear causes extensor tendon subluxation/dislocation.

- **Sonographic presentations:** Hypoechoic thickening of the sagittal band. Ulnar or radial subluxation of the tendon will occur when the MCP is in the flexed position.
  - Radial band injury - ulnar dislocation extensor tendon.
  - Ulnar band injury - radial dislocation extensor tendon.
  - Radial band is more commonly involved.
  - 3rd digit is most commonly involved.

- **Etiologies:** Penetrating or blunt trauma, flexion or extension against resistance, inflammatory conditions, and occasionally spontaneous.

- **Dynamic evaluation:** Active and passive flexion and extension maneuvers (especially against resistance) of the MCP joint will demonstrate ulnar or radial subluxation in the flexed position.

Short axis image shows hypoechoic sagittal band and centered position of the extensor tendon (t) in relation to the metacarpal bone when the MCP is held in extension (A). Greyscale ultrasound image in long axis (B) of the extensor digitorum tendon show elevation of the tendon from the MCP in hyperextension (skinny white arrows). Cine clip (C) shows abnormal ulnar subluxation of the tendon with active flexion inferring a radial band tear. MC, metacarpal; PP, proximal phalanx; Sagittal bands (thick white arrows).
A2 pulley tear

Acute disruption of one or more pulleys often due to mechanical overload.

- **Sonographic presentations:** Increased hypoechogenicity or absence of the pulley. May be associated with tenosynovitis. Bowstringing of the flexor tendons will be seen, particularly when the digit is in the flexed position.

- **Dynamic evaluation:** Active forced flexion against resistance will help induce bowstringing. This is an important indirect sign of a complete pulley tear as the injured pulley may be difficult to directly visualize.

- **Eight functional pulleys:**
  - Five annular pulleys (A1-A5)- Strong and functionally important.
  - Three cruciate (C1-C3)- Add to the strength of tendon sheaths.

- A2 is the strongest pulley but most frequently injured, followed by A4.
  - A2 and A4 are the most biomechanically important and critical to prevent bowstringing.
  - A1 and A5 are infrequently injured.

Greyscale long axis ultrasound images (A) show the normal relation of the flexor tendon (t) to the underlying proximal phalanx (PP) and A2 pulley (thick arrow). The bottom US image in a different patient shows elevation of the flexor tendon (t) due to an A2 pulley tear (B). Note the fluid surrounding the tendon (thin white arrow) representing accompanying tenosynovitis.
Dupuytren’s contracture
Fibrosing disorder involving the palmar aponeurosis of the hand.

- **Sonographic presentations:** Hypoechoic cords and nodules in the palmar fascia commonly seen at the palmar crease and overlying the third and fourth rays.

- **Associated US findings:** Hypervascularity in early nodules, vascular encasement by fibrous tissue, and progressive contracture of the digits.

- **Etiologies:** Hereditary condition. Also associated with diabetes, cirrhosis, seizure disorders, and trauma.

- **Fascial bands that become involved:**
  - **Palmar:** pretendinous cord.
  - **Palmodigital:** spiral cord (PIP contracture).
  - **Digital:** central cord (MCP contracture), lateral cord, digital cord, and retrovascular cord (DIP contracture).

Greyscale ultrasound images of the palmar fascia in long axis (A), and short axis (B) show hypoechoic cords (white arrows) in the palmar fascia overlying the flexor tendons (t) of the 3rd and 4th rays. MC, metacarpal; C, carpal bones.
Digital neuroma

Response to peripheral nerve injury. Classified into two types: neuroma in continuity (NIC) and an end-bulb neuroma.

- **Sonographic presentations:**
  - **NIC:** Focal fusiform hypoechoic mass in continuity with the digital nerve.
  - **End-bulb:** Bulbous hypoechoic mass presenting in the distal aspect of a completely severed or amputated nerve.

- **Etiology:** NIC may develop from any degree of nerve injury. End bulb neuromas develop after a peripheral nerve is completely severed or amputation.

Power Doppler ultrasound images in short axis at the level of the left (A) and right fourth metacarpal heads (MC) for comparison show a round hypoechoic mass (thick white arrows) adjacent to the digital artery (thin white arrows). Greyscale (B) and power Doppler (C) ultrasound images in long axis show an avascular, hypoechoic mass (thick white arrows) noted to be in continuity with the digital nerve (NIC). Intraoperative correlative image (D) shows a digital neuroma in continuity (thick arrows).
Conclusion

• High spatial resolution and dynamic technique make ultrasound an extremely useful tool to evaluate the ligaments and tendons of the hand.

• After reviewing this exhibit you should feel more comfortable with the normal sonographic appearance of the ligaments and tendons of the hand as well as the reviewed commonly encountered pathology.