

The Wrist & Hand



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MSKMasters.com

The Wrist & Hand

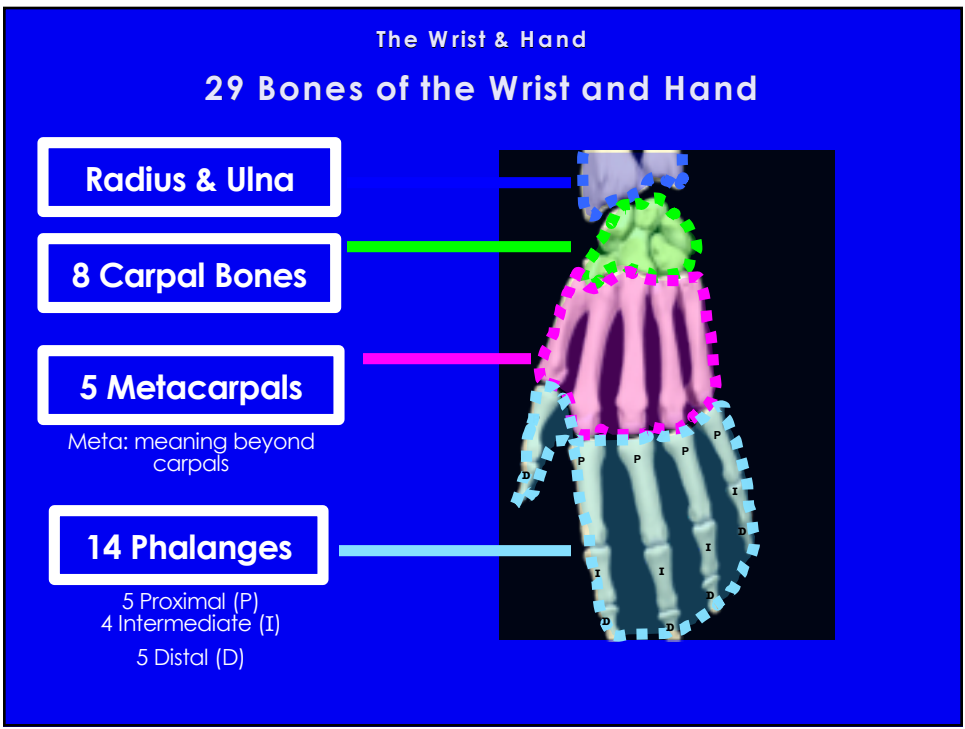
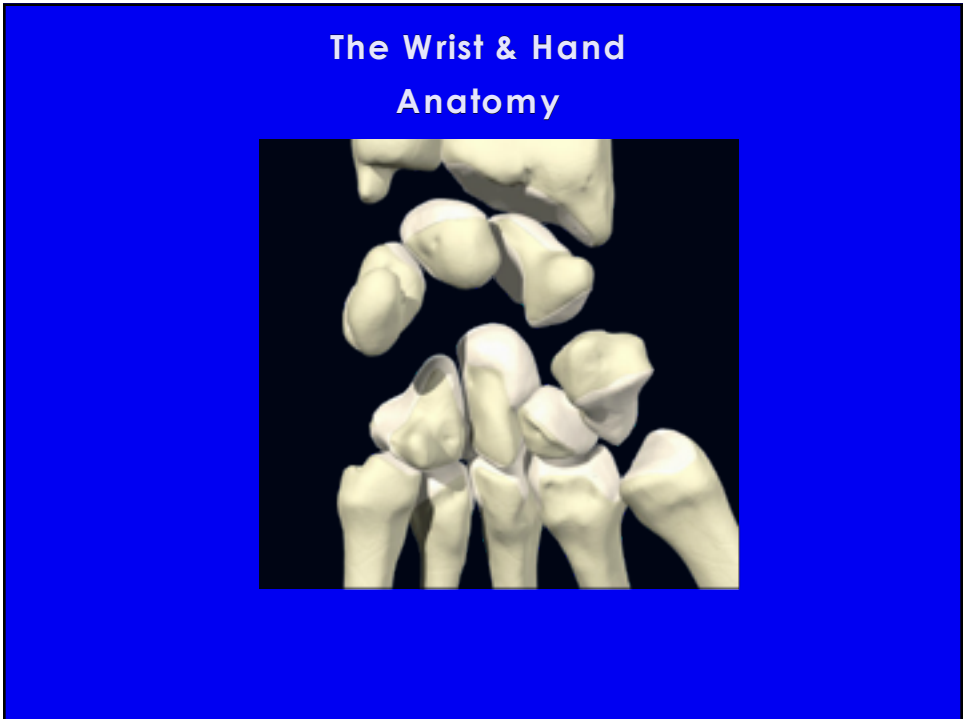
US Exam: General Concepts

**Use High Frequency:
10-15MHz**

Acoustic Standoff Pads

**Linear Probe with
Small Footprint**

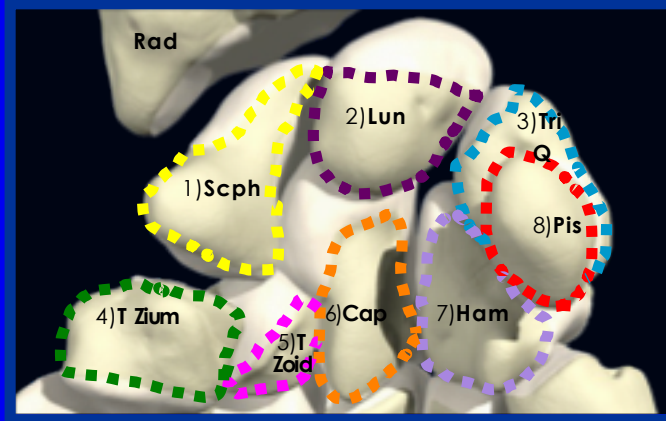




The Wrist & Hand

8 Carpal Bones...on Palmar View

- 1) Scaphoid
- 2) Lunate
- 3) Triquetrum
- 4) Trapezium
- 5) Trapezoid
- 6) Capitate
- 7) Hamate
- 8) Pisiform

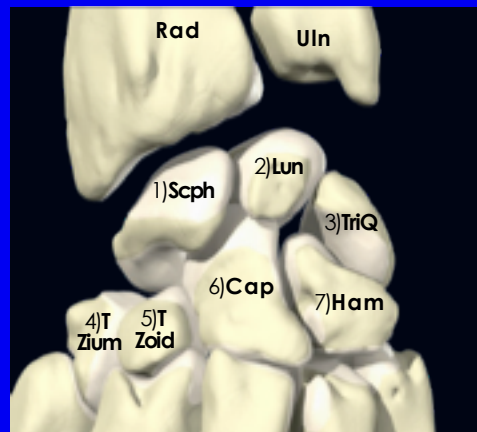


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7 Carpal Bones...Dorsal View

- 1) Scaphoid
- 2) Lunate
- 3) Triquetrum
- 4) Trapezium
- 5) Trapezoid
- 6) Capitate
- 7) Hamate

Pisiform



The Wrist & Hand

8 Carpal Bones...

Some Lovers Try Positions That They Can't Handle

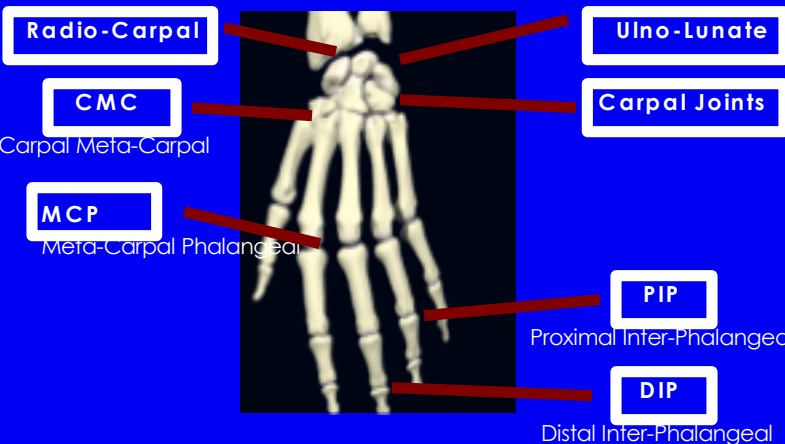
Scaphoid Lunate Triquetrum Pisiform Trapezium Trapezoid Capitate Hamate



The Wrist & Hand

Joints of the Wrist and Hand

DRUJ not listed



Radio-Carpal

Ulna-Lunate

CMC
Carpal Meta-Carpal

Carpal Joints

MCP
Meta-Carpal Phalangeal

PIP
Proximal Inter-Phalangeal

DIP
Distal Inter-Phalangeal

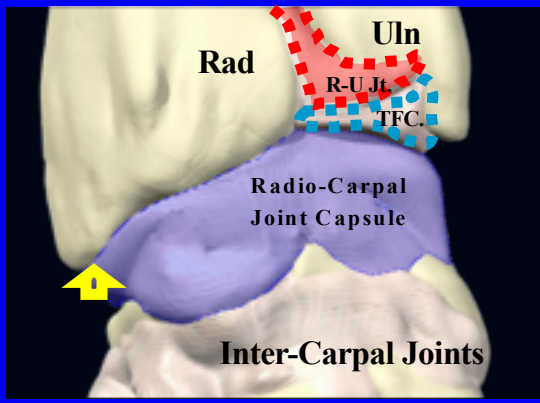
Joints of the Wrist and Hand

Radio-Carpal Joint aka "the wrist joint"

Proximal Border: Distal Radius & Distal TFC margin
Distal Border: 1st Row of Carpal Bones (Scaphoid, Lunate, Triquetrum)

Distal Radio-Ulnar Joint (DRUJ) is distinct/separate from Radio-Carpal Joint

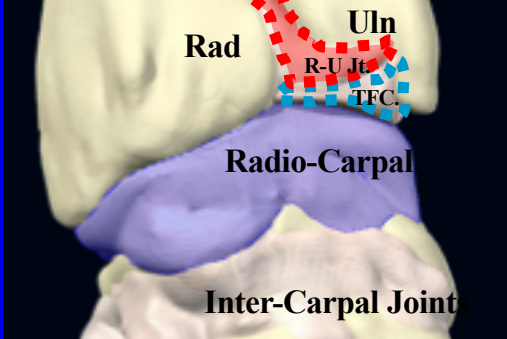

Proximal



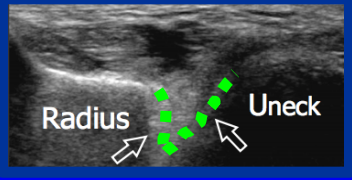
Distal

Joints of the Wrist and Hand

Distal Radial-Ulnar Joint (DRUJ)



Dysfunction, effusion mainly occurs after Radial fracture/injury





Elbow Anatomy

Bony contours/shapes that create
"secondary" articulations/joints of the elbow


Proximal Radio-Ulnar "joint"

Circular/round/"annular"
Radial Head
articulates with...





Concave/"notch" of the
Ulnar Radial Notch




The Radial Head
Rotates/spins in the notch
w/ pronation/supination
of the hand...
A "pivot" joint

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Joints of the Wrist and Hand


Scapho-Lunate Ligament: Dorsal Component




Pt. hand in Ulnar deviation
Dorsal Radio-Carpal ligament
is superficial to SL

SL Ligament deep/interosseous

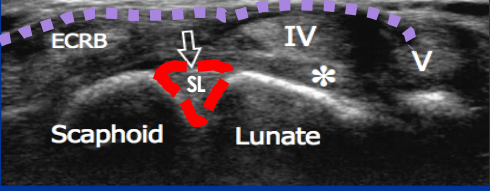
SL stabilizing power comparable
to ACL of knee



Dorsal Radio-Carpal Ligament
SL



Lunate SL Scaph




ECRB IV V
Scaphoid SL Lunate


Joints of the Wrist and Hand
Scapho-Lunate Radiographic Findings

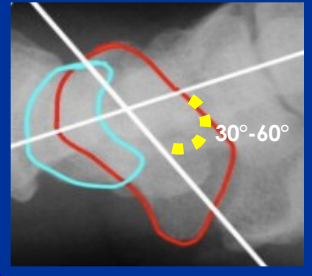
Scapho-Lunate Angle:
 30-60 degree = Normal

- >60° Dorsal Intercalated
- “Insertional”
- Segmental Instability

Positive “Terry Thomas” sign
 SL “gap” > 3mm

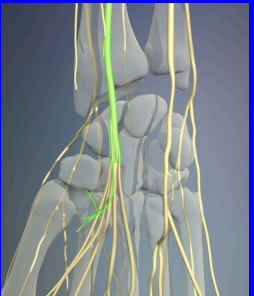


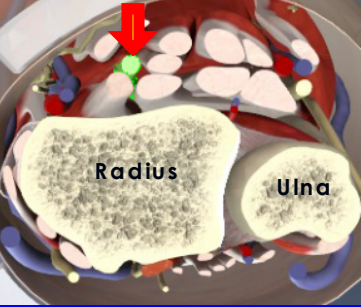




Scaphoid
Lunate

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Median Nerve Anatomy



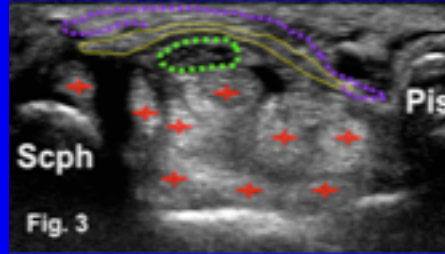


Radius Ulna

**Median nerve is NOT midline/center of the wrist,
 but found toward the Radial margin of the volar wrist**

The Wrist & Hand

Median Nerve/Carpal Tunnel Anatomy



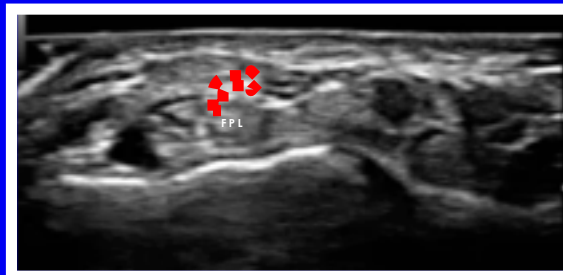
The Median nerve is remarkably superficial. Just below the Flexor Retinaculum (FR)/ Transverse Carpal Ligament (TCL) interface.

Nine (9) tendon bundles (stars) occupy the constricted area of the Carpal Tunnel.

Flexor Pollicis Longus (fpl),
 (4) Flexor Digitorum Superficialis and (4) Flexor Digitorum Profundus

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Palmar Transverse: Median Nerve Localization

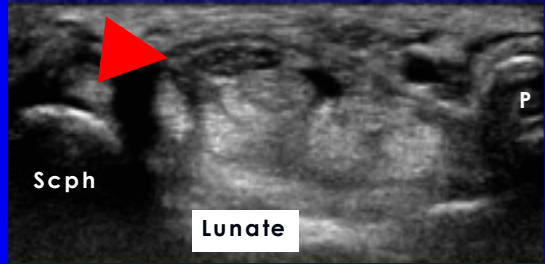
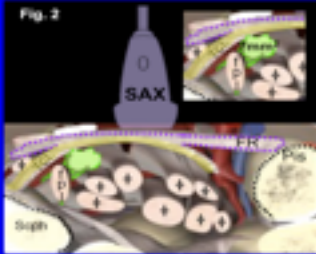


Ask the patient to slowly flex and extend the thumb to activate the FPL (Flexor Pollicis Longus)

The hyper-echoic FPL tendon is seen pushing the hypo-echoic, ovoid nerve superficially and right.

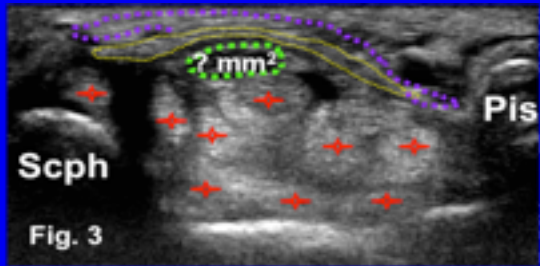
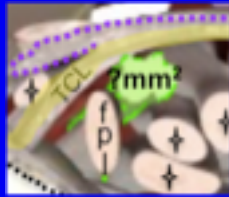
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Median Nerve Cross- Sectional Area
Wrist to Forearm Ratio : Step One



Identify the hypoechoic nerve
at the Carpal Tunnel entry...
Scaphoid and Pisiform
are bony landmarks

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Median Nerve Cross- Sectional Area
Wrist to Forearm Ratio : Step One



Elliptical measurement
yields x-sectional value

Do not compress nerve !
Reduce probe pressure

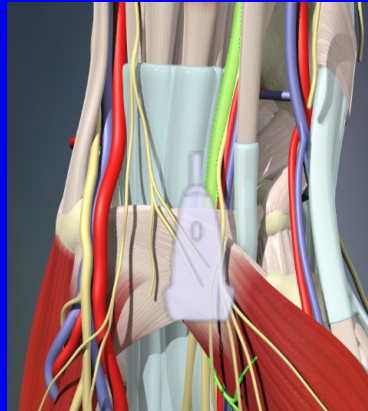
Irregular contours can
be traced manually

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Median Nerve Cross- Sectional Area
Wrist to Forearm Ratio : Step Two

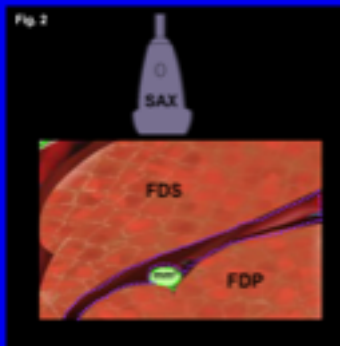


From distal image
Trace MN proximally

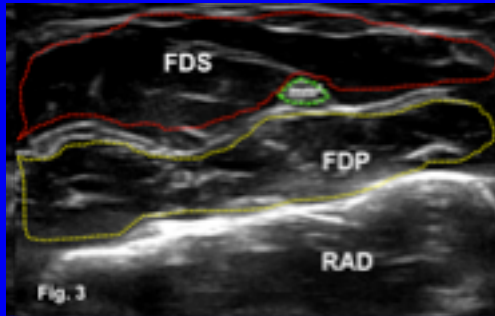
12cm ...4.7 inches



The Wrist & Hand
Median Nerve Cross- Sectional Area
Wrist to Forearm Ratio : Step Two



Trace MN proximally
12cm or 4.7 inches

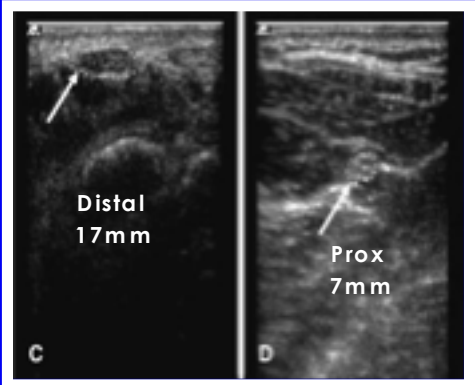


The MN is seen between
the FDS and the FDP

Flexor Digitorum Superficialis & Profundus

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Median Nerve Cross- Sectional Area Wrist to Forearm Ratio Calculation



Ratio = 2.4

7mm 17mm

> 1.4 positive
for
Carpal Tunnel

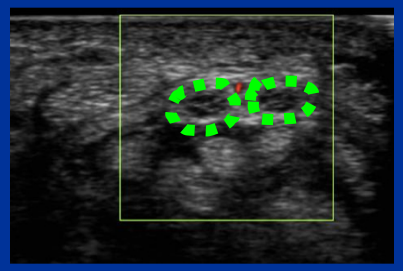
Source: [Clinical Neurophysiology 2008; 119:1353-1357](#) (DOI:10.1016/j.clinph.2008.01.101)

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Bifid Median Nerve and Persistent Median Artery

*Persistent Median Artery
is variable in presence
and association with CTS.
May/may not produce abnormal
increase in mm² area.*

Measurements are combined



SAX view of Bifid Median Nerve
Doppler signal identifies
Persistent Median Artery

Muscle Nerve. 2013 Oct; 48(4): 10.1002/mus.23797.

The Wrist & Hand

Bifid Median Nerve Configurations

Muscle Nerve. 2013 Oct; 48(4): 10.1002/mus.23797.

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Palmar Longitudinal

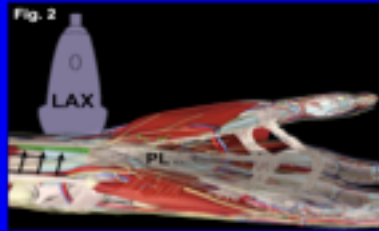
Slightly off midline toward Radial margin

Palmaris Longus (PL) passes superficial to the Flexor Retinaculum (FR).
The most superficial structure of the volar wrist.
Absent in 20 % of population

The Wrist & Hand Palmar Longitudinal

Slightly off midline toward radial margin

Median nerve is **deeper** to the Palmaris Longus.



Note !
The PL is **NOT** a sliding tendon

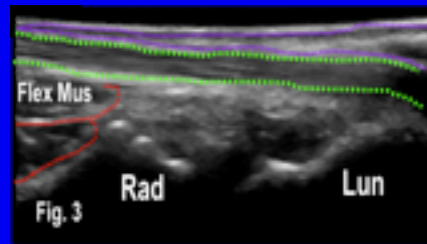
Do not confuse the more superficial PL tendon with the *slightly* deeper, less echogenic Median nerve.

The Wrist & Hand Palmar Longitudinal

Slightly off midline toward radial margin



Long axis probe
position just on Radial aspect of Palmaris Longus. (black arrow)

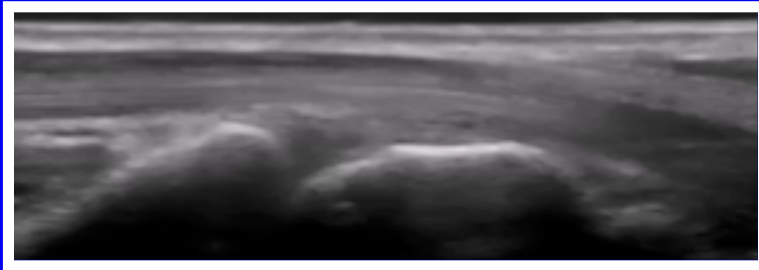
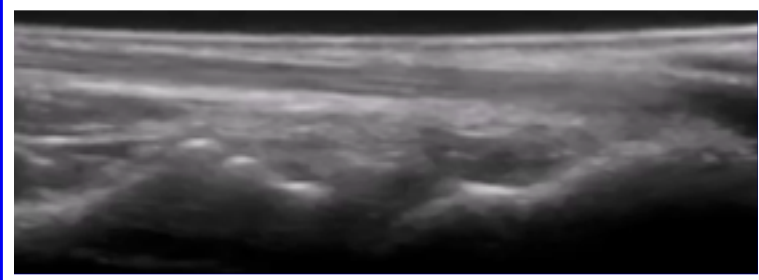


Read from the top down
PL = Palmaris Longus (purple hilite)
MN = Median Nerve (green hilite)

Median nerve will not have sliding/excursion as that of flexor tendons .

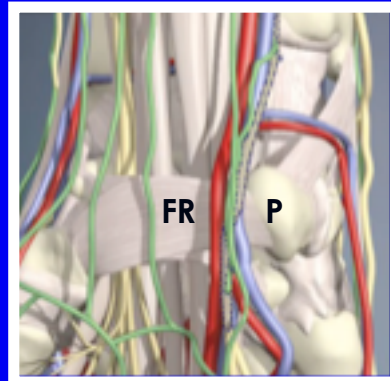
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Median Nerve Has little or NO EXCURSION !



The Wrist & Hand

Ulnar Nerve Transverse In Guyon's Canal



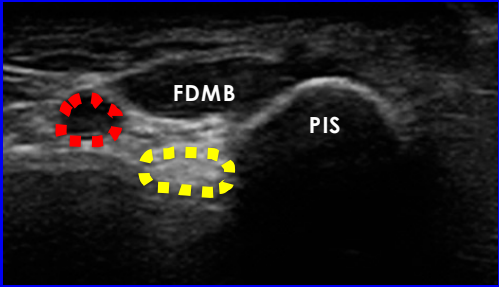
Ulnar Nerve is adjacent to the Ulnar Artery and superficial to Flexor Retinaculum
Probe is moved in short axis plane to medial/ulnar side of palmar wrist.

The Wrist & Hand

Ulnar Nerve Transverse In Guyon's Canal



Fig. 1



Pis : Pisiform

Red Hilite : Ulnar Artery (pulsatile, non-compressible)

Yellow Hilite : Ulnar Nerve

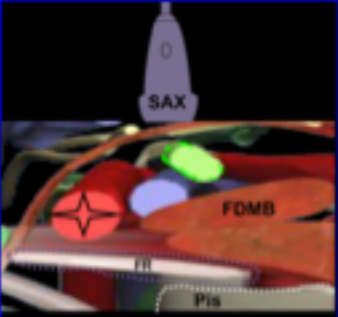
FDMB = Flexor Digiti Minimi Brevis

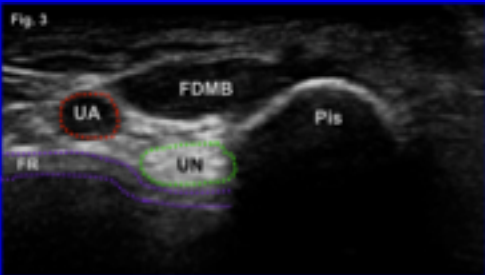


Ulnar Nerve can be identified using color flow or doppler

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Ulnar Nerve Transverse In Guyon's Canal

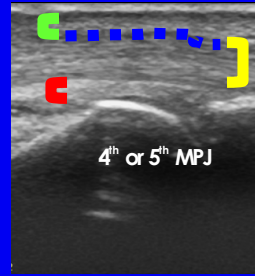
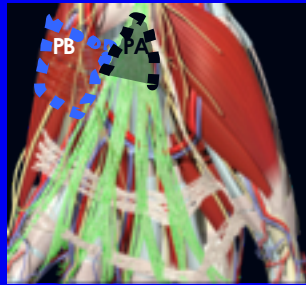




Ulnar Nerve is adjacent the artery and superficial to Flexor Retinaculum

Bony landmark is the Pisiform

Dupuytren's Contracture

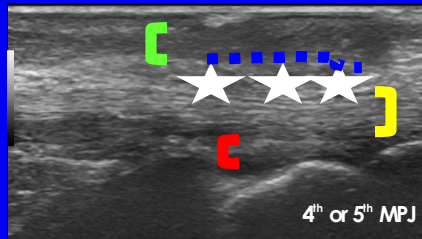
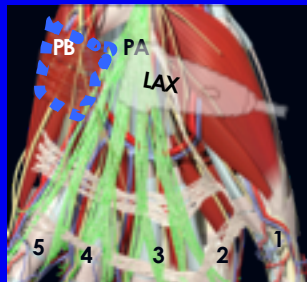


PA= Palmar Aponeurosis (black hilite)
 PB = Palmaris Brevis (blue hilite)
 Palmar Fascia (green hilite)

Normal Anatomy
 Red Bracket = Volar Plate
 Yellow Bracket = Palmaris
 Green Bracket = Fibro-fatty Layer
 Blue Hilite = Fibrous deposit interface

Dupuytren's contracture is an idiopathic, benign *proliferative* disorder that results in fibrous tissue deposition in the Palmar Aponeurosis of the hand. It occurs in the fibro-fatty layer between the skin and deep palmar structures, resulting in 1st... the formation of nodules, that over time, 2^{ndly}... develop into longitudinal cords.

The Wrist & Hand Dupuytren's Contracture



Long Axis Palmar View

Hypoechoic... or possibly hyperechoic
 subcutaneous nodules...
 In a "string of pearls" configuration

Can be treated with injectable collagenase clostridium histolyticum (Hurst L, NEJM 2009) with resolution of contracture

Product known as Xiaflex

The Wrist & Hand Dorsal Transverse



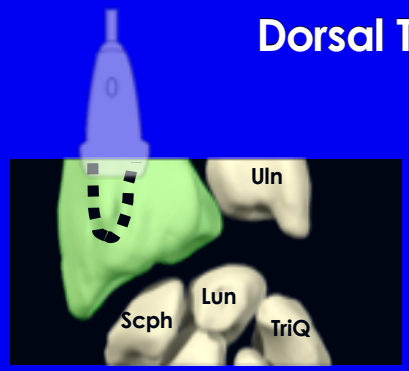
* Two key dorsum structures *

1. Non Osseous = Extensor Retinaculum

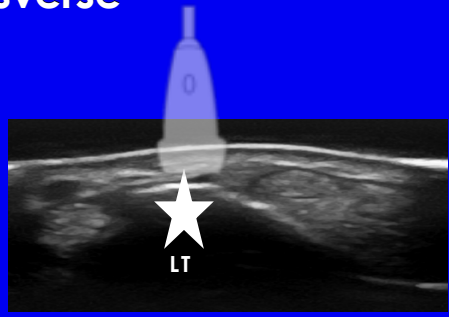
A Horizontal, Linear, Hyperechoic band
The ER defines the dorsal anatomy .

Forming 6 synovial compartments by means of
radial and ulnar attachments.

The Wrist & Hand Dorsal Transverse



Lister's Tubercle = black hilite



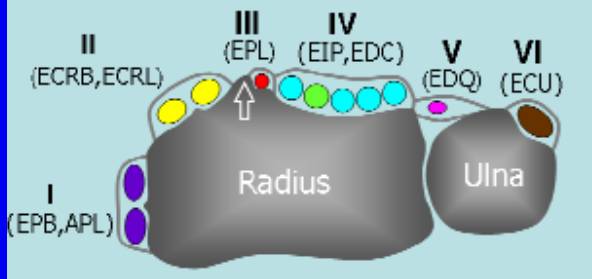
* Two key dorsum structures *

2.Osseous: Lister's Tubercle (at distal Radius)



Serves as landmark dividing
Compartment 2 from Compartment 3

The Wrist & Hand First 3 Dorsal Compartments

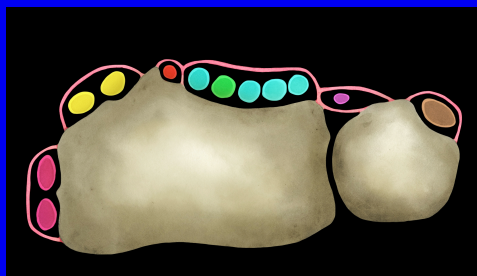


I = Extensor Pollicis Brevis & Abductor Pollicis Longus

II = Extensor Carpi Radialis Longus & Brevis

III = Extensor Pollicis Longus

The Wrist & Hand First 3 Dorsal Compartments



I = Extensor Pollicis Brevis & Abductor Pollicis Longus

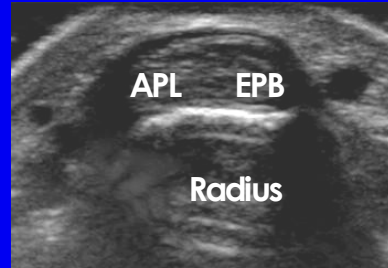
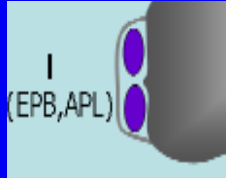
II = Extensor Carpi Radialis Longus & Brevis

III = Extensor Pollicis Longus

The Wrist & Hand

First 3 Dorsal Compartments

I = Extensor Pollicis Brevis & Abductor Pollicis Longus



Mid-Supination/Pronation to expose Radial margin



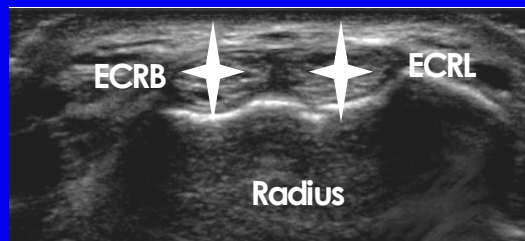
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First 3 Dorsal Compartments

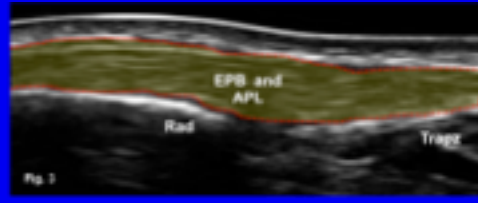
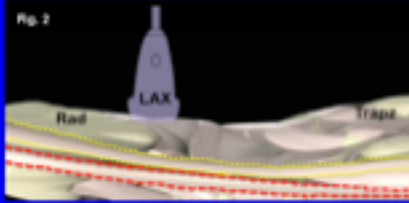
II = Extensor Carpi Radialis Longus & Brevis



SAX at Radial aspect. Not true "midline" to view 'scalloping' of cortical margin.



The Wrist & Hand DeQuervain's Tenosynovitis



Red Hilite = APL (abductor pollicis longus)
Yellow Hilite = EPB (extensor pollicis brevis)



The EPB and APL occupy the same tendon "sheath". Thickening of the "sheath" entraps the tendons..

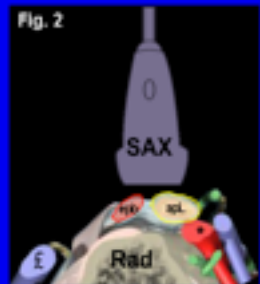
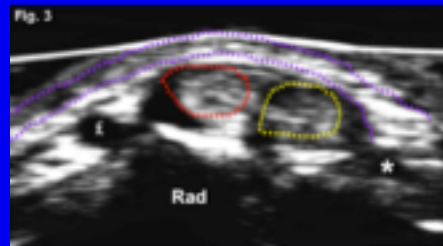
The two tendons may not be seen separately, when normal, but a fibrous band may develop between them as a sequelae to stenosing

The Wrist & Hand DeQuervain's Tenosynovitis

Transverse/Short Axis View

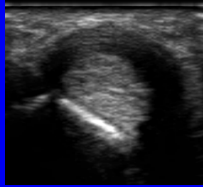


Mid-Supination/Pronation

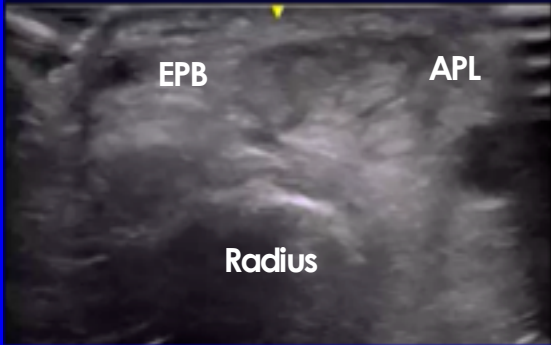


Purple Hilite = Ext. Retinaculum
Red Hilite = EPB
Yellow Hilite = APL
C = Cephalic vein
* = Radial Artery

De Quervain's Injection Out of Plane Approach Dissecting the two tendons



A perpendicular view may reveal or confirm thickening of the sheath or fluid within it.



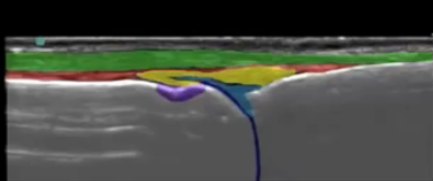
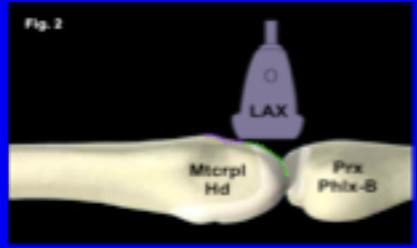
Note : Some normal physiologic fluid is expected. Significant amounts of fluid would produce a "halo"

The Wrist & Hand Dorsal Metacarpal-Phalangeal Longitudinal



Longitudinal probe position across the MCP joint.

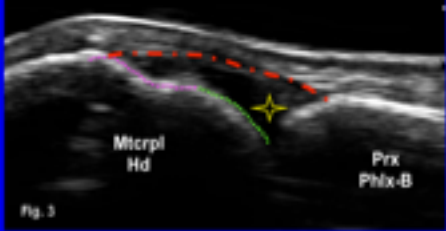
Supporting the joint on palmar side helps with flexion and distraction for dynamic imaging



Purple = anatomic neck of MC
Yellow = synovial membrane
Lite Blue = synovial fluid
Red = capsule
Green = tendon


The Wrist & Hand

Dorsal Metacarpal-Phalangeal Longitudinal





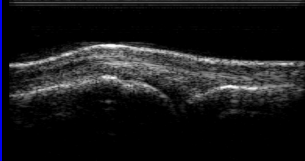
Purple = anatomic neck of MC
 Yellow = synovial membrane
 Light Blue = synovial fluid
 Red = capsule
 Green = tendon



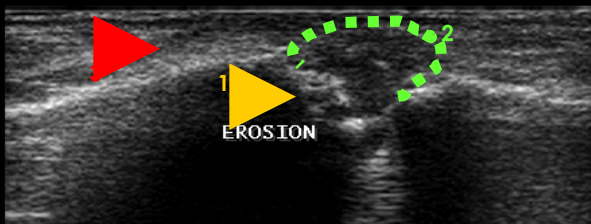
Acoustic standoff helps with probe contact

The Wrist & Hand

Dorsal MCP Longitudinal



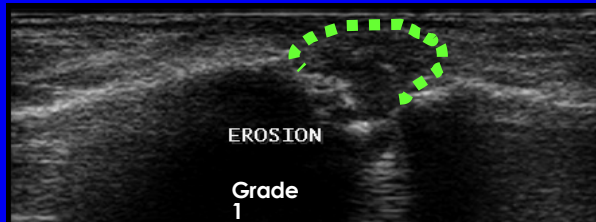

Normal
smooth, intact
cortical outline



1. Cortical erosion. No distinct anechoic cartilage margin
2. Distended joint capsule and synovial thickening
3. Poorly visualized extensor tendon

The Wrist & Hand

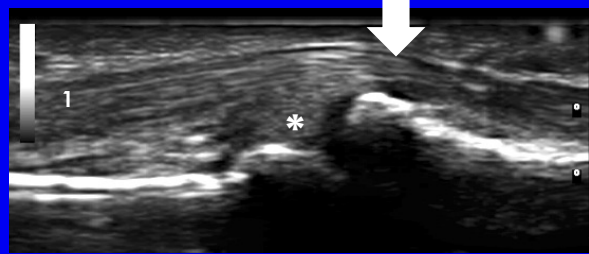

Synovial Thickening Assessment



Grade 1: Synovium in "triangle" between the bones
Grade 2: Synovium extending proximally over the Metacarpal Head
Grade 3: Synovium extending to metaphysis of Metacarpal

The Wrist & Hand

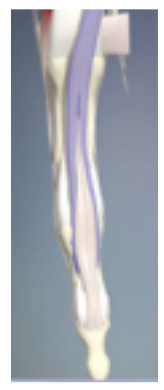
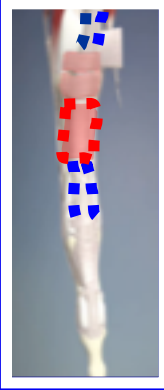

Palmar MCP Longitudinal View



* = Volar plate (thickened portion of capsule)
1 = Flexor tendons/ A1 Pulley
The A1 pulley is a very thin, anechoic line above the tendon

Not the optimal view to see the pulley

The Hand & Wrist Palmar Transverse MCP The A1-2 Pulley

The Annular Ligaments/Pulley system forms a fibro-osseous tunnel through which pass the deep and superficial flexor tendons of the fingers (FT). They provide strategic constraints to the flexor tendons and prevent "bowstringing" during flexion/extension of the digits.

The Wrist & Hand Palmar Transverse MCP The A1-2 Pulley "trigger finger"





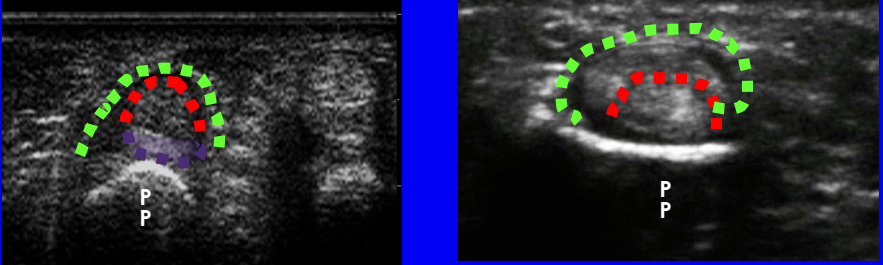
PP= Proximal Phalanx
VP/purple hilite = Volar Plate
FT/red hilite = Flexor tendons (FDS and FDP)
Green Hilite = Annular Ligament/Pulley

The Pulley ligament is a slim, uniform "anechoic arch" surrounding the VP and FT.

The Wrist & Hand

Palmar Transverse MCP

The A1-2 Pulley "trigger finger"



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The Wrist & Hand

1st CMC Joint Longitudinal Navigation

3rd Joint Space From Radius



Radius Scaphoid Trapezium

The Wrist & Hand

1st CMC Joint Longitudinal

Reciprocal reception between 1st Metacarpal and Trapezium
The 3rd Joint Space From Radius



Fig. 1



Fig. 2

FIRST identify the distal radius
Count 3 joint spaces to correctly identify the 1st CMC.

1. Radio-Scaphoid
2. Scaphoid-Trapezium
3. Trapezium-Metacarpal



Fig. 3

The Wrist & Hand

Thenar Longitudinal Views

Ulnar Side




Fig. 1

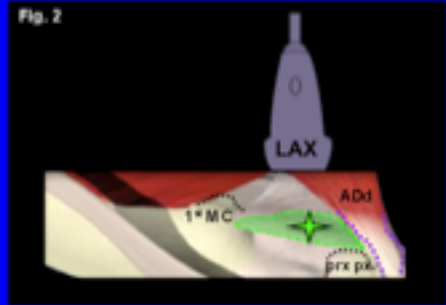


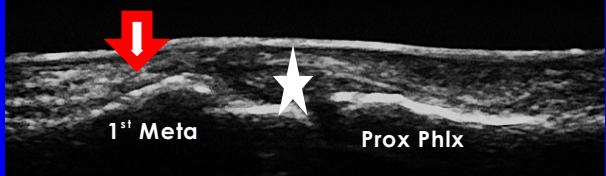

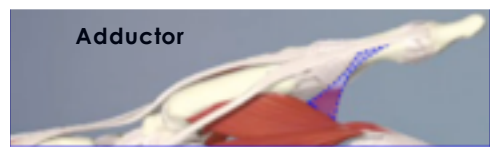

Fig. 2

Long axis probe on ulnar/medial side of the thumb

The collateral ligament is deep to the Adductor Pollicis tendon/aponeurosis (purple hilite)

The Wrist & Hand

Thenar Longitudinal Views
Ulnar Collateral Ligament

The Wrist & Hand

Gamekeeper's or Skier's Thumb, Stener Lesion

Severe hyper-abduction injury





The ligament is often torn from the bone, and avulsion fractures can be seen on ultrasound. Check continuity of met head cortex.

Stener lesion includes UCL tear PLUS Aponeurosis detachment from 1st MP jt.

Mechanism of injury
Falling forward and catching the thumb will hyper-abduct the 1st Metacarpal joint

The Wrist & Hand
TFCC: Triangular Fibrocartilage Complex

The Triangular Fibrocartilage Complex is a term used to describe the various structures suspending the distal Radius and the Ulnar Carpus...

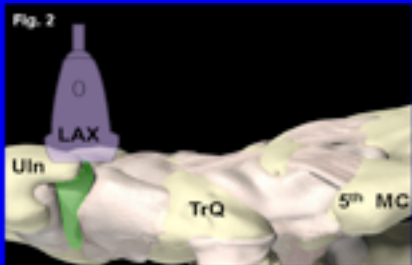
Aka...
the anatomic collection connecting the lower arm to the hand.

On the Ulnar side of the wrist, the intra-articular disc thickens, making it somewhat visible to insonation, ...and prone to impaction type injury .


The fibrocartilage/meniscus is supported by a meniscal "homologue".

Homologue means a "double or duplicate".

The Wrist & Hand
TFCC: Triangular Fibrocartilage Complex



Deep Intra-articular TFC Disc
Green Hilite



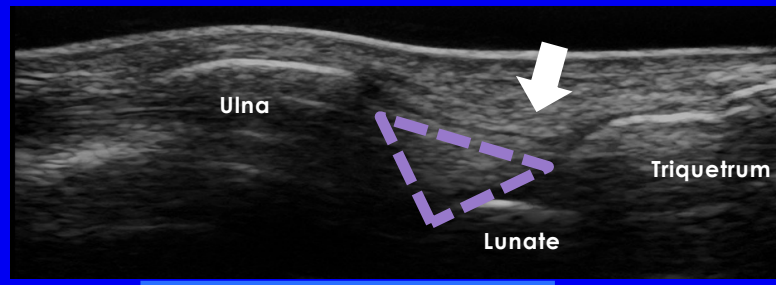
Meniscal Homologue
Purple Hilite and *
the "duplicate" attaching the disc to Triquetrum.

Homologue, referred to as
A "sling or leash"

The Wrist & Hand TFCC: Triangular Fibrocartilage Complex



Long Axis probe at the distal Ulna
active Radial deviation



*TFCC images most reliably
visualize the TFC Homologue*

The Wrist & Hand TFCC: Triangular Fibrocartilage Complex



*Identifying the Homologue as separate from the fibrocartilage is helpful,
and may display tears not involving the fibrocartilage.
Also, ultrasound has known limitations in completely
evaluating fibrocartilage in general.*

Thank You !



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