
# Upper Extremity Pathology

## Shoulder

## Elbow

## Wrist/Hand

*Randy E. Moore DC RDMS RMSK*

*General Musculoskeletal Imaging, Inc.*

# Upper Extremity Pathology
# Shoulder

**Tendinosis : 3 key Ultrasound Findings**

**1. Increased cellularity…** *thickened and…*

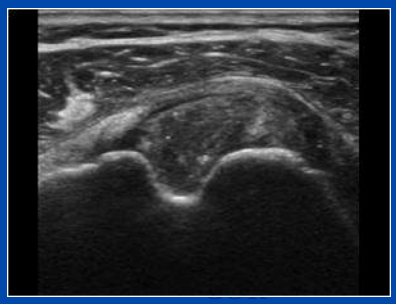
*"inhomogeneous"… Not homogeneous…*

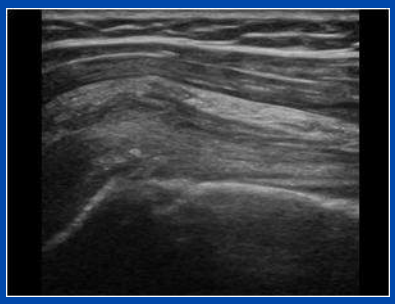
*Mixed echoes of hyper and hypo echoic tissue.*

**2. Neovascularization**

**3. Disrupted fibers within the tendon**

## Biceps Tendinosis: Increased "cellularity"



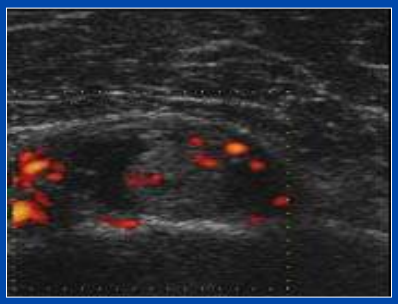


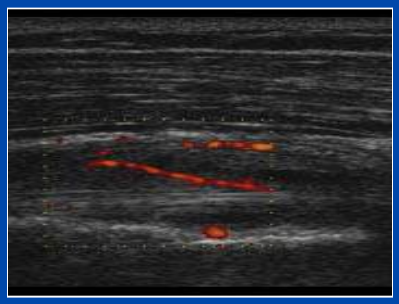
*thickened and…*

*"inhomogeneous"… (Not homogeneous)…*

*Mixed echoes of hyper and hypo echoic tissue.*

## Biceps Tendinosis: Neo-vascularization

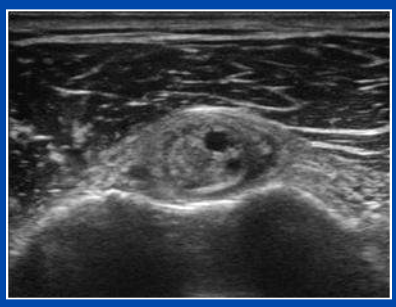




AKA… angio-fibro- blastic infiltration

New blood vessel formation within abnormal tissue

## Biceps Tendinosis: Disrupted Fibers



Short axis: "bullet hole"

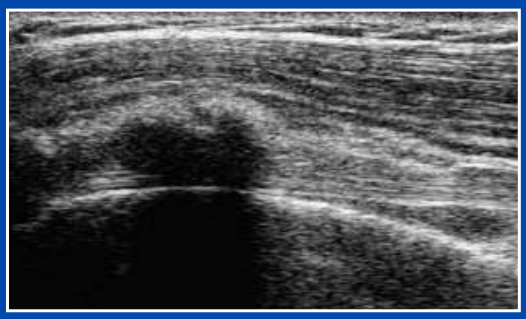
Long axis: "split tear"

Fiber failure resulting from degeneration of tendon.

Leading to partial or full thickness tear.

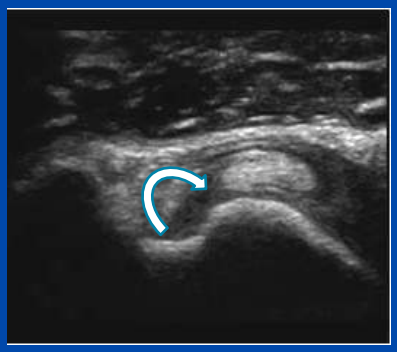
## Biceps Calcific Tendinosis





Dense calcification with posterior shadowing

## Biceps Tendon: Subluxation



External rotation is the dynamic movement that can demonstrate the medial subluxation of the tendon.

## Supraspinatus Tendon : Rotator Cuff Tears

A Progression…

Type I : Cuff degeneration / tendinosis without visible tears on bursal or articular surface

Type II : Cuff degeneration / tendinosis with partial tears on bursal or articular surfaces.

Type III : Complete thickness rotator cuff tears of varying size, complexity, and functional compromise.

## Supraspinatus Tendon : Impingement

Controversy exists …

Impingement leading to cuff tear…

Or cuff tear leading to impingement.

Most common location is ANTERIOR…

Decreased distance between the anterior one-third of the acromion and underlying tendons.

Anatomic or pathologic changes that have compromised the cuff, allowing proximal humeral migration are often seen with a tear.

## The Shoulder

## Anterior Impingement Imaging

Flexion with aBuduction immediately abuts the Supraspinatus against the coraco-humeral ligament and the Acromion

## The Shoulder
## Anterior Impingement

Longitudinal probe
Firmly anchored as the patient SLOWLY abducts and elevates the arm.

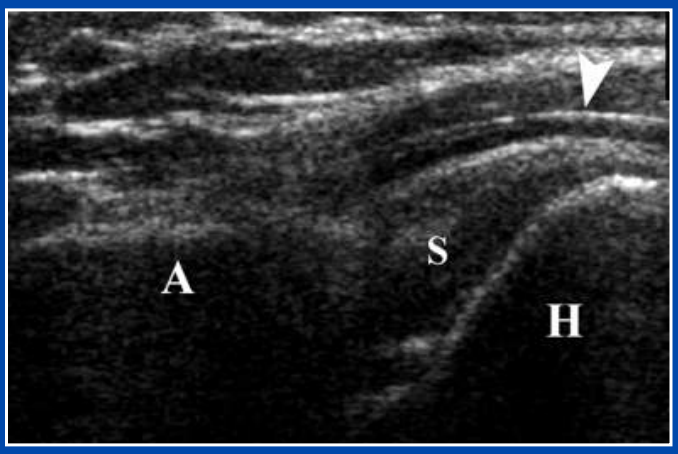
Supraspinatus should slide smoothly under the Acromion
No shearing of bursal fluid by Acromion.
No SSP "snapping" under Acromion

## The Shoulder
## Anterior Impingement


The Acromion is at far left/proximal side of image.

The bursal fluid is sheared off by the Acromion.

## Supraspinatus Tendon : Impingement

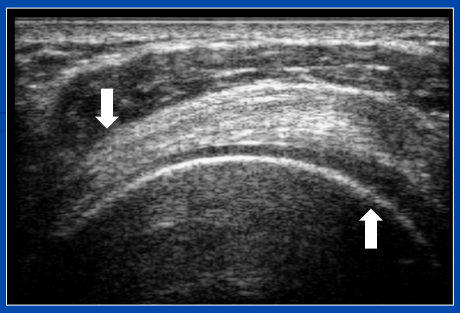



Humeral height above Acromion
In extension and abduction

## Partial Rotator Cuff Tears

Bursal surface VS Articular surface

Identify … Individual… Interfaces



Partial Rotator Cuff Tears

## Articular Surface Tears

1. Not over the full thickness of the tendon

2. Has a connection/communication with the articular cartilage

3. Has no connection with the bursa

COR

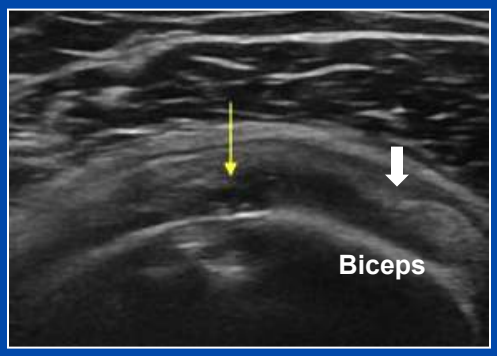
4. Can have a connection with the greater tuberosity

(LAX view. Recall normal enthesis)

5. Usually no or little volume loss

Partial Rotator Cuff Tears

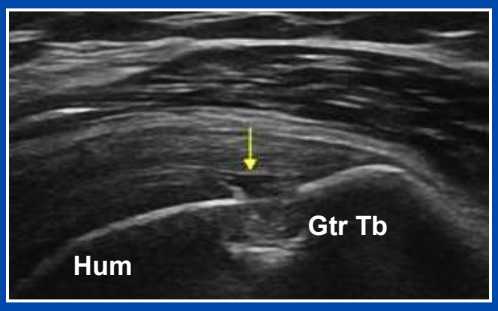
## Articular Surface Tears: Short Axis




Anechoic area of fiber non-visualization adjacent to cortical margin

## Partial Rotator Cuff Tears

### Articular Surface Tears: Long Axis




Anechoic area of fiber non-visualization adjacent to cortical margin

Recall the normal contour of tendon enthesis tapering to sharp point…

And the "tendon footprint"

### Articular Surface Tears: Long Axis
### "Rim Rent " Tear
(an "edge/border" opening caused by "ripping"

PASTA Lesion
"Partial Articular Supraspinatus Tendon Avulsions" …

A partial-thickness articular surface tear at the insertion of the Supraspinatus

Considered most common partial tear.

## Partial Rotator Cuff Tears

### Intra-substance/ Intra-tendinous Tears

1. Not over the full thickness of the tendon
2. No connection/communication with the articular cartilage
3. No connection with the bursa
3. Can have a connection with greater tuberosity
4. Usually little or no volume loss

## Partial Rotator Cuff Tears

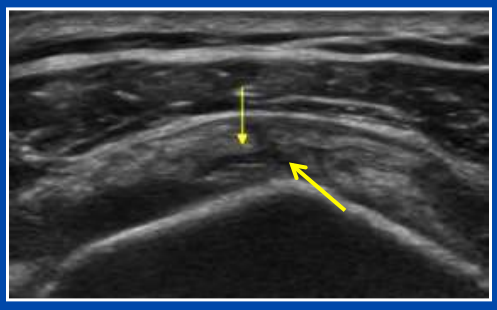
### Intra-substance/ Intra-tendinous Tears: Short Axis

Anechoic area of fiber non-visualization within the mid-substance.

No communication with articular or bursal surfaces

## Partial Rotator Cuff Tears

### Dissecting Intra-tendinous Tears: Short Axis



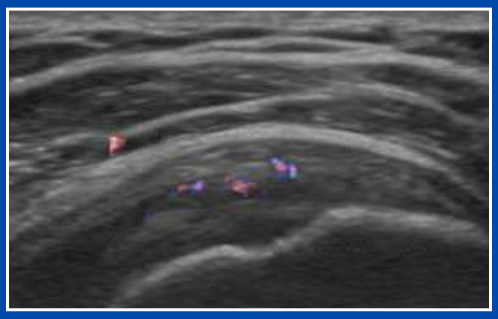
Anechoic area of fiber non-visualization within the mid-substance may dissect.

May communicate with articular or bursal surfaces.

Aka "complex " tear.

## Partial Rotator Cuff Tears

### Intra-substance/ Intra-tendinous Tears: Neovascularization



New blood vessel formation within abnormal tissue

Remember…

Tear = disrupted fibers

Tendinosis= abnormal tissue

Tears DO NOT display Doppler signal

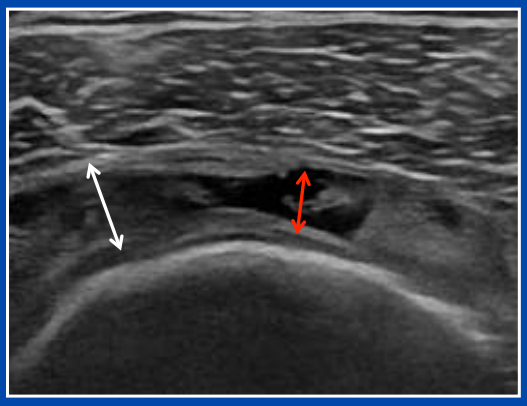
## Full thickness Rotator Cuff Tears

### Direct Signs

1. Defect seen over the full thickness of the tendon
2. Communication with the articular cartilage and bursa
3. Can have a complete rupture from greater tuberosity
4. Usually visualize volume loss

## Full Thickness Rotator Cuff Tears

### Direct Signs: Short Axis



1. Articular & Bursal Sides
2. Volume Loss
(Thicker at area of tendinosis
and narrow at site of tear )

**No** Deltoid /Bursal Herniation

## Full Thickness Rotator Cuff Tears

### Direct Signs: Short Axis

1. Articular & Bursal Sides

2. *Minimal* Volume Loss
(Thicker at area of tendinosis
and narrow at site of tear )

**No** Deltoid /Bursal Herniation

## Full Thickness Rotator Cuff Tears

### Direct Signs : Long Axis

1. Articular & Bursal Sides

2. Volume Loss

3. Tuberosity attachment remains intact

**No** Deltoid /Bursal Herniation

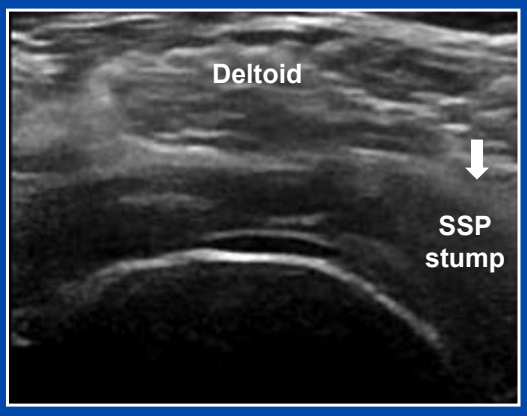
## Full Thickness Rotator Cuff Tears

Indirect Signs (variable in occurrence)

1. Herniation of Deltoid and Peri- Bursal fat into the tear
2. Bursal effusion
3. *"naked cartilage"… or "naked tuberosity" sign*
4. "Cartilage Interface" sign

## Full Thickness Rotator Cuff Tears

Indirect Signs : Short Axis




Herniation
of Deltoid /Peribursal fat
into void of tear

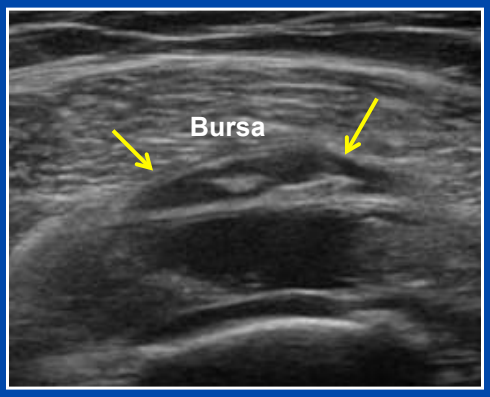
## Full Thickness Rotator Cuff Tears

### Indirect Signs : Long Axis


**Herniation of Deltoid /Peribursal fat into void of tear**

## Full Thickness Rotator Cuff Tears

### Indirect Signs : Short Axis




**Bursal effusion with full thickness tear**

## Full Thickness Rotator Cuff Tears

### Indirect Signs : Long Axis


**Bursal effusion with full thickness tear**

## Full Thickness Rotator Cuff Tears

### Indirect Signs :
Naked Cartilage or Tuberosity Sign

**Definition: A full thickness tear or rupture of the Supraspinatus with retraction from the Greater Tuberosity thus… leaving the bone "uncovered".**

**There is *NOT* a fluid interface associated with the sign !**

*** Care should be taken to mistake the Deltoid for the Supraspinatus**

## Full Thickness Rotator Cuff Tears

### Indirect Signs :
Naked Cartilage or Tuberosity Sign


**Normal**
Tendon visible at
The slope of tuberosity

**Abnormal**
The tuberosity uncovered.
Deltoid laying along slope

## Full Thickness Rotator Cuff Tears

### Indirect Signs :
Cartilage Interface Sign

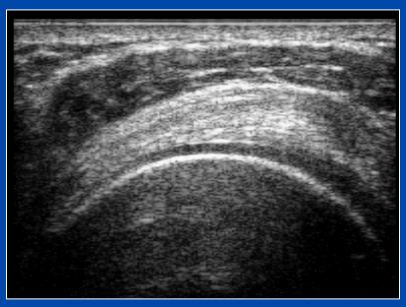
**Definition: A distinct , well-defined , hyperechoic reflection of the ultrasound beam at the interface between…**
***Fluid*** **and the hyaline cartilage.**

**A "hyper-reflection" of the cartilage when the US beam is perpendicular (90°) to it…**
**due to the presence of edema.**

## Full Thickness Rotator Cuff Tears

**Indirect Signs :**
Cartilage Interface Sign

Interface Sign



No Interface Sign

Rotator Cuff Tears
**Review of Signs**

**Tear Progression**
- Tendinosis w/ no tears
- Tendinosis w/ partial tears
- Tendinosis w/ full thickness tears

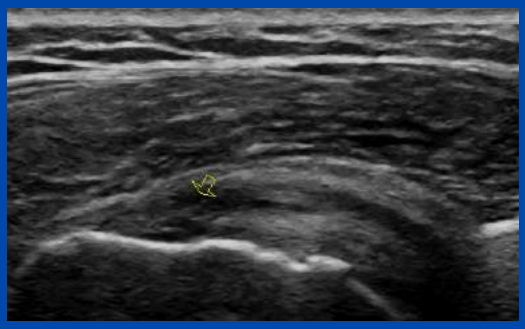
Full Thickness
**Direct Signs**
- Bursal and Articular side
- Volume Loss
- Grtr. Tube rupture

Full Thickness
**Indirect Signs**
- Delt/Bursa herniation
- Bursal effusion
- * "Naked Tube" No Fluid !
- "Cartilage Interface" Fluid/Edema !

# Upper Extremity Pathology

## Subscapularis Tendon

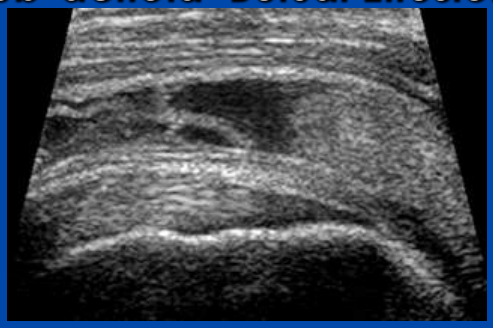
Isolated tears seen in 2 % of cuff tears.



Typically, a linear anechoic defect in the mid to upper one-third of the tendon

# Upper Extremity Pathology

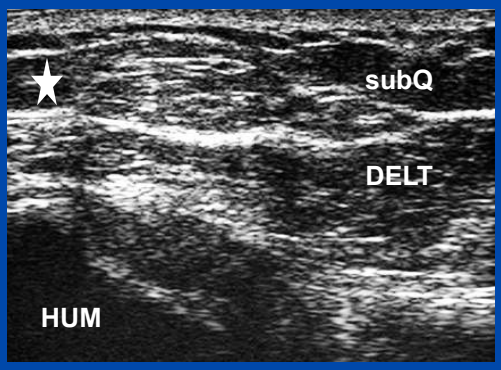
## Sub-deltoid Bursal Effusion



Longitudinal view intact SSP tendon

Septations within the bursa are compatible with chronic bursal effusion.

# Upper Extremity Pathology
## Subcutaneous Lipoma: Shoulder



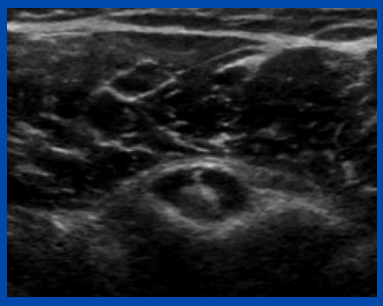

Palpable mass in a middle aged physician who suspected a chronic bursal effusion.

Note deeper location of the humerus ,and "through transmission "artifact .

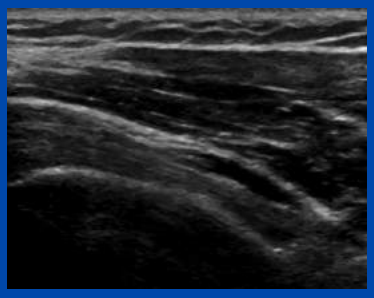
# Upper Extremity Pathology
## Sub Deltoid Bursal Effusion

Anechoic, non-viscous… non-septated fluid

## Upper Extremity Pathology
## Tenosynovitis or Capsulitis ?
## Biceps Tendon



SAX at bicipital groove

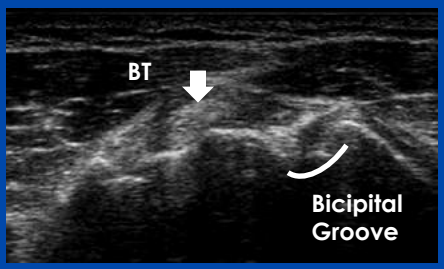


LAX

Anechoic ring or "halo" seen on SAX suggests either pathology because BIC is intra-capsular.

LAX view reveals presence of fluid distally…tenosynovitis

## Upper Extremity Pathology
## Laterally Subluxed Biceps Tendon

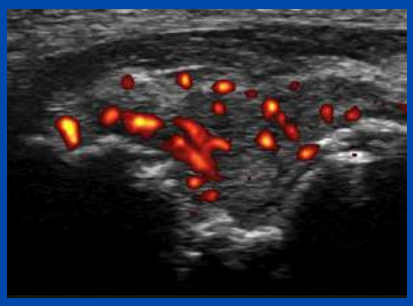



Transverse view of proximal Biceps tendon.
Male , early 30's, physician, asymptomatic.
Fell from ladder impacting right shoulder.

Multiple cortical defects. Laterally subluxed tendon.

# Upper Extremity Pathology
# Elbow

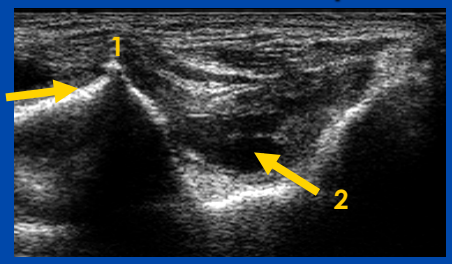
## Upper Extremity Pathology
## Olecranon Fossa Synovitis
### Doppler Flow Imaging



Synovial vascularization is seen with inflammatory arthropathies.

Doppler Flow imaging presents low amplitude flow as a percolating color signal. Non-directional flow evaluation. Not dependent on angle

## Upper Extremity Pathology
## Posterior Elbow : Intra-capsular Effusion



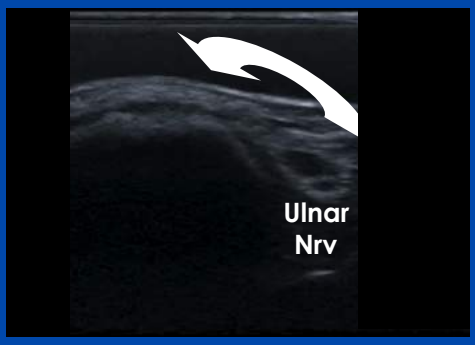

Short axis image of posterior elbow compartment.
Cortical fragment at peak of lateral trochlea. (1)

Fluid is intra-capsular(2), and the fat pad is displaced superficially.

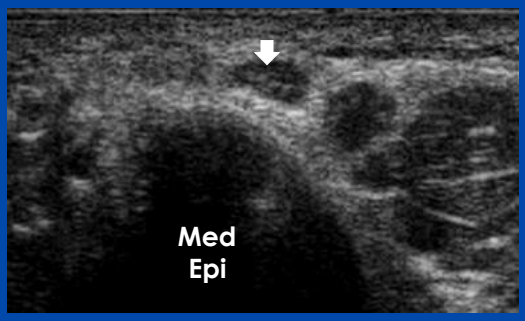
## The Elbow
## Ulnar Nerve Dynamic Imaging
### Subluxing Nerve

The hypo echoic Ulnar nerve will slide up and over the adjacent Medial Epicondyle

## Upper Extremity Pathology
## Ulnar Nerve subluxation



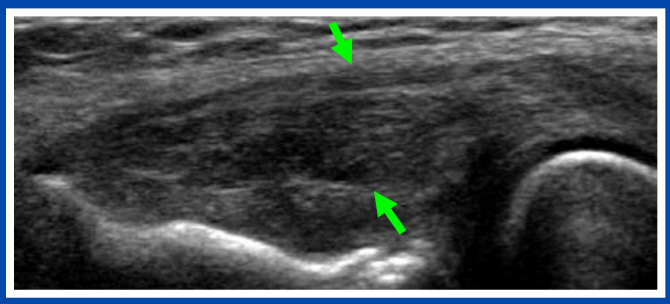

## Upper Extremity Pathology
### Ulnar Nerve X-sectional Area




**Abnormal x-sectional value is**
**10 mm slightly proximal to ulnar groove**
**Recommend SAX** ($mm^2$) **and LAX** (mm @ widest location)

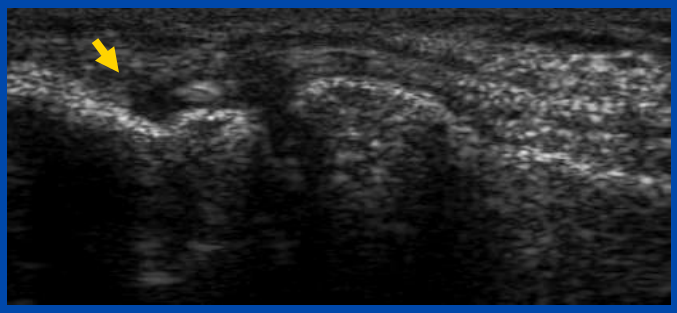
**Variability based on BMI and patient position.**
**Contra-lateral imaging recommended**

## Upper Extremity Pathology
## Elbow: Lateral Epicondylitis



Note the thickness of the common extensor tendon between the green arrows.
There is nonvisualization of the tendon fibers due to tendinosis and fiber failure.

## Upper Extremity Pathology
## Elbow : Lateral Epicondyle



Near full-thickness tear with calcification of RCL.

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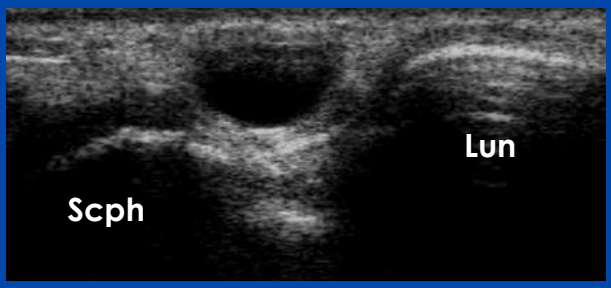
# Upper Extremity Pathology
# Wrist/Hand

## Upper Extremity Pathology
## Wrist and Hand: Dorsal Ganglion

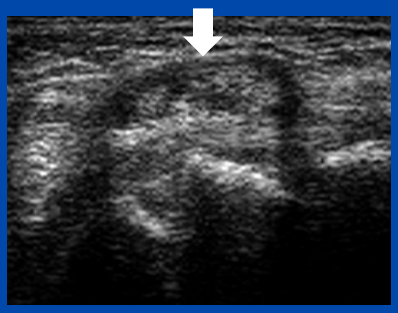



May be indicative of carpal instability.
May or may not be painful.

Recurrent dorsal ganglia may demonstrate neo-vascularization on Doppler Flow.

## Upper Extremity Pathology

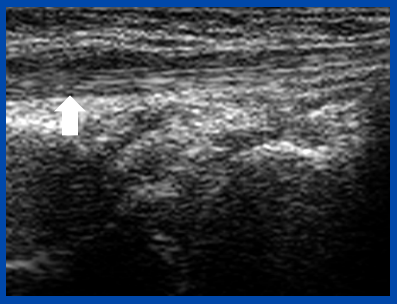
### Wrist and Hand : Dorsal Wrist Tendinosis



Dorsal Wrist Transverse

Minimal fluid in sheath.

Edge artifact : arrow
Hypoechoic, thickened



Dorsal Wrist Longitudinal

Ellipsoidal area of thickening and poor fiber visualization

## Upper Extremity Pathology

### De Quervain's Tenosynovitis


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

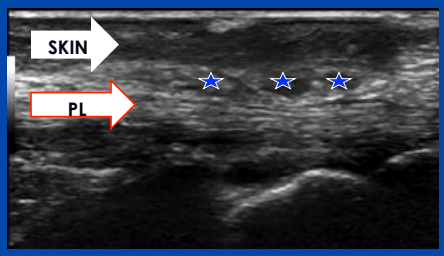
The two tendons may not be seen distinctly,when normal but a fibrous band may develop between them as a sequelae to stenosing

# Upper Extremity Pathology
## DeQuervain's Tenosynovitis


Some normal physiologic fluid is expected on SAX.

Significant amounts of fluid would produce a "halo"

# Upper Extremity Pathology
## Dupuytren's Contracture

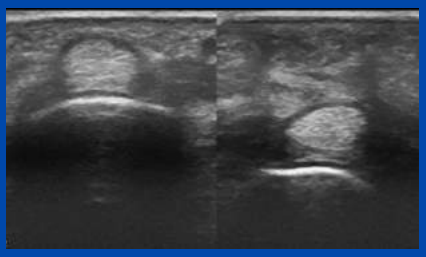



Long Axis Palmar View

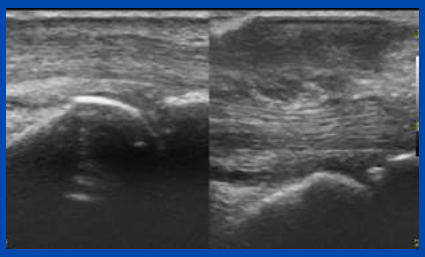
Hypoechoic subcutaneous ***nodules…***

*An idiopathic, benign proliferative disorder resulting in fibrous tissue deposition in the palmar aponeurosis . Occurs in the fibro-fatty layer between the skin and deep palmar structures, with the formation of nodules, that develop into longitudinal cords.*

## Dupuytren's Disease



Normal SAX Abnormal

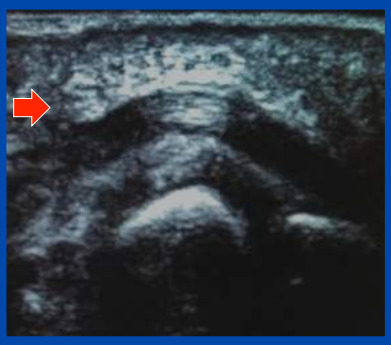


Normal LAX Abnormal

*Can be treated with injectable collagenase clostridium histolyticum (Hurst L, NEJM 2009) with resolution of contracture in 64% c/w 7% in placebo group.*

*Product known as Xiaflex*

## Ultrasound Exam



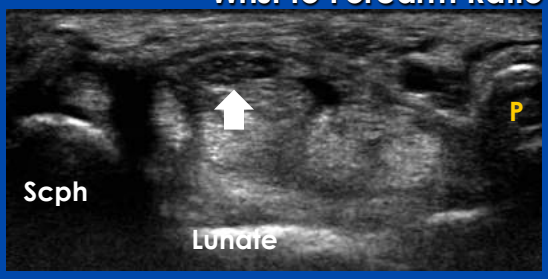
LAX over the the 5th MTP
Normal cortical margin of meta carpal head
Normal flexor tendon
Hyperechoic thickened palmar fascia

## Need to Know: De Puytren's

* Proliferative disease of the palmar fascia
* Three phases:
  1) Proliferative
  2) Involutional (curling or braiding inwardly)
  3) Residual

US Exam: Thickened Palmar Fascia with normal tendon

## Upper Extremity Pathology
## Median Nerve Cross- Sectional Area
## Wrist to Forearm Ratio : Step One




Identify the hypoechoic nerve. at the Carpal Tunnel entry….

Scaphoid and Pisiform are boney landmarks

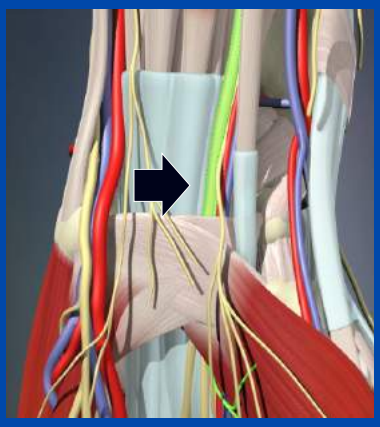
Ellipitical measurement yields x-sectional value

Irregular contours can be traced manually

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

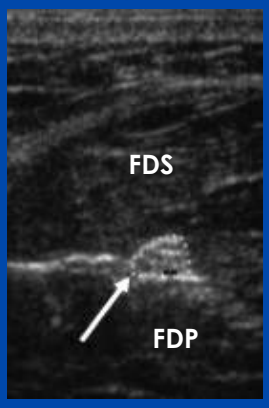
From distal image
Trace MN proximally

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

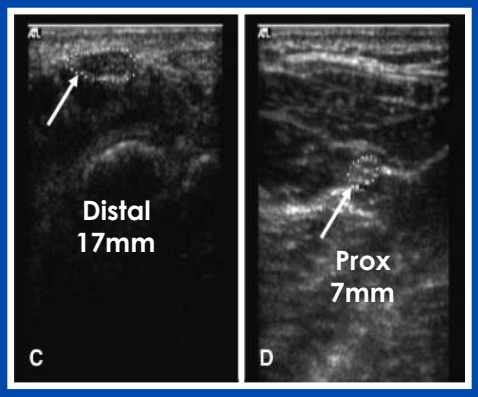



The MN is seen between
the FDS and the FDP
Flexor Superficialis & Profundus

## The Wrist & Hand

### Median Nerve Cross- Sectional Area

### Wrist to Forearm Ratio Calculation




Ratio = 2.4

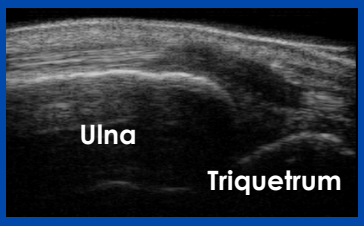
7mm | 17mm

> 1.4 positive for Carpal Tunnel

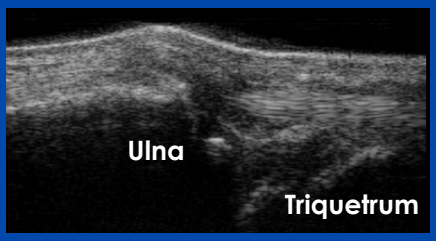
Source:
Clinical Neurophysiology 2008; 119:1353-1357
(DOI:10.1016/j.clinph.2008.01.101 )

## Upper Extremity Pathology

### Medial Wrist : Bilateral ECU Inflammation




LAX Left Wrist.
No Debridement

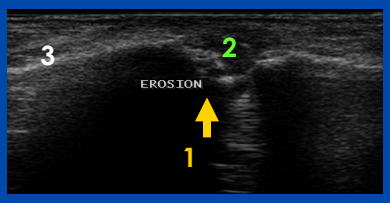



LAX Right Wrist.
2 years Post-debridement

Female. Mid-twenties. Life long bilateral wrist pain.
Diagnosis : “elongated ulnar styloid, bilateral”.

# Upper Extremity Pathology
## Dorsal MCP Longitudinal w/RA

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




Active Rheumatoid Arthritis
1.Cortical erosion

2. No distinct cartilage margin.
Distended joint capsule
and synovium

3. Poorly visualized extensor

# Upper Extremity Pathology
## Synovial Fluid vs Synovial Hypertrophy

| Fluid | Hypertrophy |
|---|---|
| Hypo-echoic | Hypo-echoic |
| ↓ | ↓ |
| Intra-articular | Intra-articular |
| ↓ | ↓ |
| NO DOPPLER SIGNAL | YES ! DOPPLER SIGNAL |
| ↓ | ↓ |
| COMPRESSIBLE | NON-COMPRESSIBLE |

# Upper Extremity Pathology

**Normal Values for Upper Extremity**

*Supraspinatus Tendon Thickness = 6mm*

*Critical Zone= 1cm proximal from SSP attachment*

*Biceps Tendon Cross- section = 5 mm*

*Sub- Deltoid Bursa = 2mm or less*

*Rotator Cuff Interval = 3mm*
*( variable sonolucent area on either side of biceps tendon)*

*Ulnar nerve Cross -section = 10 mm*

*Median Nerve WFR = > 1.4*

# Thank You !