

# Imaging of Peripheral Neuropathies

## Involvement of the Upper Limb

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# Objectives

- Illustrate the peripheral nerve anatomy at common sites of neural entrapment in the upper extremity
- Highlight clinically important sites of peripheral nerve pathology and their associated clinical syndromes
- Identify ultrasound and MR imaging features of upper limb peripheral neuropathies

# Objectives

Draw the Brachial Plexus in 10 seconds! - YouTube

http://www.youtube.com/watch?v=gTas7ijp0YE

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## Draw the Brachial Plexus in 10 seconds!

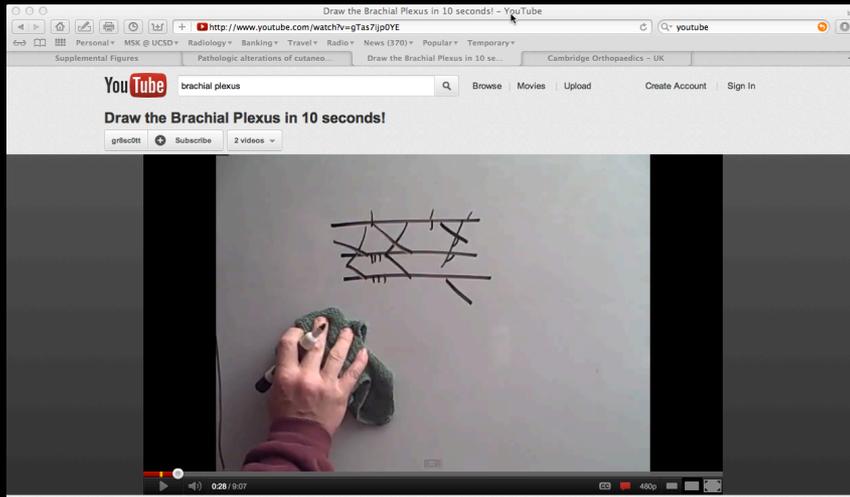
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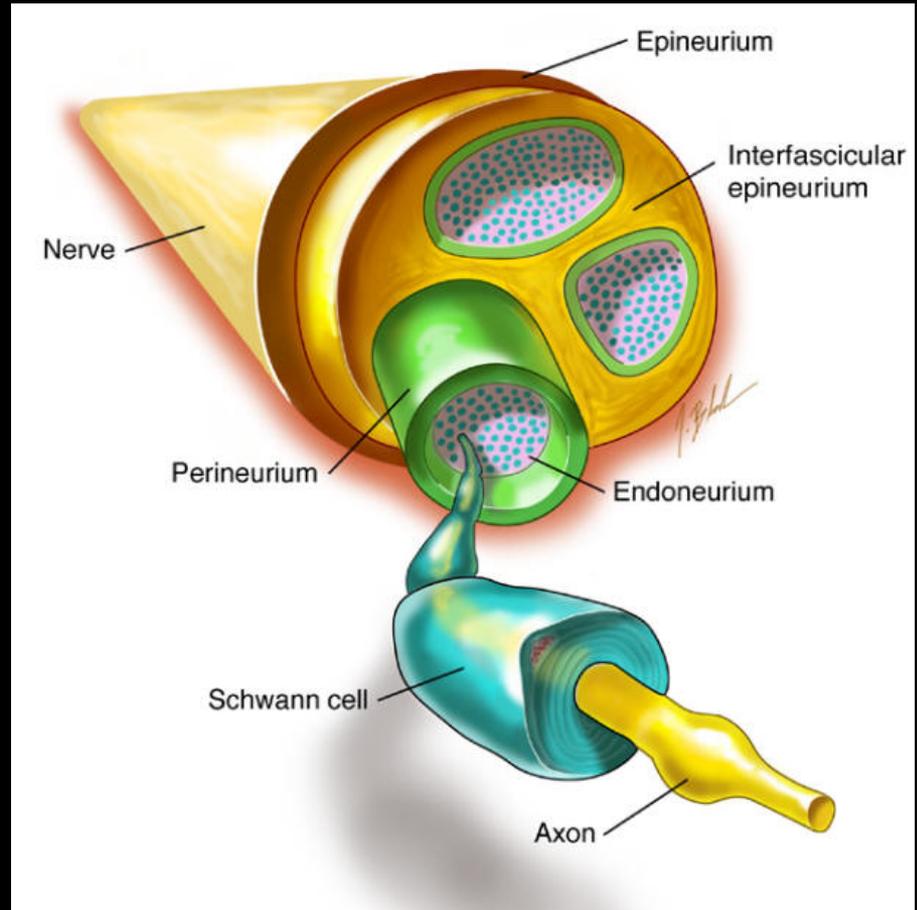
# Objectives



- musculocutaneous nerve
- axillary nerve
- suprascapular nerve
- radial nerve
- ulnar nerve
- median nerve

# Nerves

- parallel bundles of nerve fibers grouped together in fasciculi
  - endoneurium
    - fibers
  - perineurium
    - fasciculi
  - epineurium
    - nerve trunk

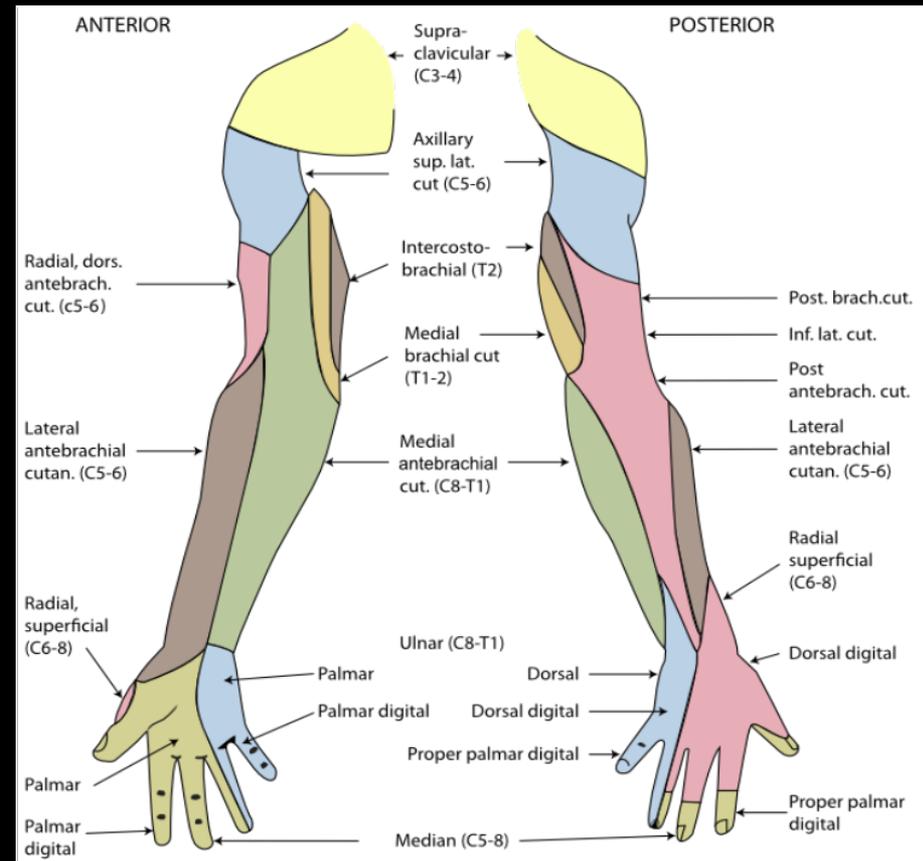


# Entrapment Neuropathies

- compression of a short segment of a single nerve at a specific site
  - fibro-osseous tunnel
  - opening in fibrous tissue or muscle
- injured structures
  - nerve fibers
  - Schwann cells
  - endoneurium
  - perineurium
  - epineurium
  - intraneural microvessels

# Peripheral Neuropathies

- traditional diagnosis
  - clinical history
  - physical examination
  - electrophysiologic studies
    - able to determine location & severity of underlying nerve injury
    - mildly invasive
    - operator dependent
- limitations
  - inability to determine structural causes
  - inability to assess spatial information



# Peripheral Neuropathies

- imaging

- US

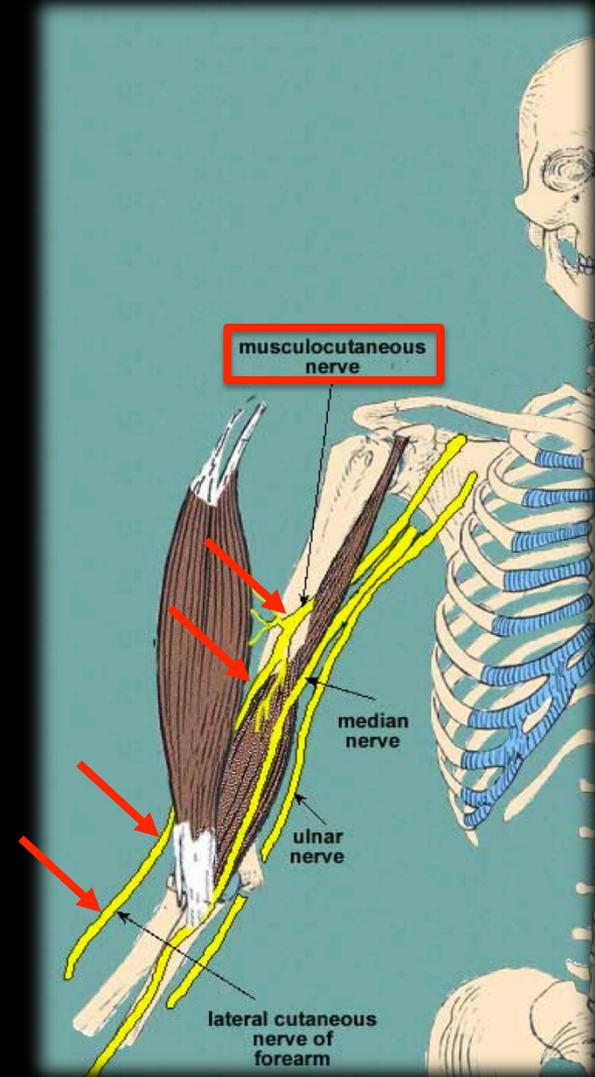
- quick, low-cost, noninvasive
    - dynamic evaluation
    - high spatial resolution
    - capacity to explore long nerve segments
    - limitations: operator dependence, confined use for assessment of superficial nerves

- MRI

- depiction of deeper nerves
    - high contrast resolution
    - identify specific muscle denervation patterns
      - muscle edema within 24-48 hours
      - fatty atrophy within several months

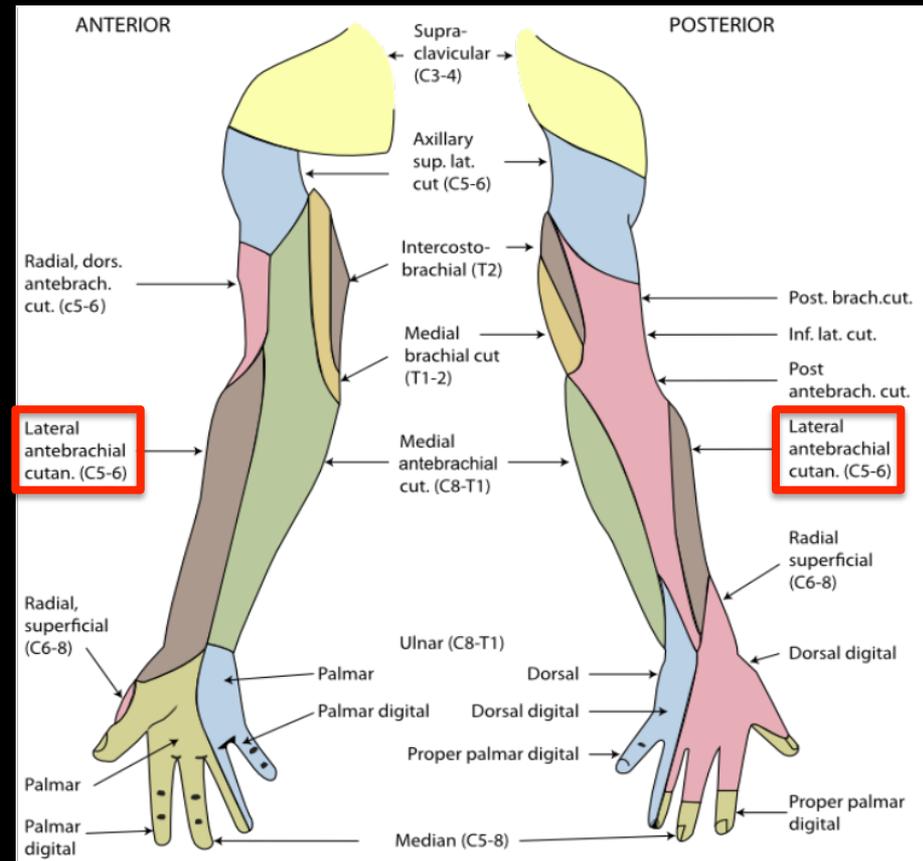
# Musculocutaneous Nerve

- lateral cord of brachial plexus
  - between brachialis & biceps brachii muscles
  - lateral to biceps brachii tendon
  - through antebrachial fascia



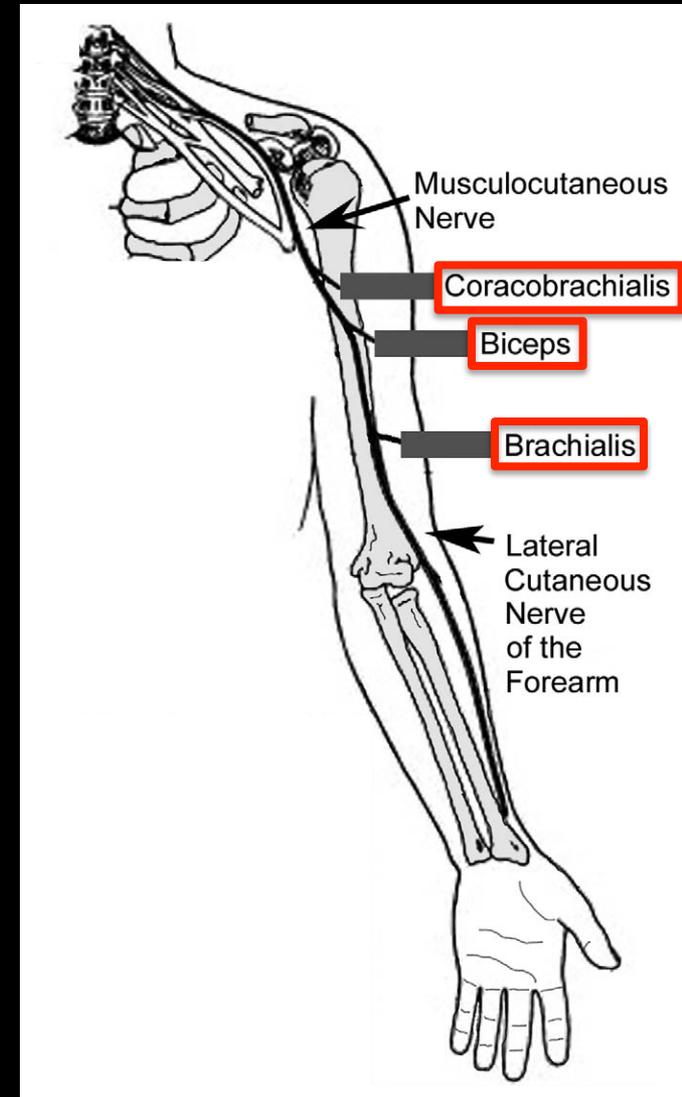
# Musculocutaneous Nerve

- lateral cord of brachial plexus
  - between brachialis & biceps brachii muscles
  - lateral to biceps brachii tendon
  - through antebrachial fascia
- lateral antebrachial cutaneous nerve
  - lateral forearm



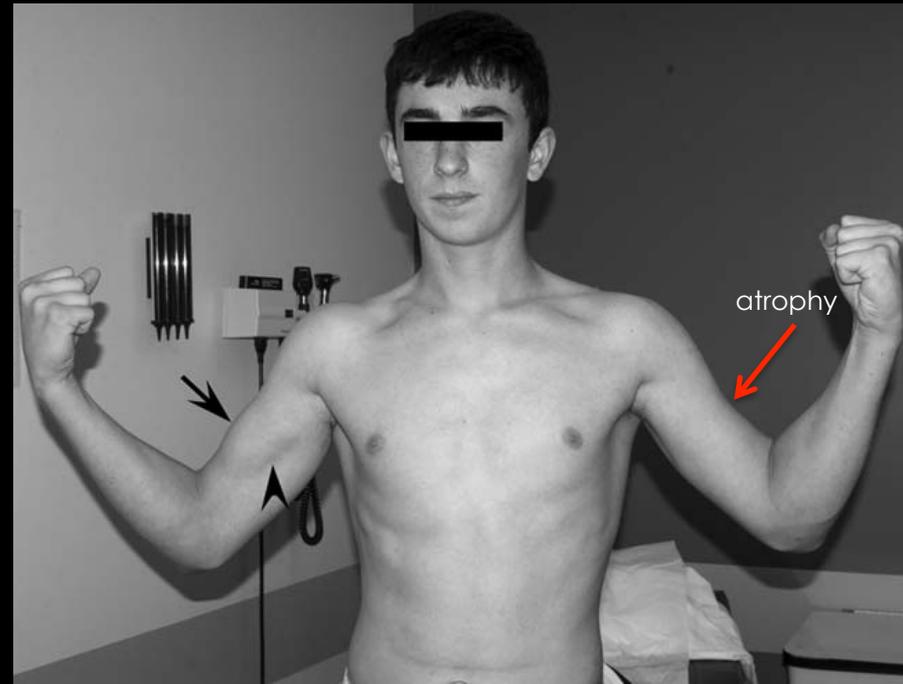
# Musculocutaneous Nerve

- muscle supply
  - coracobrachialis
  - brachialis
  - biceps brachii



# Musculocutaneous Nerve

- entrapment is uncommon; posttraumatic
- sites of entrapment
  - coracobrachialis muscle
  - antebrachial fascia in cubital fossa
    - external compression against biceps tendon
    - repetitive & vigorous arm exercise
- clinical features
  - muscle weakness
    - at/distal to coracobrachialis muscle
      - brachialis & biceps branchii muscles
  - sensory abnormalities mimicking lateral epicondylitis



# Musculocutaneous Nerve

- MR imaging
  - nerve may not be well visualized
  - muscle edema
    - coracobrachialis muscle
    - brachialis muscle
    - biceps brachii muscle
- US
  - point of emergence of lateral antebrachial cutaneous nerve

# Musculocutaneous Nerve

43-year-old patient with laceration to the upper arm and biceps weakness

biceps muscle



AX T2 FS

brachialis muscle

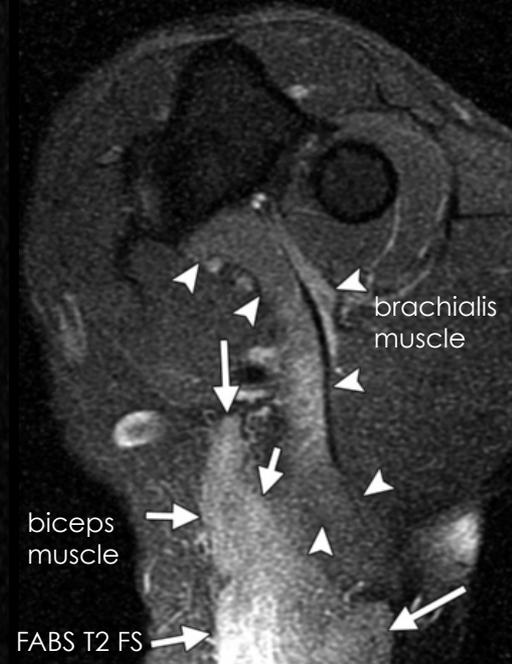


AX T2 FS

brachialis muscle

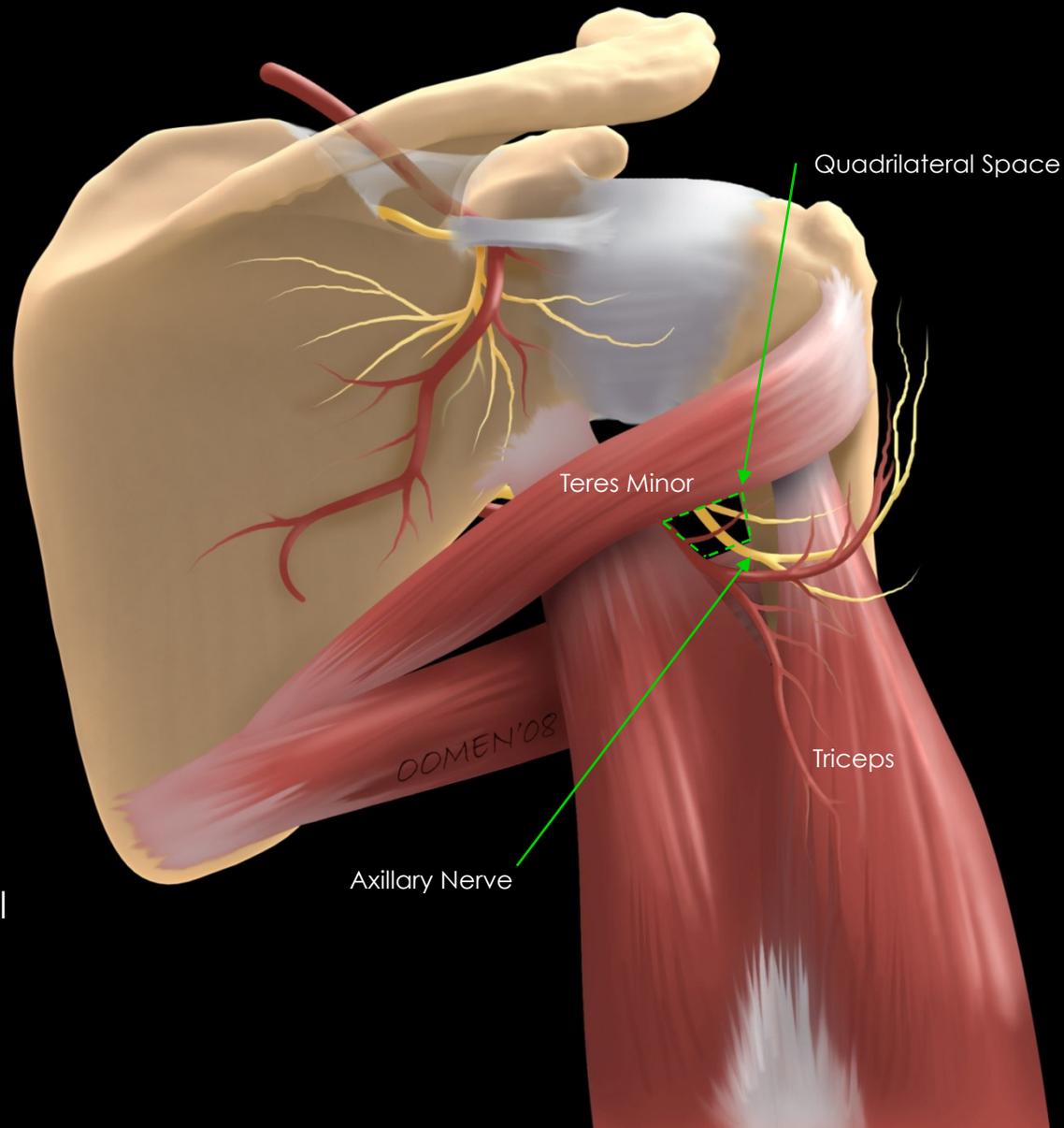
biceps muscle

FABS T2 FS



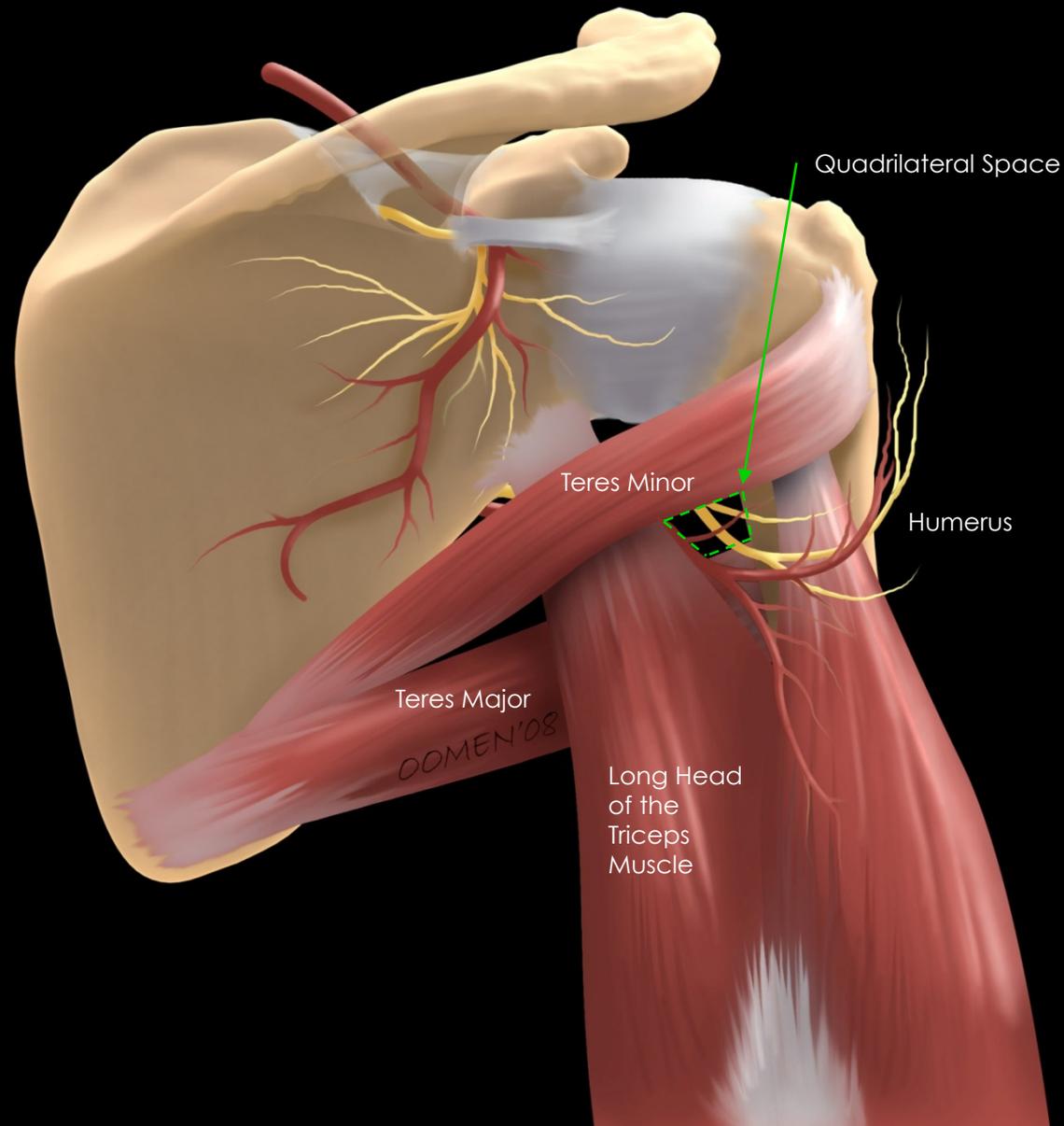
# Axillary Nerve

- posterior cord of brachial plexus
  - below coracoid process along anterior surface of subscapularis muscle
  - toward inferior aspect of shoulder, through quadrilateral space
  - divides
    - anterior branch
      - anterior & middle deltoid muscle
    - posterior branch
      - upper lateral brachial cutaneous nerve
      - teres minor muscle



# Axillary Nerve

- quadrilateral space
  - teres minor muscle
  - teres major muscle
  - long head of the triceps muscle
  - humerus

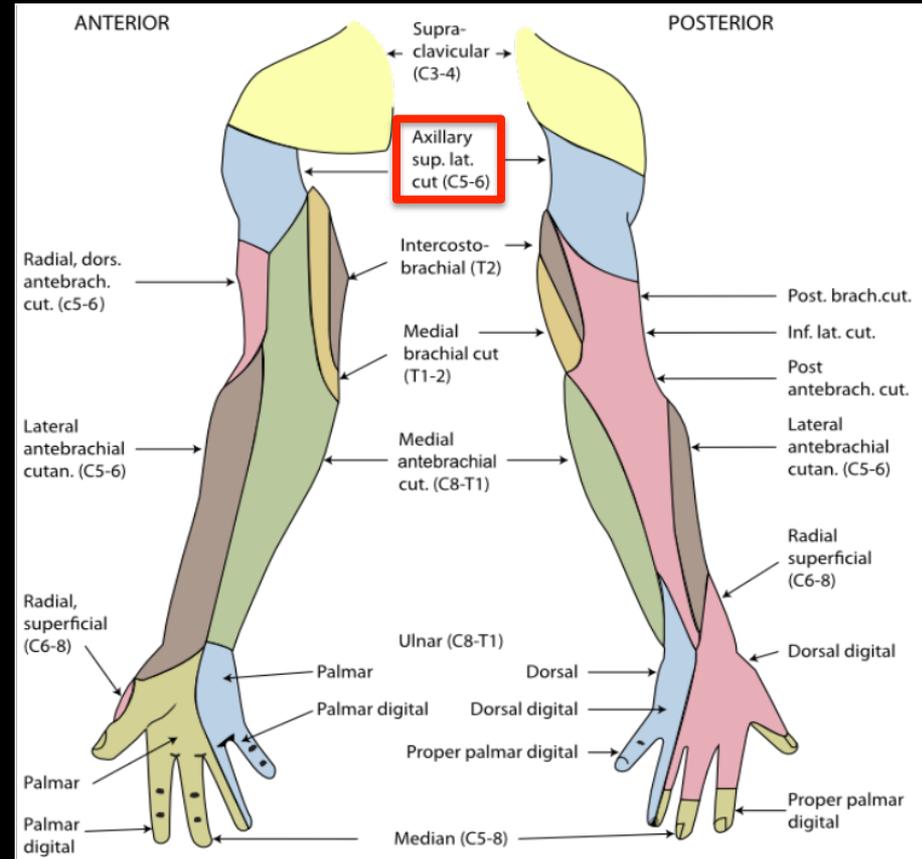


# Axillary Nerve

- sites of entrapment
  - quadrilateral space
  - anteroinferior to glenohumeral joint
- CAUSES
  - usually secondary to brachial plexus impairment
  - open surgical intervention
  - posttraumatic in up to 45% of shoulder dislocations
  - quadrilateral space syndrome
    - fibrous bands (most common)
    - tumors
    - paralabral cysts
    - osteophytes

# Axillary Nerve

- clinical features
  - vague
  - poorly localized pain over anterior shoulder with potential radiation to arm & forearm
  - paresthesias
  - weakness of deltoid
  - fatigue in athletes
  - atrophy of teres minor & deltoid muscles

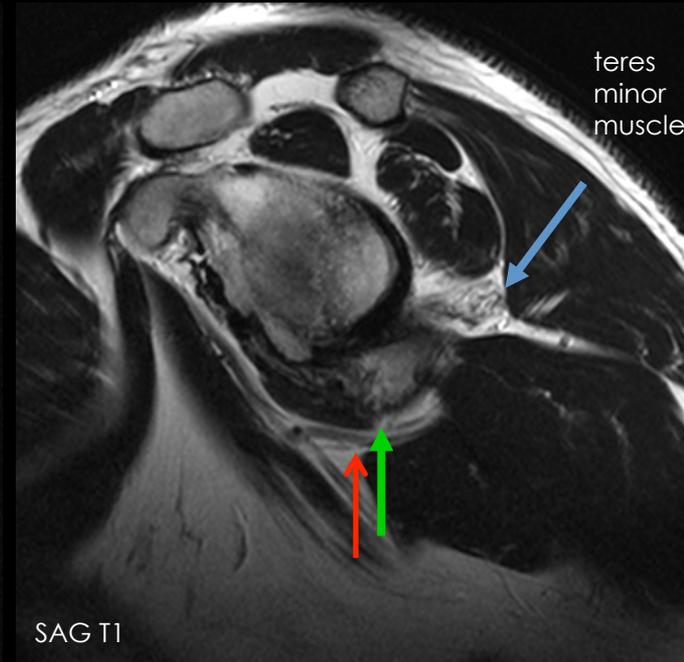
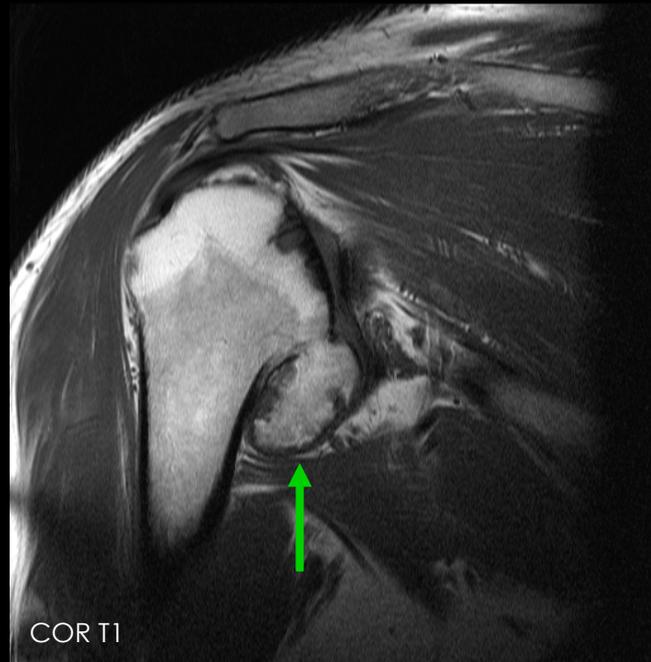
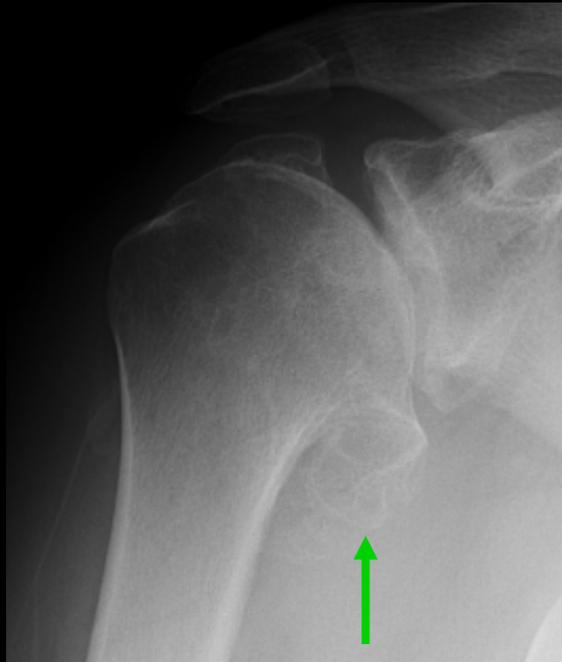


# Axillary Nerve

- radiography
  - proximal humeral fracture
  - severe osteoarthritis
  - adequacy of shoulder reduction
- MR imaging
  - masses
  - edema involving teres minor & deltoid muscles

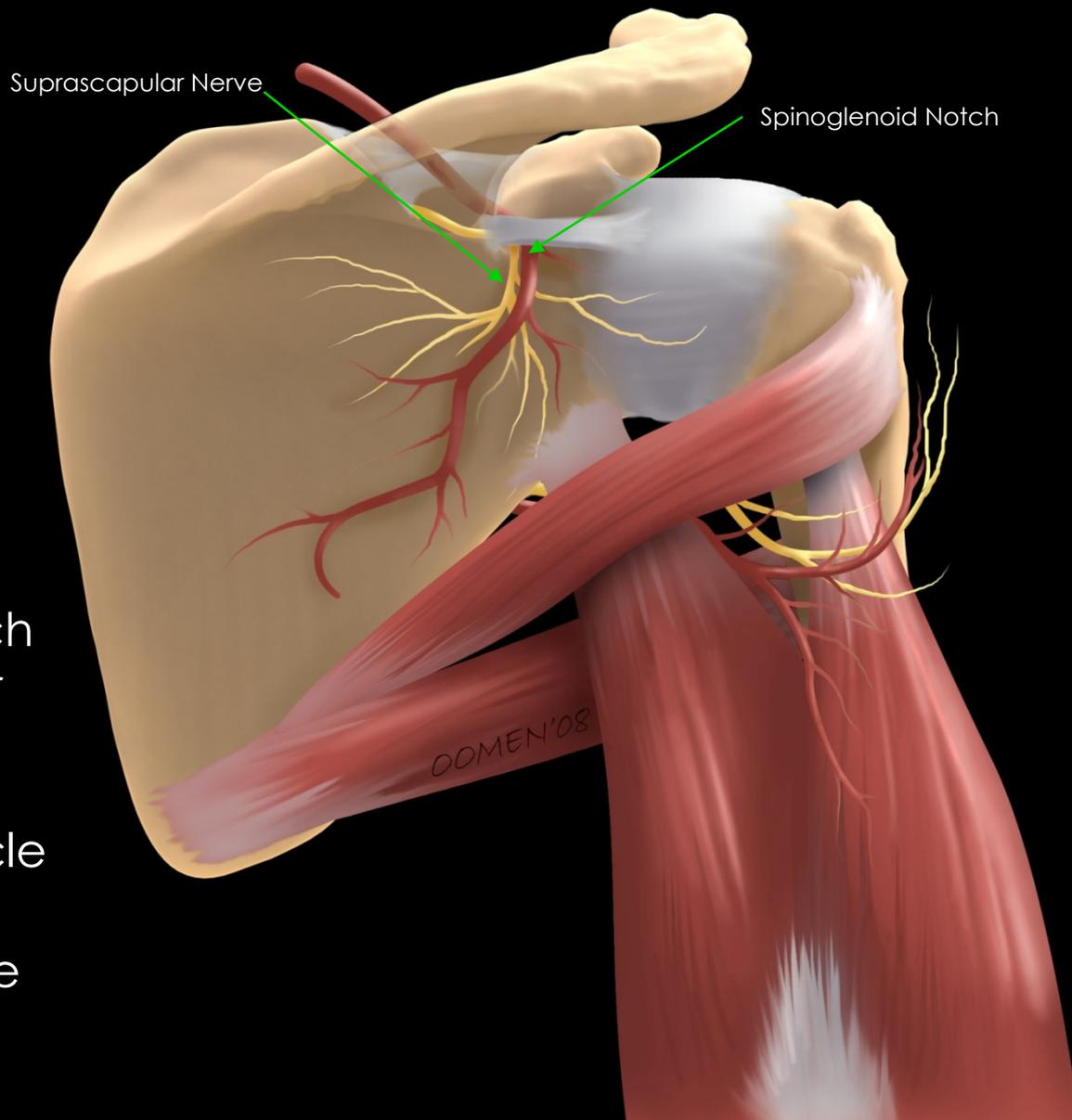
# Quadrilateral Space Syndrome

60-year-old patient with shoulder pain and weakness



# Suprascapular Nerve

- upper trunk of brachial plexus
  - obliquely across posterior triangle of neck toward coracoid process
  - through suprascapular foramen
    - suprascapular notch
    - transverse scapular ligament
  - supraspinatus fossa
    - supraspinatus muscle
  - spinoglenoid notch
    - infraspinatus muscle

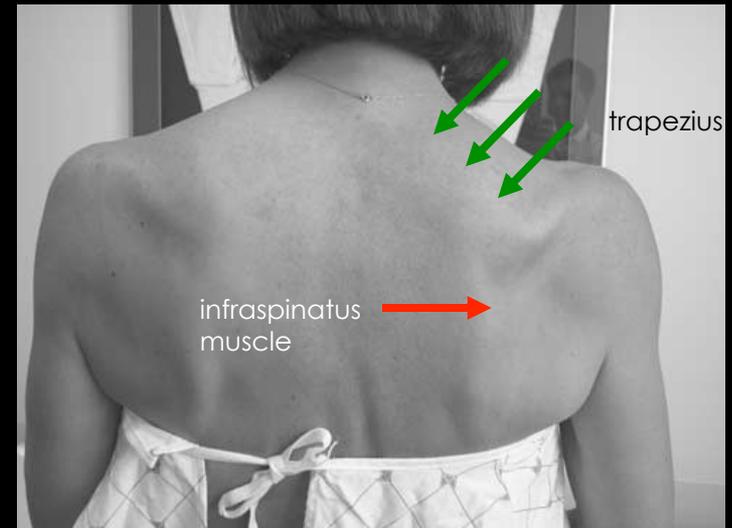


# Suprascapular Nerve

- sites of entrapment
  - suprascapular notch
  - spinoglenoid notch
- causes
  - thickened transverse scapular ligament
    - repetitive strain on abducted externally rotated shoulder
  - paralabral cysts
  - tumors
  - iatrogenic surgical injury
  - enlarged varicosities

# Suprascapular Nerve

- clinical features
  - insidious onset of deep, generalized, dull posterior shoulder pain
  - minimal functional motor loss
  - atrophy of supraspinatus &/or infraspinatus muscles

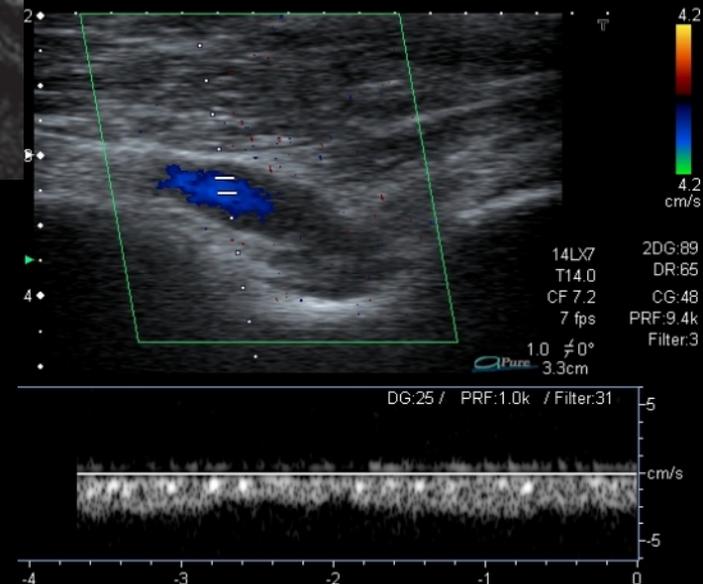
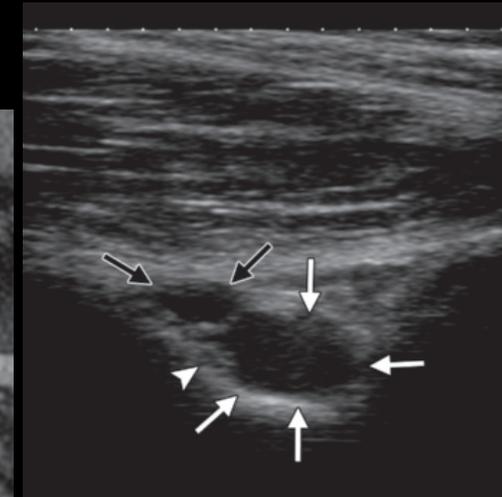
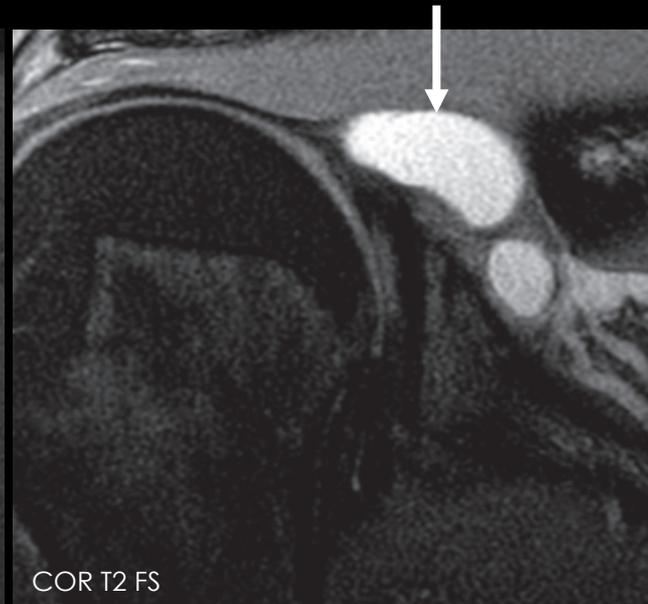
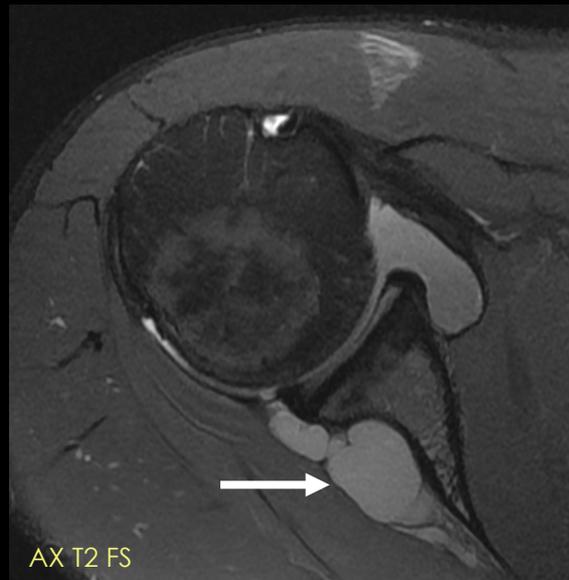


# Suprascapular Nerve

- MR imaging
  - muscle edema & atrophy
    - suprascapular notch syndrome
      - supraspinatus & infraspinatus muscles
    - spinoglenoid notch syndrome
      - infraspinatus muscle only
- US
  - distinguishing paralabral cysts from a varix
  - guiding aspiration of large paralabral cysts at spinoglenoid notch

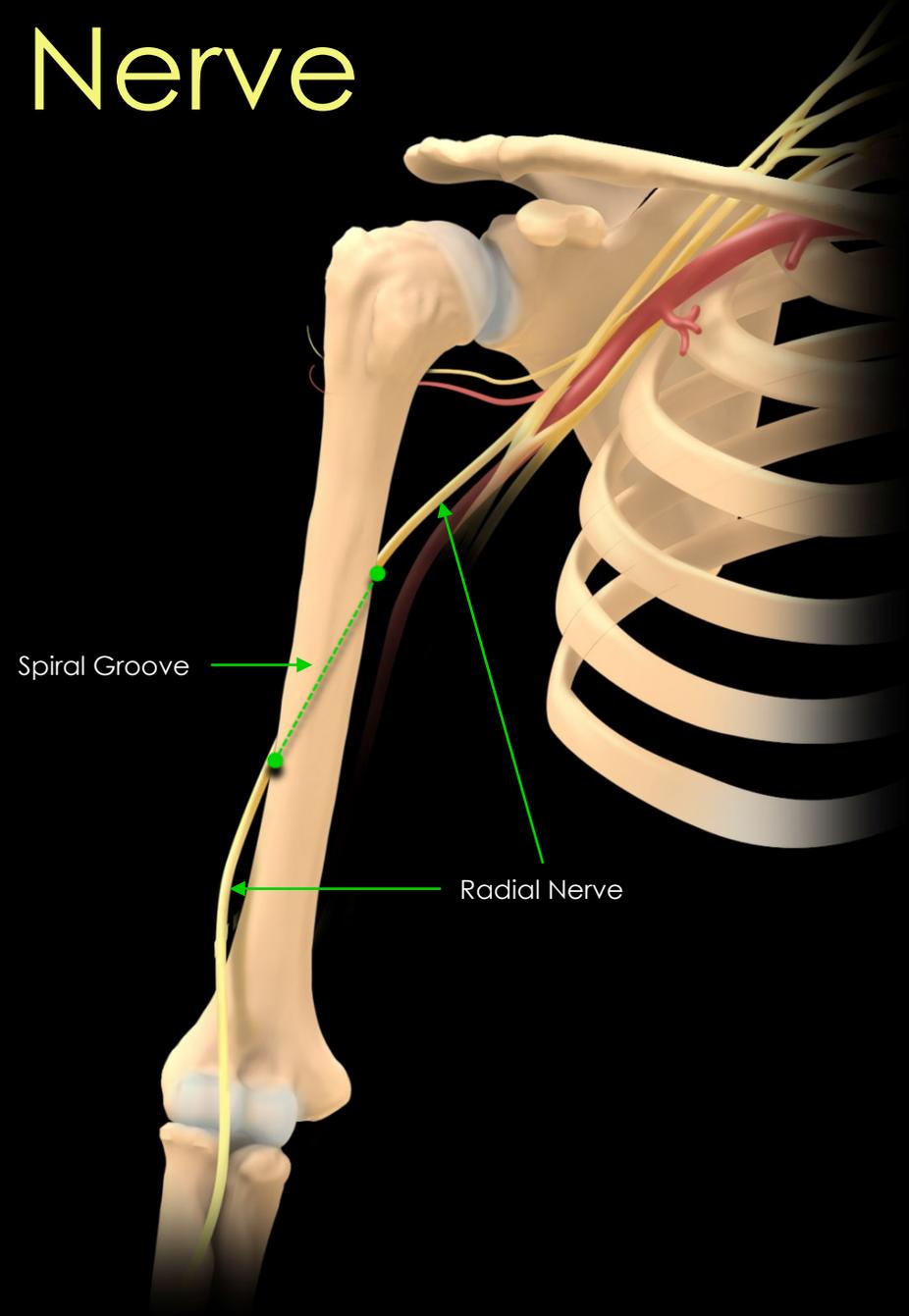
# Suprascapular Nerve

22-year-old patient with muscle pain about the shoulder and EMG findings suggesting mild suprascapular nerve compression likely at the spinoglenoid notch



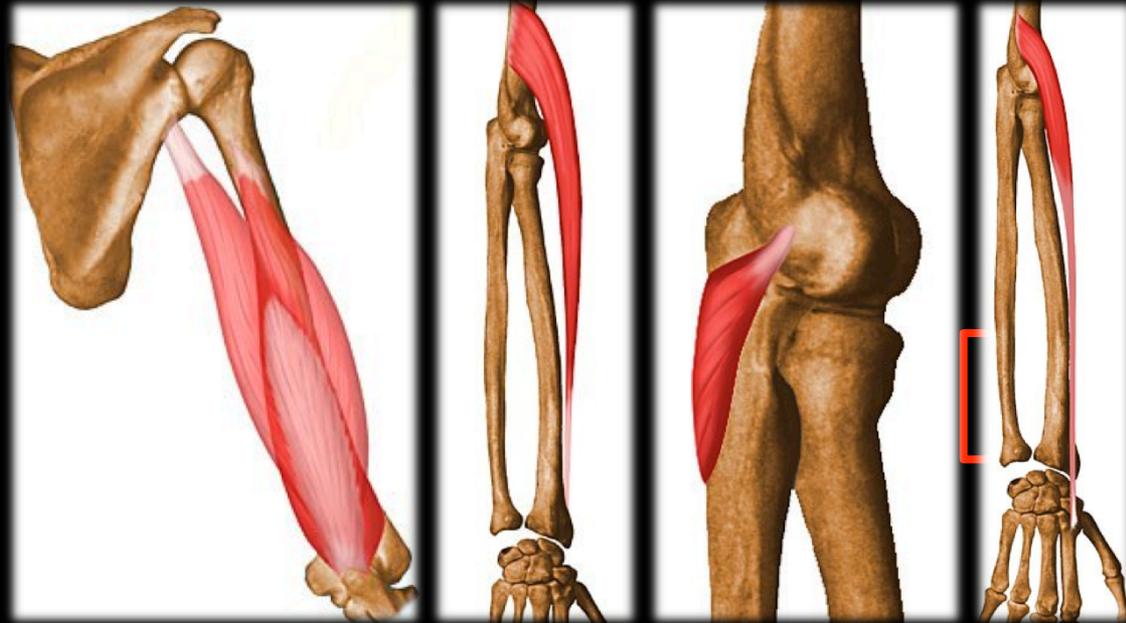
# Radial Nerve

- posterior cord of brachial plexus
  - around posterolateral humeral shaft
  - dorsally along spiral groove between lateral & medial heads of triceps muscle
  - enters anterior compartment by piercing lateral intermuscular septum ~10cm proximal to lateral epicondyle
    - superficial branch
    - deep branch



# Radial Nerve

- muscle supply
  - triceps
  - brachioradialis
  - anconeus
  - extensor carpi radialis longus
- cutaneous innervation to posterior upper arm



triceps

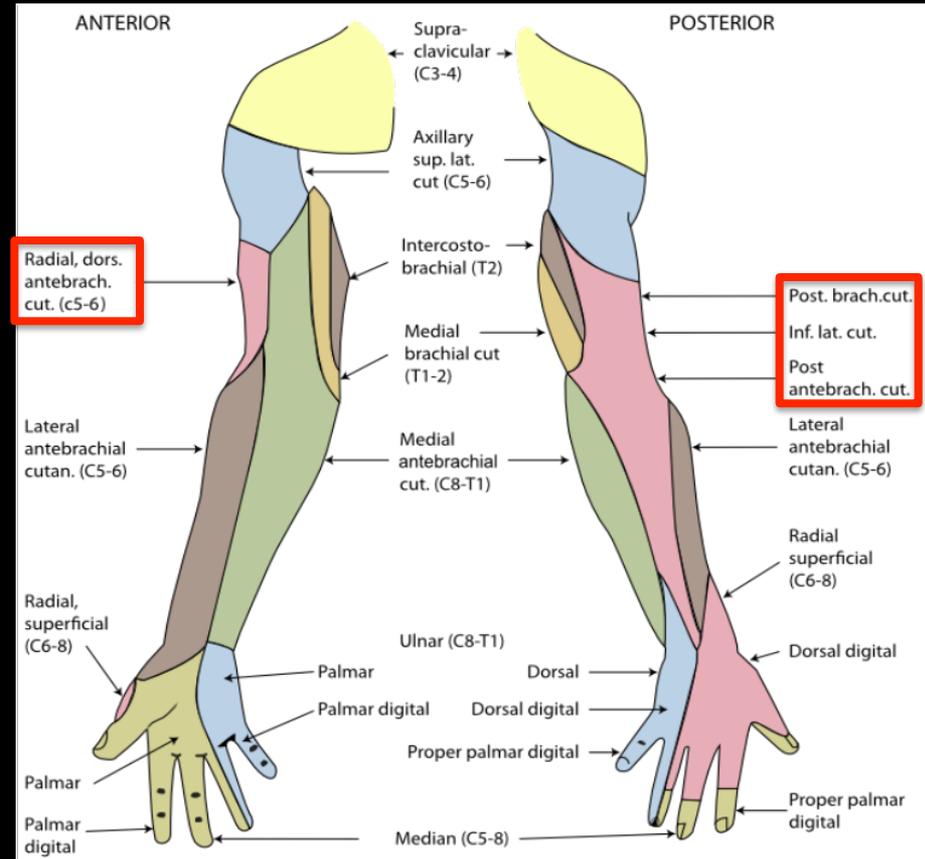
brachioradialis

anconeus

ECRL

# Radial Nerve

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  - triceps
  - brachioradialis
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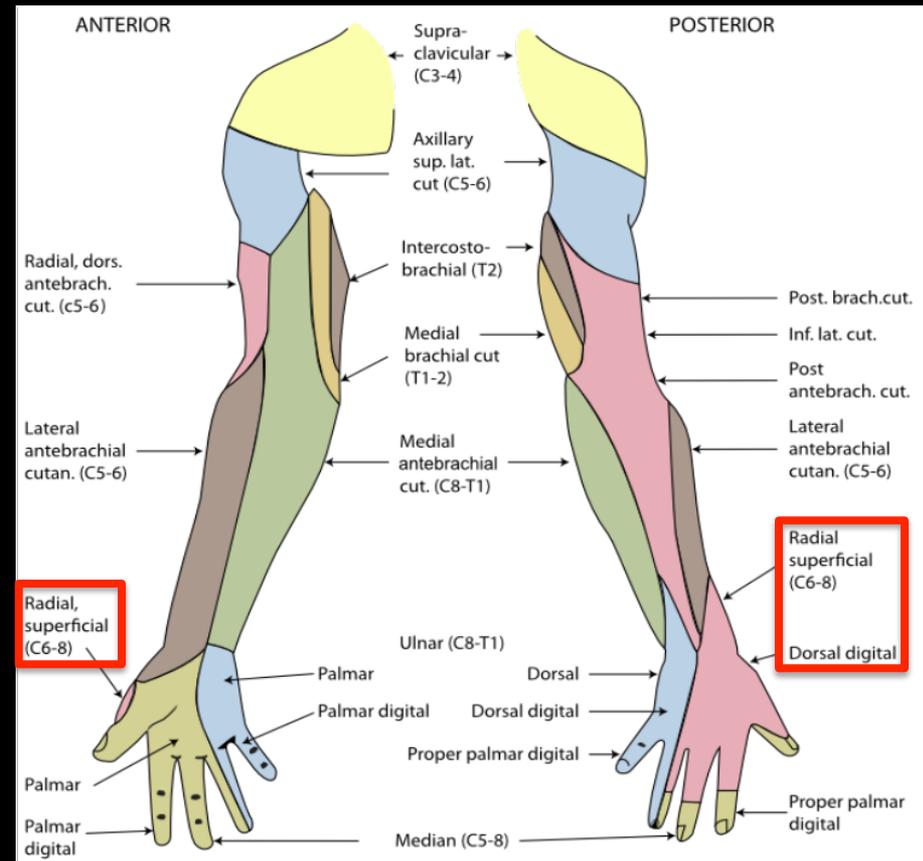
# Radial Nerve

- sites of entrapment at arm & elbow
  - spiral groove
  - lateral head of triceps muscle
- causes
  - Saturday night palsy
    - classic radial neuropathy secondary to intoxication
  - humeral shaft fracture
  - misuse of crutches
  - deep intramuscular injections
  - fibrous arch of lateral head of triceps muscle
    - weight lifters



# Radial Nerve

- clinical features (spiral groove)
  - functional loss
    - accessory forearm supination
    - elbow flexion
    - wrist & digital extension
    - thumb abduction
  - sensory loss dorsolateral hand
  - elbow extension is spared
    - triceps muscle branch proximal to spiral groove

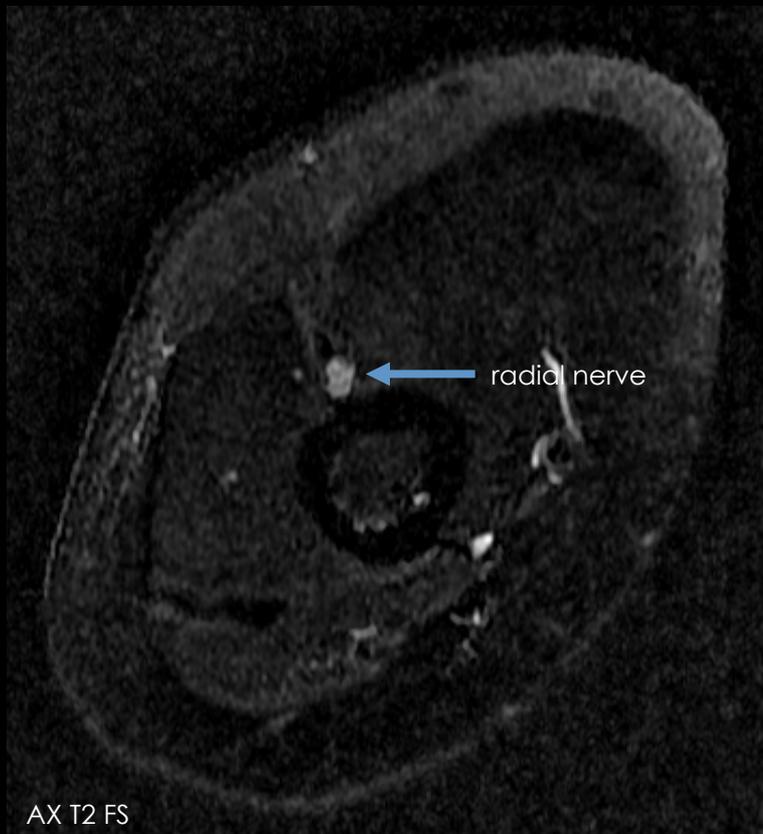


# Radial Nerve

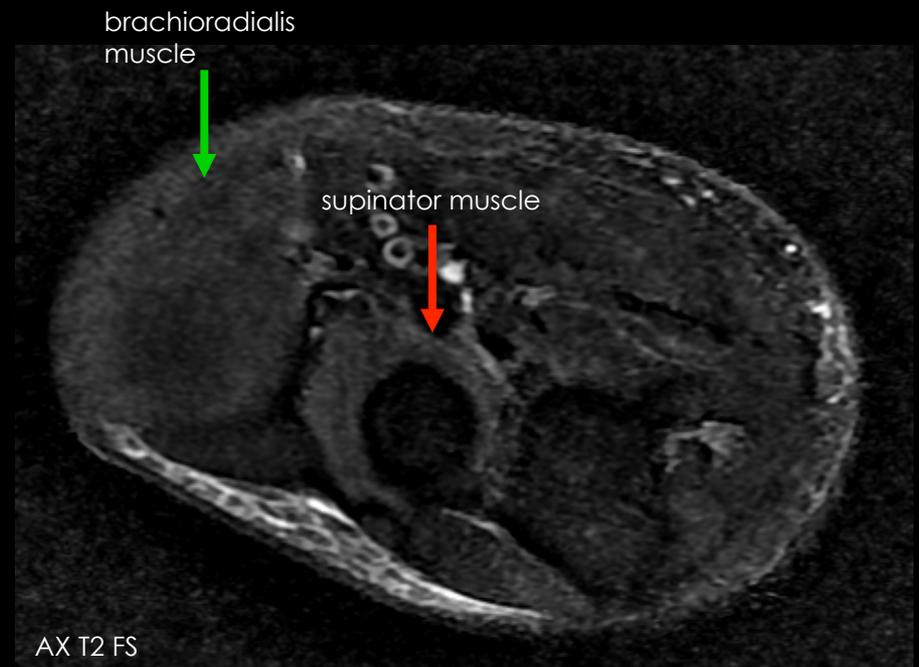
- MR imaging
  - muscle edema in some or all muscles
    - spiral groove entrapment
      - most except for triceps muscle
    - proximal muscles = high radial nerve entrapment
      - triceps muscle
      - extensor carpi radialis longus muscle
      - anconeus muscle
- US
  - neuroma
    - focal swelling
    - hypoechogenicity
    - loss of normal fascicular pattern

# Saturday Night Palsy

56-year-old patient with possible history of trauma, numbness of arm and weakness of extensor muscles

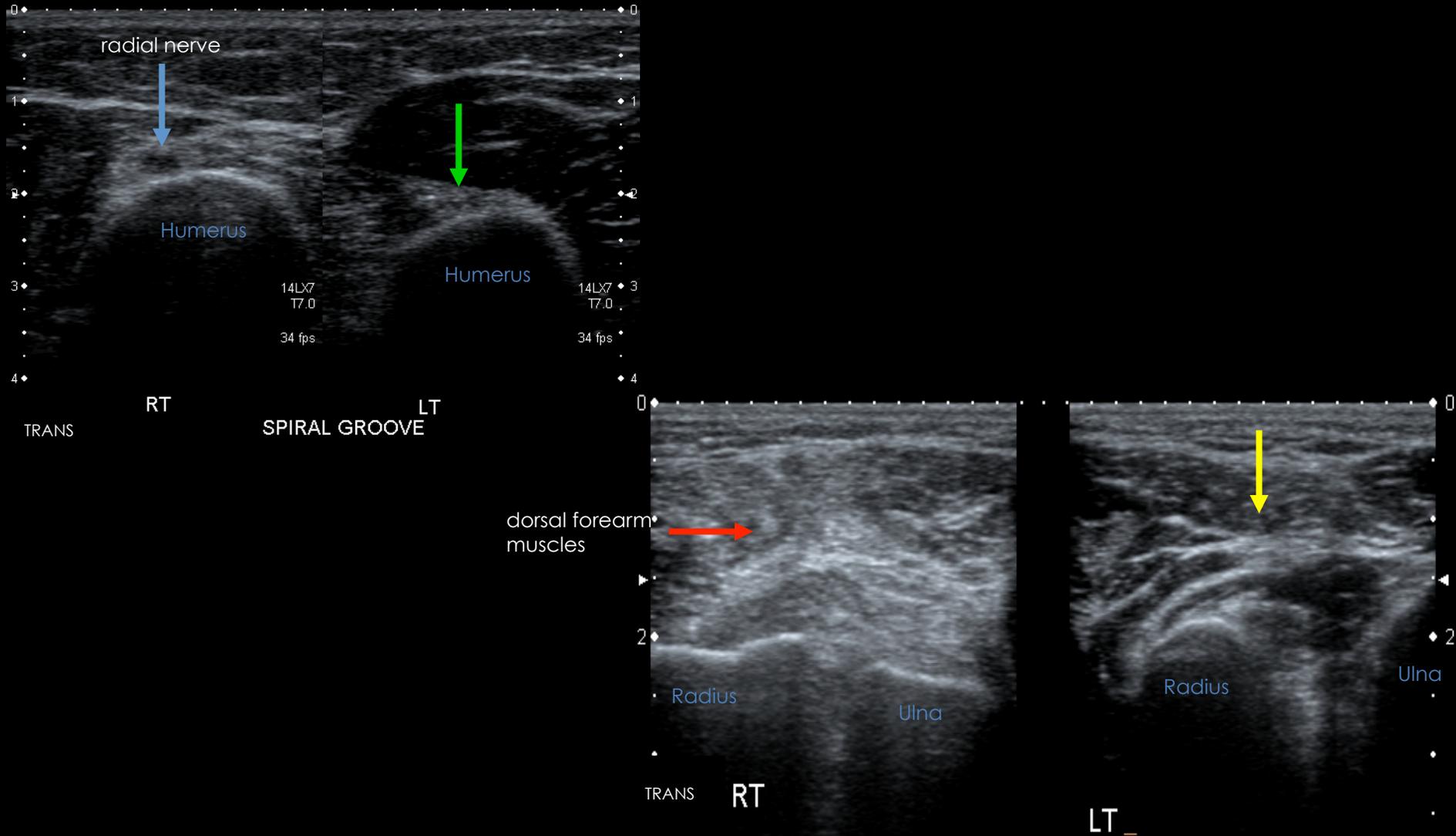


spiral groove



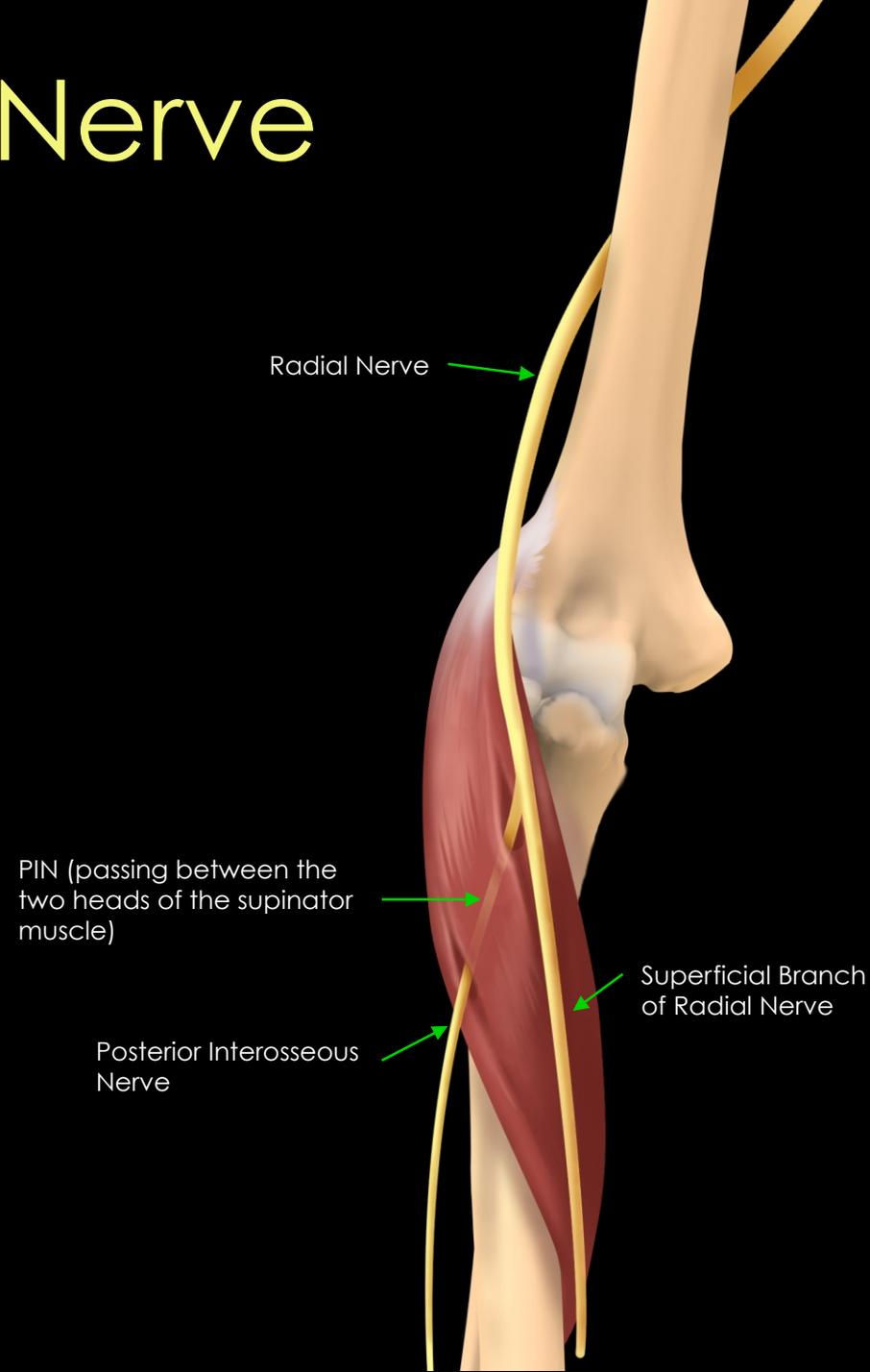
# Saturday Night Palsy

50-year-old patient with history of trauma and a flaccid right arm following shoulder subluxation



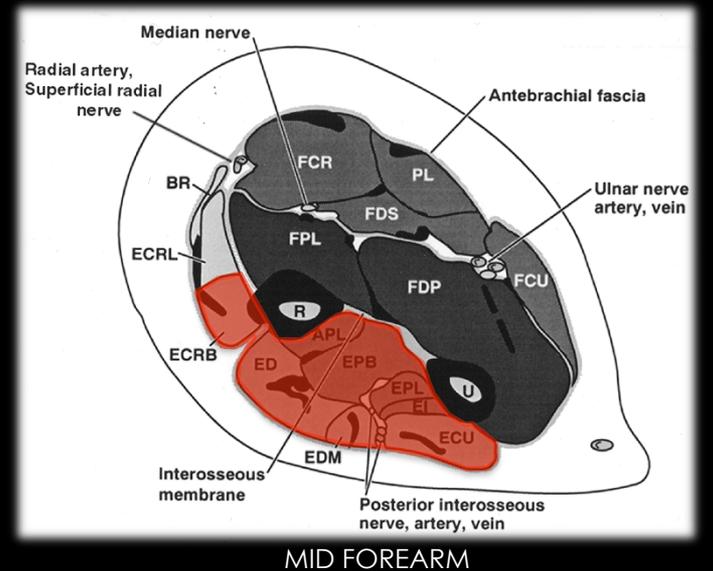
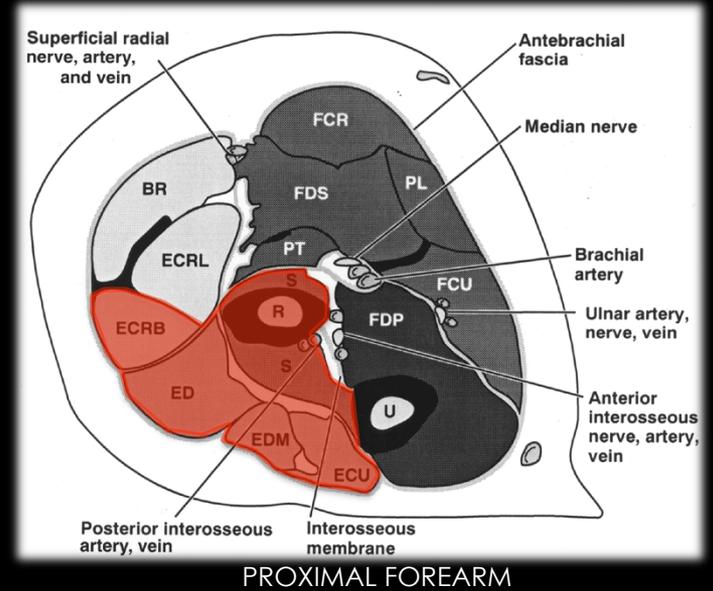
# Radial Nerve

- radial tunnel
  - mobile wad
  - elbow joint capsule
  - radiocapitellar joint
  - arcade of Frohse
    - fibrous arch at proximal superficial head supinator muscle
- divides
  - deep motor branch
    - posterior interosseous nerve
    - between superficial & deep portions of supinator muscle
    - along dorsal surface of interosseous membrane
  - superficial sensory branch
    - deep to brachioradialis muscle



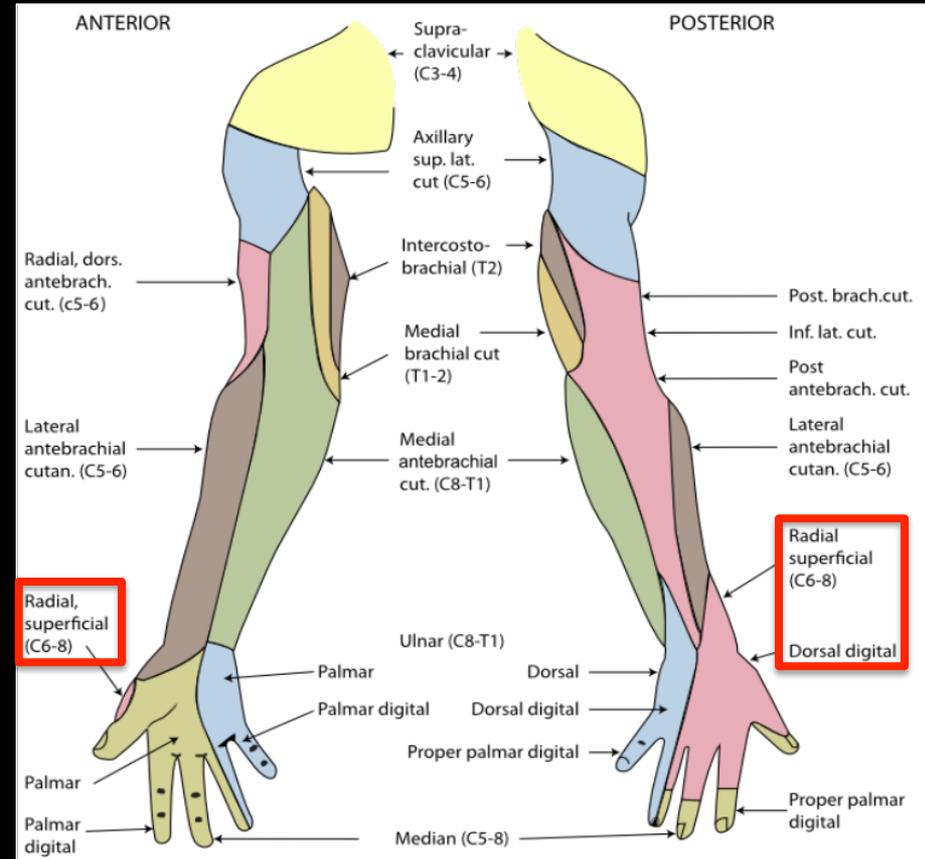
# Radial Nerve

- muscle supply (PIN)
  - supinator
  - abductor pollicis longus
  - extensor carpi ulnaris
  - extensor digitorum communis
  - extensor indicis
  - extensor digiti minimi
  - extensor pollicis longus
  - extensor pollicis brevis
  - extensor carpi radialis brevis
- cutaneous innervation to dorsolateral hand (superficial branch)



# Radial Nerve

- muscle supply (PIN)
  - supinator
  - abductor pollicis longus
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  - extensor digiti minimi
  - extensor pollicis longus
  - extensor pollicis brevis
  - extensor carpi radialis brevis
- cutaneous innervation to dorsolateral hand (superficial branch)



# Posterior Interosseous Nerve

- sites of entrapment at elbow
  - radiocapitellar joint & radial tunnel
  - arcade of Frohse
  - leash of Henry
    - vessels arising from recurrent radial artery
- causes
  - involvement of posterior interosseous nerve (PIN) with two distinct syndromes
    - differentiation based on presence or absence of neurologic deficits
    - radial tunnel syndrome
      - pain involving dorsolateral forearm
    - PIN syndrome
      - pain & paresis of extensor muscles
    - speculation: different nerve fibers are affected
      - PIN also carries sensory afferent fibers from wrist & innervated muscles

# Posterior Interosseous Nerve

- causes
  - forceful supination & pronation
    - athletes & workers
  - trauma
  - fibrous bands
  - thickened arcade of Frohse or margin of ECRB tendon
  - space-occupying lesions
    - ganglia, bursae, lipomas, recurrent pulsating radial vessels, synovitis, neurogenic tumors

# Posterior Interosseous Nerve

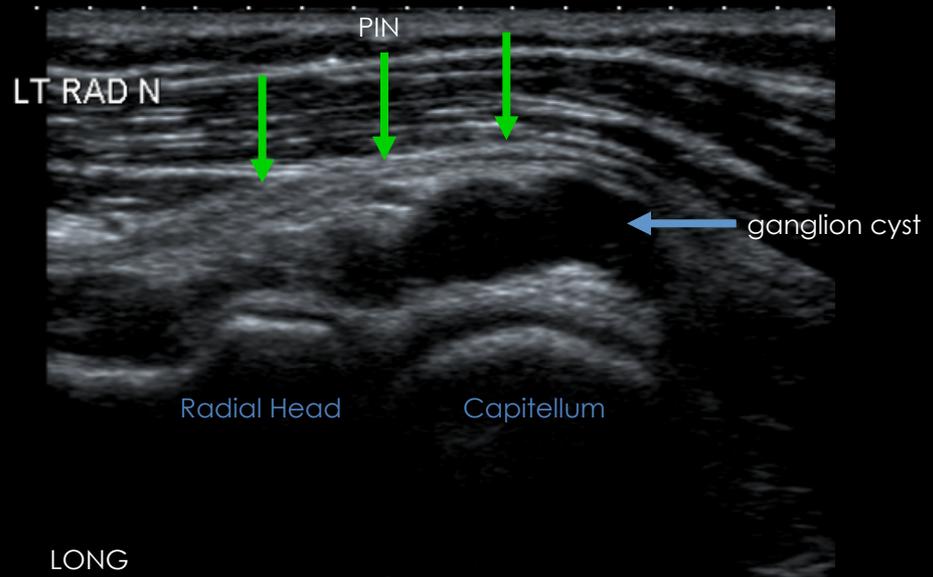
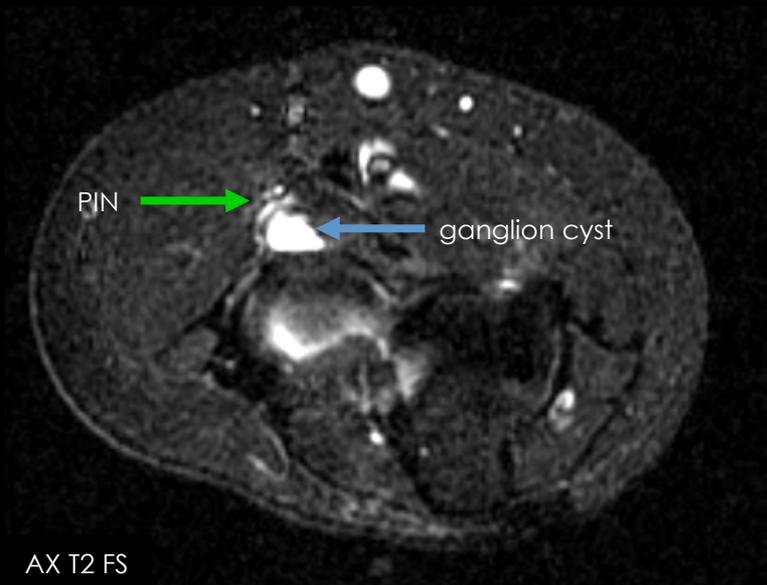
- clinical features
  - radial tunnel syndrome
    - pain over anterolateral proximal forearm
    - clinically similar to lateral epicondylitis
      - both are simultaneously present in 7%
      - 5% of patients with recurrent “tennis elbow” may have radial tunnel syndrome
  - PIN syndrome
    - inability to extend metacarpophalangeal joints of thumb & fingers
    - pain over supinator muscle, exacerbated by forced extension of fingers & supination of forearm

# Posterior Interosseous Nerve

- MR imaging
  - exclude mass lesion
  - muscle signal alterations
- US
  - exclude lateral epicondylitis
  - focal nerve swelling & loss of normal fascicular pattern
    - adjacent & proximal to compression

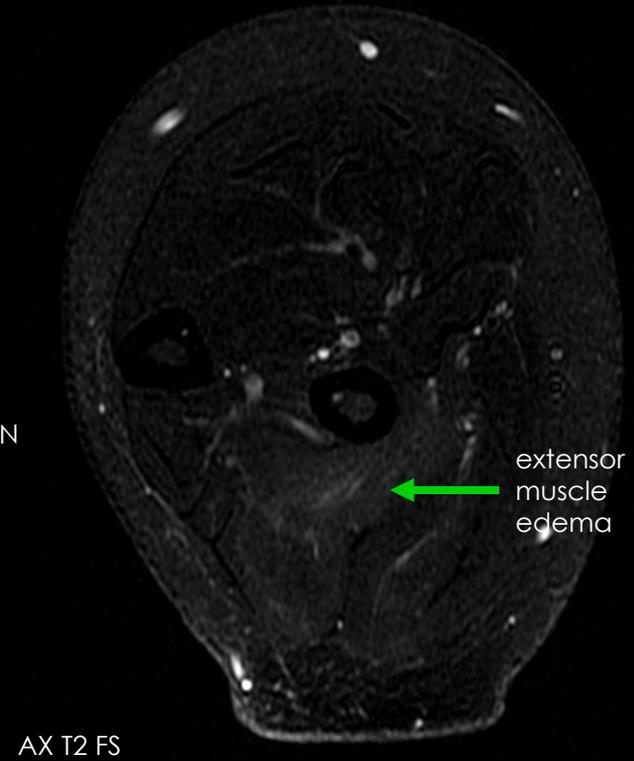
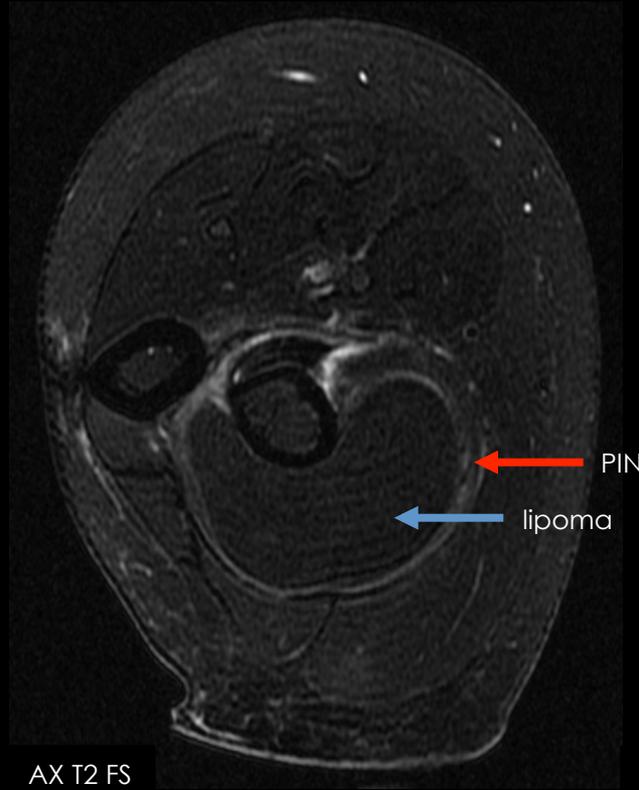
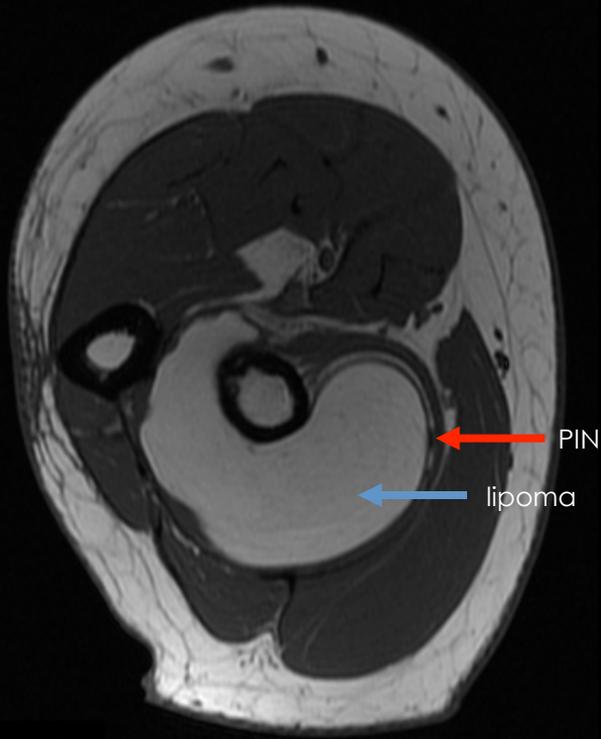
# Radial Tunnel Syndrome

46-year-old patient with history of lateral elbow pain diagnosed as lateral epicondylitis



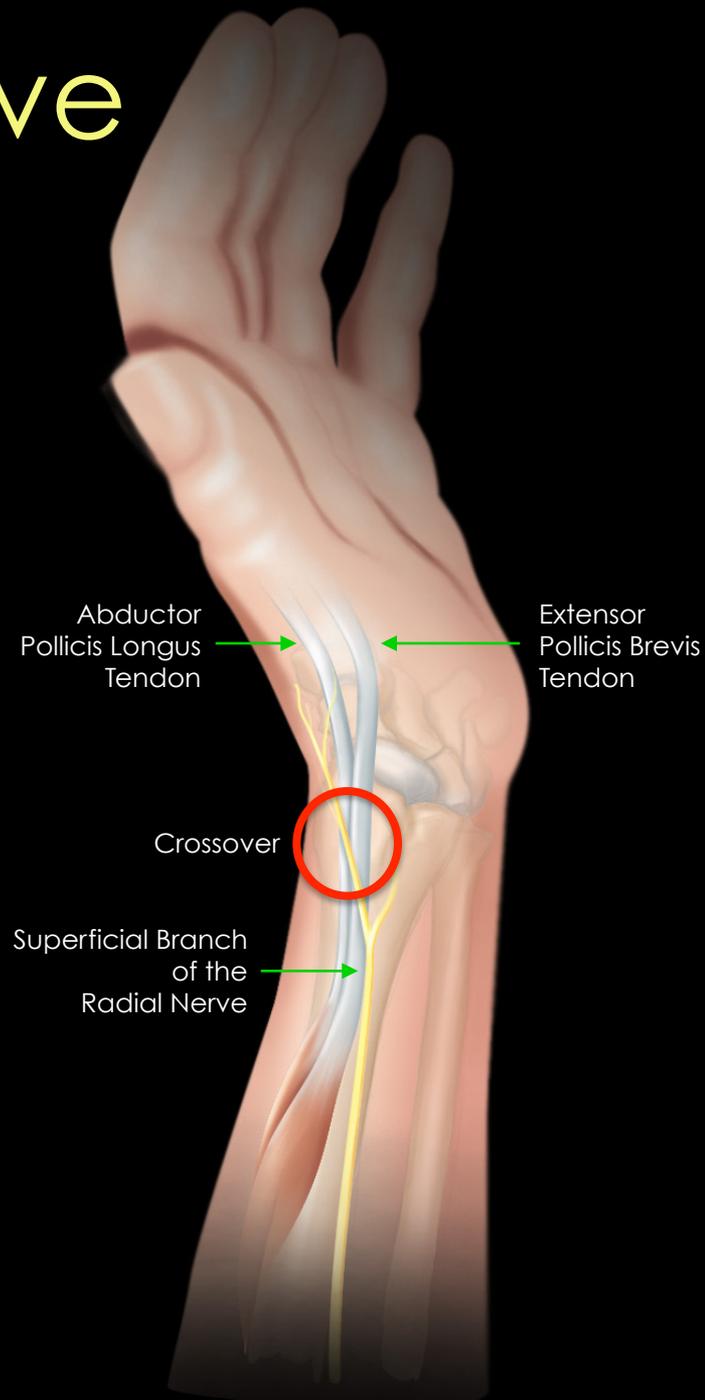
# Posterior Interosseous Nerve Syndrome

59-year-old patient with a lump and vague weakness of forearm, without sensory symptoms



# Radial Nerve

- superficial branch of radial nerve
  - deep to the brachioradialis tendon to pierce fascia & become subcutaneous
  - around radial aspect of wrist
    - dorsum of wrist, hand & two-and-a-half radial fingers to level of PIP joints
    - crosses 1<sup>st</sup> extensor compartment



# Superficial Branch of Radial Nerve

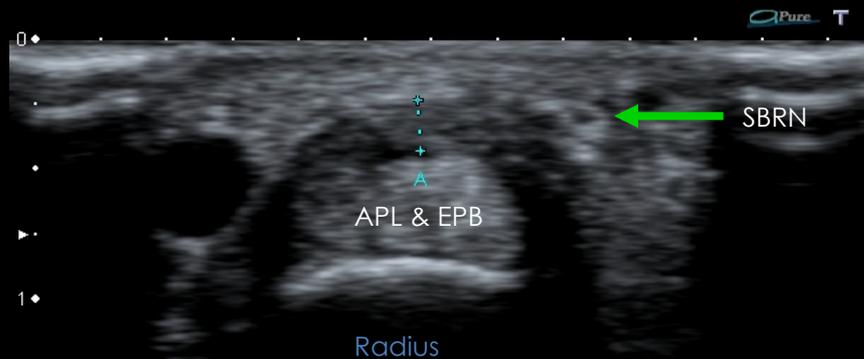
- clinical features
  - Wartenburg syndrome or cheiralgia paresthetica
    - nerve involvement at wrist causing paresthesia over dorsal thumb
    - causes
      - de Quervain tenosynovitis
      - injury during venipuncture
      - compression: handcuffs, casts, wristbands
  - entrapment at distal third of forearm
    - pain over distal radial forearm with associated paresthesia
    - positive Tinel sign

# Superficial Branch of Radial Nerve

- US
  - comparison with asymptomatic contralateral side
  - identification of swollen nerve
    - de Quervain disease prior to surgical release
      - avoid incomplete relief of symptoms
      - aggravation of neuritis symptoms

# Wartenburg Syndrome

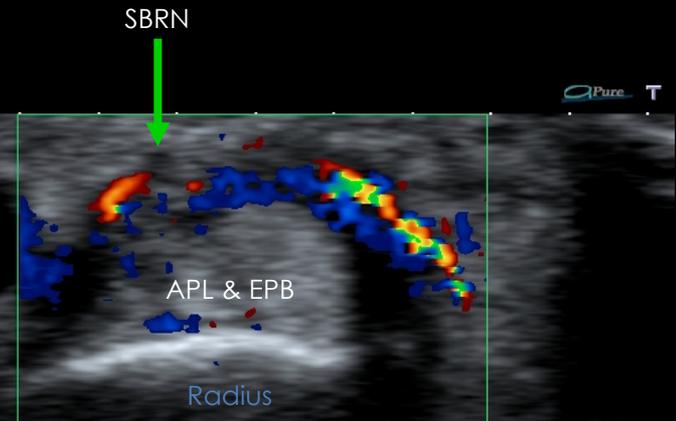
49-year-old patient with paresthesia over dorsal radial hand and vague pain along radial side of forearm radiating both proximally and distally



RT EXT 1 DST RAD

TRANS

4.2  
cm/s



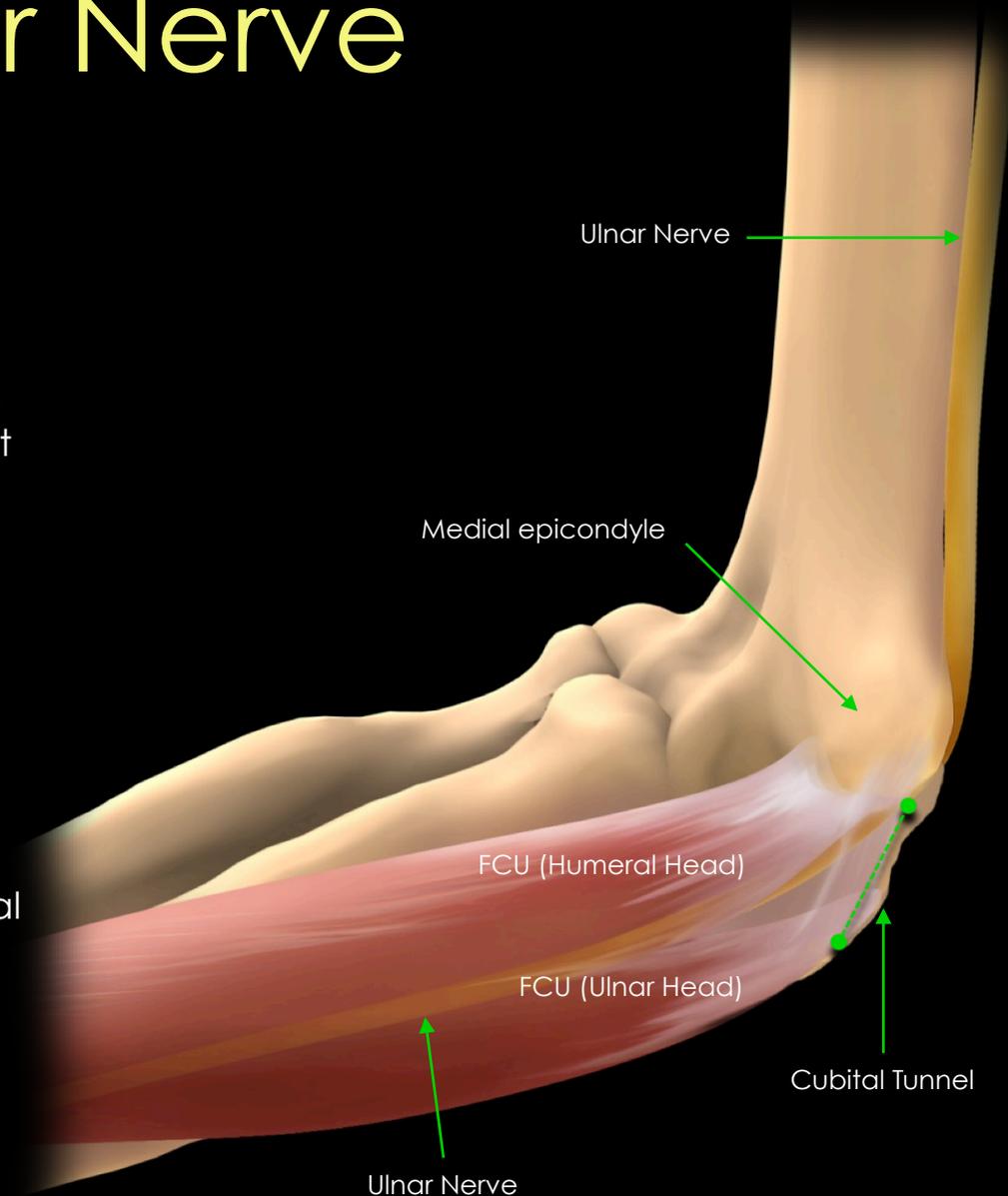
RT EXT 1 DST RAD

14Lx7  
T14.0  
CF 7.2  
10 fps

TRANS

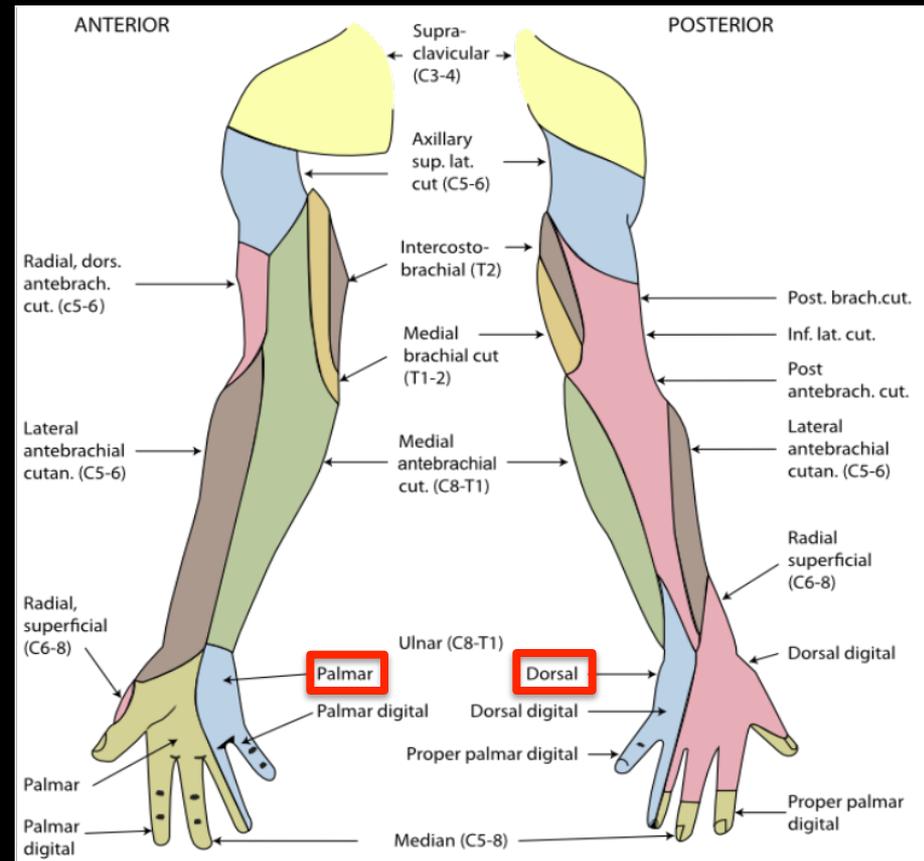
# Ulnar Nerve

- medial cord of brachial plexus
  - midhumerus level
    - pierces intermuscular septum
    - enters posterior compartment
  - under arcade of Struthers
    - 8cm proximal to medial epicondyle
    - 70% of individuals
  - follows groove in medial head of triceps muscle
  - cubital tunnel
    - medial epicondyle
    - olecranon
    - joint capsule & ulnar collateral ligament
    - cubital tunnel retinaculum
  - between humeral & ulnar heads of flexor carpi ulnaris muscle
  - pierces flexor pronator aponeurosis



# Ulnar Nerve

- muscle supply
  - flexor carpi ulnaris
  - flexor digitorum profundus
    - 4<sup>th</sup> & 5<sup>th</sup> fingers
- cutaneous innervation
  - palmar cutaneous nerve
    - hypothenar eminence
  - dorsal ulnar cutaneous nerve
    - 5<sup>th</sup> & half of 4<sup>th</sup> fingers



# Ulnar Nerve

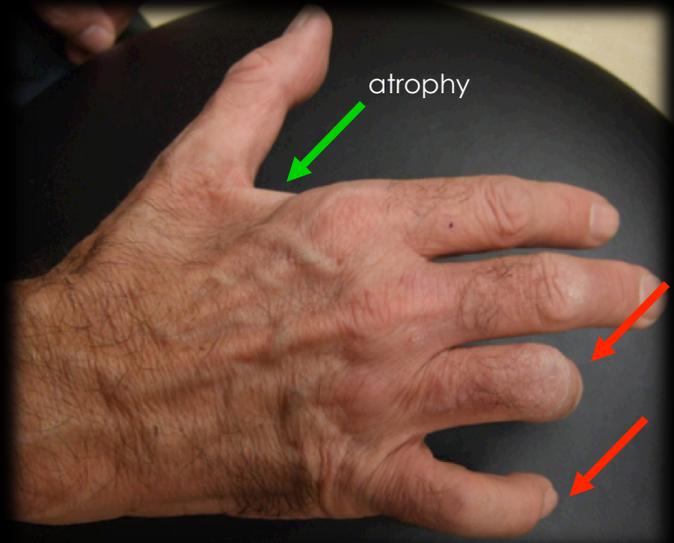
- sites of entrapment at elbow
  - arcade of Struthers
  - medial intermuscular septum
  - cubital tunnel
  - between two heads of flexor carpi ulnaris muscle
  - flexor pronator aponeurosis

# Ulnar Nerve

- cubital tunnel syndrome
  - 2<sup>nd</sup> most common neuropathy in upper limb
  - volume change during elbow flexion
    - tightening arcuate ligament
    - bulging medial head triceps muscle
  - causes
    - blunt trauma
    - compression
      - anconeus epitrochlearis muscle
      - osteophytes
      - ganglia
      - synovitis
    - lax ulnar collateral ligament
    - tardy ulnar nerve palsy
      - delayed neuropathy
    - valgus instability
    - ulnar nerve subluxation
      - 10-16% of individuals
      - may be associated with symptoms of neuritis

# Ulnar Nerve

- clinical features
  - medial elbow pain radiating to hand
    - exacerbated by elbow flexion
  - pain or numbness at ulnar aspect of hand & fingers
  - weakness of finger abduction, thumb adduction, pinching of thumb & forefinger
  - muscle atrophy
  - flexion contractures

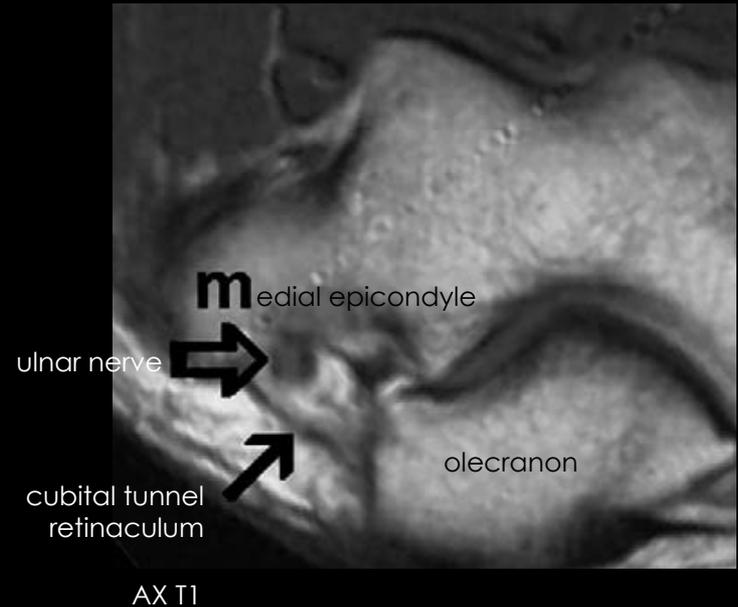


# Ulnar Nerve

- US
  - assess entire course of nerve to determine site of compression (when EMG nonlocalizing)
  - hypoechoic & swollen nerve proximal to compression or “hourglass” constriction
  - dynamic evaluation throughout elbow flexion & appreciation of “snapping” sensation
    - ulnar nerve
    - triceps muscle

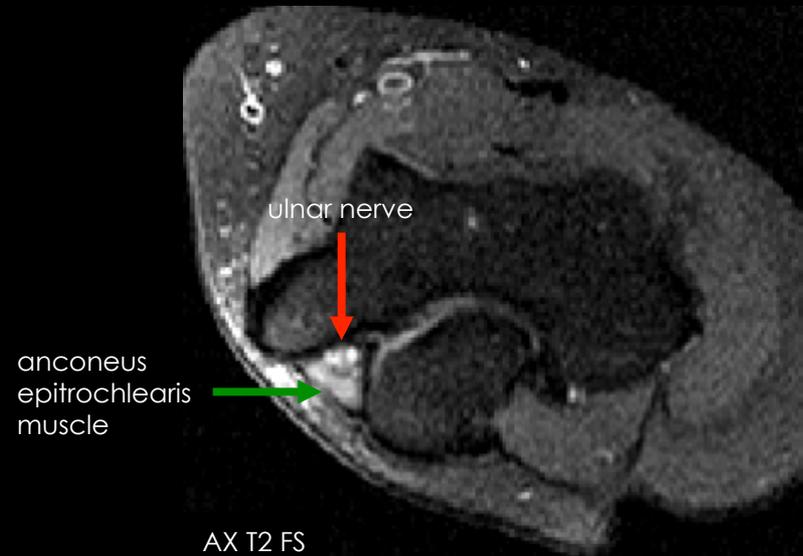
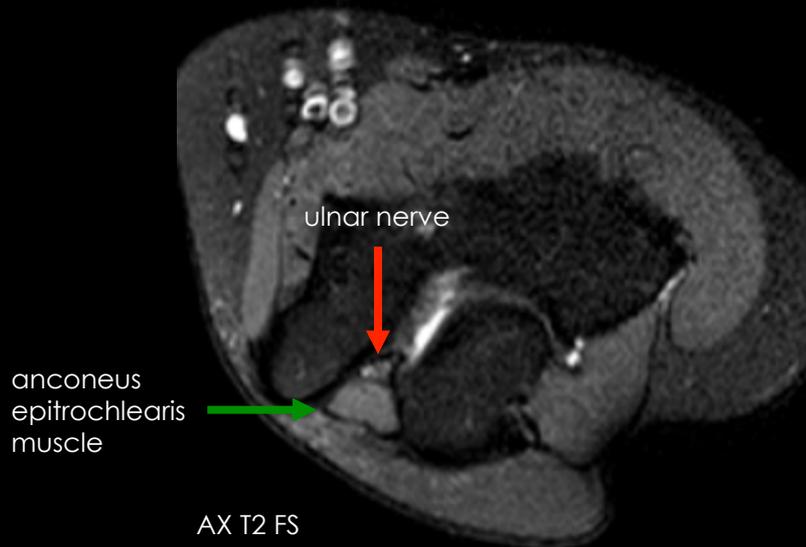
# Ulnar Nerve

- MR imaging
  - comprehensive assessment
  - appearance of normal ulnar nerve
    - round, hypointense surrounded by fat
    - may be hyperintense in asymptomatic individuals
      - focal nerve thickening & fascicular distortion is pathologic
  - anconeus epitrochlearis
    - 4-34% of individuals
  - muscle edema or atrophy



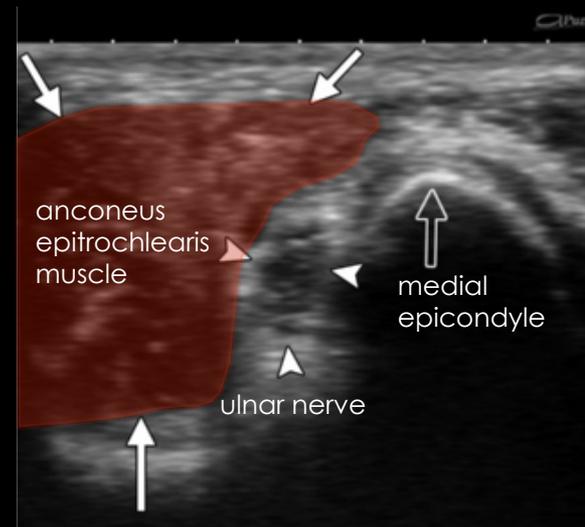
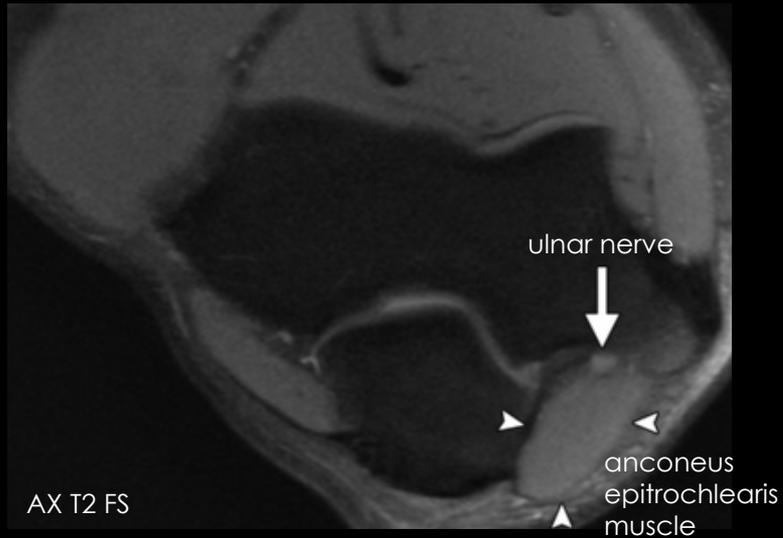
# Anconeus Epitrochlearis

31-year-old patient with constant tingling and numbness in ring & little fingers



# Anconeus Epitrochlearis

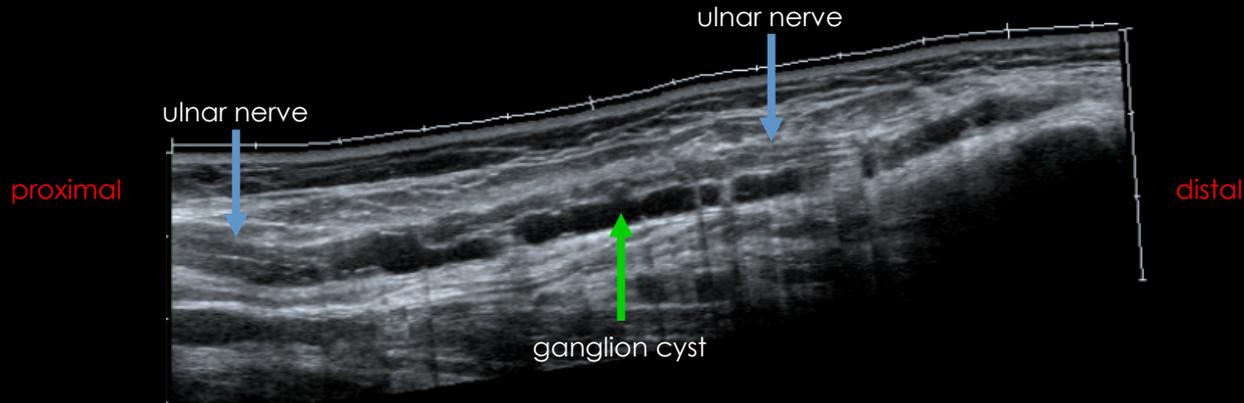
35-year-old patient with hand weakness



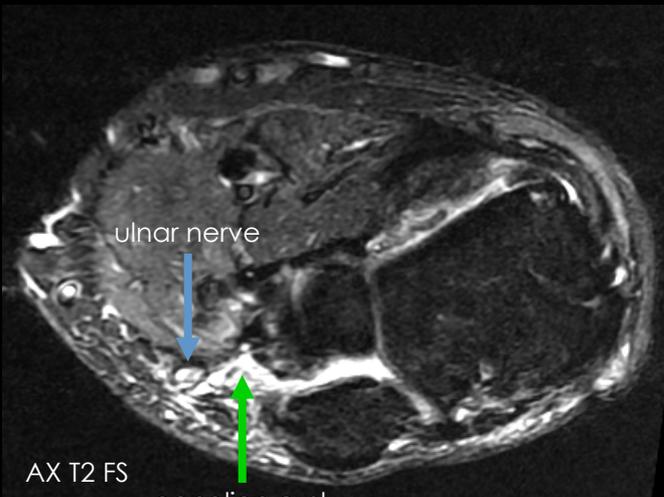
TRANS with ELBOW FLEXION

# Intraneural Ganglion Cyst

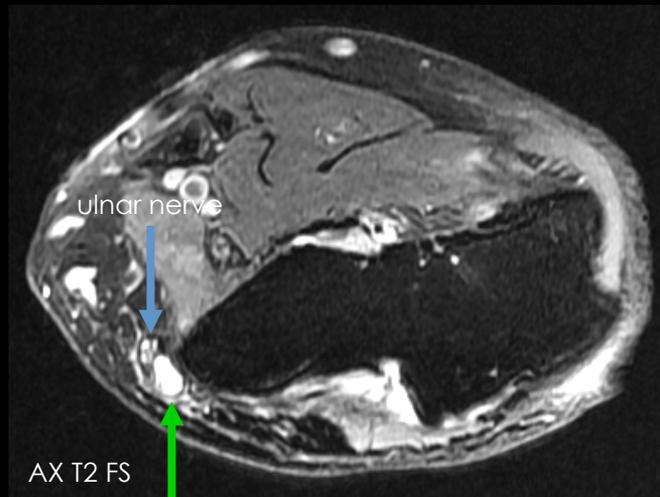
59-year-old patient with two year history of ulnar nerve symptoms



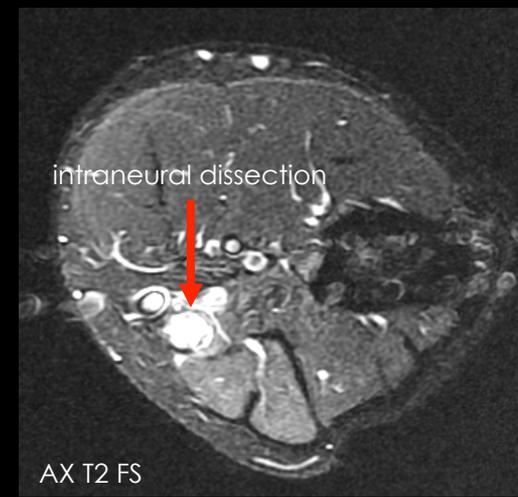
PANORAMIC PROXIMAL TO ELBOW



distal



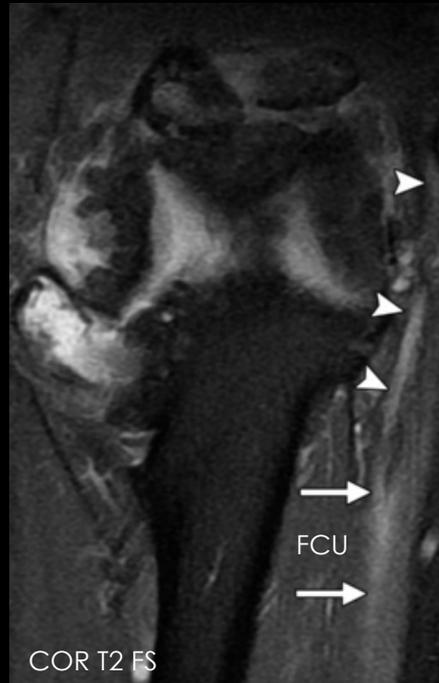
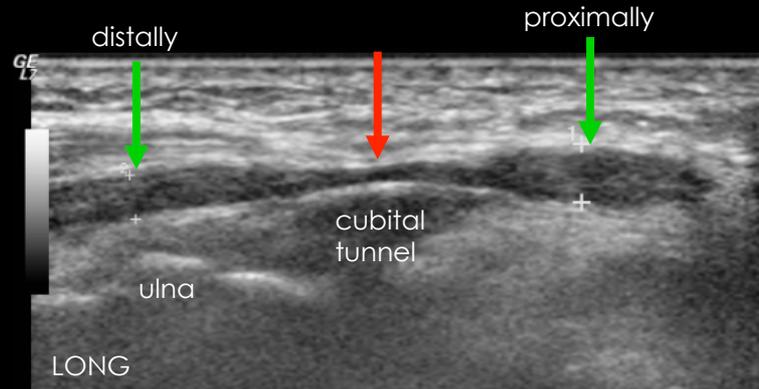
ganglion cyst



proximal

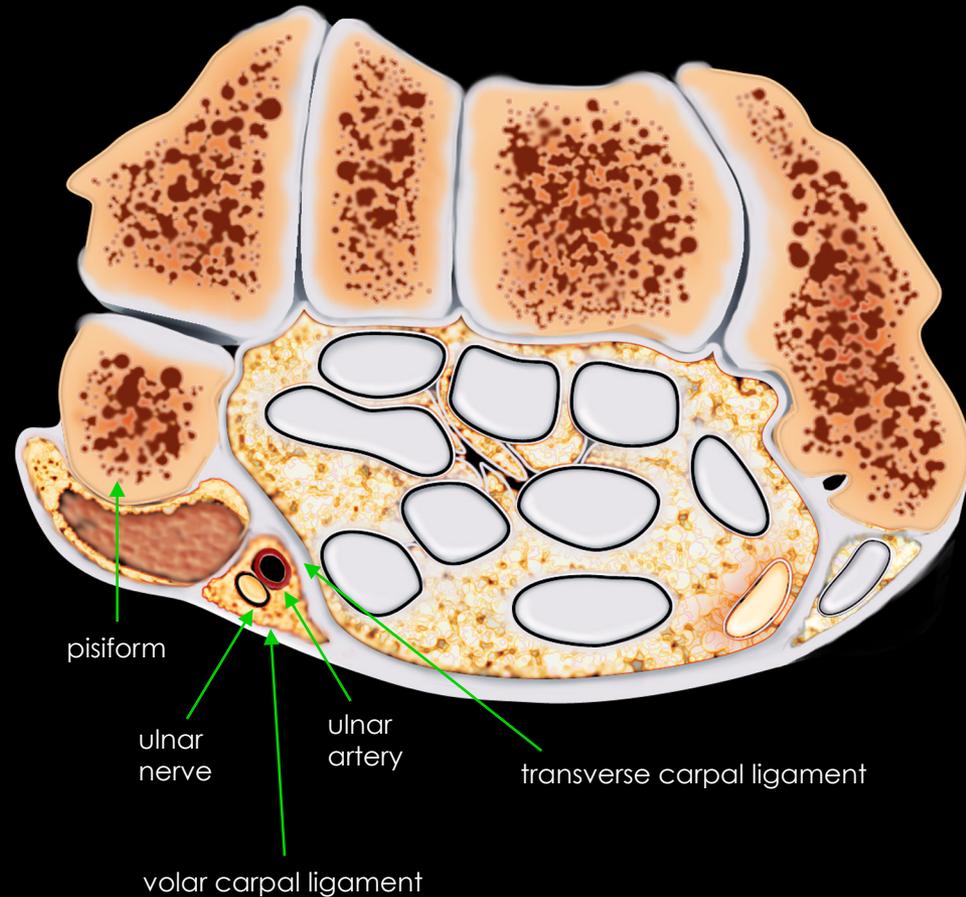
# Cubital Tunnel Syndrome

44-year-old patient with prior elbow fracture and new ulnar motor weakness



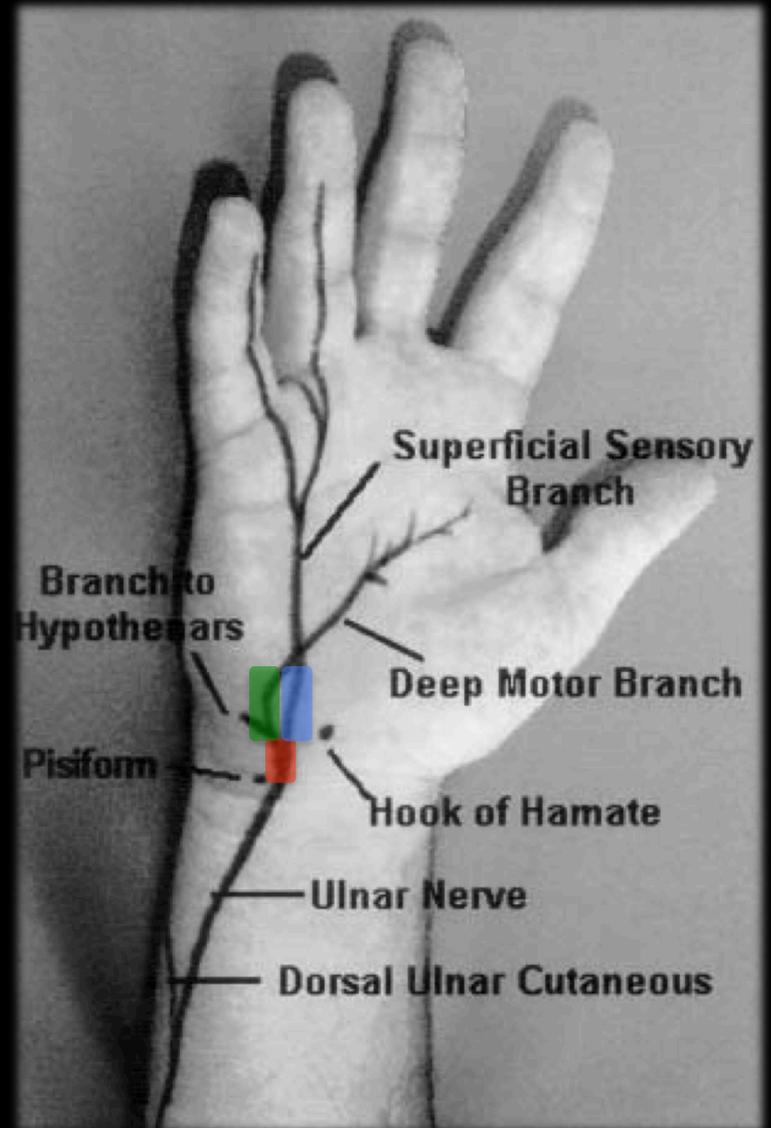
# Ulnar Nerve

- forearm
  - deep to flexor carpi ulnaris muscle proximally & lateral to muscle distally
- wrist
  - through Guyon's canal aka pisohamate tunnel
    - pisiform
    - hamate hook
    - flexor retinaculum
    - volar carpal ligament
  - divides
    - superficial sensory branch
    - deep motor branch
      - around hamate hook, posteriorly through hypothenar muscles, crossing deep palm to adductor pollicis muscle



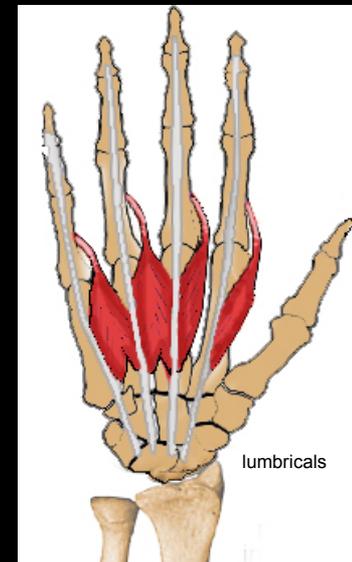
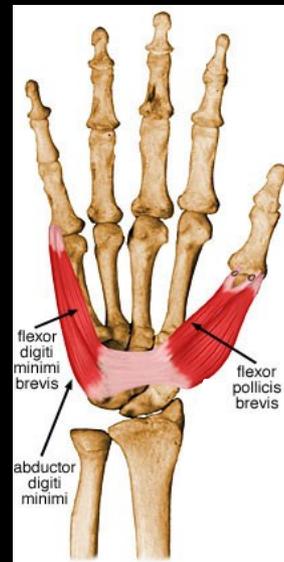
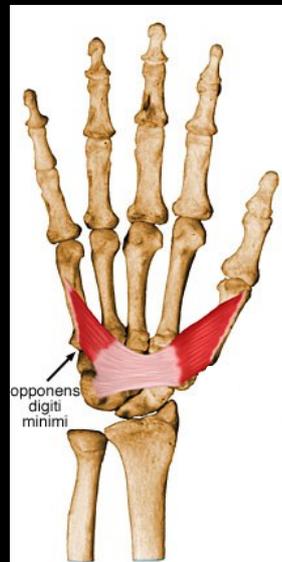
# Ulnar Nerve

- zones
  - 1: proximal to bifurcation
  - 2: deep motor branch
  - 3: superficial sensory branch



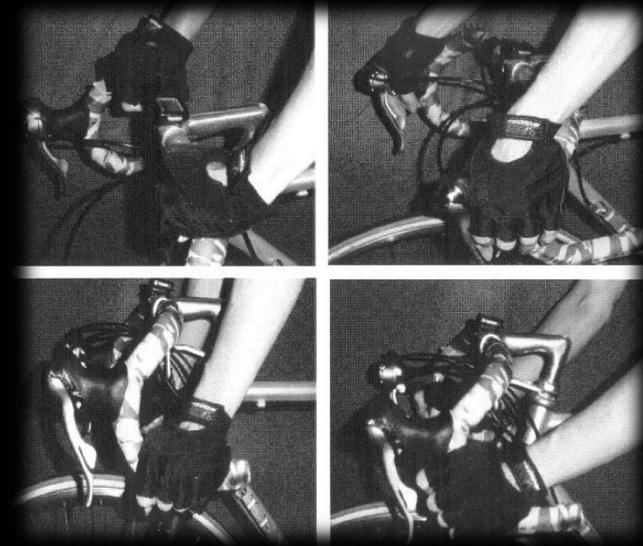
# Ulnar Nerve

- muscle supply
  - hypothenar
  - palmaris brevis
  - 3<sup>rd</sup> & 4<sup>th</sup> lumbricals
  - interossei
    - palmar
    - dorsal
  - adductor pollicis
  - deep head of flexor pollicis brevis



# Ulnar Nerve

- sites of entrapment at wrist
  - Guyon's canal
  - tendinous arch of adductor pollicis muscle
- causes
  - ganglia from pisotriquetral joint
  - chronic repetitive trauma
    - use of tools (hypothenar hammer syndrome)
    - bicycle handlebars (cyclist's palsy)
    - crutches
  - lipoma
  - pisotriquetral osteoarthritis
  - pisiform hamate coalition
  - os hamuli proprium
  - fractures
  - muscle anomalies
    - accessory abductor digiti minimi
    - accessory or reversed palmaris longus
    - hypertrophic flexor carpi ulnaris



# Ulnar Nerve

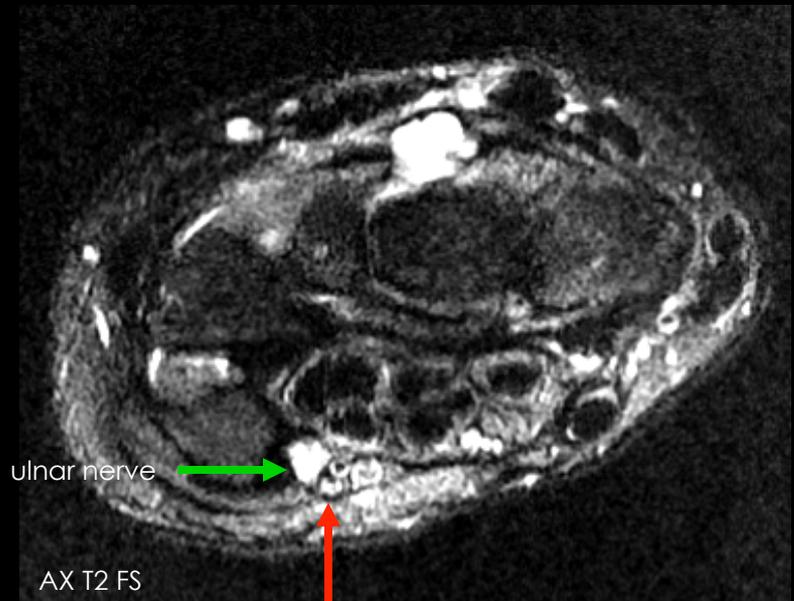
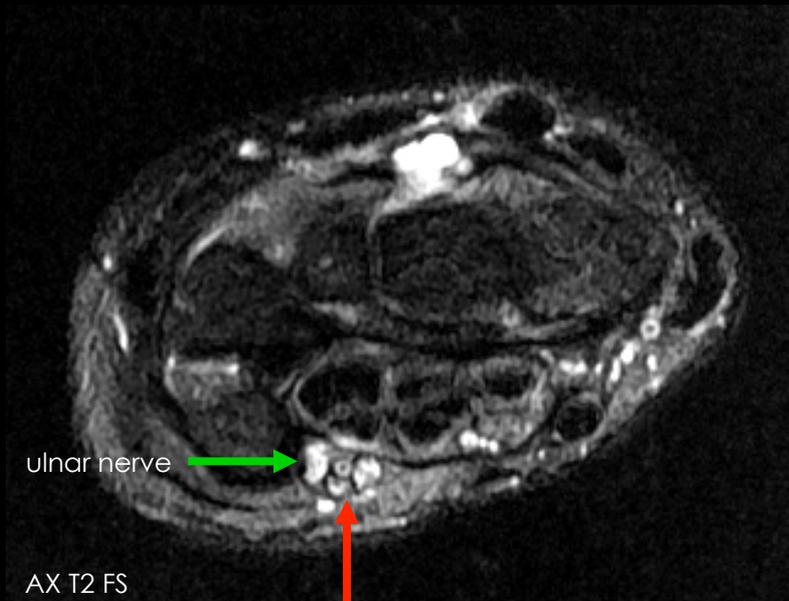
- clinical features
  - depending on site of lesion relative to ulnar nerve bifurcation
    - type 1 syndrome (most common)
      - proximal to or within Guyon's canal
        - » weakness of all ulnar intrinsic hand muscles
        - » sensory loss
          - without dorsal sensory deficit of hand
    - type 2 syndrome
      - deep motor branch in region of hook of hamate
        - » weakness of ulnar intrinsic hand muscles
          - anatomic location determines which muscles
        - » no sensory loss
    - type 3 syndrome
      - superficial sensory branch
        - » sensory loss over volar aspect of the ulnar two fingers
        - » no motor loss

# Ulnar Nerve

- MR imaging
  - T1-weighted imaging
    - round, oval hypointense structure in Guyon's canal
    - surrounded by fat
    - 3mm
  - anomalous or accessory muscles or fibrous bands
  - indirect evidence of entrapment
    - muscle edema or atrophy
- US
  - level of pisiform
    - thin, round structure medial to ulnar artery
    - bifurcation into sensory & motor branches
  - ganglia & space occupying lesions

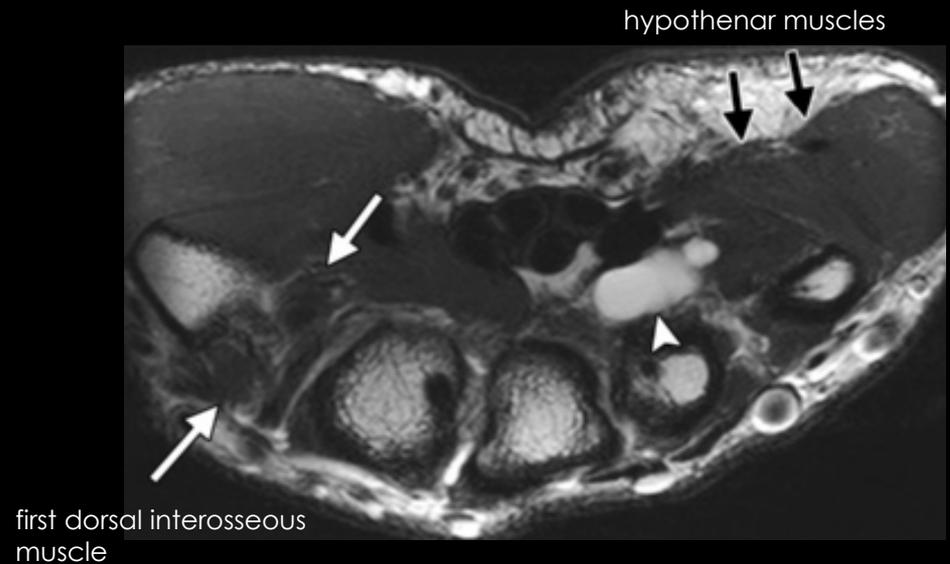
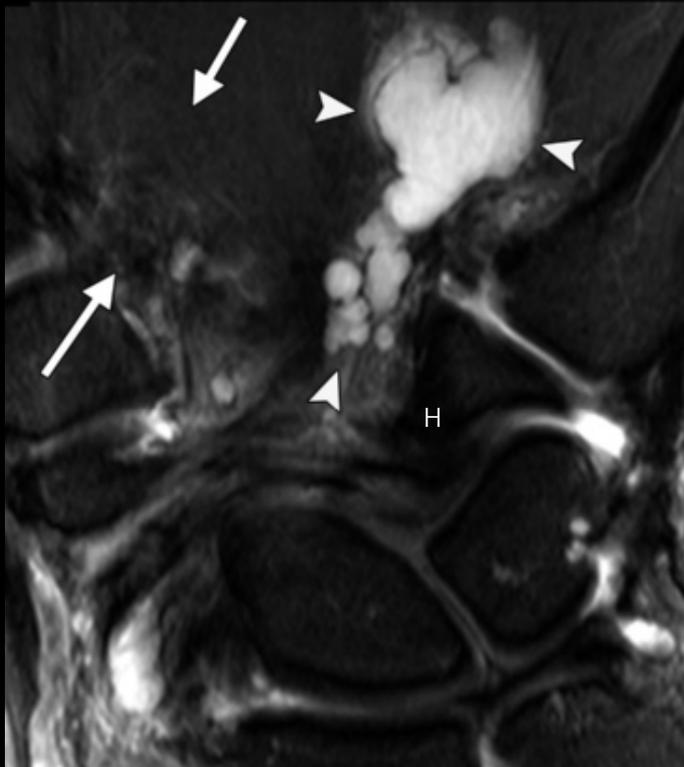
# Guyon's Canal Syndrome

29-year-old massage therapist with new onset ulnar dysesthesia and decreased grip strength

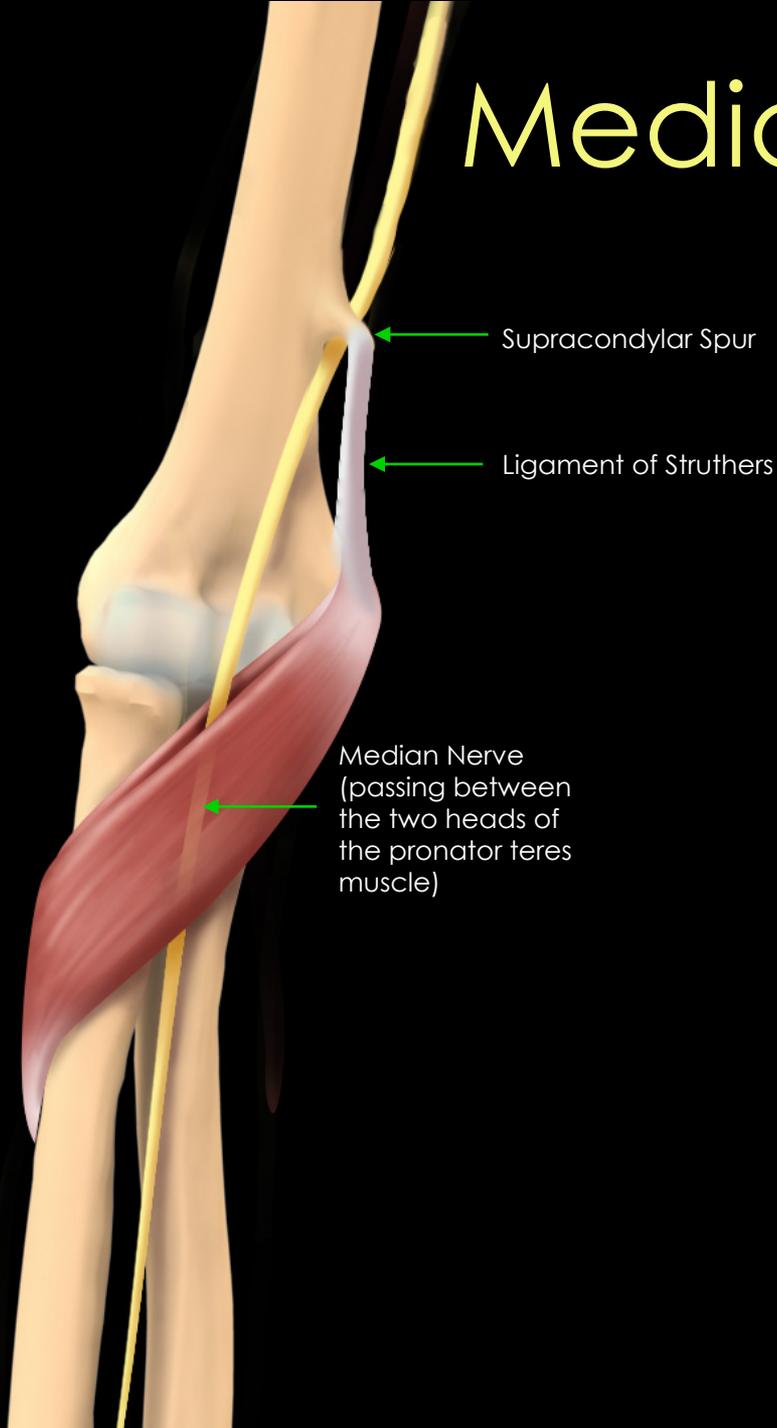


# Ganglion Cyst

39-year-old patient with ulnar motor symptoms, without sensory abnormalities and negative US of Guyon's canal



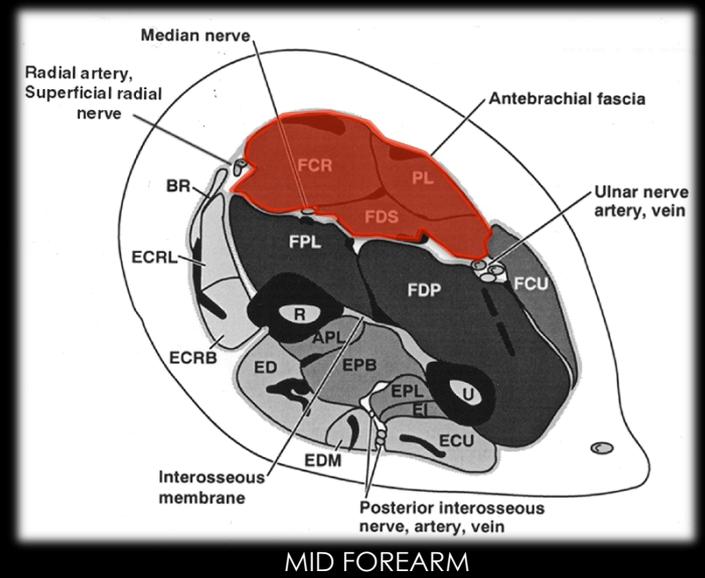
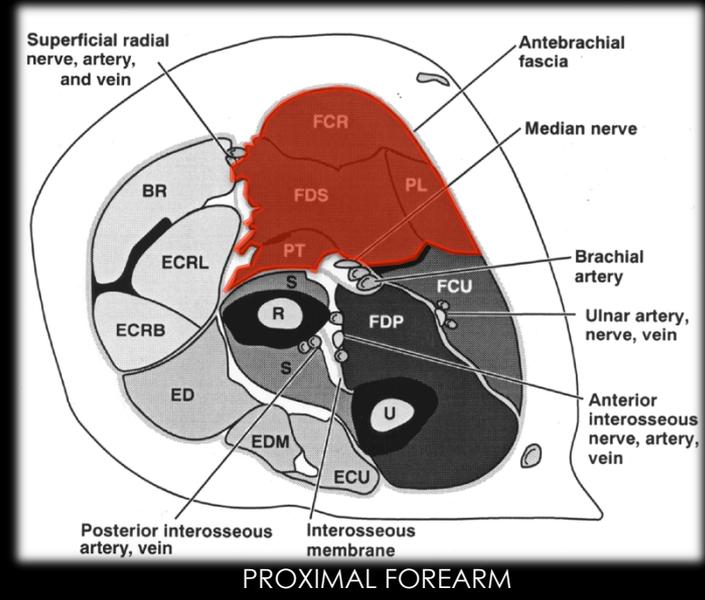
# Median Nerve



- medial & lateral cords of brachial plexus
- medial to biceps muscle & deep to bicipital aponeurosis
- between humeral & ulnar heads of pronator teres muscle
- deep to fibrous arch of flexor digitorum superficialis
- anterior interosseous nerve
  - 5cm proximal to medial epicondyle
- Martin-Gruber anastomosis
  - anomalous communication between median or anterior interosseous nerve & ulnar nerve
  - up to 40%

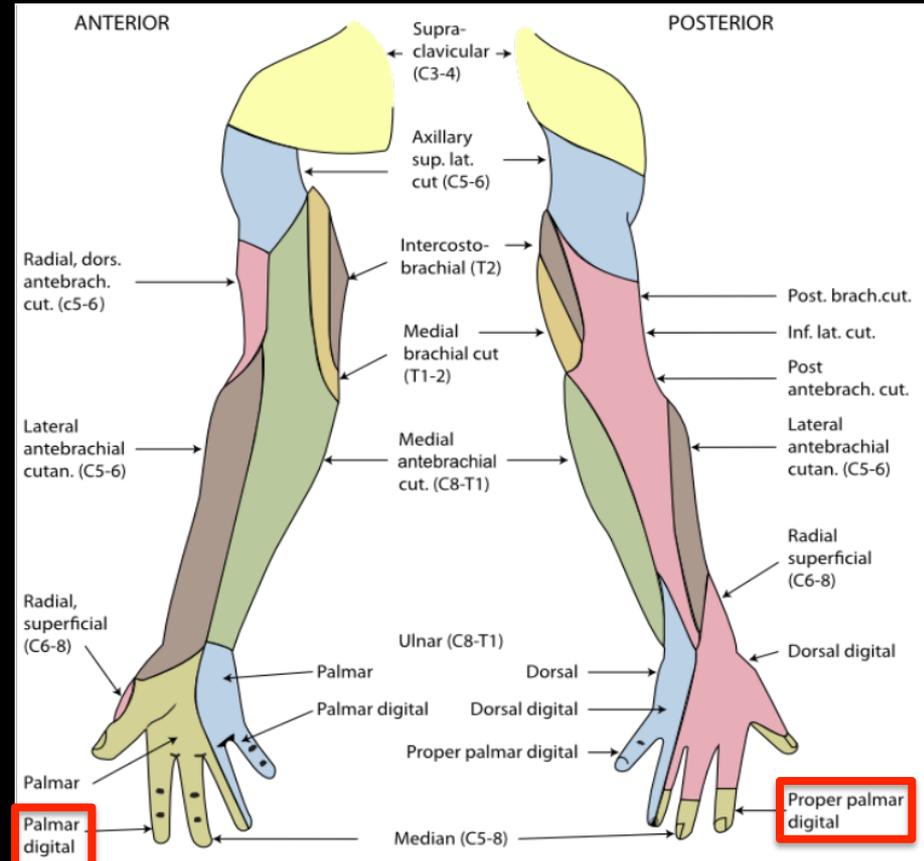
# Median Nerve

- muscle supply
  - pronator teres
  - flexor carpi radialis
  - palmaris longus
  - flexor digitorum superficialis
- cutaneous innervation
  - palmar & distal dorsal aspects of 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> & half of 4<sup>th</sup> digits



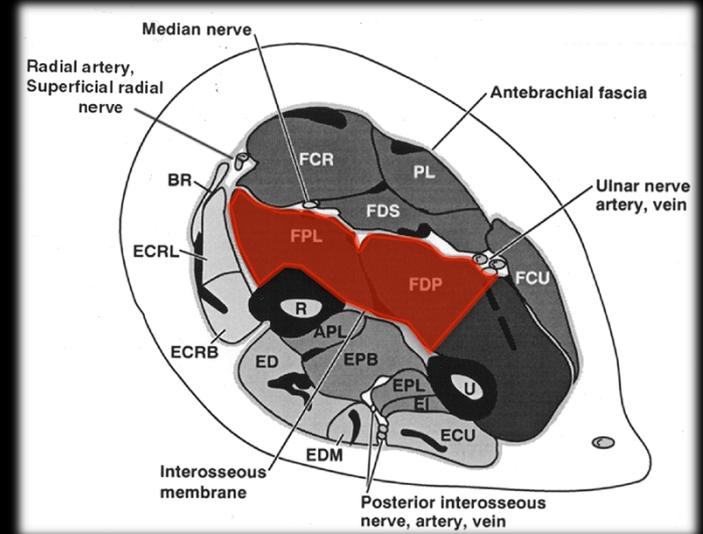
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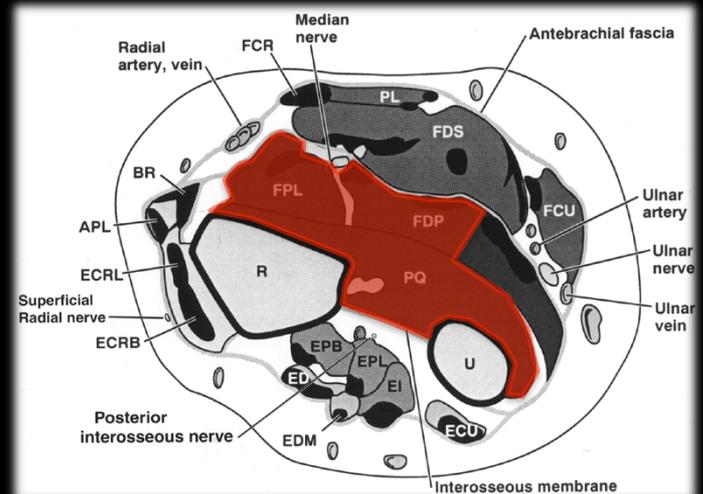


# Anterior Interosseous Nerve

- muscle supply
  - flexor digitorum profundus to 2<sup>nd</sup> & 3<sup>rd</sup> digits
  - flexor pollicis longus
  - pronator quadratus



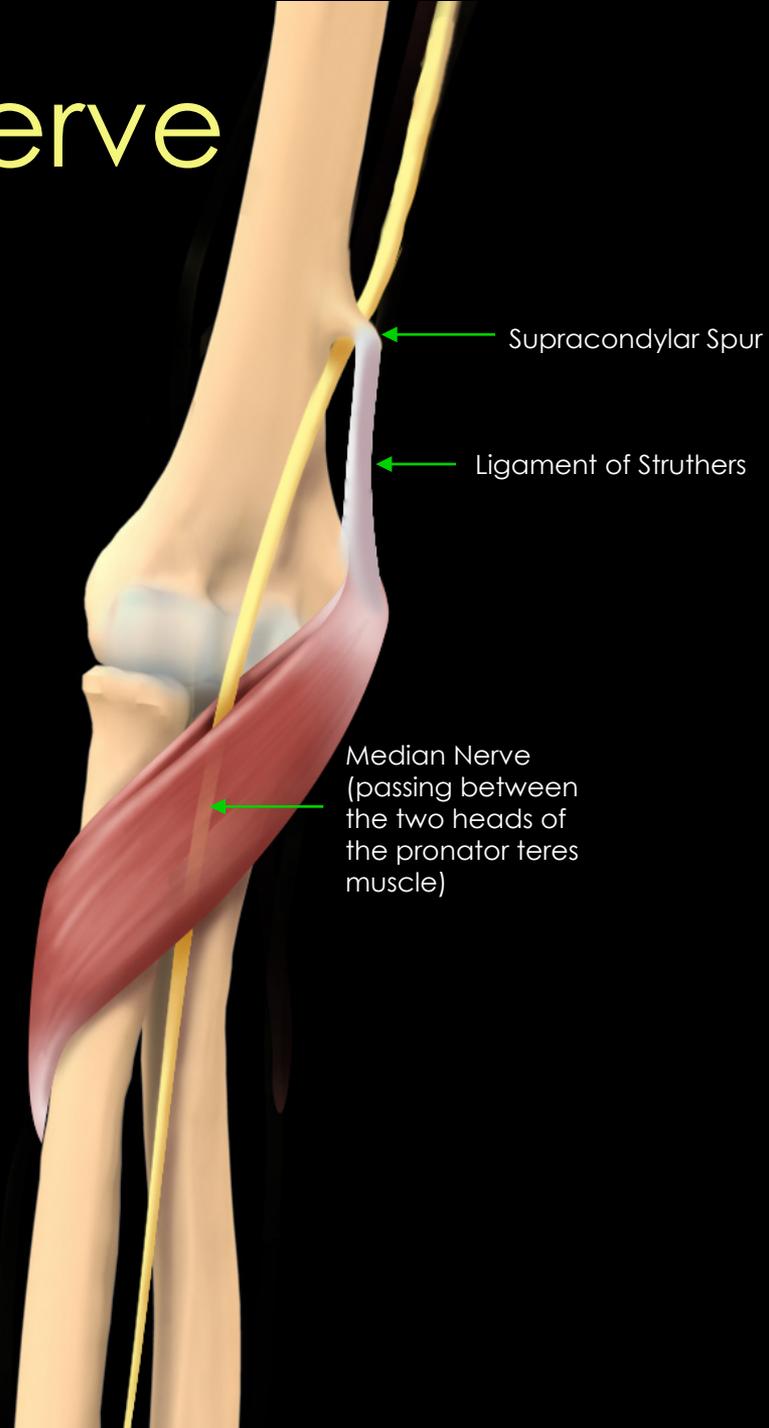
MID FOREARM



DISTAL FOREARM

# Median Nerve

- sites of entrapment at elbow
  - supracondylar spur & Struthers ligament
  - between humeral & ulnar heads of pronator teres muscle (pronator syndrome)
  - lacertus fibrosus
  - fibrous arch of flexor digitorum superficialis muscle



# Median Nerve

- causes
  - supracondylar fracture
  - elbow dislocation
  - injection injury
  - aberrant median artery
  - crossing branch of radial artery
  - soft tissue mass

# Anterior Interosseous Nerve

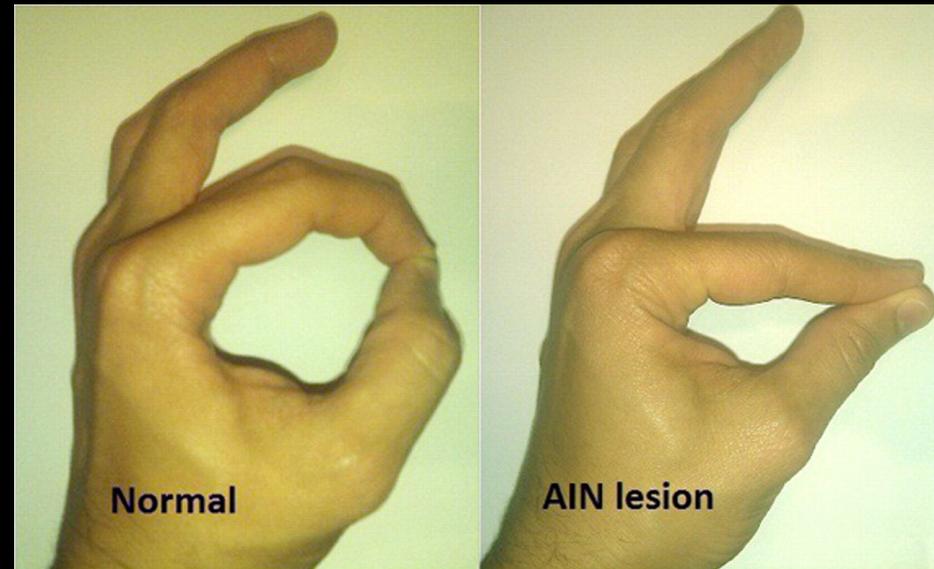
- causes
  - anterior interosseous nerve syndrome or Kiloh-Nevin syndrome
  - direct trauma
  - compression
    - midshaft radial fracture
    - poorly applied casting
    - repetitive heavy lifting
    - soft tissue mass
    - tendinous origin of pronator teres muscle
    - enlarged bicipital bursa
    - varices
  - anatomical abnormalities
    - Gantzer muscle
    - vascular anomalies

# Median Nerve

- clinical features
  - volar forearm pain
  - paresthesia & sensory loss of innervated digits
  - pronator muscle weakness
  - sensory loss over thenar eminence
  
  - exacerbated by forearm supination & elbow extension
  - pronator syndrome
    - pronator teres muscle is spared

# Anterior Interosseous Nerve

- clinical features
  - motor dysfunction
    - flexor pollicis longus
    - flexor digitorum profundus (radial half)
    - pronator quadratus
  - unable to form an O
  - differential diagnosis
    - tendon rupture



# Median Nerve

- radiography
  - supracondylar spur
- MR imaging
  - pronator syndrome
    - normal or altered nerve signal intensity
  - denervation pattern (edema & atrophy) is important
  - deeper course of median nerve between brachialis & pronator muscles
    - 17% asymptomatic elbows

# Median Nerve

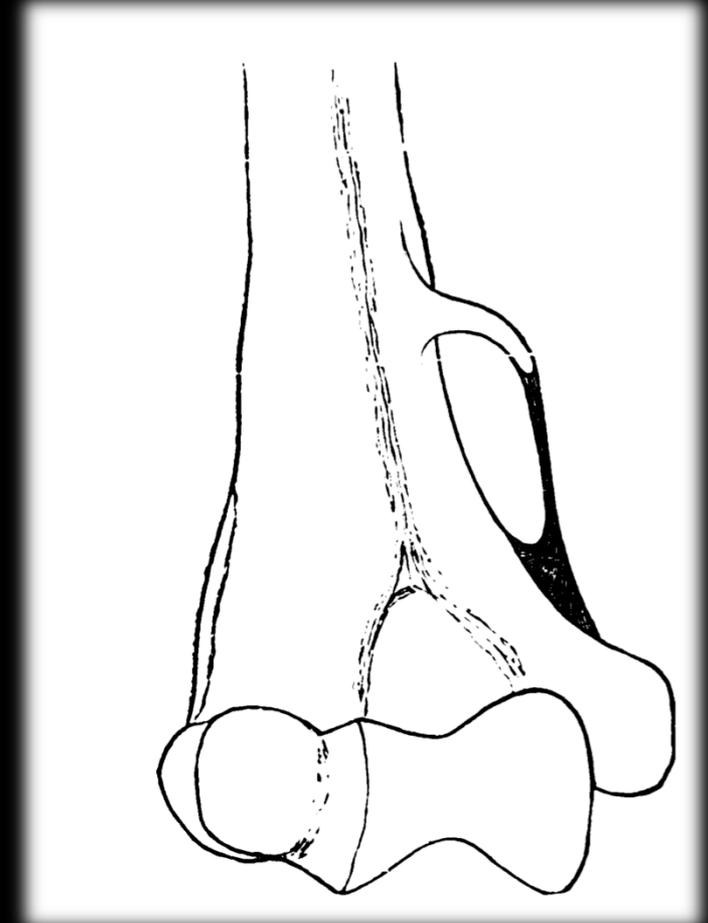
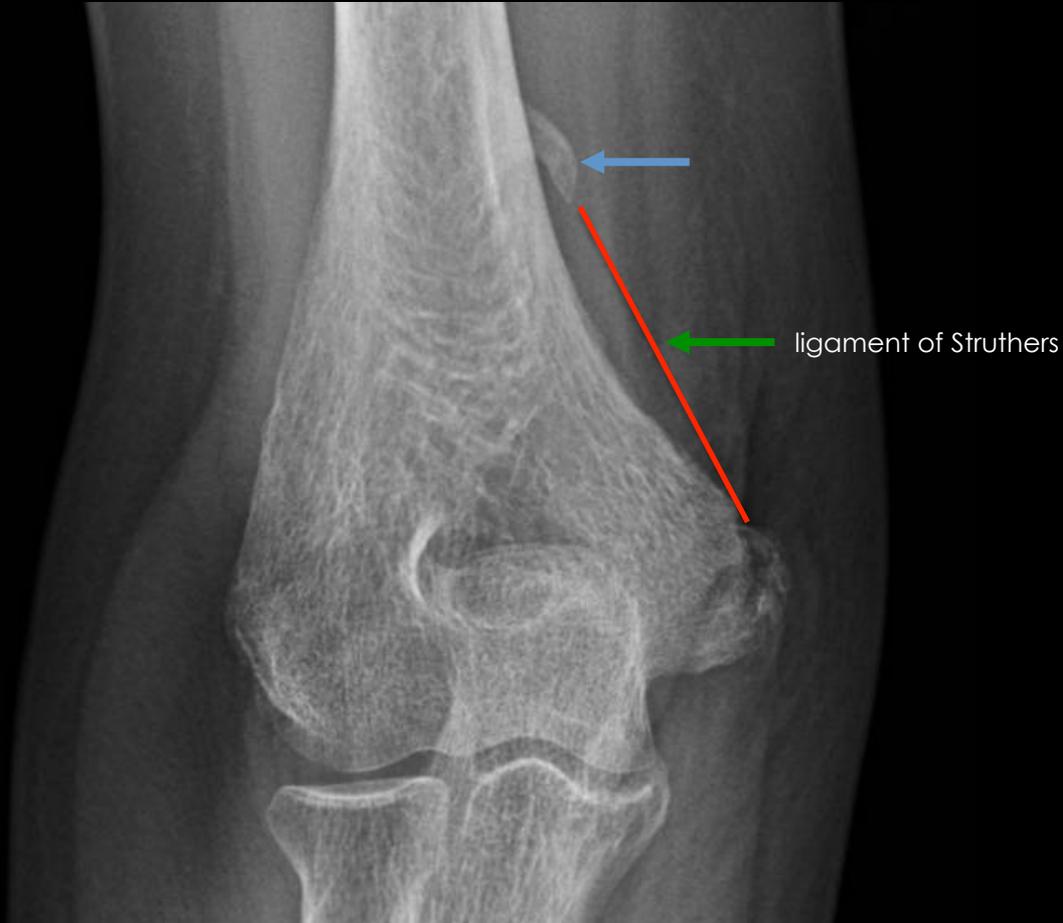
- US
  - dynamic compression deep to bicipital aponeurosis with pronation & supination
  - suspected median nerve laceration

# Anterior Interosseous Nerve

- MR imaging
  - muscle edema or atrophy
  - most reliable sign of AIN lesion
    - edema with pronator quadratus muscle
  - edema within non-AIN-innervated muscles
    - flexor carpi radialis
    - flexor digitorum profundus to 3<sup>rd</sup> & 4<sup>th</sup> digits

# Supracondylar Process

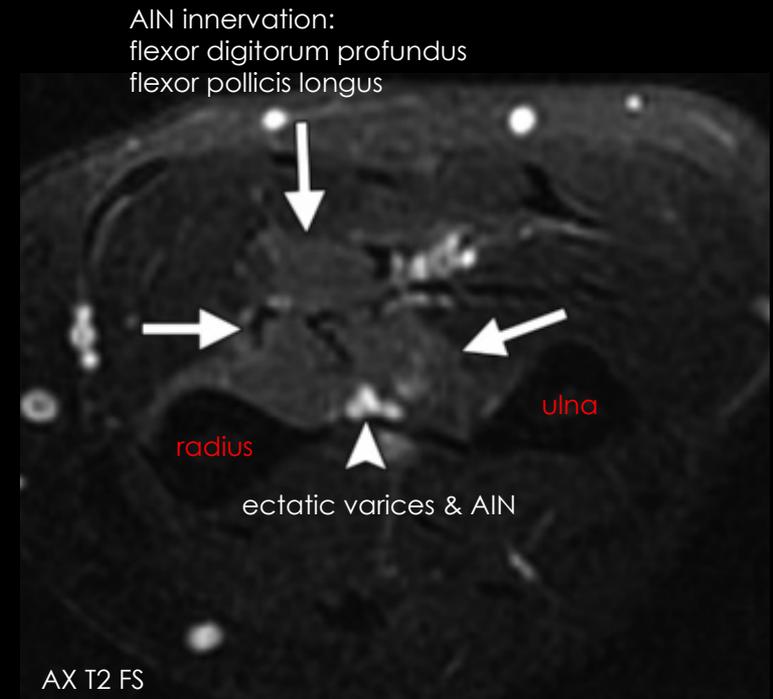
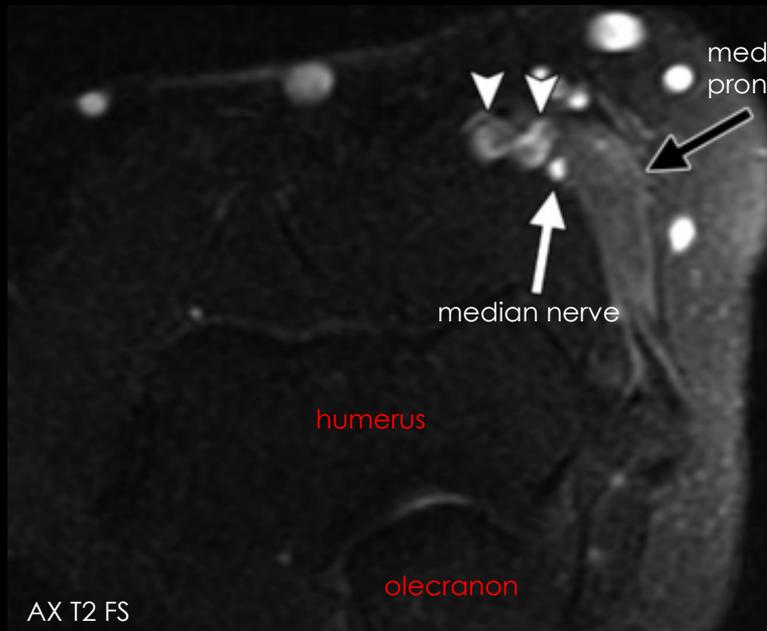
68-year-old patient with vague medial forearm pain



Sir John Struthers (1849)

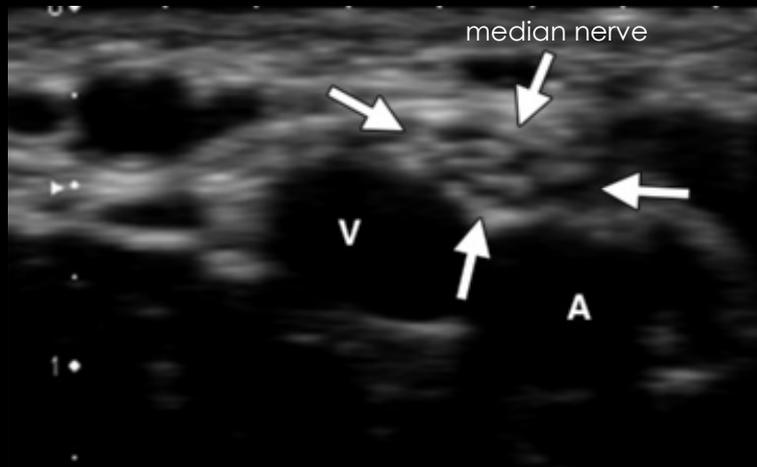
# Median Nerve & AIN

48-year-old weight lifter with burning and discomfort in the fingers & clinical exam suggesting AIN injury

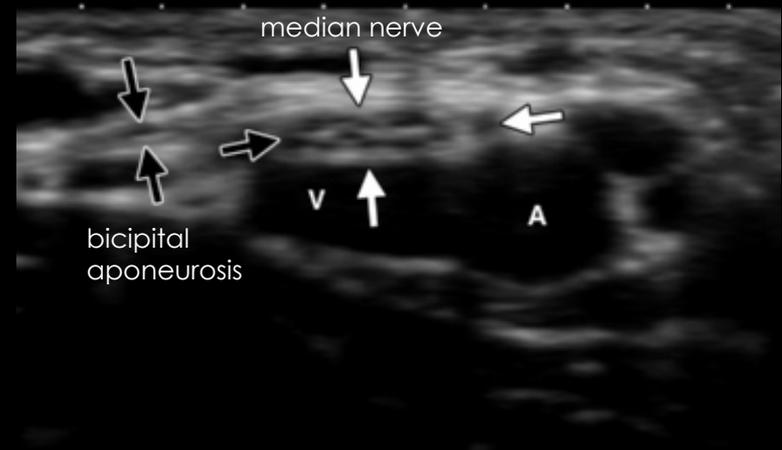


# Median Nerve

34-year-old manual labourer with intermittent episode of shooting pain radiating from anterior elbow to wrist, particularly with pronation



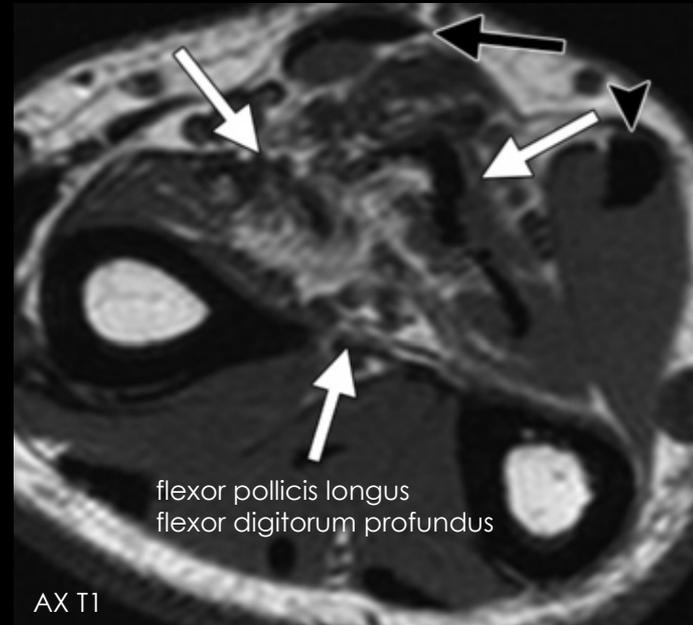
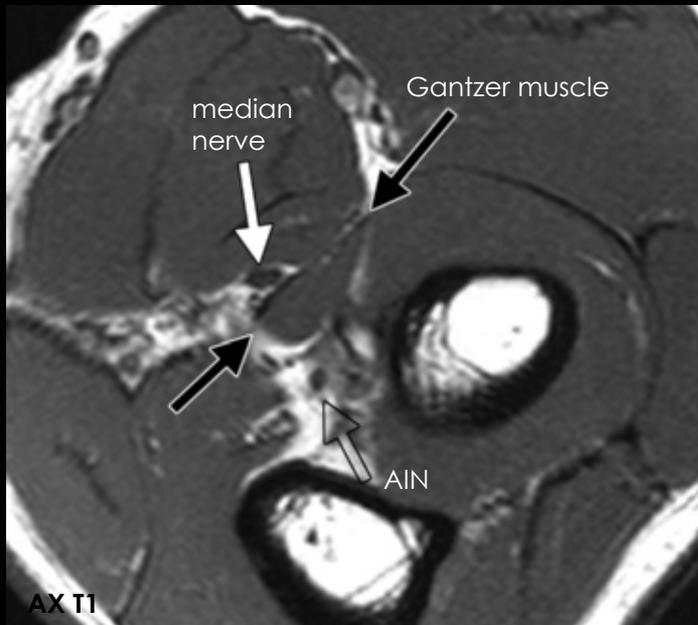
supination



pronation

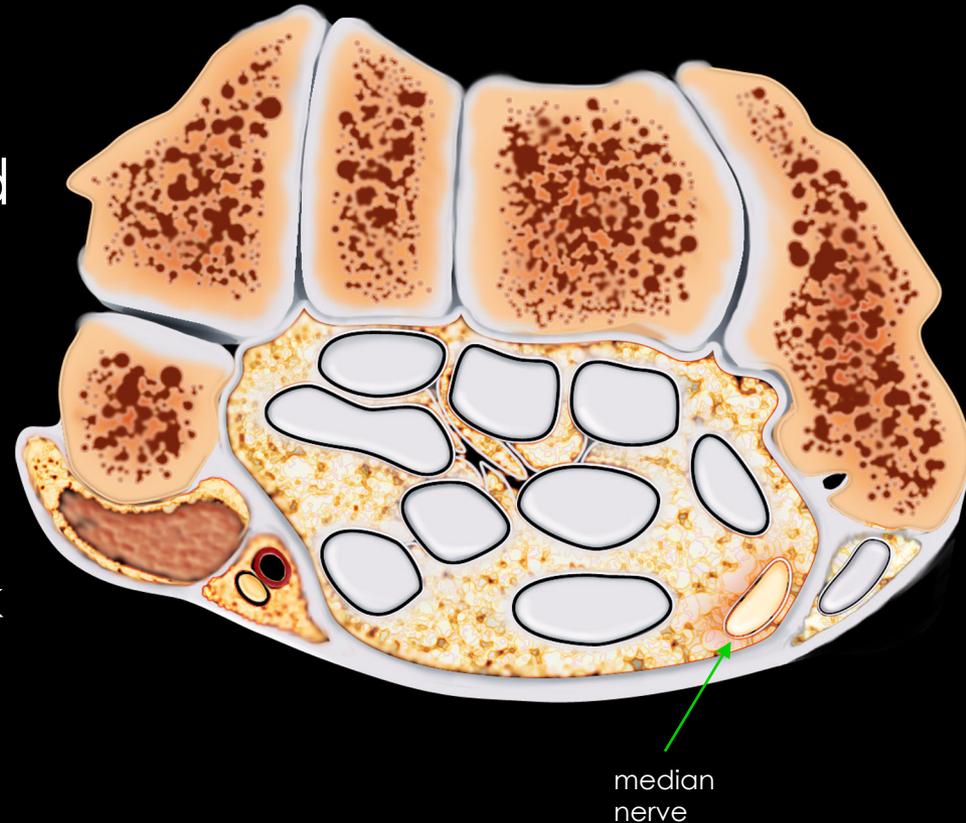
# Anterior Interosseous Nerve (Kiloh-Nevin) Syndrome

39-year-old patient with weakness of wrist and forearm musculature



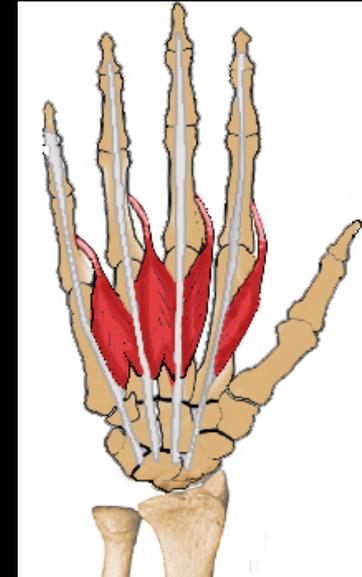
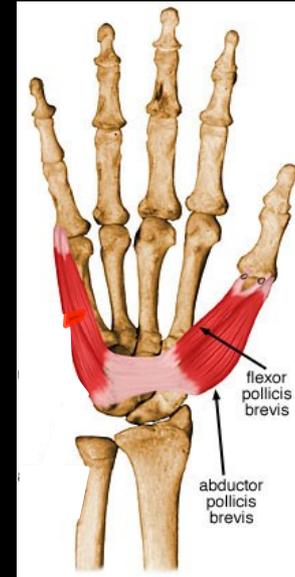
# Median Nerve

- carpal tunnel – 6cm
  - carpal bones
  - tubercles of scaphoid & trapezium
  - pisiform & hamate hook
  - flexor retinaculum
    - proximally: thin & slack
    - distally: thick & taut



# Median Nerve

- distal to carpal tunnel
  - terminal motor branches
    - opponens pollicis
    - abductor pollicis brevis
    - superficial head of flexor pollicis brevis
    - 1<sup>st</sup> & 2<sup>nd</sup> lumbricals
  - 4 terminal sensory branches
    - thumb, index, middle & half of ring fingers

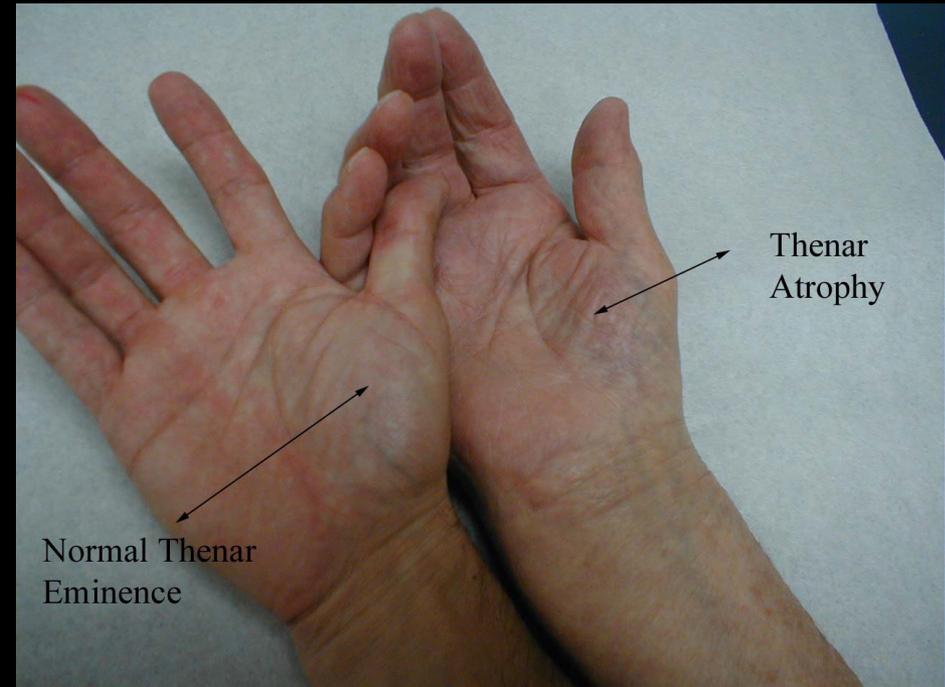


# Median Nerve

- sites of entrapment at wrist
  - carpal tunnel
  - recurrent branch of median nerve
    - pierces or wraps around flexor retinaculum
  - metacarpal tunnels
- causes
  - carpal tunnel syndrome
    - middle aged women
    - precise cause is often unknown
    - etiologies
      - diabetes, rheumatoid arthritis, gout, calcium pyrophosphate deposition, amyloid deposition, pregnancy, hypothyroidism
      - mass lesions: ganglia, lipomas, neurofibromas
      - postoperative: incomplete release, granulation tissue

# Median Nerve

- clinical features
  - burning wrist pain radiating into fingers
  - paresthesia & numbness in median nerve distribution
  - symptoms worsening at night & exacerbated by repetitive wrist flexion/extension, strenuous gripping or vibration
  - clumsiness of hand
  - thenar eminence atrophy



# Median Nerve

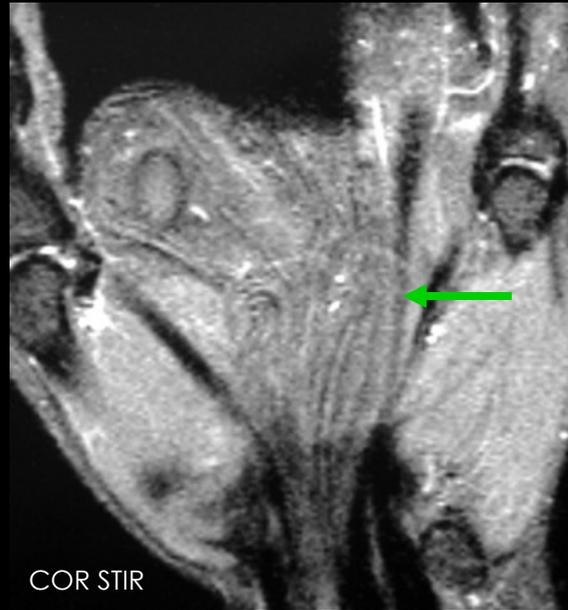
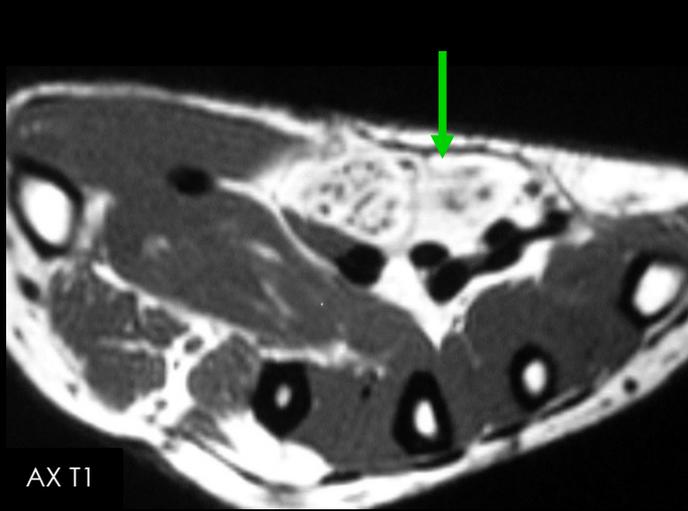
- imaging not required in majority
  - secondary cause
  - doubt about diagnosis
  - atypical presentation
  - recalcitrant symptoms postoperatively
- MR imaging
  - proximal & distal carpal tunnel nerve assessment
    - hyperintensity
    - volar bowing of flexor retinaculum at level of hamate hook (ratio 0.18)
    - increased caliber at level of pisiform
    - flattening at level of hamate hook
  - muscle edema & atrophy
    - chronic or severe
    - isolated recurrent branch at distal carpal tunnel
  - mass lesions
    - pathognomonic fibrolipomatous hamartoma

# Median Nerve

- US
  - nerve flattening in distal tunnel
  - palmar bowing of flexor retinaculum
  - reduced nerve echogenicity & loss of normal fascicular pattern
  - nerve swelling & intraneural hypervascularity
    - good predictors
  - useful
    - tenosynovitis
    - ganglia
    - anomalous muscles

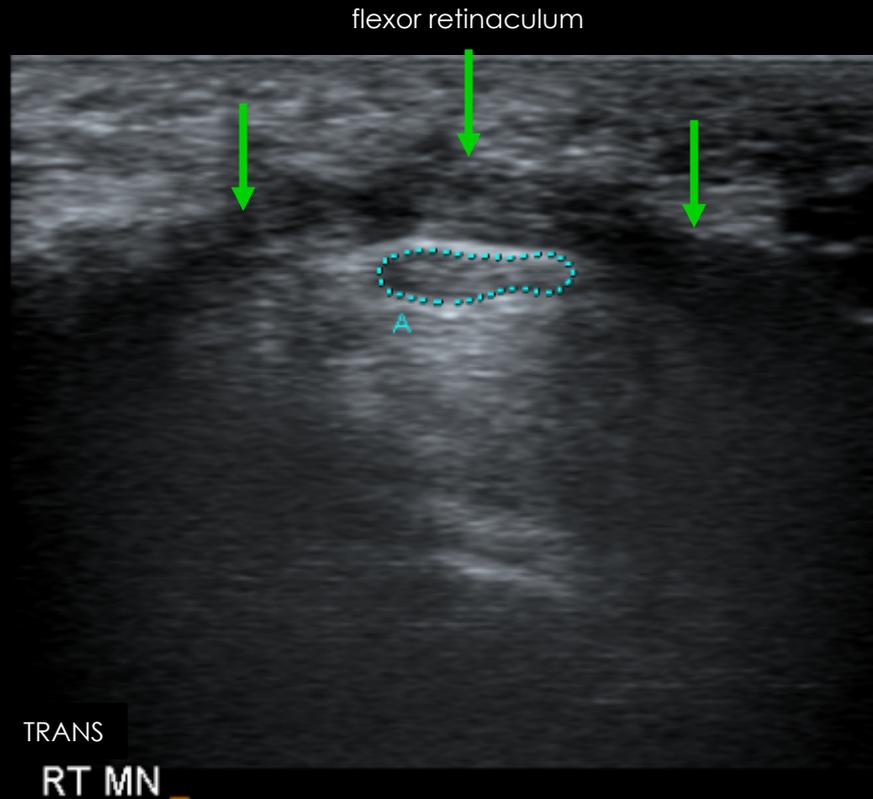
# Fibrolipomatous Hamartoma

Patient with symptoms of carpal tunnel and bulkiness and swelling at the volar aspect of wrist



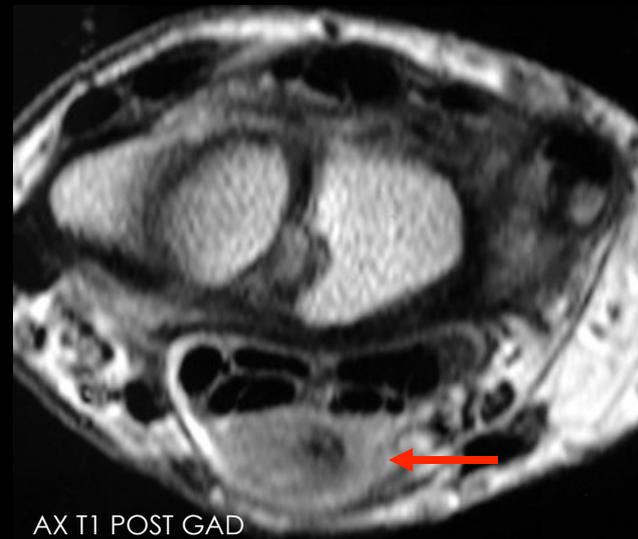
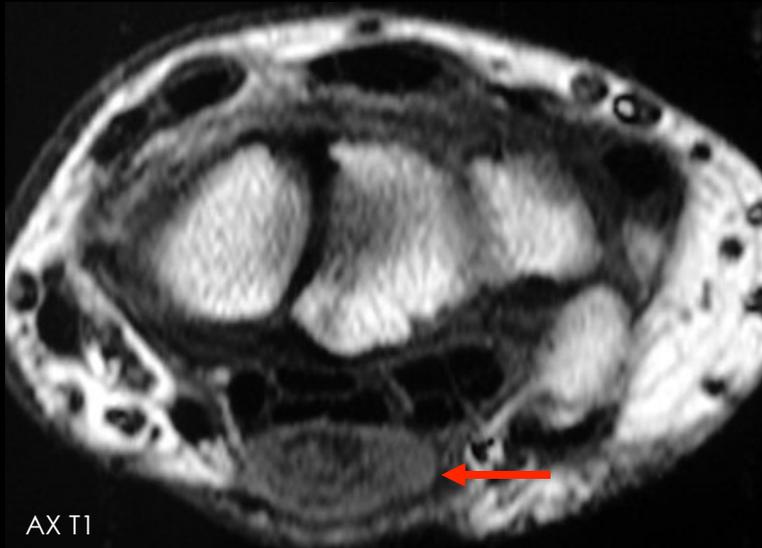
# Carpal Tunnel Syndrome

42-year-old patient with prior carpal tunnel release and persistent median nerve symptoms



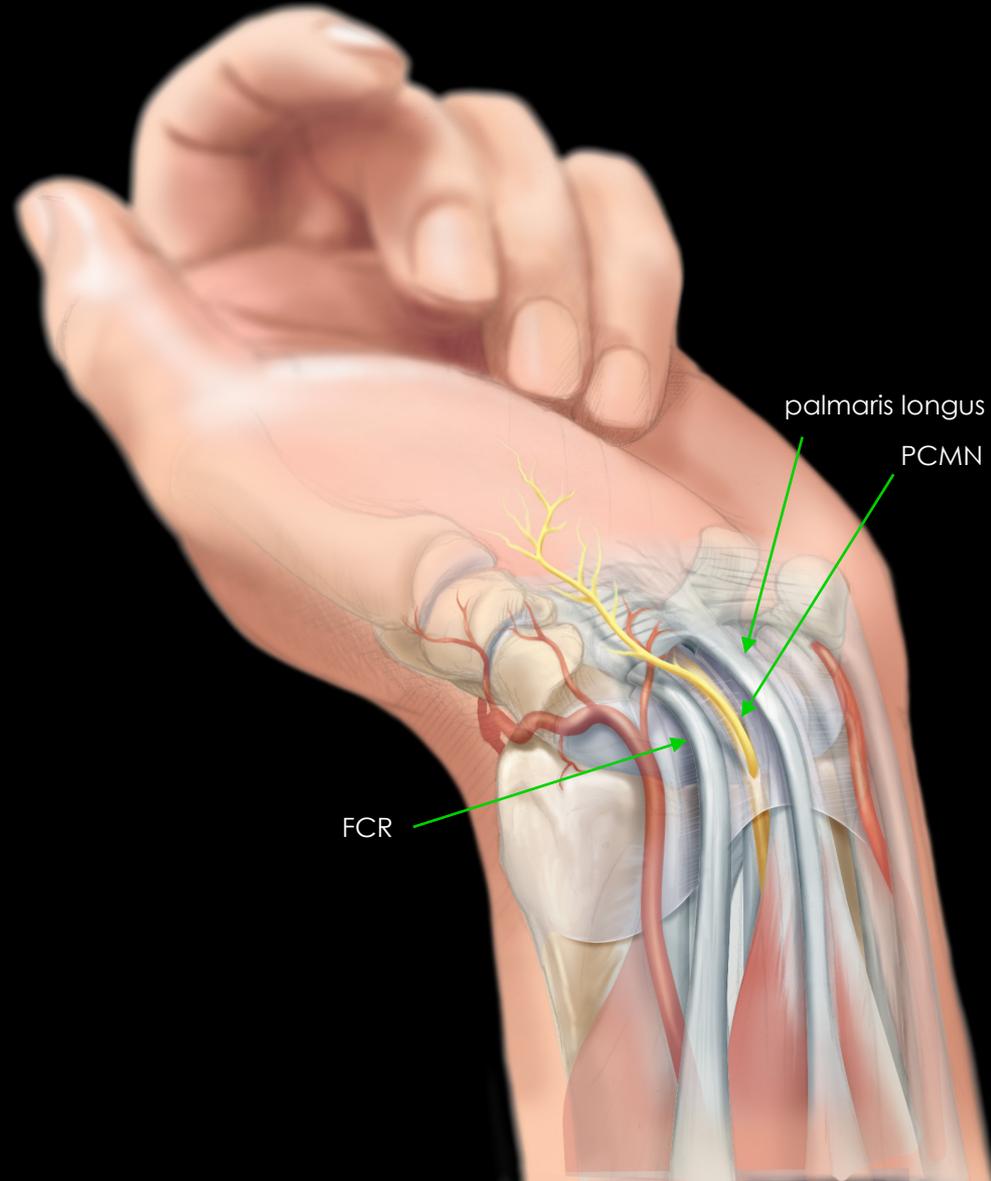
# Median Nerve Sarcoma

57-year-old patient with 2 year history of soft, fluctuant mass at volar aspect of wrist, concerning for CTS due to ganglion cyst



# Palmar Cutaneous Branch of Median Nerve

- final collateral branch from radial aspect of median nerve in distal forearm
- with median nerve between palmaris longus & flexor carpi radialis tendons
- “palmar cutaneous branch of median nerve tunnel”
  - 1.5cm proximal to wrist
  - 8mm fascial passage between superficial & deep layers of distal antebrachial fascia
  - supplies skin overlying thenar eminence



# Palmar Cutaneous Branch of Median Nerve

- causes
  - ganglia of flexor carpi radialis tendon
  - antebrachial fascia
  - atypical palmaris longus muscle
  - entrapment concomitant with carpal tunnel syndrome
  - direct trauma
    - accidental
    - iatrogenic
      - resection of ganglia
      - carpal tunnel release
        - » erroneous skin incisions

# Palmar Cutaneous Branch of Median Nerve

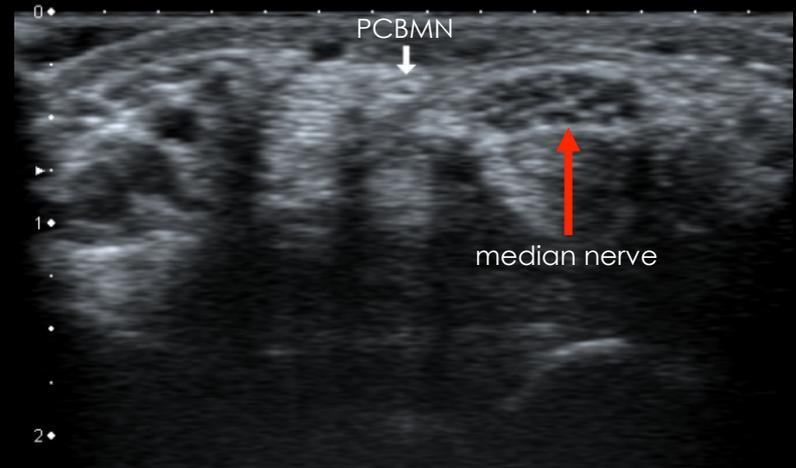
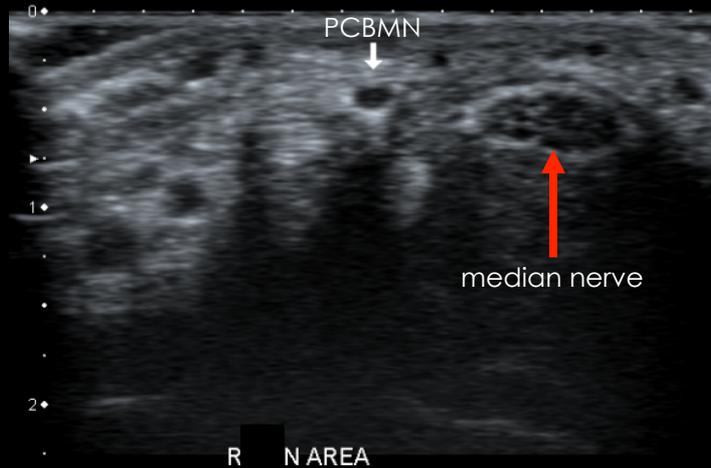
- clinical features
  - overlying thenar eminence
    - new onset of painful discharges
    - sensory loss
    - local numbness
    - hyperesthesia
  - similar to sensory distribution of the median nerve

# Palmar Cutaneous Branch of Median Nerve

- US
  - identify nerve in up to 83%
  - focal hypoechoic swelling
  - neuroma due to transection

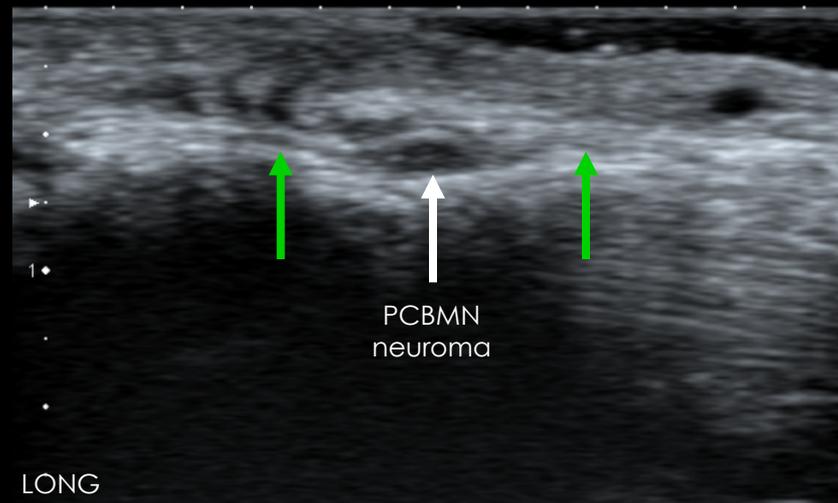
# Palmar Cutaneous Branch of Median Nerve

49-year-old patient history of wrist laceration, retracted tear of palmaris longus and persistent hyperesthesia in region of laceration



carpal tunnel distally

carpal tunnel proximally



# Summary

- numerous peripheral neuropathies affect the upper limb
- diagnostic mainstay
  - clinical examination
  - electrophysiologic studies
- MR imaging & US
  - useful spatial information
  - narrow differential diagnosis
  - guide treatment
  - valuable in complex cases with discrepant nerve function tests
- awareness of clinical features, relevant anatomy & most common sites & causes of entrapment
  - choice of diagnostic test
  - syndrome identification
  - appropriate case management

# Imaging of Peripheral Neuropathies

## Involvement of the Upper Limb

Thursday, February 2, 2012

Dorota D. Linda

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University of California, San Diego