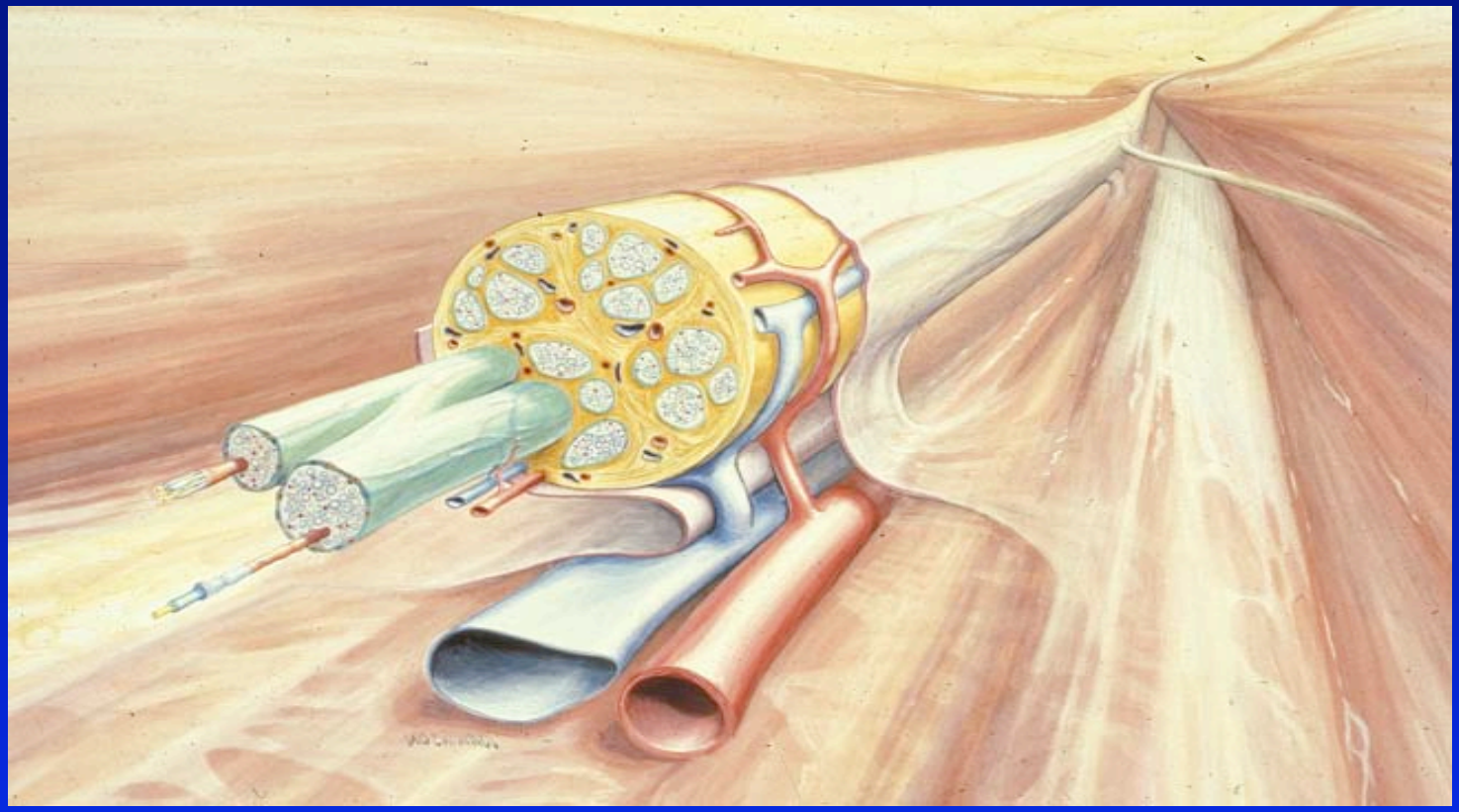
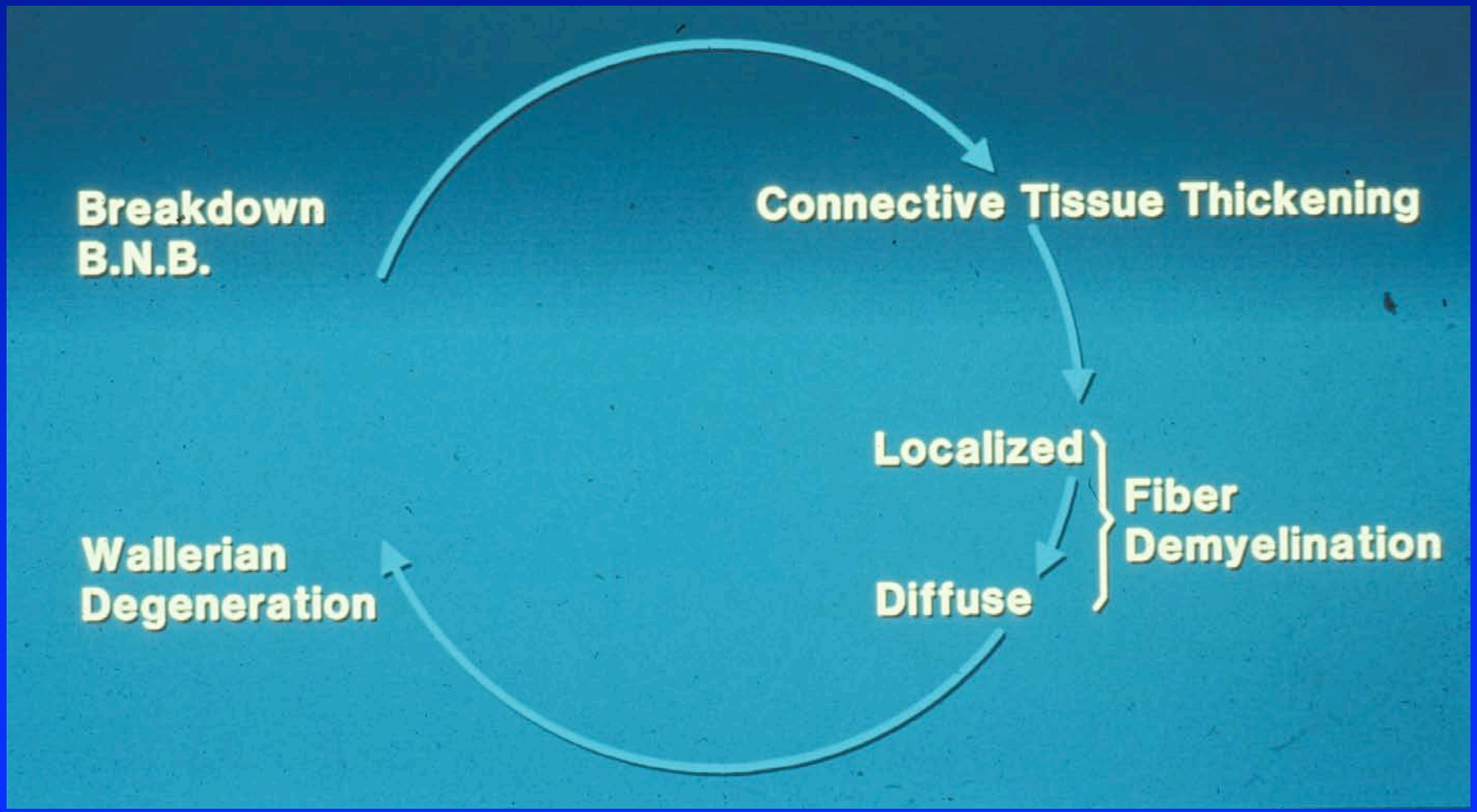
Pathophysiology of Entrapment Neuropathy

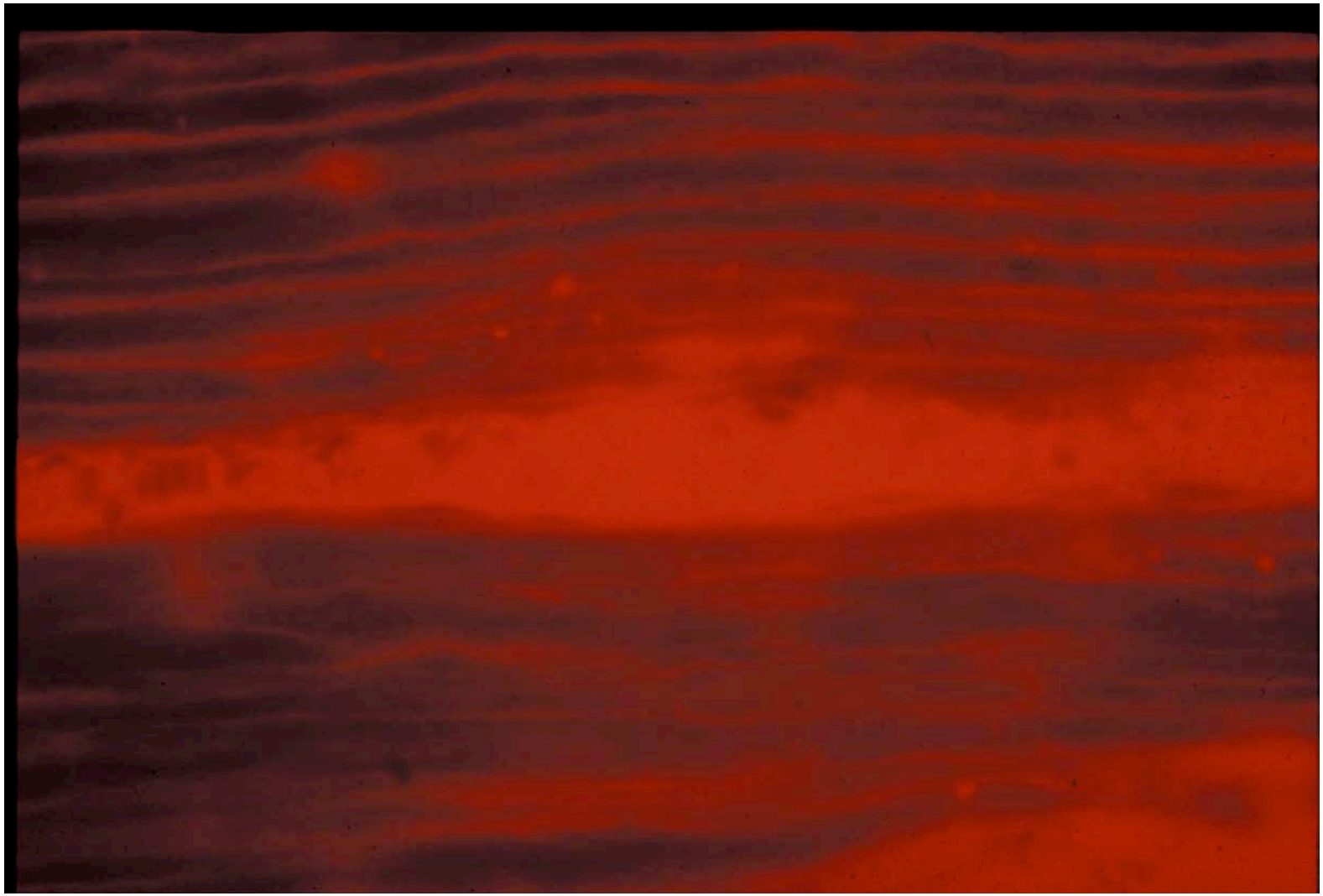


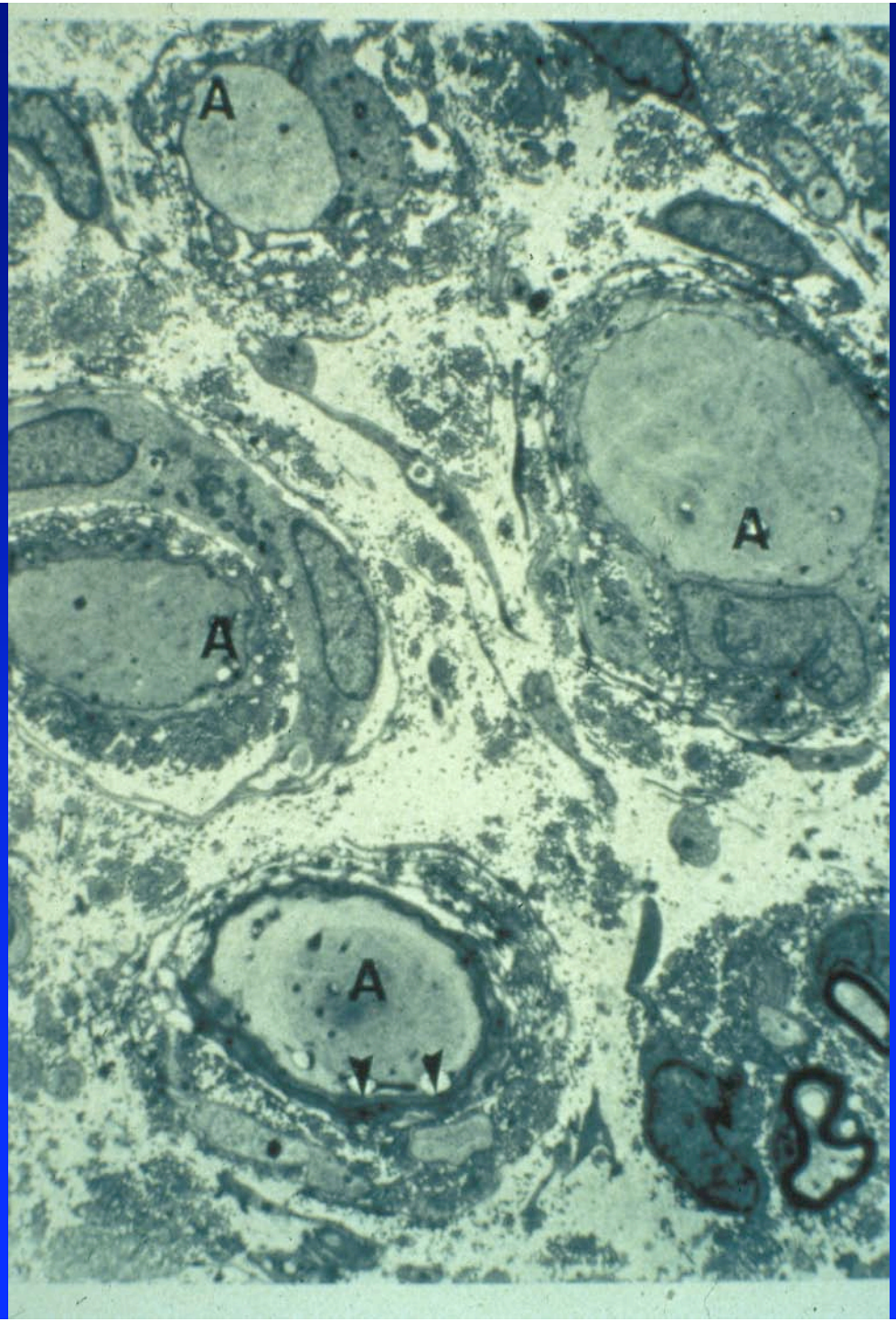
Blood- nerve Barrier

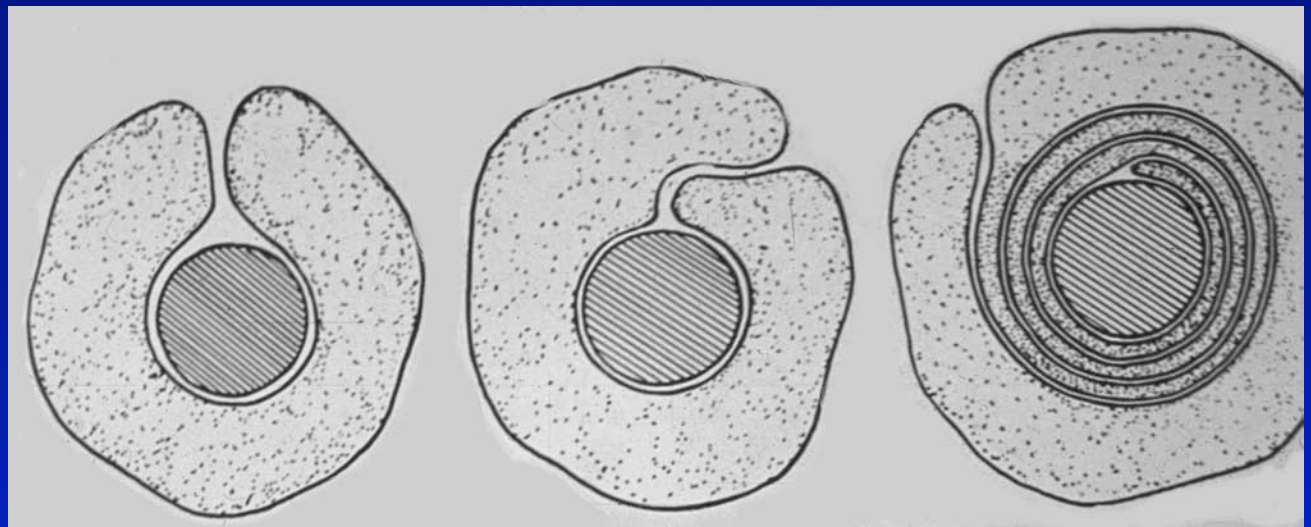
Histopathology:
(Chronic) Nerve Compression



BNB Breakdown




A
A
A
A



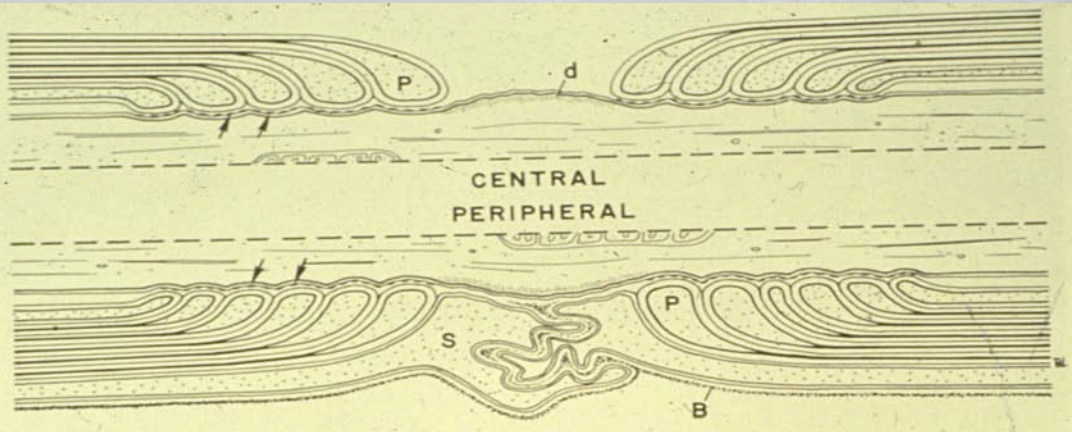
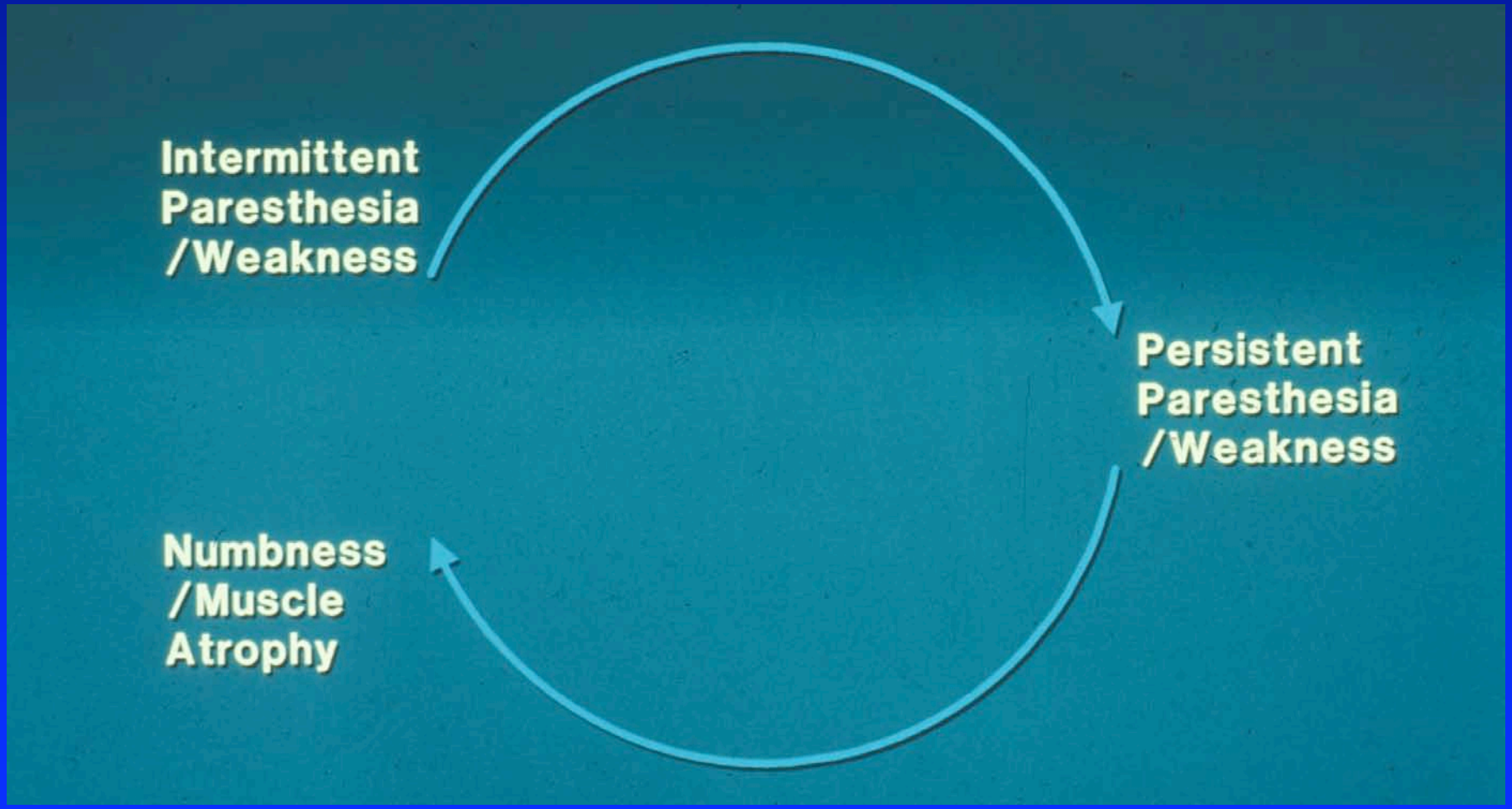
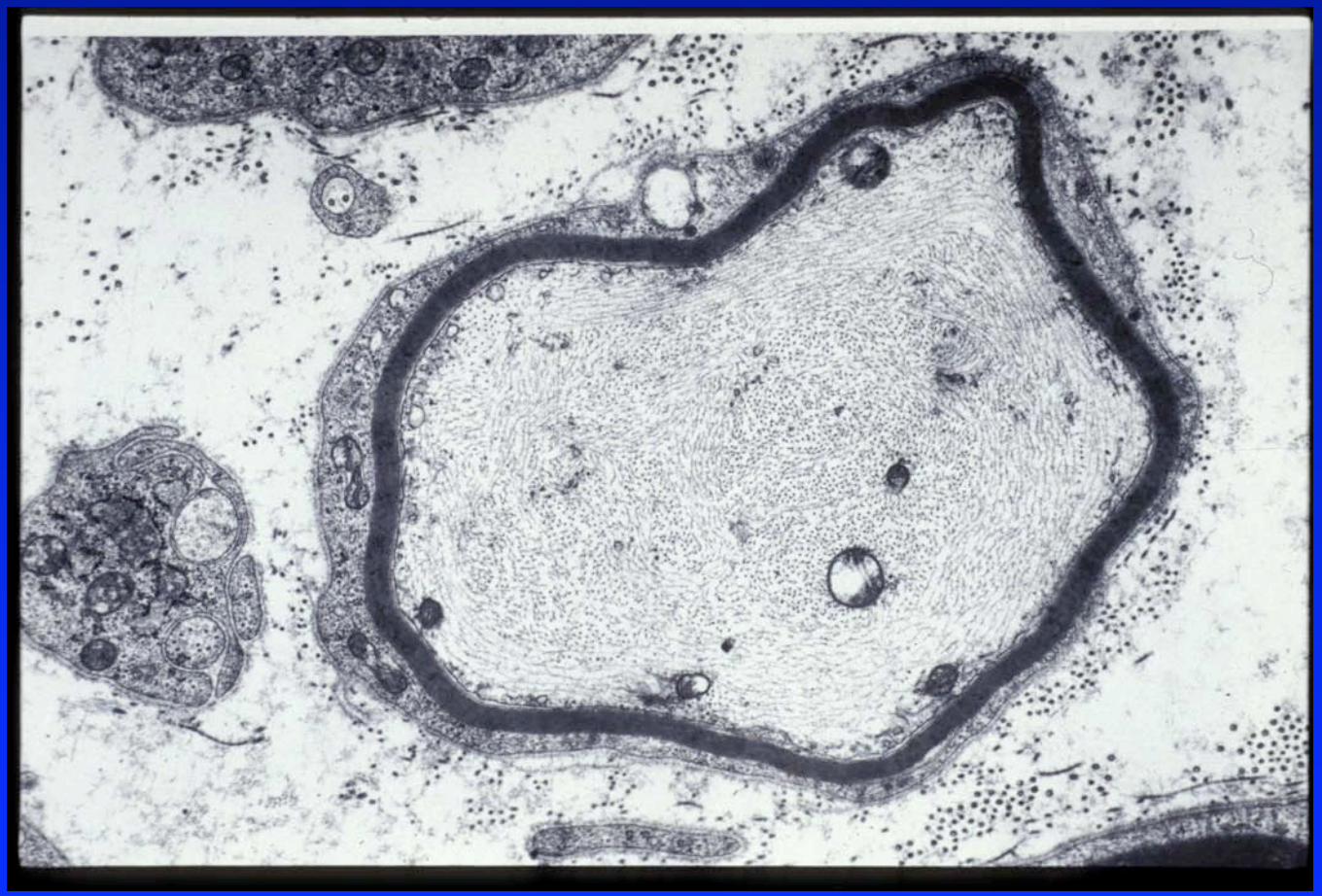


FIGURE 1-31. Diagram to compare the form of the nodal region of myelinated axons in the central (above) and peripheral (below) nervous systems. In each case, the myelin becomes thinner at the paranode as the myelin lamellae terminate to enclose pockets (*P*) of cytoplasm. Where these pockets indent the axolemma, the extracellular space is greatly reduced, and the outer leaflet of the axolemma forms a series of dense bands (arrows). In the central nervous system, the nodal axon is bare and the axolemma has an undercoating of dense material (*d*). A similar undercoating is also present at the peripheral node, but here the axon is covered by interdigitating processes that extend from the outer layer of cytoplasm (*S*) of the two Schwann cells. A basal lamina (*B*) is present on the outside of the myelin sheath in the peripheral nervous system, but absent in the central nervous system.

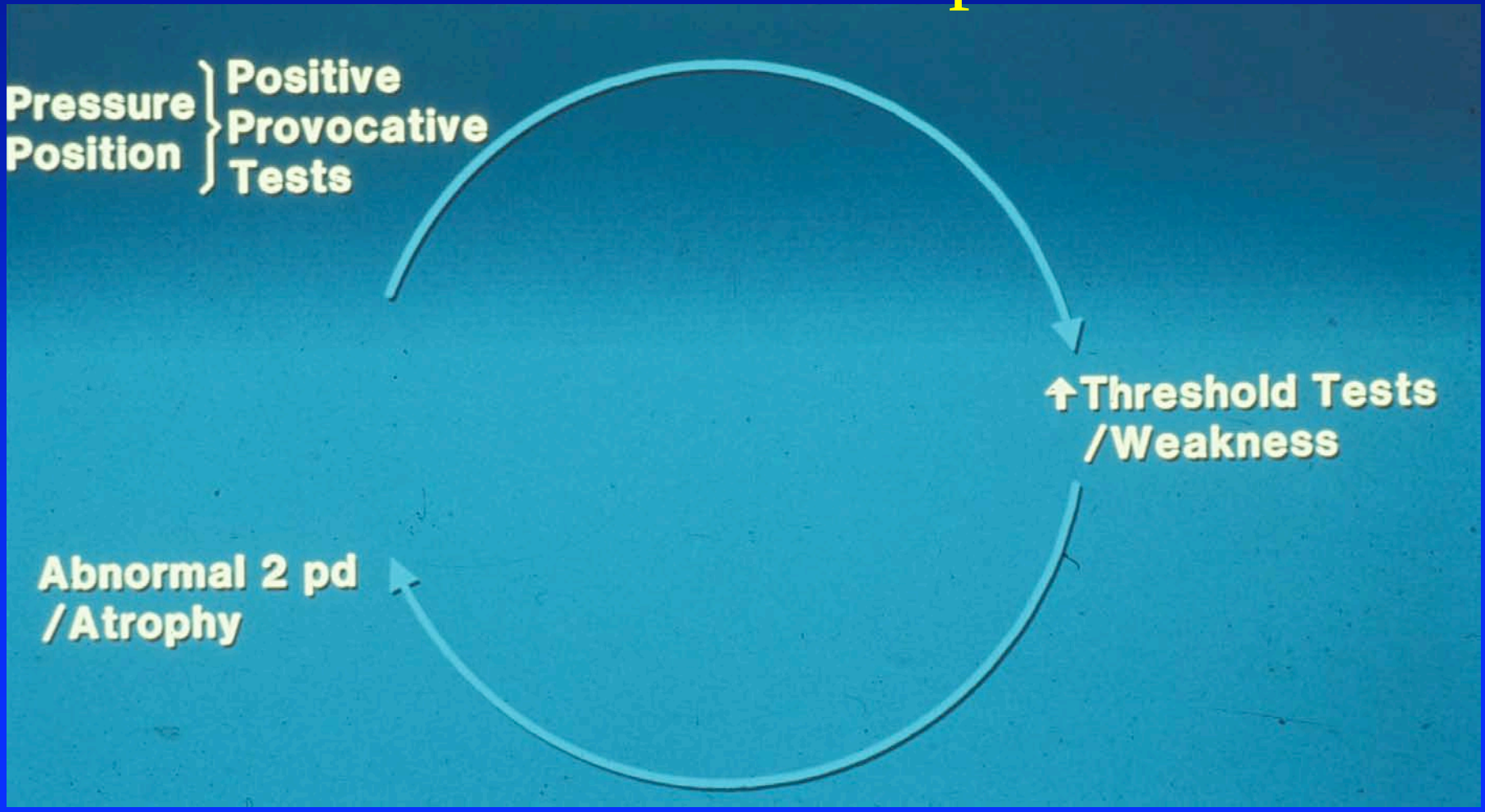
Symptoms
Chronic Nerve Compression



Axonal Remyelination



Clinical Finding
Chronic Nerve Compression



Unusual Nerve Entrapment Syndromes

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Hotchkiss Brain Institute & Department of Clinical Neurosciences, Professor and Chief, Division of Neurosurgery, University of Calgary

Unusual Nerve Entrapments: Upper Extremity

- Suprascapular nerve
- Thoracic outlet syndrome
- Median nerve/Pronator syndrome/AIN
- Posterior interosseous nerve (PIN)
- Radial sensory nerve
- Ulnar nerve at the wrist (Guyon's canal)

Unusual Nerve entrapments: Lower Extremity

- Lateral Femoral Cutaneous Nerve (Meralgia paresthetica)
- Peroneal Nerve Entrapment
- Tarsal Tunnel Syndrome

Thoracic Outlet Syndrome

- Vascular
  - Arterial
  - Venous
- Neurogenic
  - Pain Syndrome – common or disputed TOS
  - Plexus Compression – Classic TOS

Neurogenic TOS: Clinical Features

- Chronic unilateral arm pain followed by hand intrinsic atrophy
- Women > men (4:1)
- Seldom seen in childhood
- Occupational factors
- Postural factors:
  - Asthenic, long necked
  - Droopy shoulders

Classic TOS:
Atrophy often selective
- lateral thenar (APB)

Gilliat-Summner hand

Common (Disputed) TOS

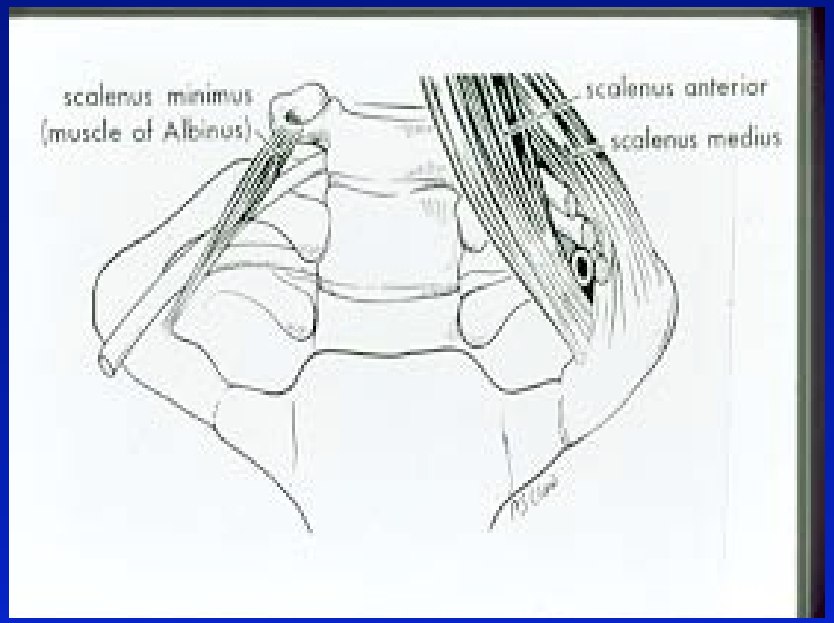
- Electrophysiologic tests (EMG,NCV,SSEP) usually normal
- Cervical rib or abnormal C7 transverse process rare
- Pain and /or paresthesias may be reproduced by a variety of provocative maneuvers, such as Adson's

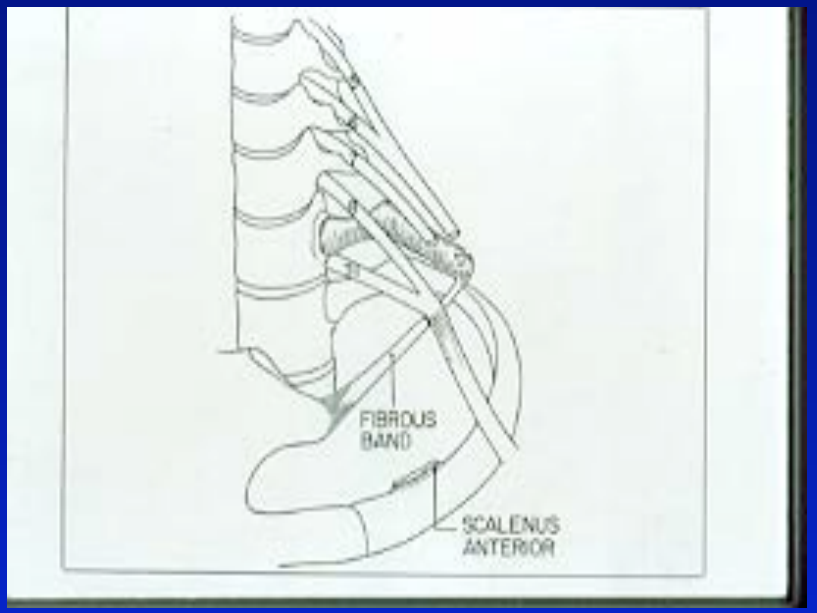
Classic Neurologic Syndrome

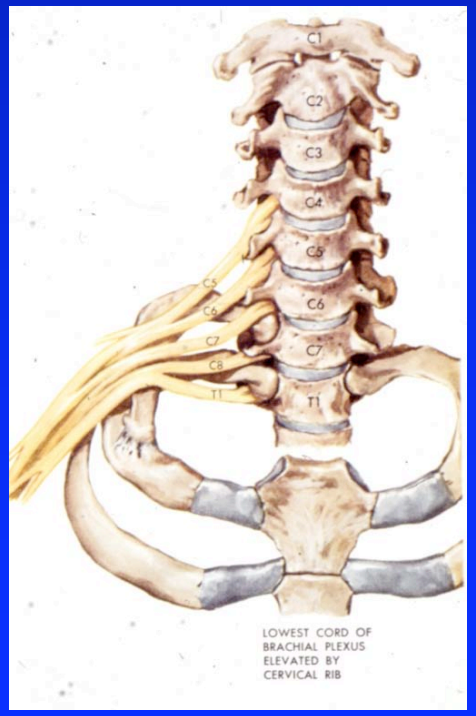
- **Pain and paresthesias rare; dull ache in medial forearm**
- **Sensory loss in 4th and 5th fingers**
- Tinel's sign or tenderness over supraclavicular plexus
- **Weakness and wasting in hand intrinsics (lower trunk plexopathy)**
- **Characteristic findings on EMG and NCV**
- **Cervical rib or elongated C7 transverse process nearly always present**

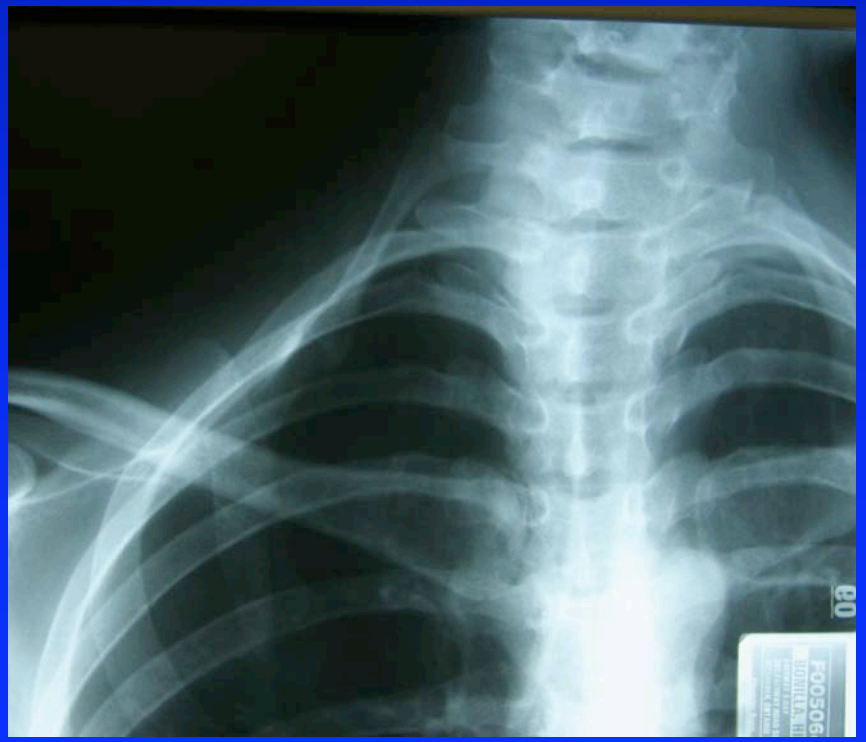
True Neurogenic TOS: Electrodiagnostic Studies

- Most affected = amplitude of CMAP to median nerve stimulation (median motor potential)
- Reduced ulnar sensory potential
- Ulnar motor potential mildly reduced or nl
- Median sensory potential normal (upper trunk)
- EMG shows denervation in abductor pollicis brevis, lesser chronic neurogenic changes in other hand muscles


scalenus minimus
(muscle of Albinus)
scalenus anterior
scalenus medius


FIBROUS
BAND
SCALENUS
ANTERIOR

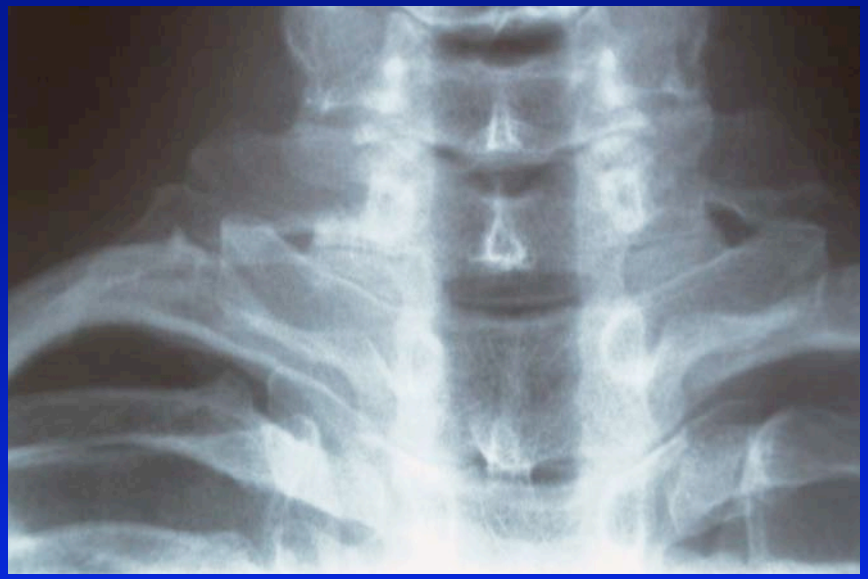

C1
C2
C3
C4
C5
C6
C7
C8
T1
LOWEST CORD OF
BRACHIAL PLEXUS
ELEVATED BY
CERVICAL RIB

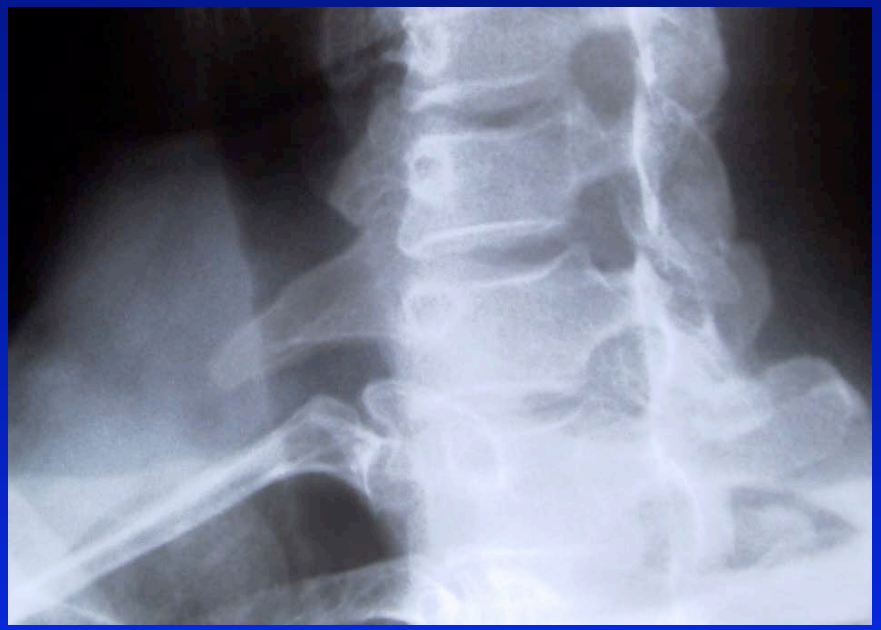


Thoracic Outlet Syndrome: Operative Approaches

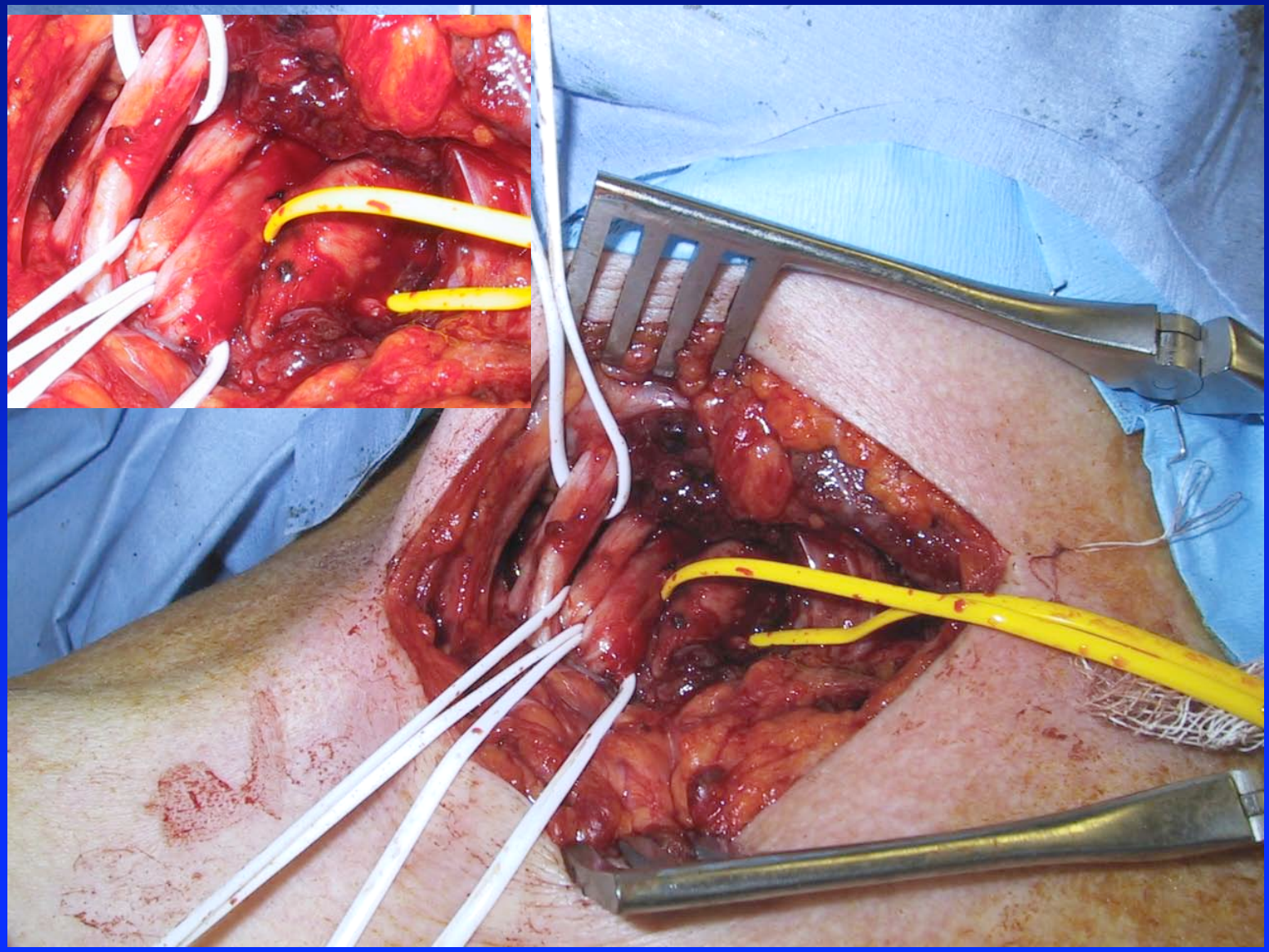
- Anterior supraclavicular - allows neurolysis at root and trunk level, cervical rib resection
- Transaxillary - allows 1st rib resection, lysis of congenital bands
- Posterior subscapular - avoids scar in re-do cases

35 y.o. F with classic neurogenic TOS



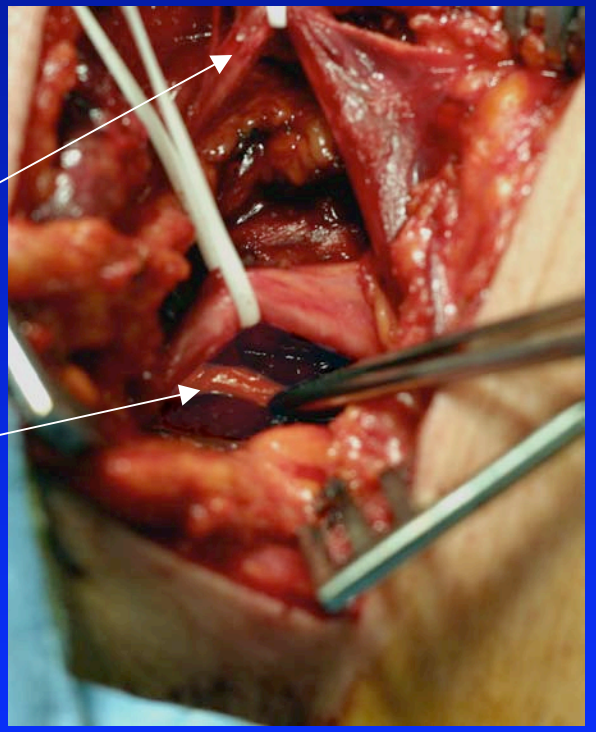


Lower trunk compression



Thoracic Outlet Decompression: Technical Issues

- Full exposure of all 3 trunks
- Requires division of anterior scalene- identify and protect the phrenic nerve
- Exposure and protection of long thoracic nerve, posterior and lateral to upper trunk, within medial scalene
- Resect all compressive soft tissue pathology +/- bony elements



Thoracic Outlet Syndrome: Surgical Series

- Most suffer from observer bias
- Most are retrospective
- Indications for surgery differ
- No uniform rating scales for preop condition or postop outcome
- Different surgical techniques

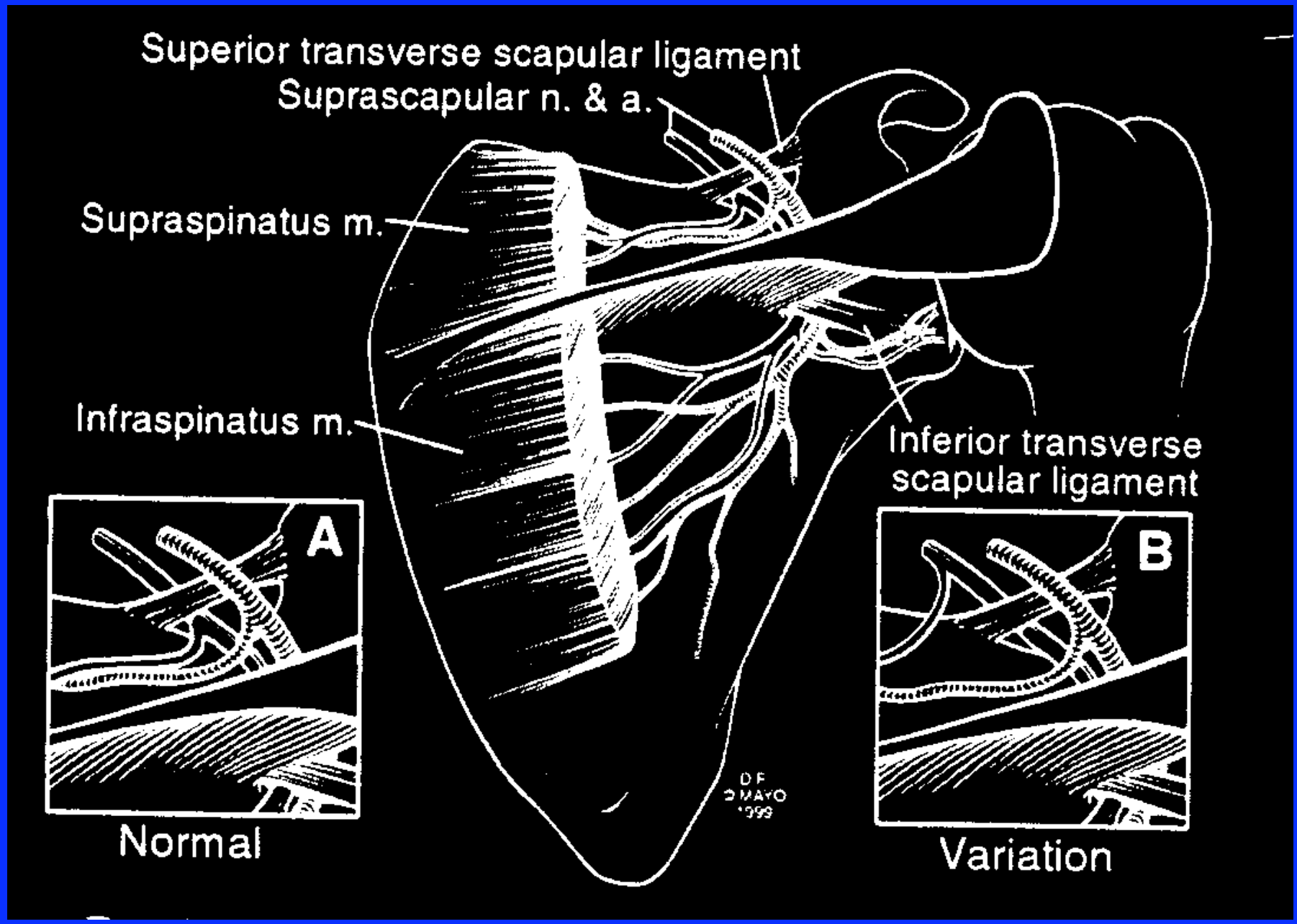
Thoracic Outlet Syndrome

- Conclusions:
  - Classic TOS is rare
  - Think - soft tissue compression
  - Think - close to the spine
  - We must improve our diagnostic techniques
  - We must improve conservative management
  - Never trust a surgeon

Suprascapular Nerve Entrapment

- Posterior shoulder pain
- Weakness ± atrophy of supraspinatus and/or infraspinatus
- 2 potential entrapment sites:
  - suprascapular notch (superior transverse scapular ligament)
  - spinoglenoid notch (inferior transverse scapular ligament) - only infraspinatus affected

Suprascapular Entrapment Neuropathy: Clinical


Superior transverse scapular ligament
Suprascapular n. & a.
Supraspinatus m.
Infraspinatus m.
Inferior transverse scapular ligament
A
Normal
B
Variation

Suprascapular Nerve Entrapment

- Overhead work or athletic activity
- No sensory loss
- Tenderness over suprascapular or spinoglenoid notch

Suprascapular Nerve Entrapment

- DDx: rotator cuff injury, bursitis, cervical DJD, ganglion cyst
- MRI shoulder for ganglion cyst or rotator cuff tear; MRI neck for disc, osteophyte
- EMG/NCV study to confirm dx and to localize the site of entrapment (may be normal)
- Local injection may be diagnostic & therapeutic

Suprascapular Nerve Entrapment

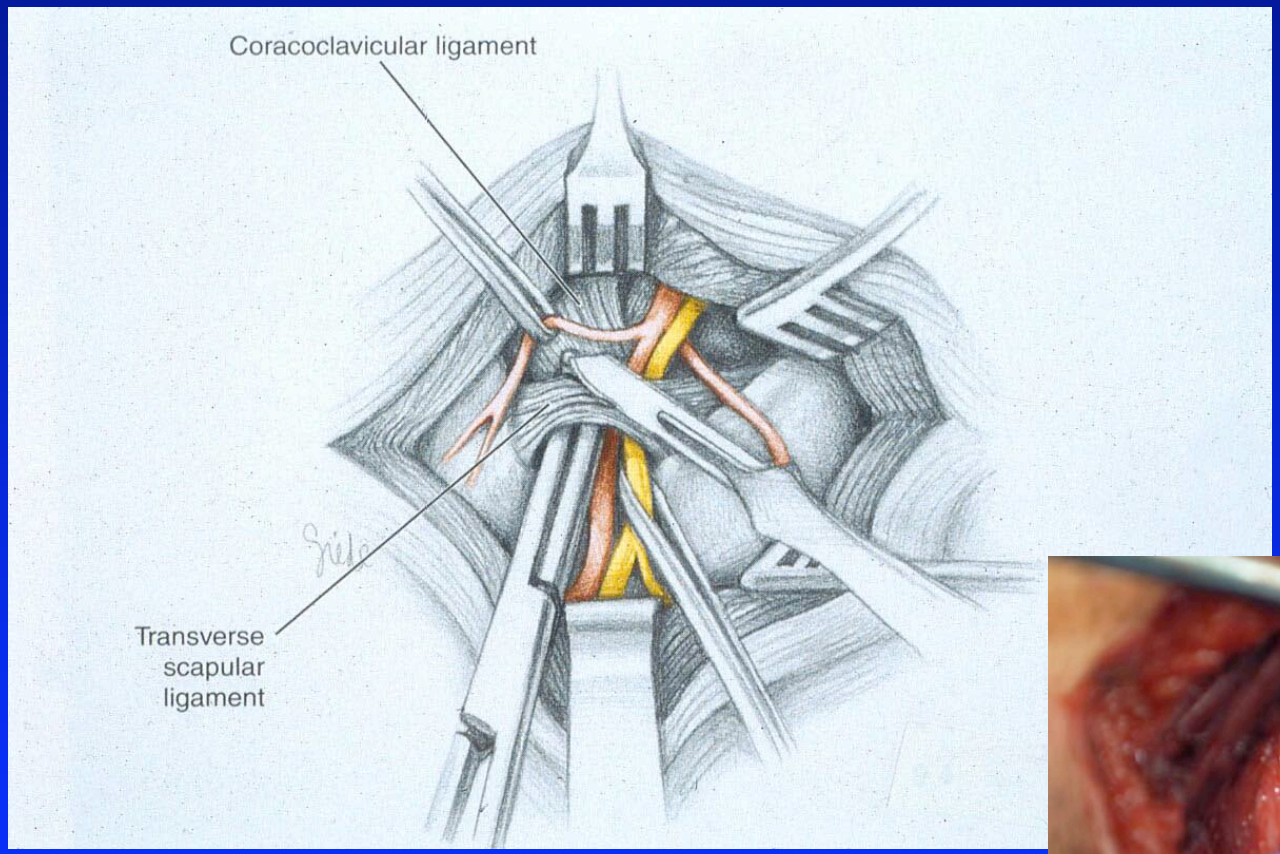
- Operative treatment
  - General anesthesia
  - Prone or supine with a shoulder roll
  - Transverse incision above & parallel to scapular spine
  - Blunt dissection through trapezius & supraspinatus

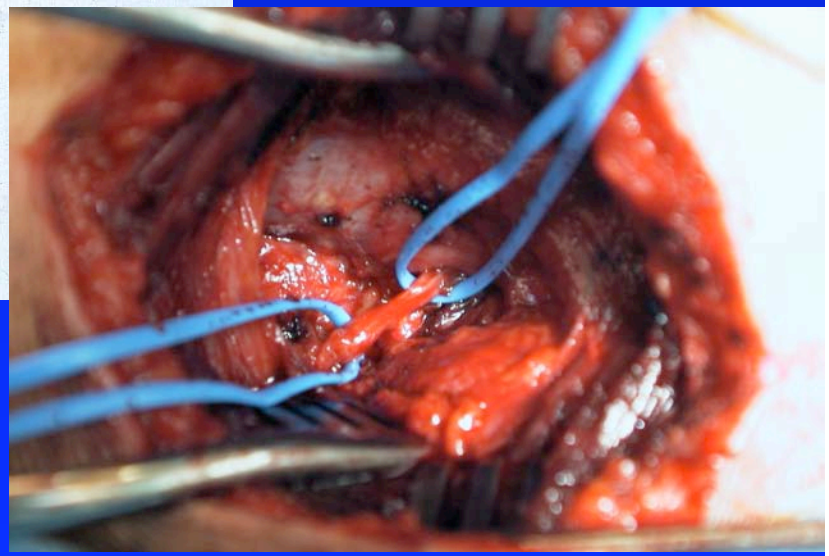

SS
IF

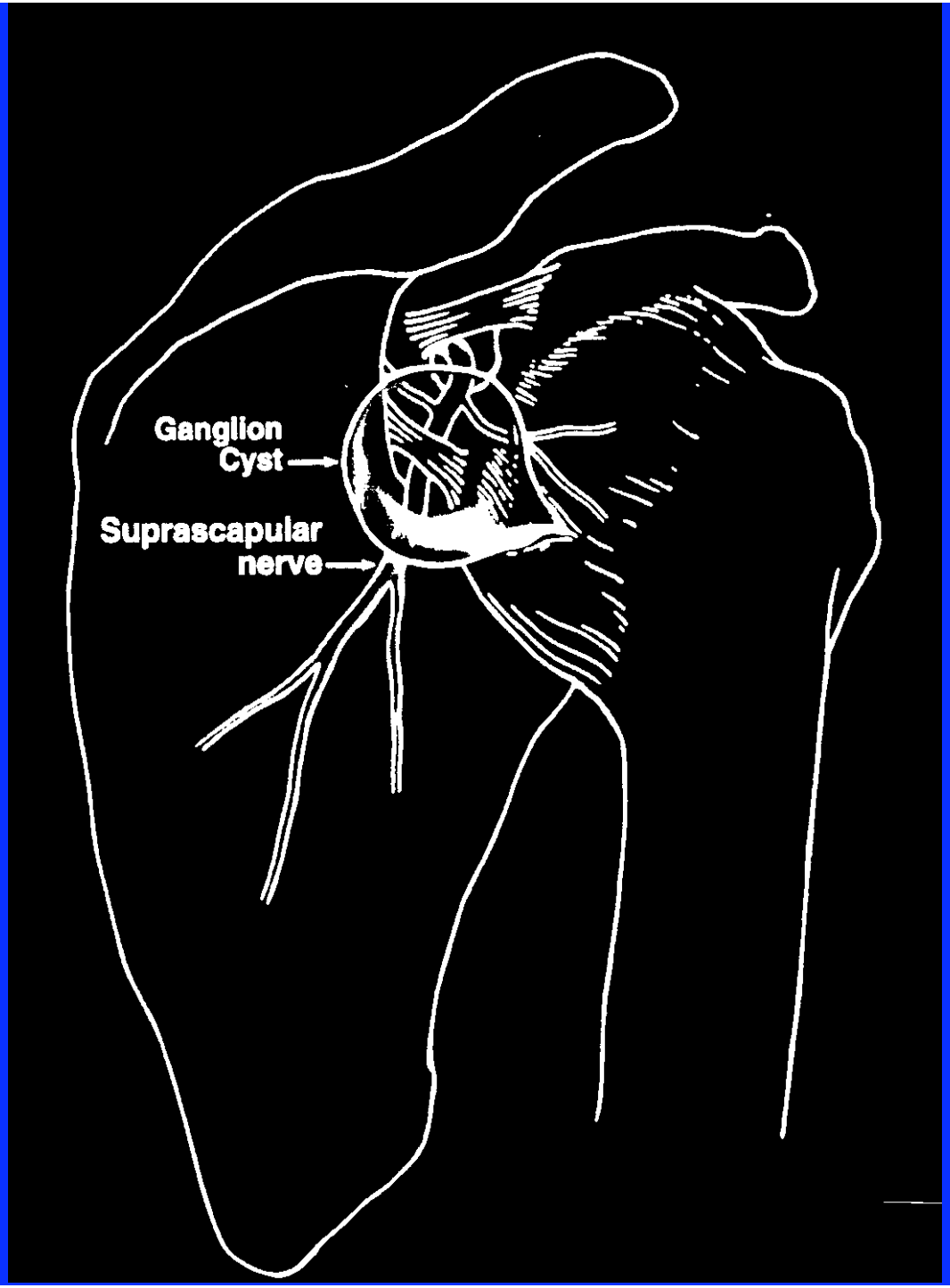
Suprascapular Nerve Entrapment

- Operative tx (cont'd)
  - Palpate along the scapular spine for the suprascapular notch
  - Operating microscope is helpful
  - Identify SSN visually & by stimulation
  - Suprascapular artery usually superficial to the superior transverse scapular ligament
  - Divide the ligament

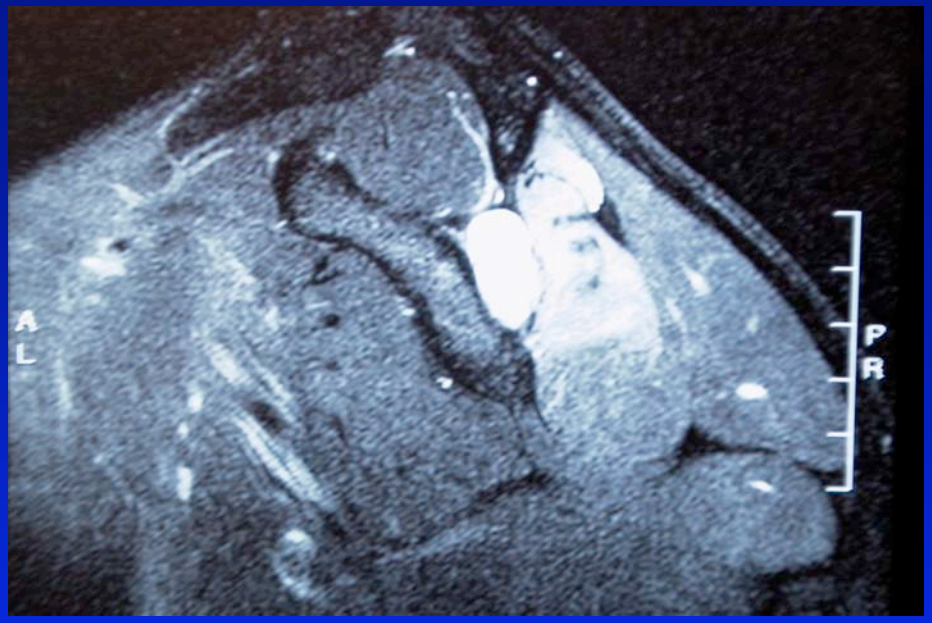
Release of Suprascapular entrapment

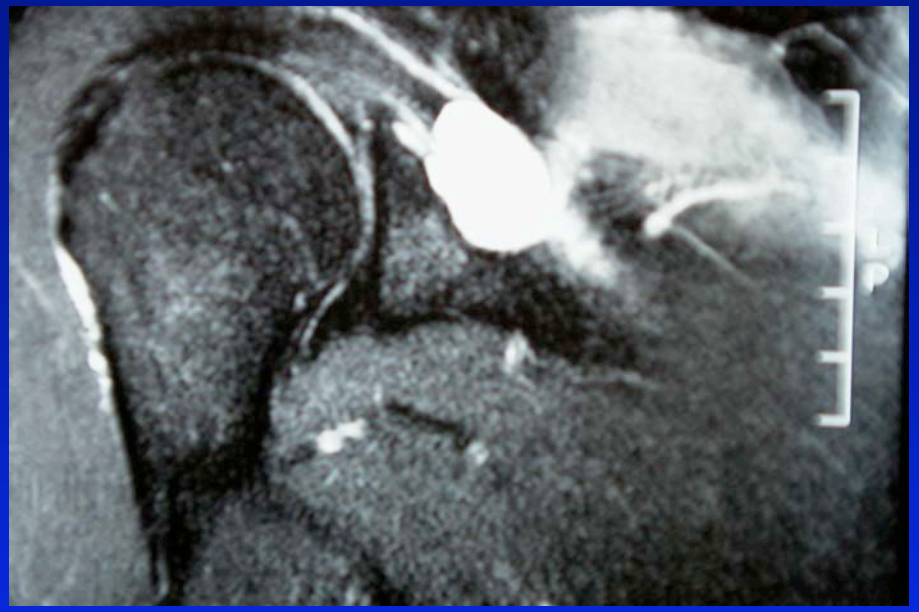


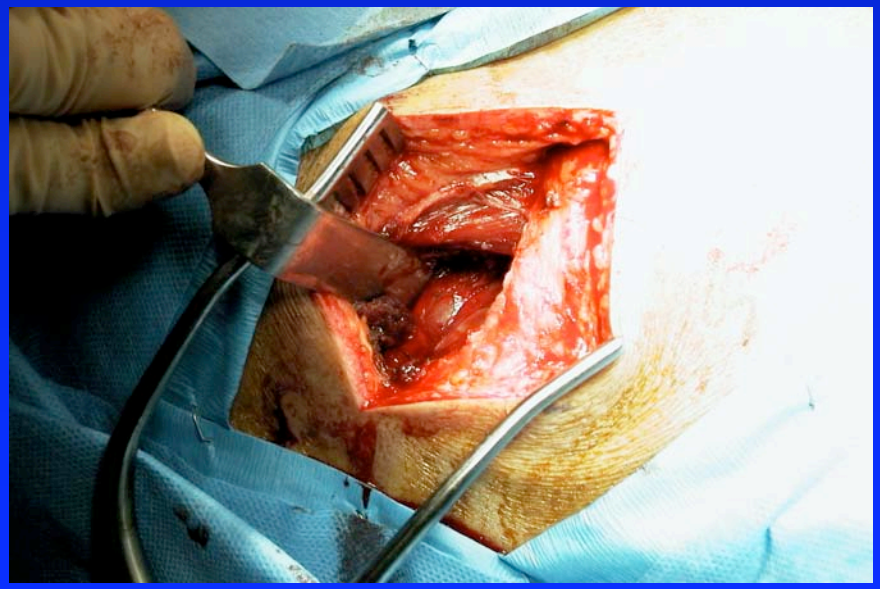



Ganglion
Cyst
Suprascapular
nerve

Splenoglenoid Region Ganglion Cyst







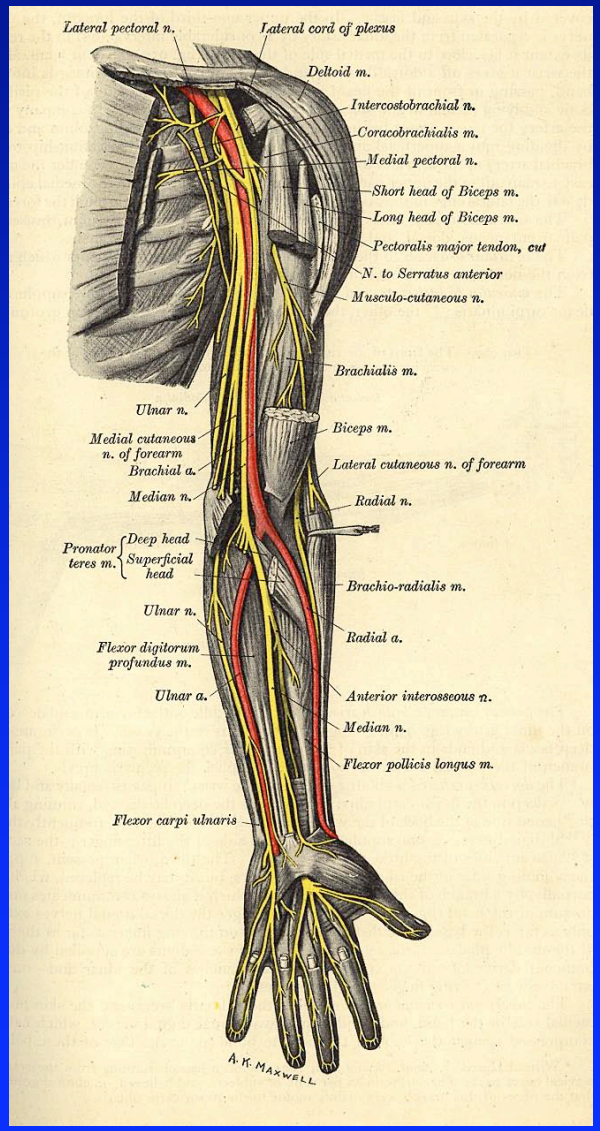
Suprascapular Nerve Entrapment

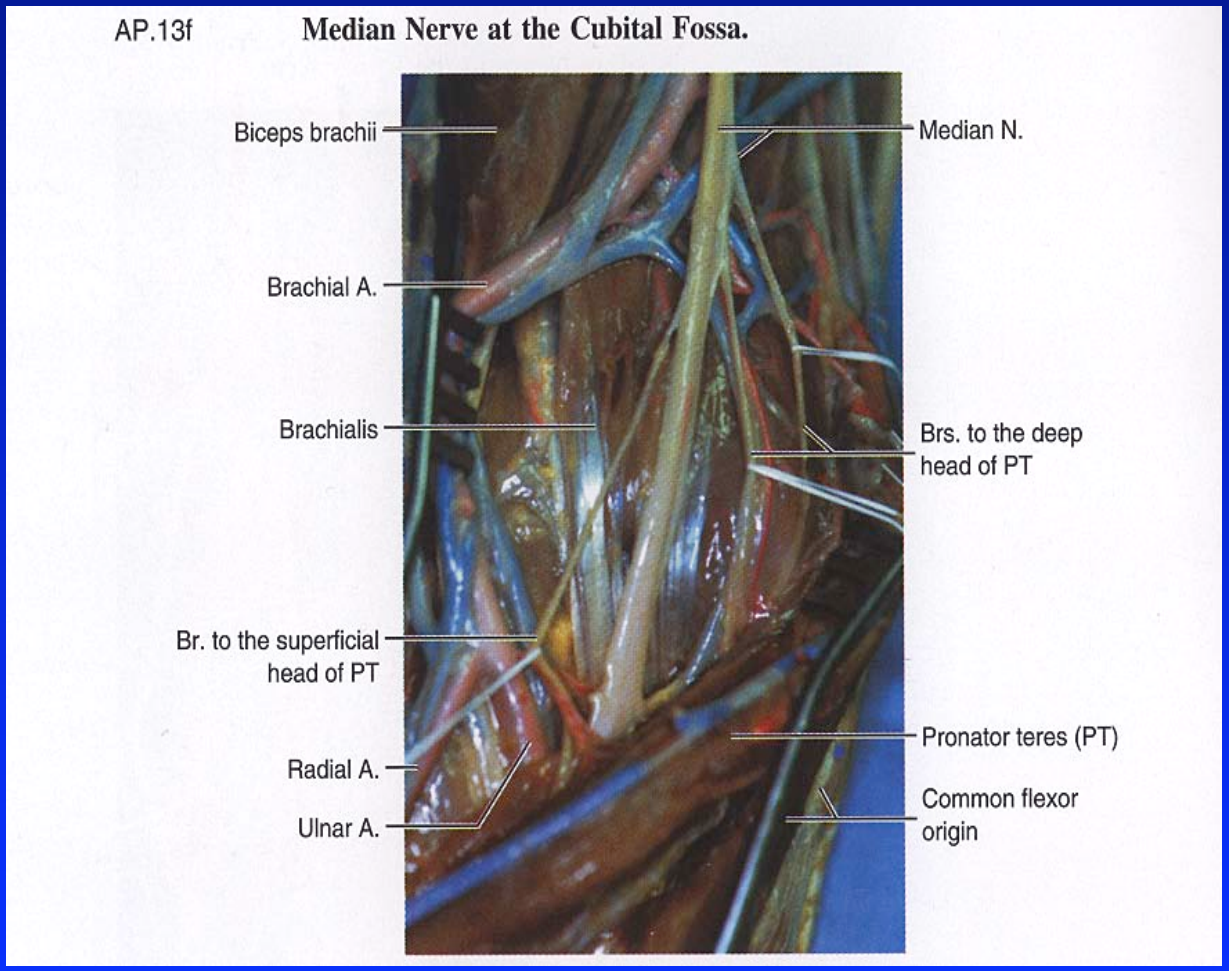
- Outcome of surgery
  - Pain responds very well
  - Atrophy does not
  - External rotation may be normal due to compensation by teres minor

Acute Brachial Neuritis

- Sudden onset
- Spontaneous or minimal “trauma”
- Associated with severe pain then weakness and atrophy
- Long thoracic nerve involvement frequent
- Also C5, C6 and UT distributions, branches
- EMG helpful in looking for sub-clinical and bilateral involvement

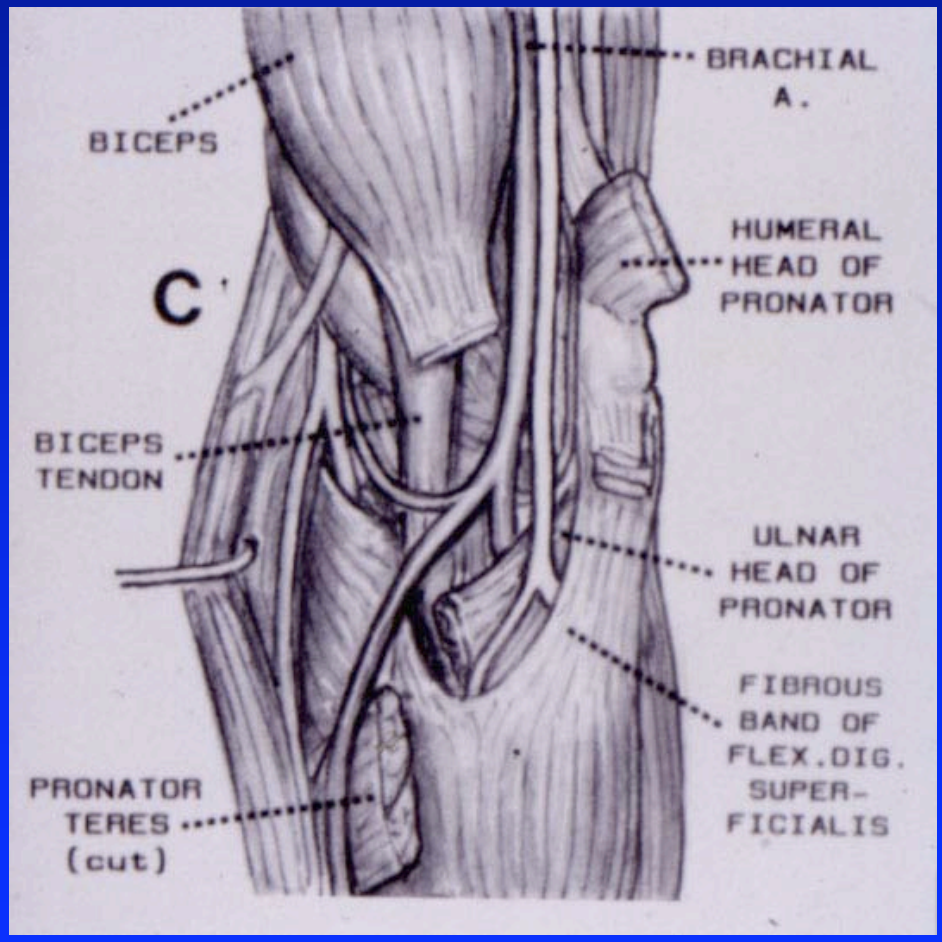
Median Nerve and AIN





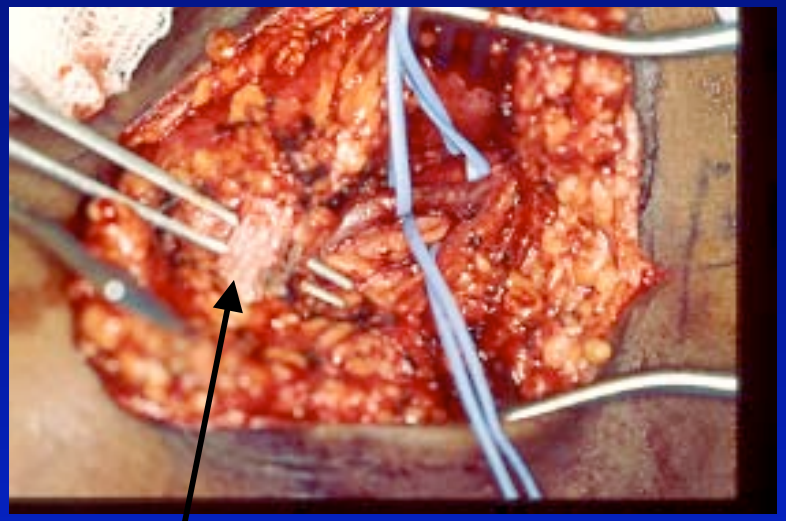
Median Nerve: Potential Points of Compression

- Forearm
  - Lacertus fibrosus (bicipital aponeurosis)
  - Pronator teres
  - Flexor digitorum superficialis (sublimis) arch
  - Anomalous muscles
  - Ulnar collateral or radial artery branches

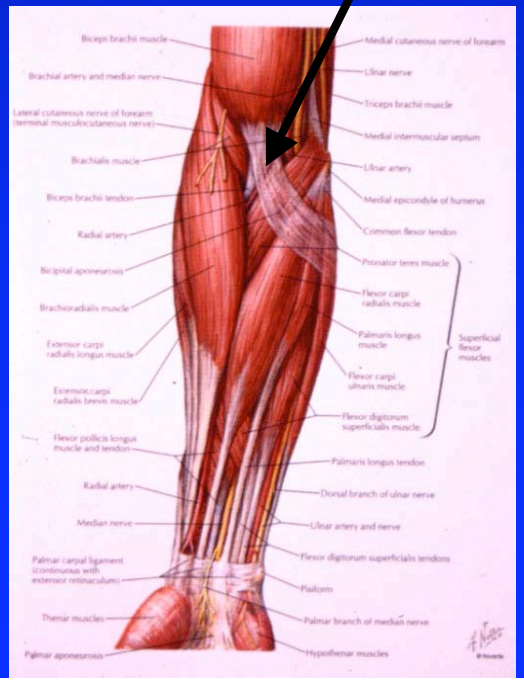


Median Nerve Compression in the Forearm: Symptoms

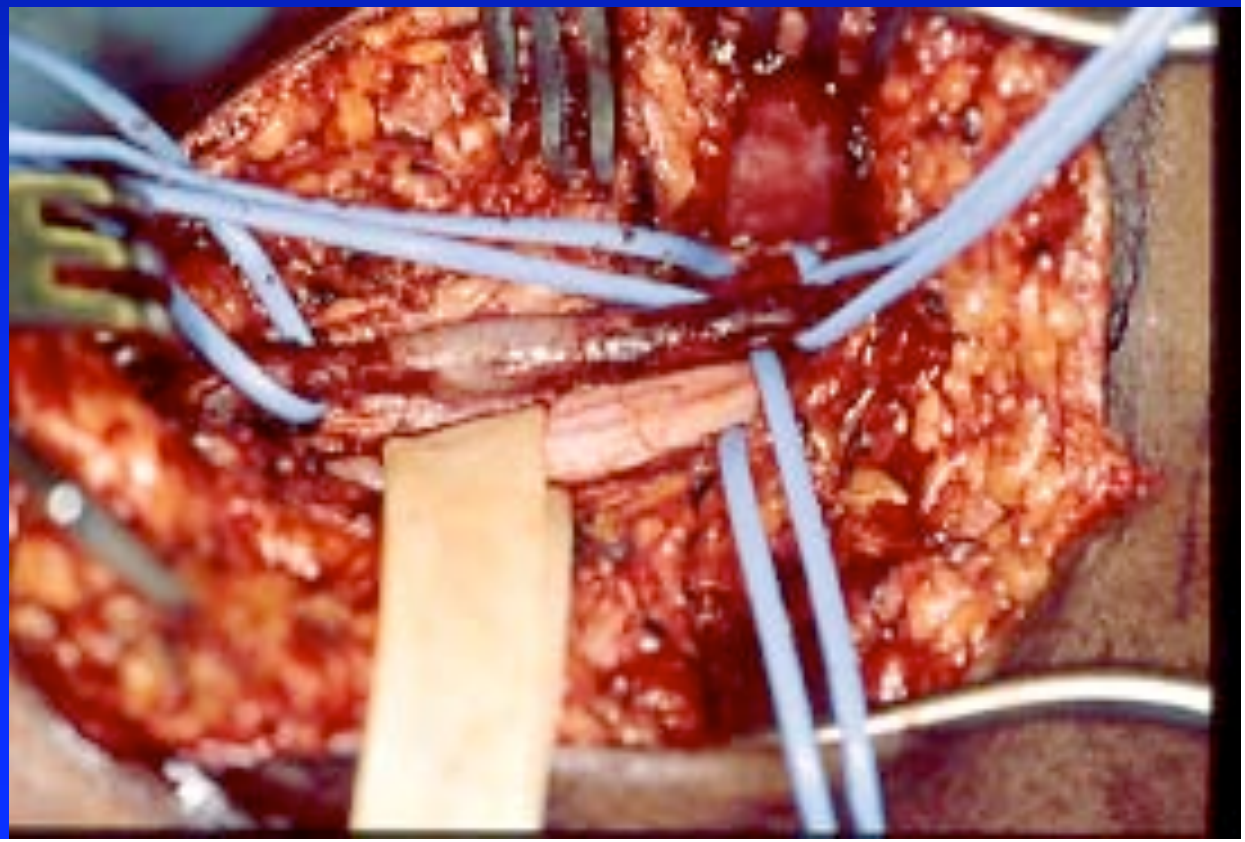
- Aching, heaviness in the forearm
- Clumsiness, weakness of the hand
- Numbness in the hand - usually more vague than CTS
- Worse after repetitive motions
- Night sx's not prominent, unlike CTS
- Changes in wrist position do not provoke sx's, unlike CTS



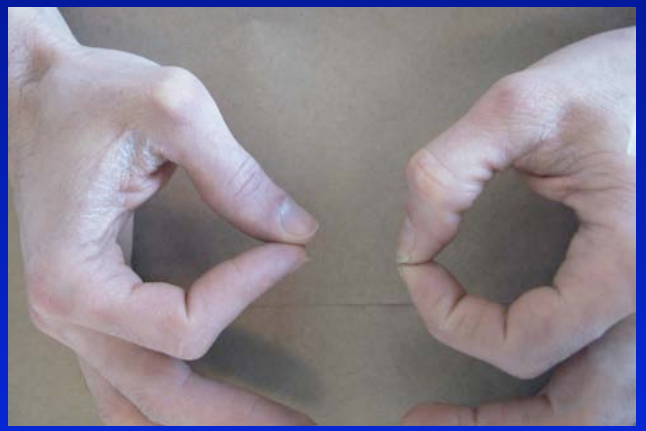
Lacertus fibrosus



Median nerve decompressed

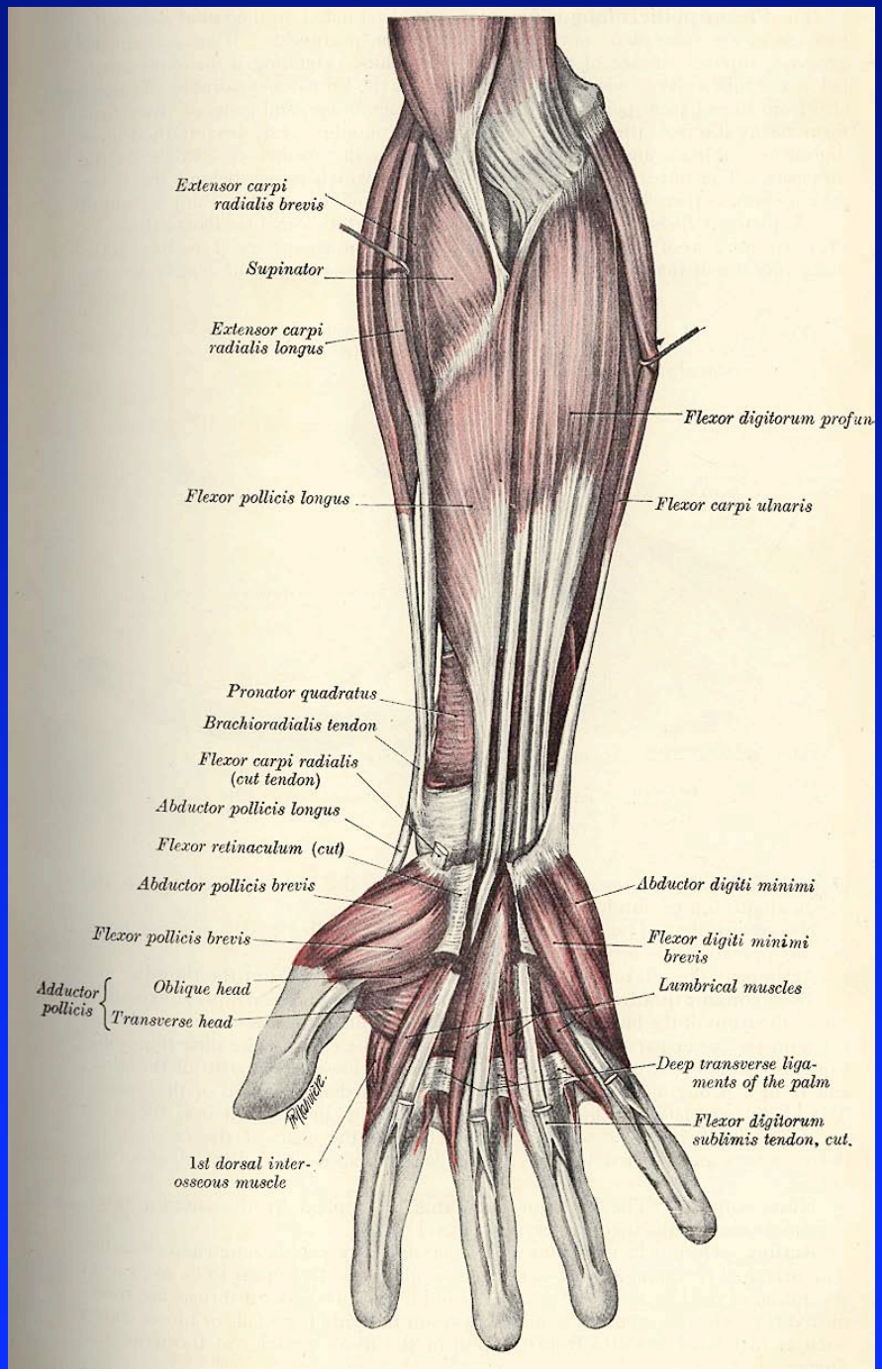


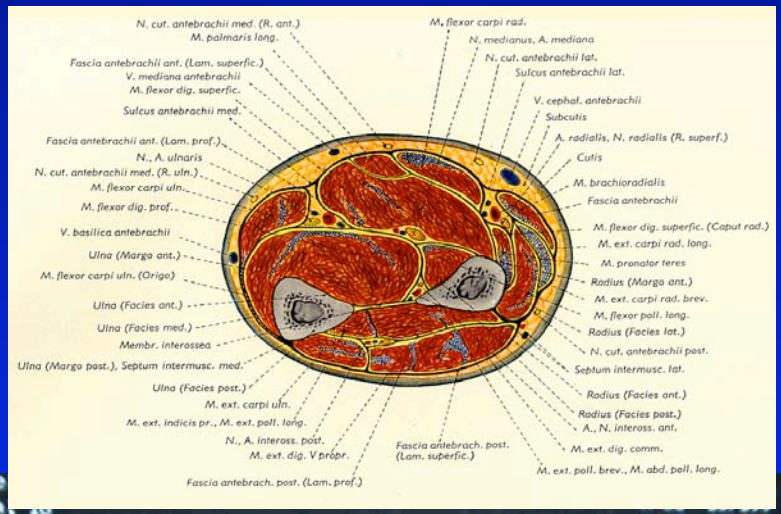
Anterior Interosseous Nerve (AIN) Entrapment

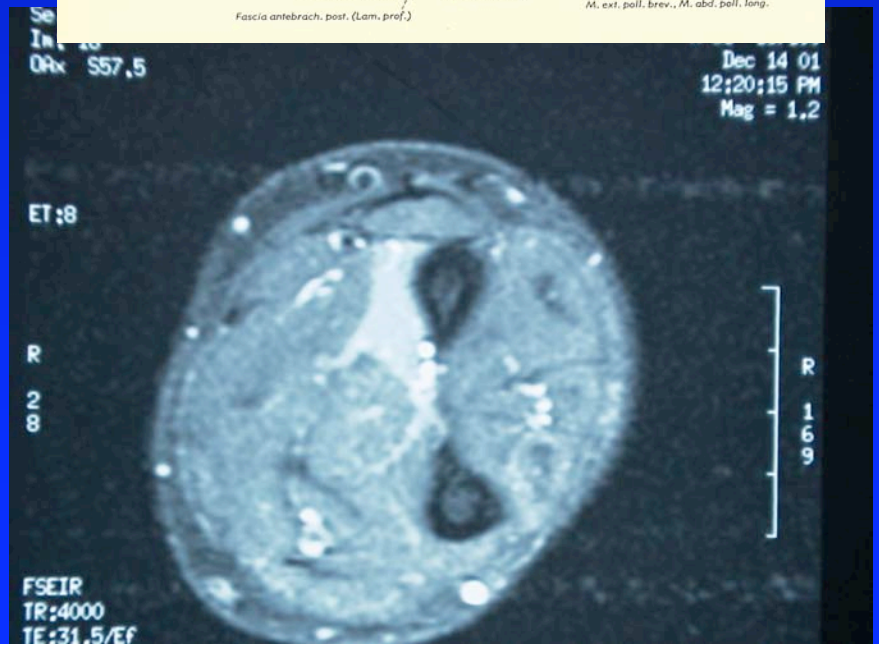


- Weakness of FPL & FDP
- Pinch posture (OK sign)
- Weak pronation w/ elbow flexed
- No sensory loss – pure motor nerve
- Site of entrapment controversial
- Trauma more common than entrapment
- Idiopathic cases may be brachial neuritis

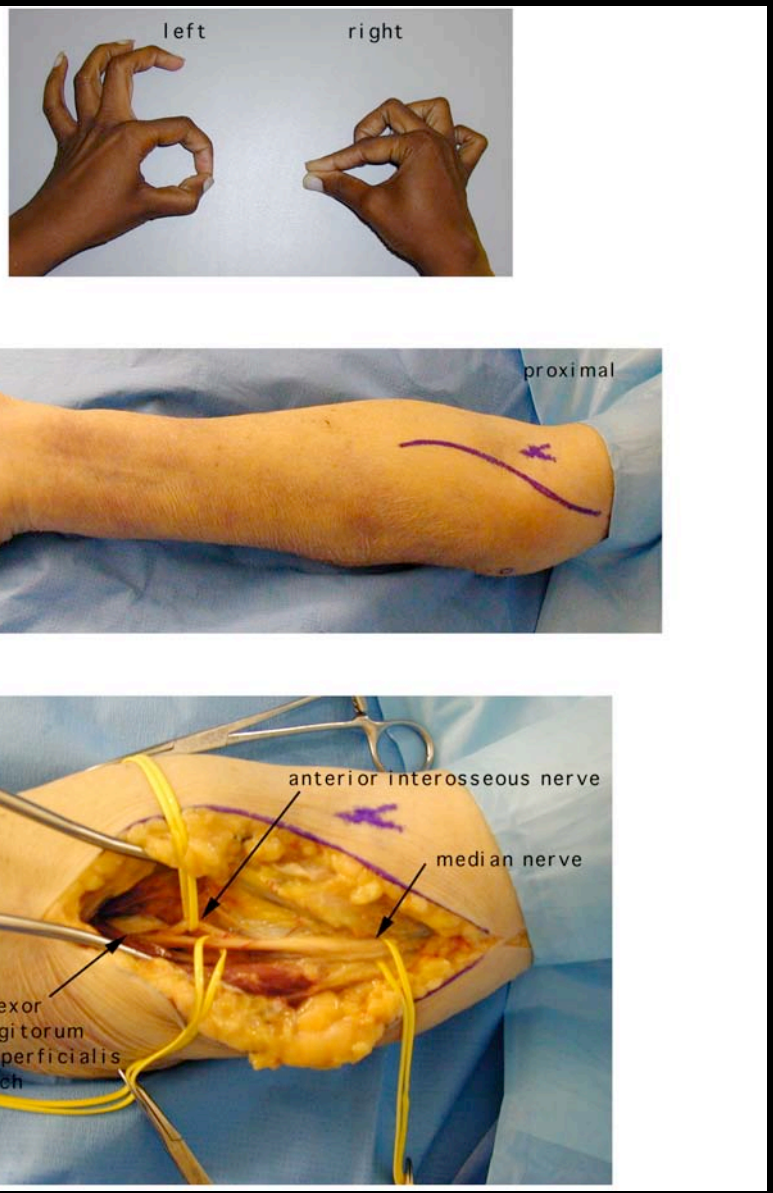
AIN Syndrome:
Signal change (denervation) on MRI in FDP and FPL

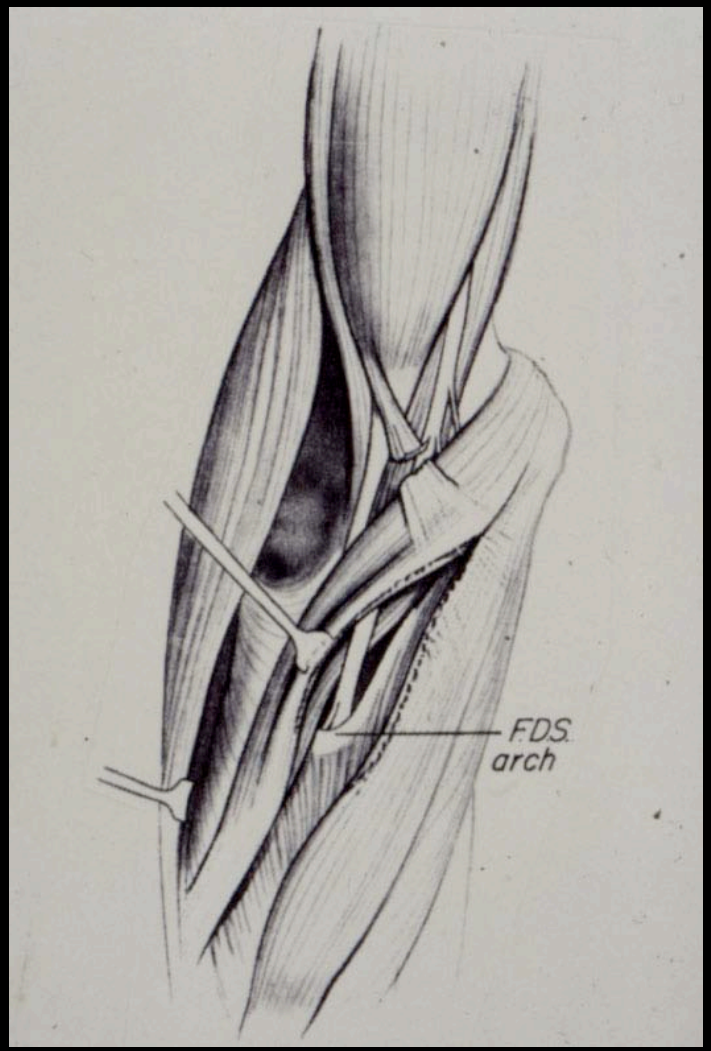




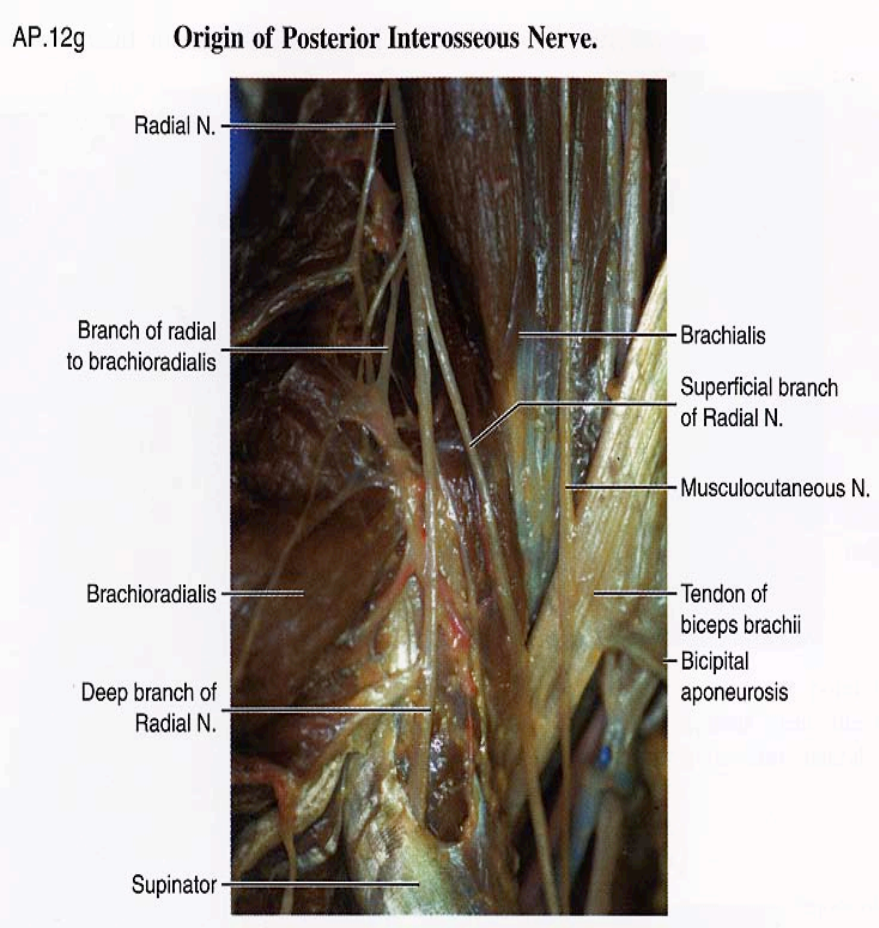


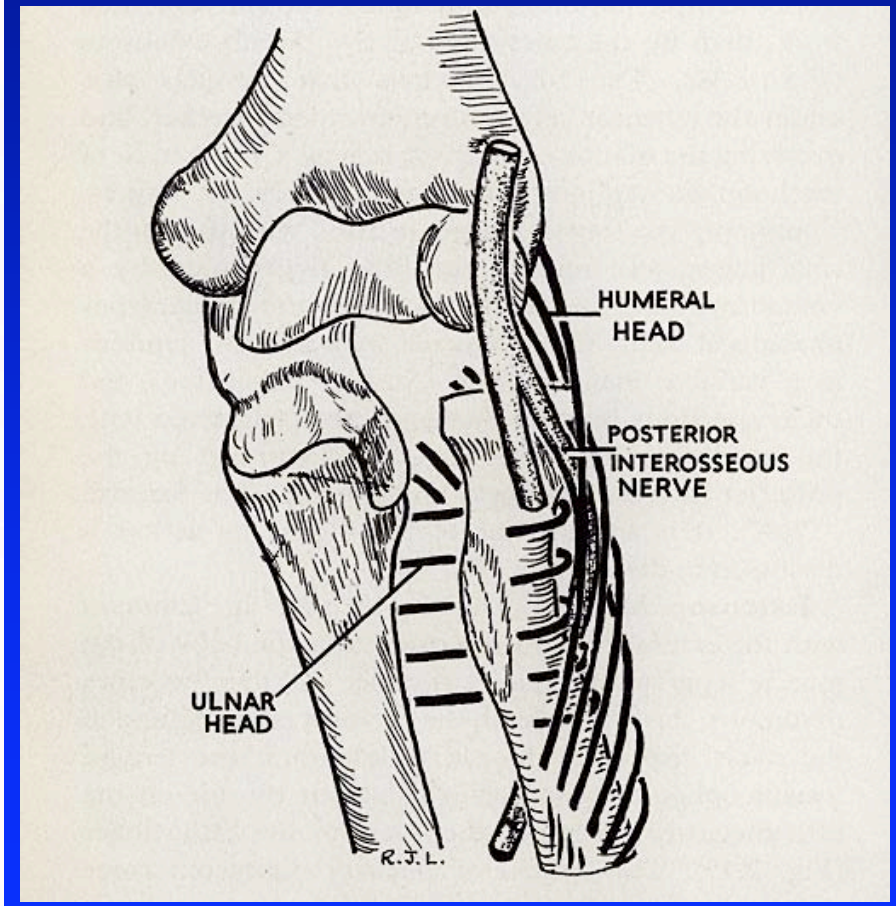
AIN Decompression





Radial Nerve and PIN





Distal Radial Nerve Entrapment Syndromes

Posterior Interosseous Nerve (PIN)

Radial Sensory Nerve (RSN)

Posterior Interosseous Nerve (PIN) Entrapment

- PIN Compression Syndrome
- Radial Tunnel Syndrome

PIN Compression Syndrome

- PIN palsy:
  - Spares ECRL
  - Allows wrist extension in radial direction

Radial Tunnel Syndrome: Clinical Features

- No motor deficit
- No sensory deficit
- No EMG abnormality
- Pain precisely located – proximal supinator
- Pain provoked by palpation (direct) or by middle finger test & resisted supination (indirect)

Radial Tunnel Syndrome: Clinical Features

- Pain over lateral elbow, may radiate
- Deep ache, cramp, charley horse (motor nerve)
- Pain worse w/ activity, better w/ rest
- Night pain is common
- **DDx: lateral epicondylitis (tennis elbow)**

PIN Compression Syndrome: Operative Approaches

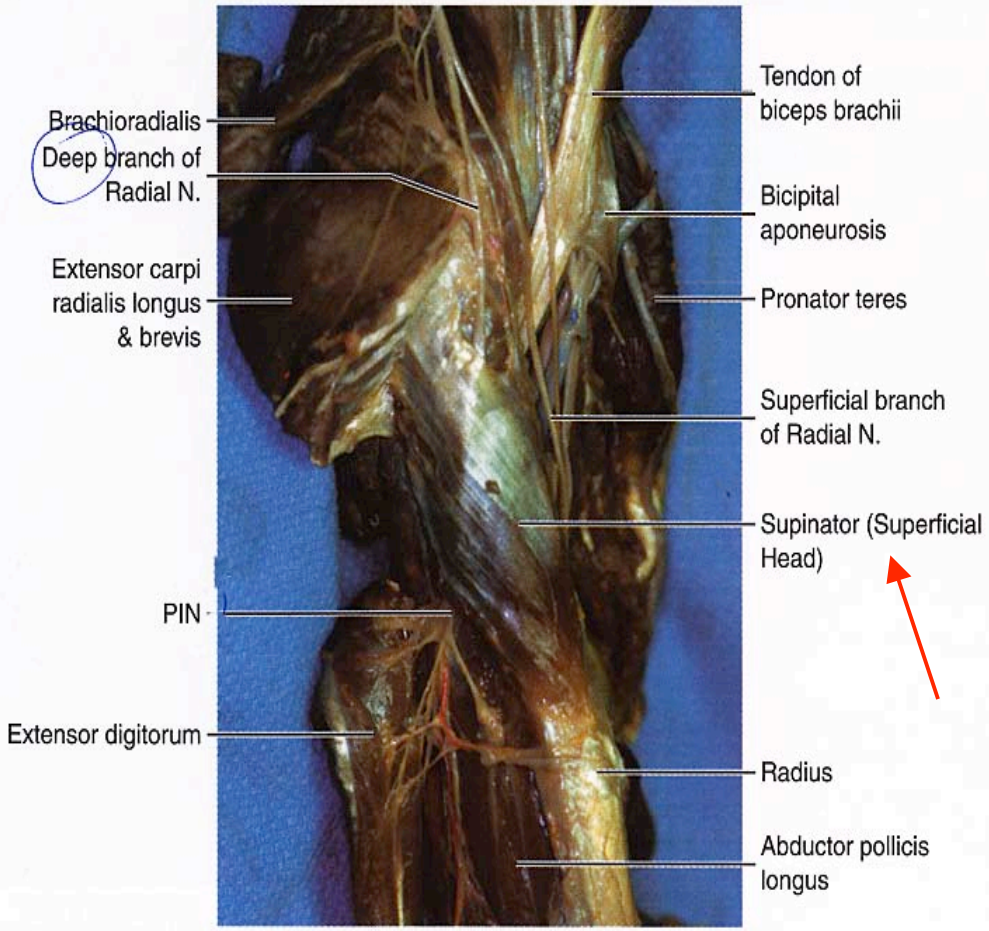
- Anterior
- Transmuscular (BR)
- BR - ECRL interval
- Posterior

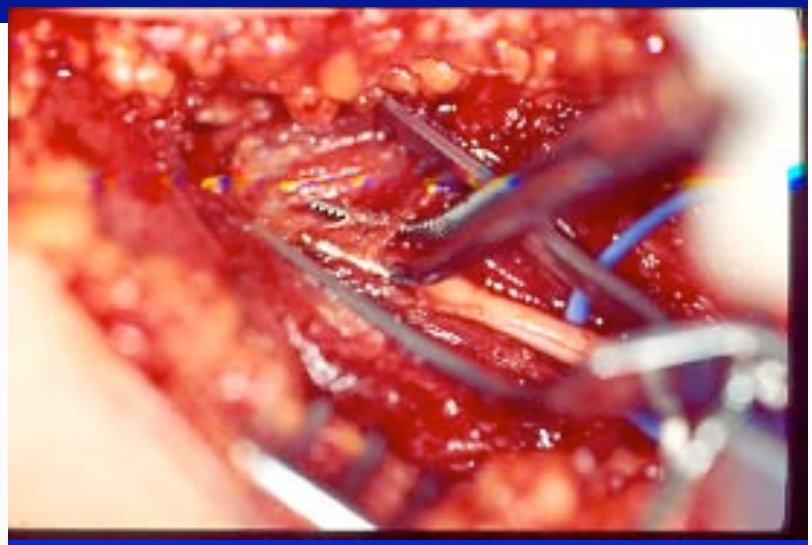
PIN Compression Syndrome: Surgical Pointers

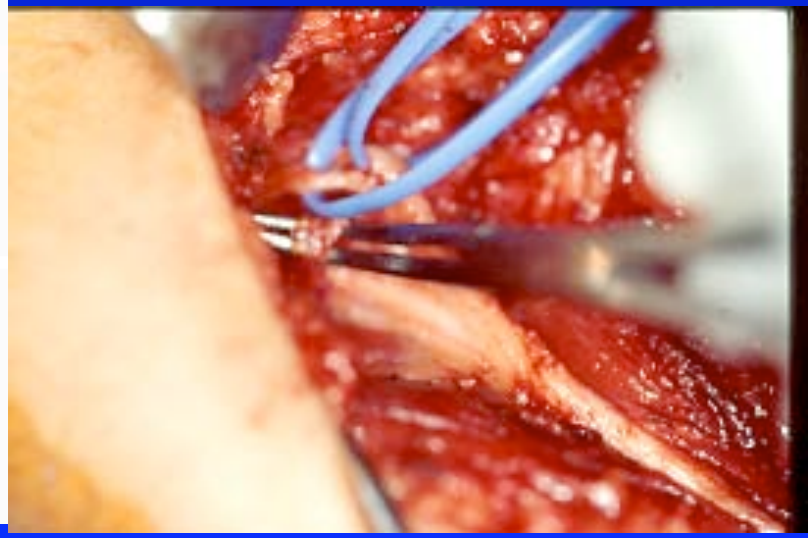
- Approaches are relative to MOBILE WAD (BR, ECRB, ECRL)
- Goals: Divide superficial supinator, ECRB leading edge, vascular leash of Henry
- Beware of veins
- ECRB leading edge may be mistaken for Arcade of Frohse

PIN Decompression through the Supinator Heads

AP.12h **Posterior Interosseous Nerve Passing Between the Two Heads of Supinator.**

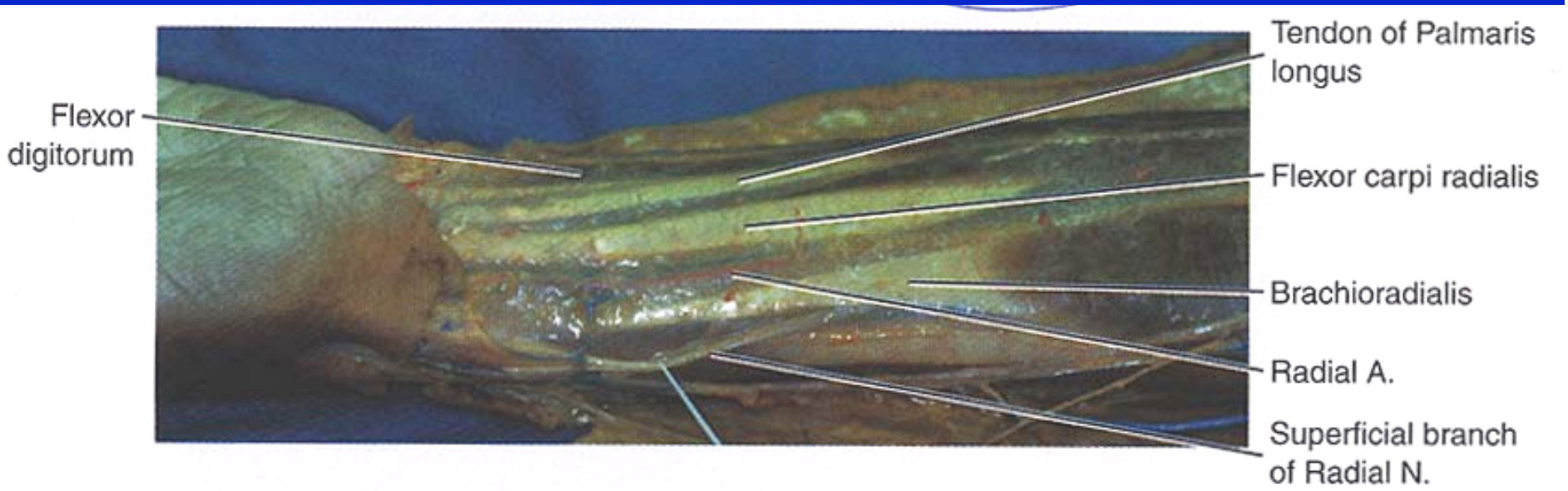






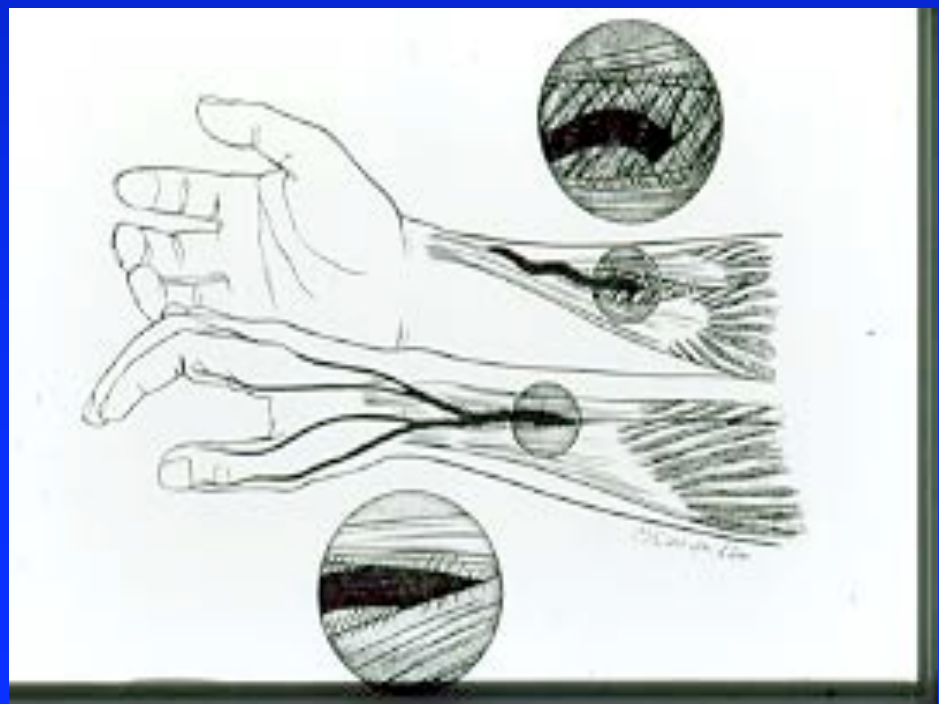
Radial Sensory Nerve (RSN)

Superficial Sensory Radial Nerve (SSRN)



Radial Sensory Nerve (RSN) Entrapment

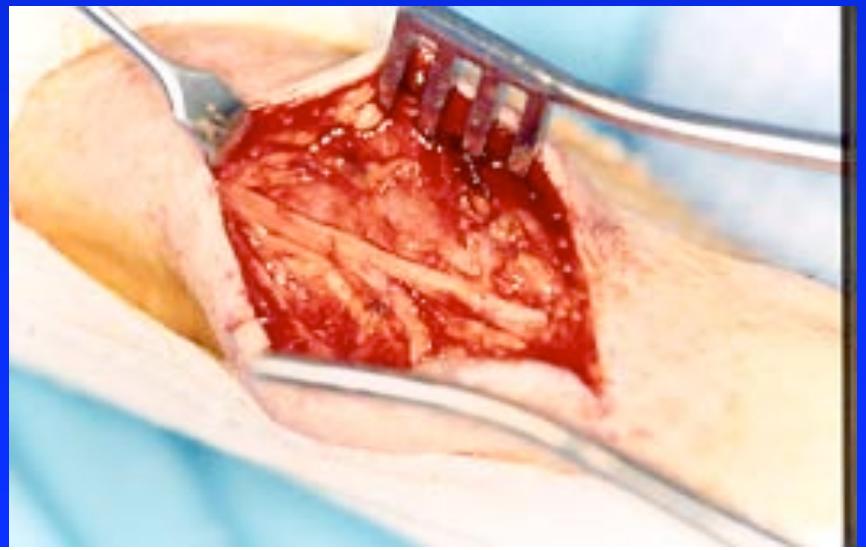
- Burning pain, paresthesias of dorsal radial hand. $\pm$ Tinel's sign
- No motor loss
- Variable sensory loss, small autonomous zone (anatomic snuffbox)
- DDx: cervical radiculopathy, DeQuervain's tenosynovitis

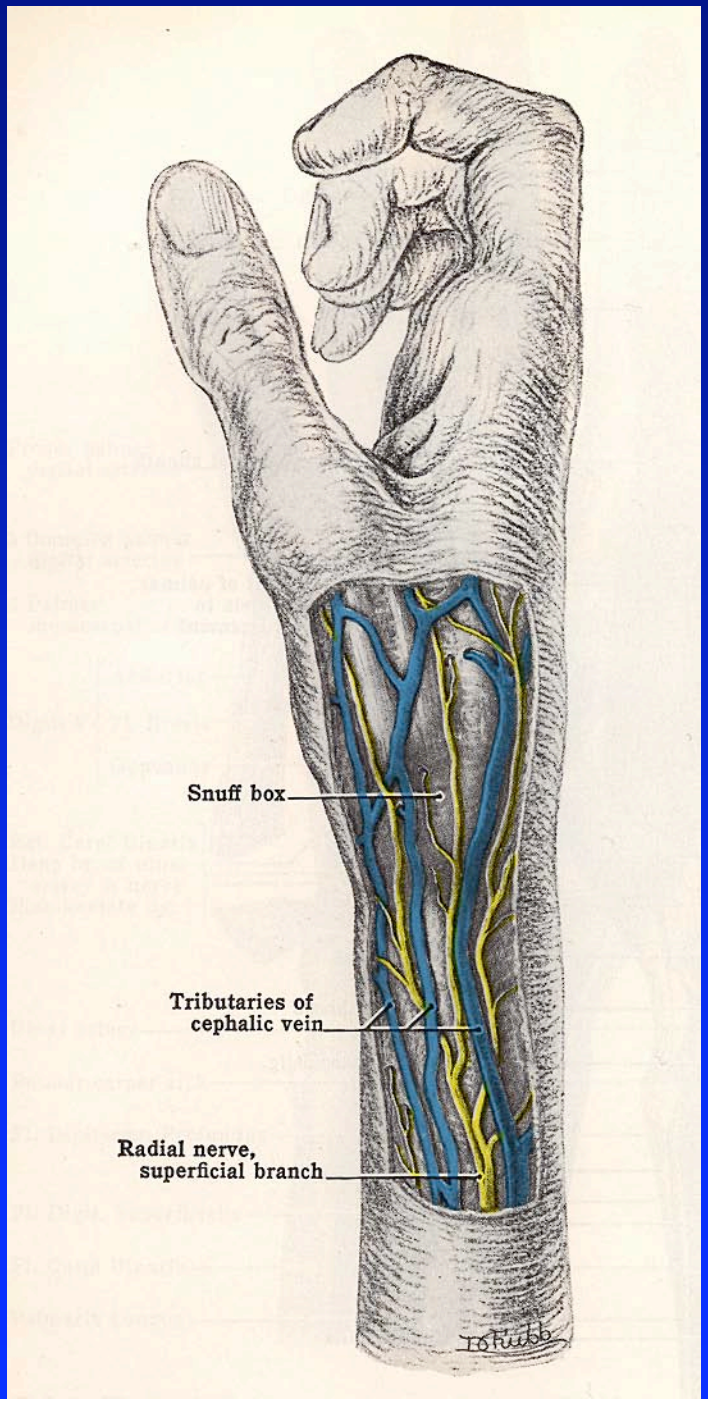


Radial Sensory Nerve: Operative Technique

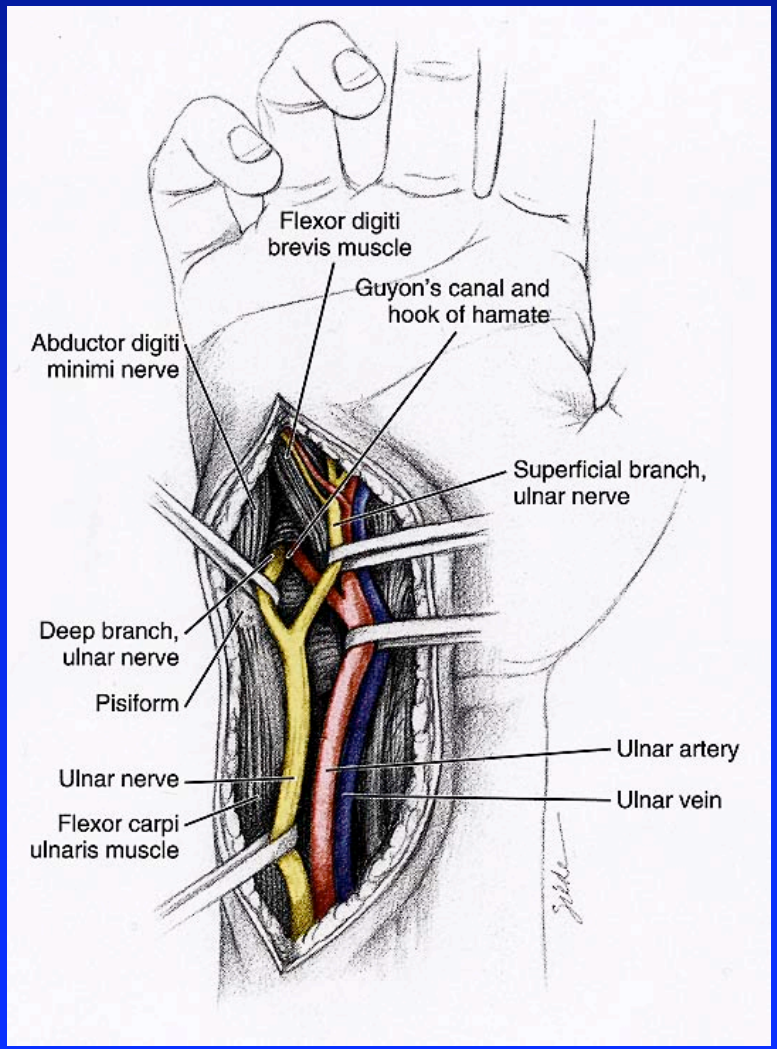
- Regional or general anesthesia
- Incision 3-4 cm over volar radial forearm
- Beware of lat. antebrachial cutaneous n.
- Open fascia between BR & ECRL tendons
- Resect neuromas

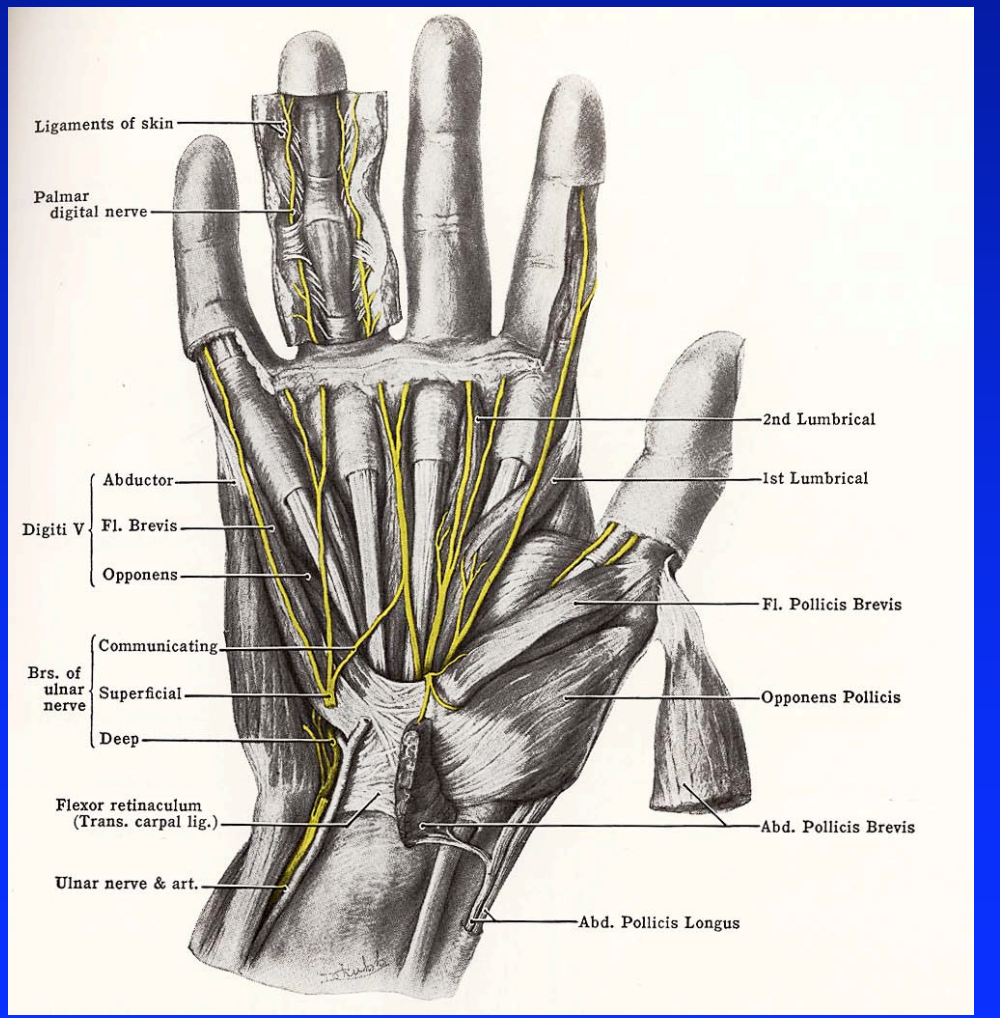
SSR Decompression





Ulnar Nerve Entrapment at the Wrist: Guyon's Canal





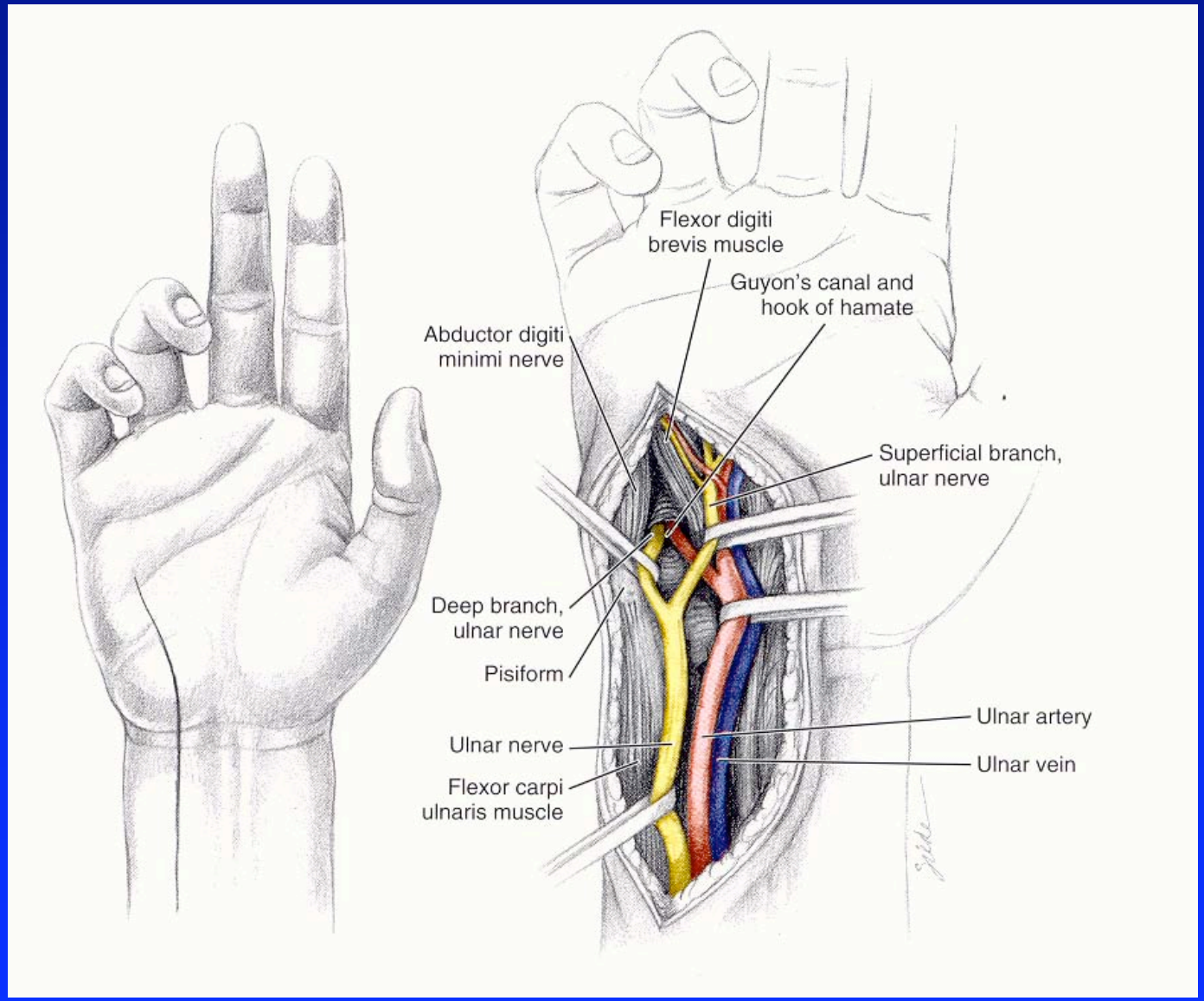
Guyon's canal: Anatomy

- An oblique fibro-osseous tunnel that lies within proximal part of hypothenar eminence
- Roof: palmar fascia (volar carpal ligament) and palmaris brevis muscle
- Floor: flexor retinaculum and pisohamate ligament
- Walls:
  - Terminal tendon of FCU and pisiform bone forms medial wall
  - Curved ulnar surface of hook of hamate forms lateral wall distally
- Contains ulnar artery (medial) and ulnar nerve in loose fibrofatty tissue
- Deep motor branch and ulnar artery turn laterally and pass under pisohamate hiatus

Distal Ulnar Neuropathy (Guyon's Canal Entrapment)

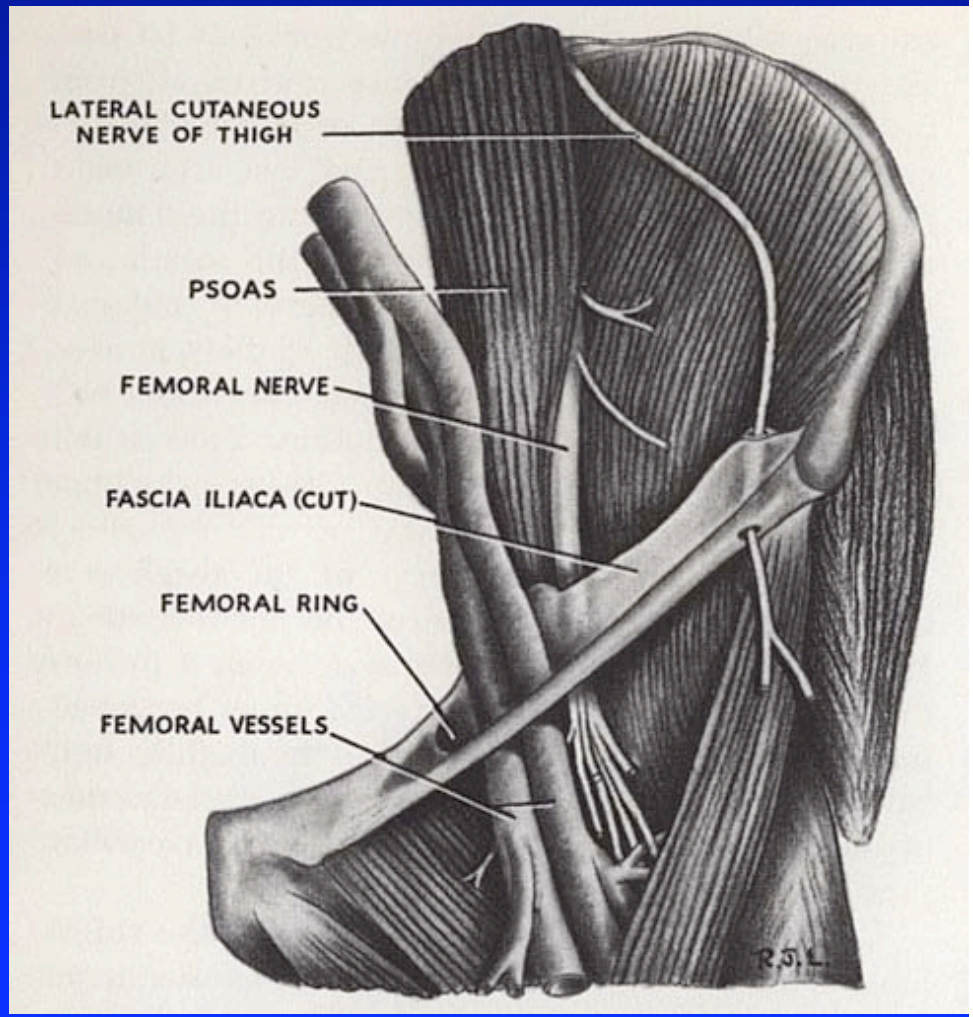
- Sensory changes confined to ulnar distribution distally, with sparing of palmar and dorsal ulnar cutaneous nerve branch distributions
- FCU and FDP to D4 and D5 spared
- Ulnar intrinsic muscle weakness
  - Hypothenar mass may be spared (along with sensation) in variant where deep branch compressed at pisohamate hiatus
- Clawing of D5 (D4) may be pronounced
- Tinel's sign over ulnar nerve overlying wrist

Surgical approach: Ulnar nerve at wrist

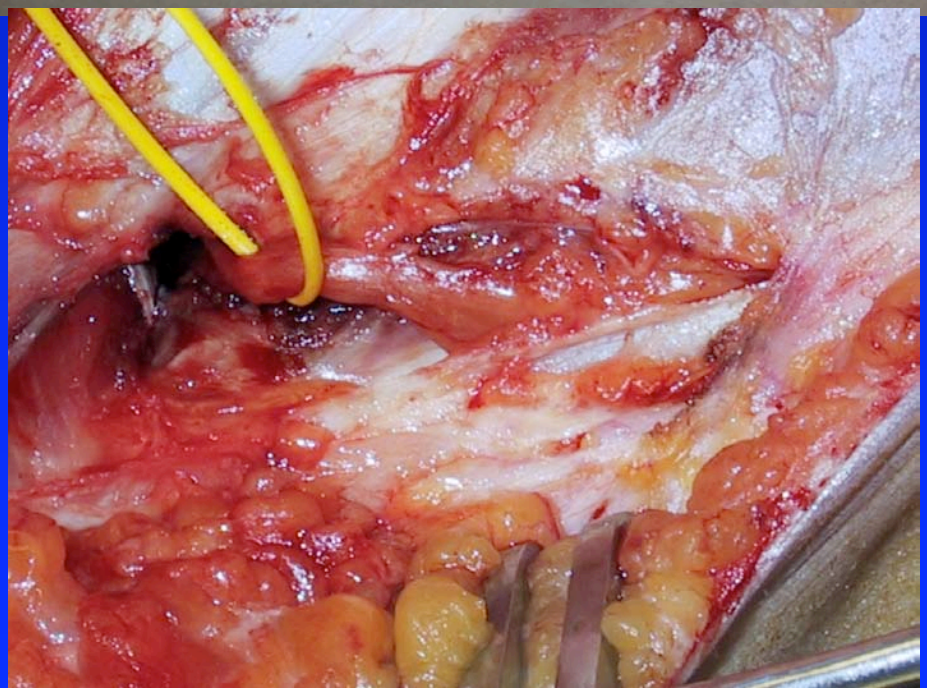


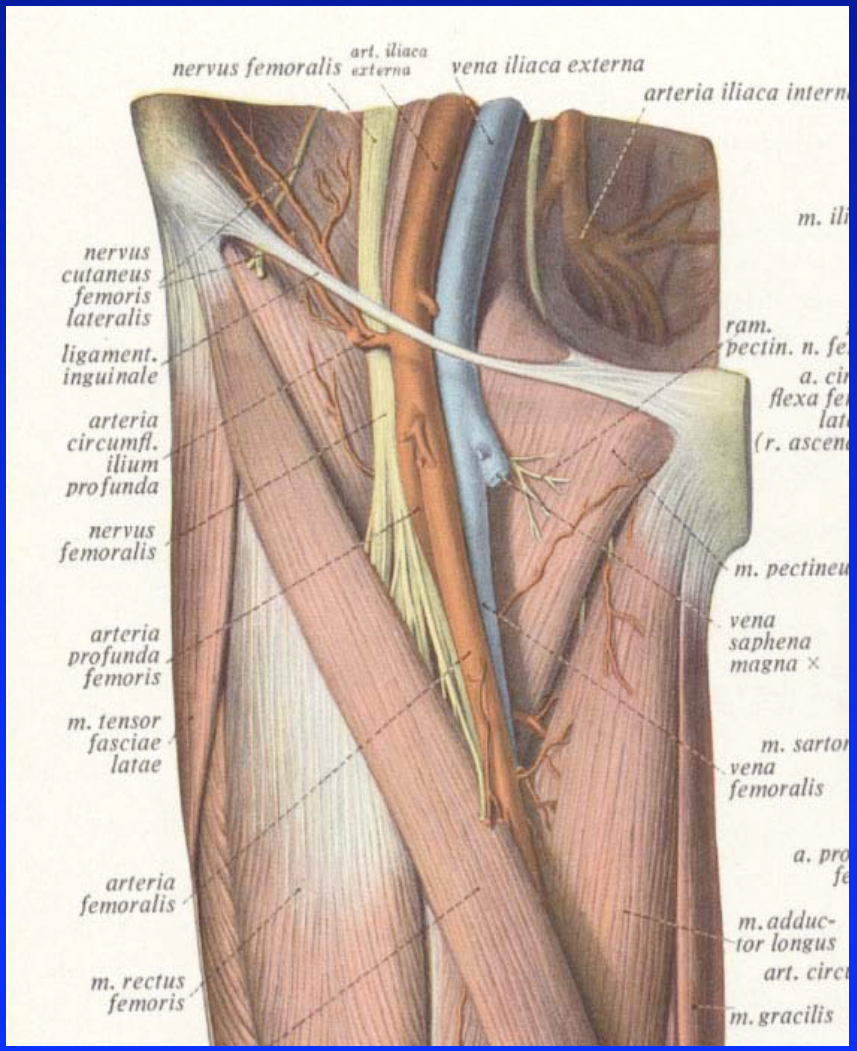
Meralgia Paraesthetica: Surgical Anatomy

- Entrapment of lateral femoral cutaneous nerve of the thigh at the inguinal ligament
- Nerve passes through ligament just medial to the anterior superior iliac spine
- Key to finding the nerve is the sartorius; nerve just deep to fascia overlying this



LFCN Decompression



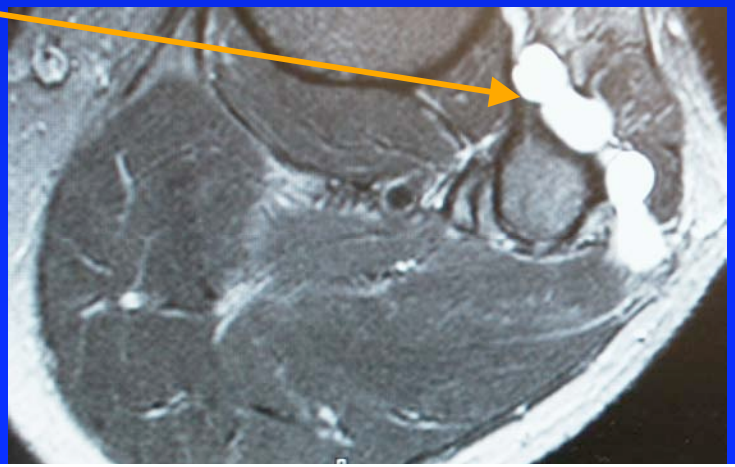


Peroneal Entrapment Neuropathy

- Painless (usually) development of partial/complete foot drop and sensory loss in peroneal distribution
- Distinguish from L5 radiculopathy: no back pain, sciatica, SLR normal
- findings confined to peroneal nerve distribution and Tinel's behind fibular head into lateral compartment

Peroneal Entrapment Neuropathy

- Etiology:
  - spontaneous
  - external compression (habitual crossing legs; postoperative)
  - metabolic (diabetes)
  - post-traumatic
  - lesions (ganglion cyst)
  - tumors

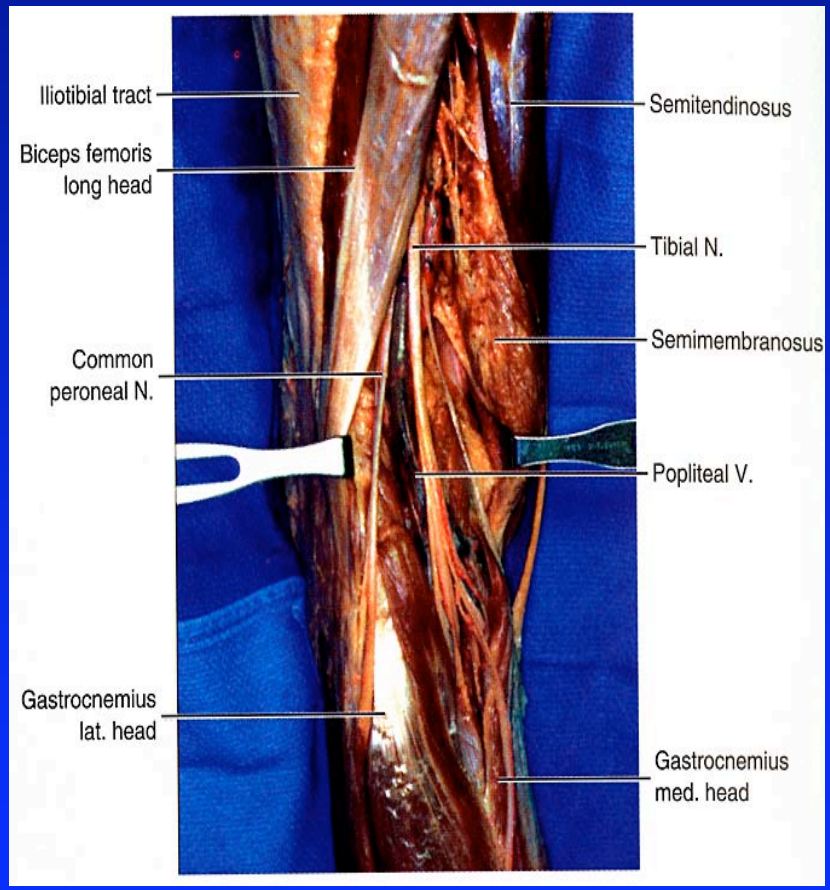


Peroneal Nerve Entrapment

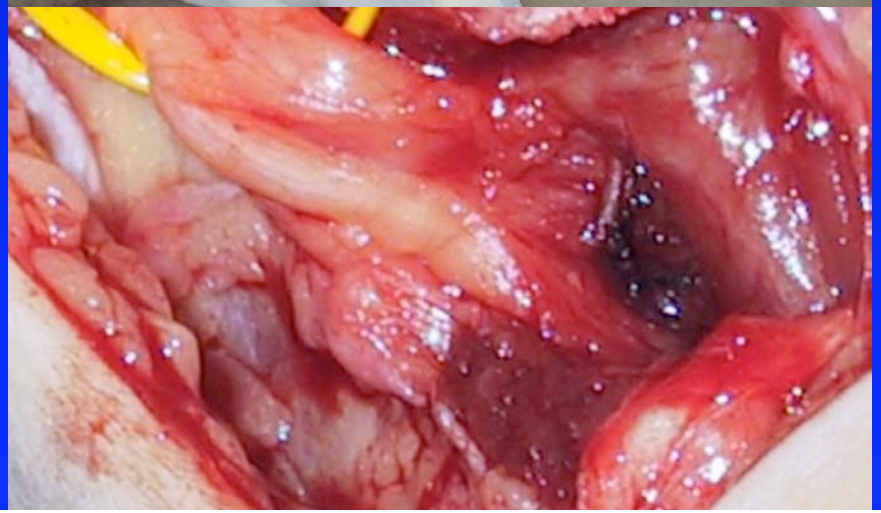
- Verify diagnosis with electrodiagnostic studies
- Conduction delay or block at fibular head/neck level. Denervational changes.
- Eliminate extrinsic compression (avoid leg crossing)
- AFO foot drop brace
- Surgery: decompression
- Results variable: patients with partial deficits do better. Complete foot drop often does not reverse. Consider tendon transfers

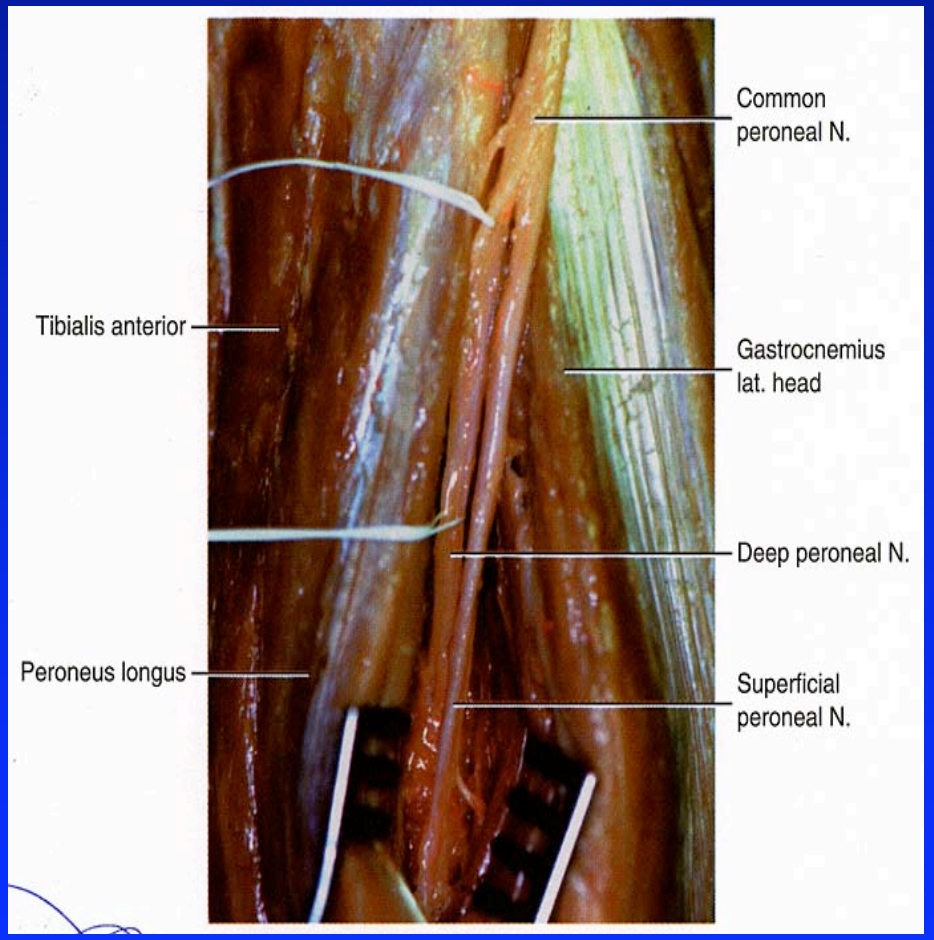
Peroneal Nerve Entrapment

- Peroneal nerve entrapped by fascia overlying and sharp fibrous band of the peroneus longus muscle
- Nerve crosses fibular neck obliquely, just below head of fibula
- Can be palpated just below head of fibula
- Just beneath fascia – can be difficult to distinguish from surrounding fat
- Find nerve just posterior to biceps femoris tendon, follow distally to decompress

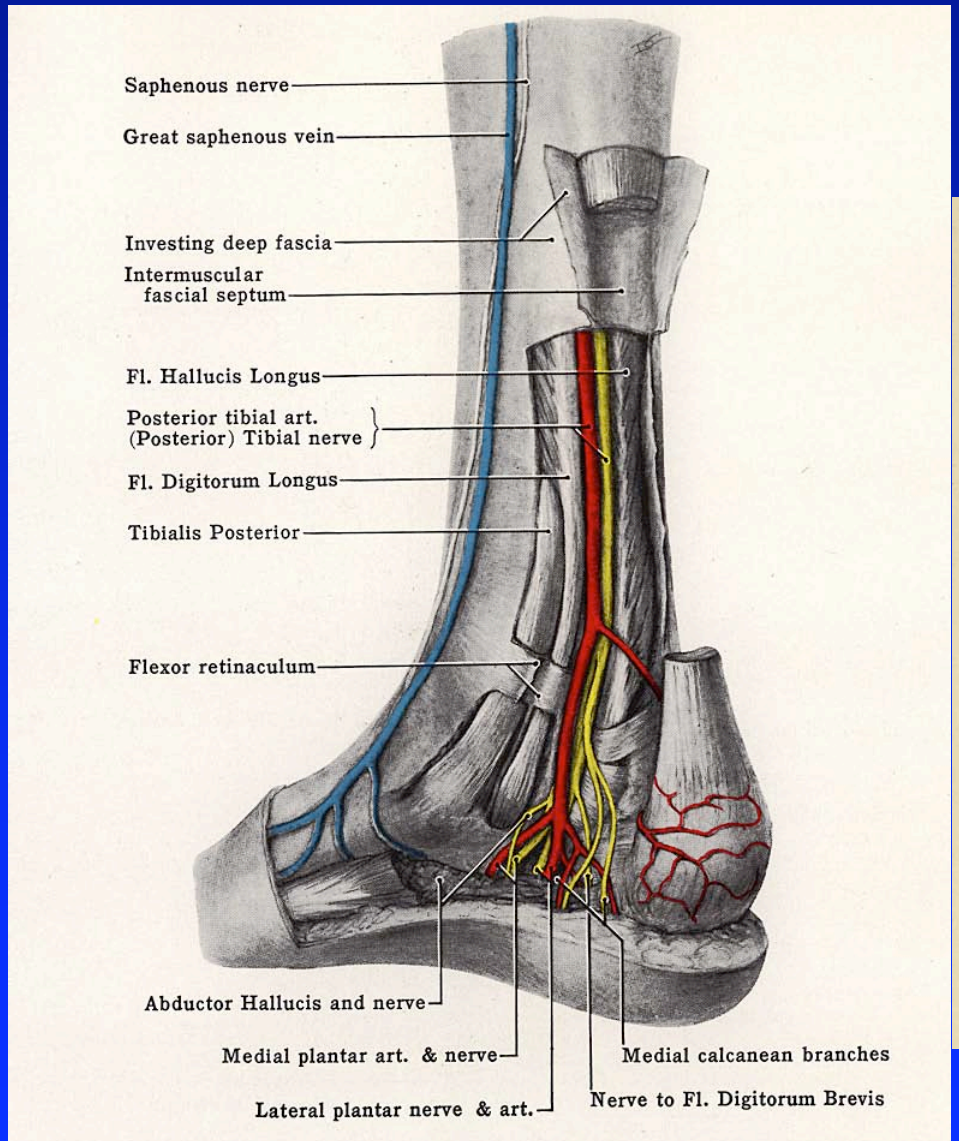


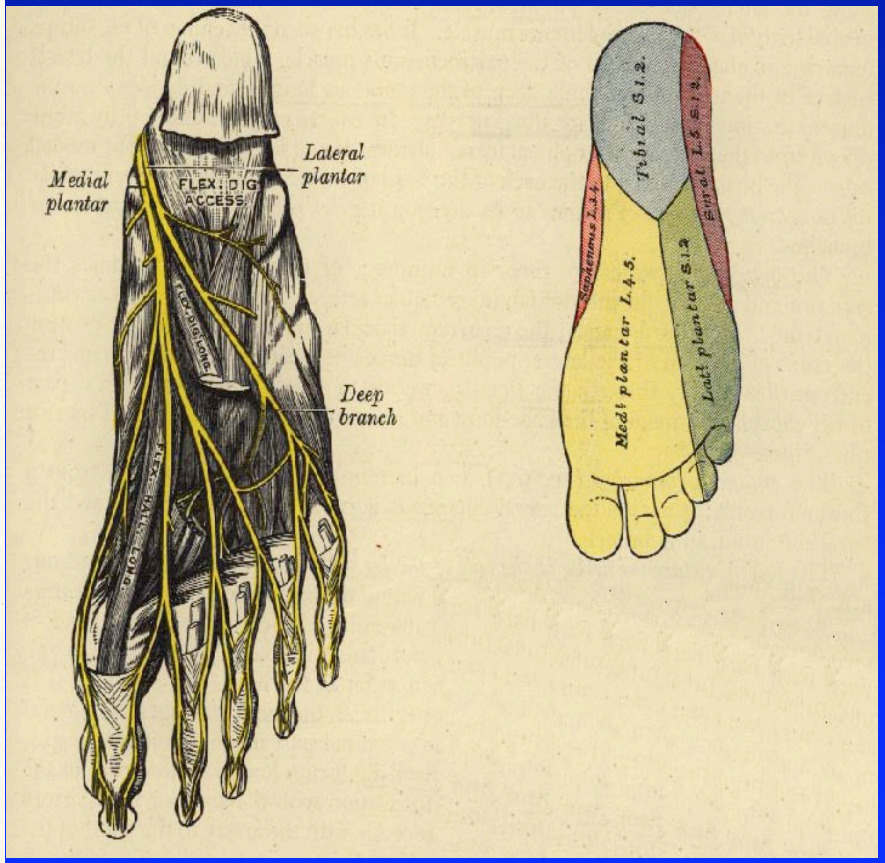
Peroneal Nerve Decompression





Tibial Nerve Anatomy





Tarsal Tunnel Syndrome

- Entrapment of posterior tibial nerve posterior to medial malleolus (flexor retinaculum) and fibrous septa in foot
- VERY much rarer than CTS
- history of previous ankle trauma in 50%
- burning pain and paraesthesias along plantar aspect of foot
  - medial or lateral plantar or both; heel may be spared (calcaneal branch variable in origin and entrapment)
  - pain may radiate to calf
  - worse with activity (walking), relieved by rest
- sensory findings, foot intrinsic atrophy and Tinel's

Tarsal Tunnel Syndrome: Diagnosis

- Electrical tests are key to making diagnosis (distinguish many causes of foot pain from the much rarer tarsal tunnel syndrome)
- normal conduction in leg PT nerve
- prolonged distal motor latencies to abductor hallucis (medial plantar) or abductor digiti quinti (lateral plantar)
- decreased distal sensory nerve CV
- denervation of foot intrinsics on EMGs

Surgery: Tarsal Tunnel

- Incision
- Undertake thorough decompression of main nerve and distal divisions at fibrous septum compartments
- Results of surgery variable