Peripheral Nerve Injuries

د. عبدالعزيز الأحيدب

Abdulaziz Al-Ahaideb

FRCS(C)

Professor of Orthopedics

Knee and Shoulder Surgeon

Peripheral Nerve Injuries

- Compression neuropathy
- Peripheral nerve injury

Compression Neuropathy

- Chronic condition with sensory, motor, or mixed involvement

- First lost → light touch – pressure – vibration
- Last lost → pain - temperature

- microvascular compression → neural ischemia → paresthesias → Intraneural edema → more microvascular compression → demyelination --> fibrosis --> axonal loss

Common systemic conditions leading to compression neuropathy

- **SYSTEMIC**
  - Diabetes
  - Alcoholism
  - Renal failure
  - Vit B deficiency
- **INFLAMMATORY**
  - Rheumatoid arthritis
  - Infection
  - Gout
  - Tenosynovitis
- **FLUID IMBALANCE**
  - Pregnancy
  - Obesity
- **ANATOMIC**
  - Fibrosis
  - Anomalous tendon
  - Fracture deformity
- **MASS**
  - Ganglion
  - Lipoma
  - Hematoma

Symptoms

- numbness
- night symptoms
- dropping of objects
- clumsiness
- weakness

- Rule out systemic causes

Physical Exam

- Examine individual muscle strength --> grades 0 to 5 --> pinch strength - grip strength

- Neurosensory testing -->
  - dermatomal distribution
  - peripheral nerve distribution

Special Tests

- Semmes-Weinstein monofilaments (for the fine touch) -->
  - First to be affected in compression neuropathy
  - Sensing 2.83 monofilament is normal

- Two-point discrimination →
  - performed with closed eyes
  - abnormal → Inability to perceive a difference between points > 6 mm
  - late finding

Electrodiagnostic testing

- Electromyography (EMG) and Nerve Conduction Study (NCS)
- Sensory and motor nerve function can be tested
- Objective evidence of neuropathic condition
- Helpful in localizing point of compression

Electrodiagnostic testing

- NCS →
  - Tests conduction velocity, distal latency and amplitude
  - Demyelination → ↓conduction velocity + ↑distal latency
    axonal loss → ↓ potential amplitude

- EMG →
  - Tests muscle electrical activity
  - Muscle denervation → fibrillations - positive sharp waves

- Peripheral nerve compression (median / ulnar / radial nerves)
- Peripheral nerve injury (neuropraxia / axontemesis / neurotemesis)

Common peripheral nerve compressions

- Median nerve compression at the wrist (Carpal Tunnel Syndrome)
- Median nerve compression at the arm (Pronator Syndrome)
- Ulnar nerve compression at the elbow (Cubital Tunnel Syndrome)
- Ulnar nerve compression at the wrist (Ulnar Tunnel Syndrome)
- Radial nerve Compression

Median Nerve Compression

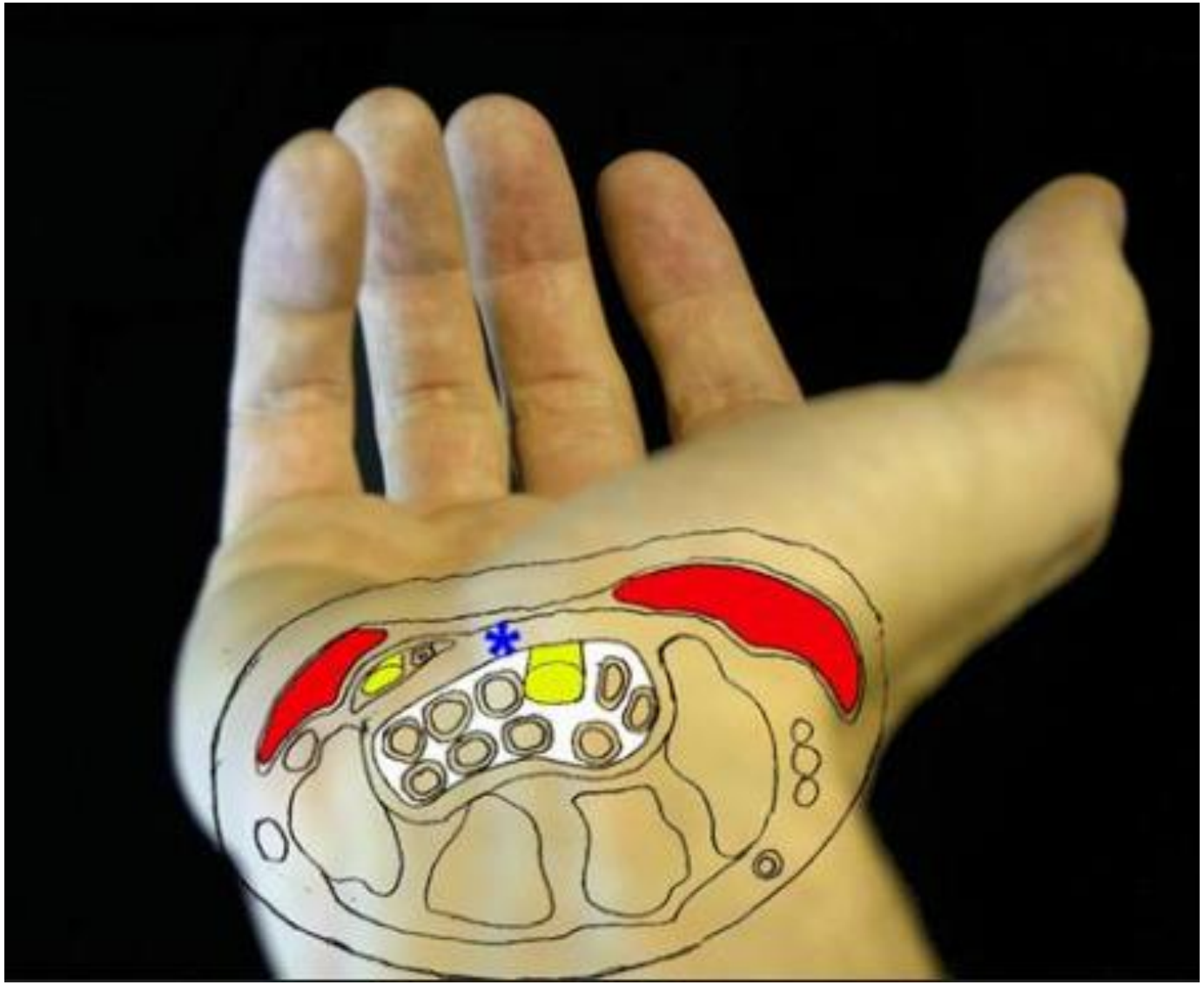
- Carpal Tunnel Syndrome
- Pronator Syndrome

CTS

- Most common compressive neuropathy
  Anatomy of the carpal tunnel:
  - Volar → TCL
  - Radial → scaphoid tubercle +trapezium
  - Ulnar → pisiform +hook of hamate
  - Dorsal → proximal carpal row

  + deep extrinsic volar carpal ligaments

- Carpal Tunnel Contents:
  - median nerve + FPL + 4 FDS + 4 FDP = 10



CTS

- Normal pressure → 2.5 mm Hg
- >20 mm Hg → ↓↓ epineural blood flow + nerve edema
- 30 mm Hg → ↓↓ nerve conduction

Risk Factors

- **obesity**
- **pregnancy**
- **diabetes**
- **thyroid disease**
- **chronic renal failure**
- Others → RA, storage diseases, alcoholism, acromegaly, advanced age.
- **Repetitive strain injury**

Acute CTS

- Causes →
  - high-energy trauma
  - hemorrhage
  - infection
- Requires emergency decompression

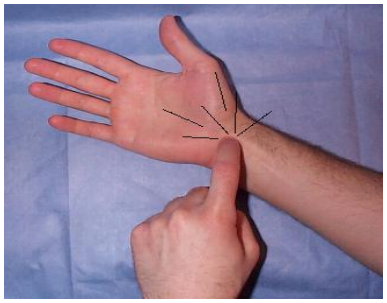
CTS diagnosis

- History:
  - Numbness and pain
  - Often at night
  - Volar aspect → thumb - index - long - radial half of ring
  - Risk factors

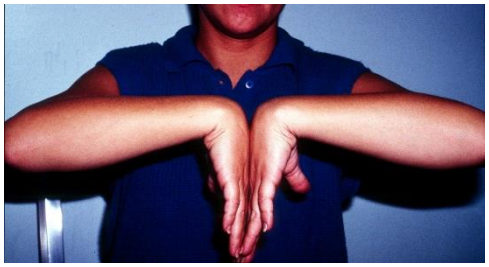
CTS diagnosis

- Physical examination:
  - Durkan's test → Most sensitive

  - Tinel's test



  - Phalen's test



CTS diagnosis

- affected first → light touch + vibration
- affected later → pain and temperature

- Semmes-Weinstein monofilament testing → early CTS diagnosis
- late findings → Weakness - loss of fine motor control - abnormal two-point discrimination
- Thenar atrophy → severe denervation

CTS – Electrodiagnostic testing

- **Not necessary for the diagnosis of CTS**
- Distal sensory latencies > 3.5 msec
- Motor latencies > 4.5 msec

CTS - Differential diagnoses

- cervical radiculopathy
- brachial plexopathy
- TOS
- pronator syndrome
- ulnar neuropathy
- peripheral neuropathy of multiple etiologies

CTS Treatment

- Nonoperative
  - Activity modification
  - Night splints
  - NSAIDs
  - Steroid injection
- Operative

CTS – Operative

- Can be:
  - Open
  - Endoscopic

Figure-6

CTS – Endoscopic release

- Short term:
  - less early scar tenderness
  - improved short-term grip/pinch strength
  - better patient satisfaction scores
- Long-term:
  - **no significant difference**
  - May have slightly higher complication rate
  - incomplete TCL release

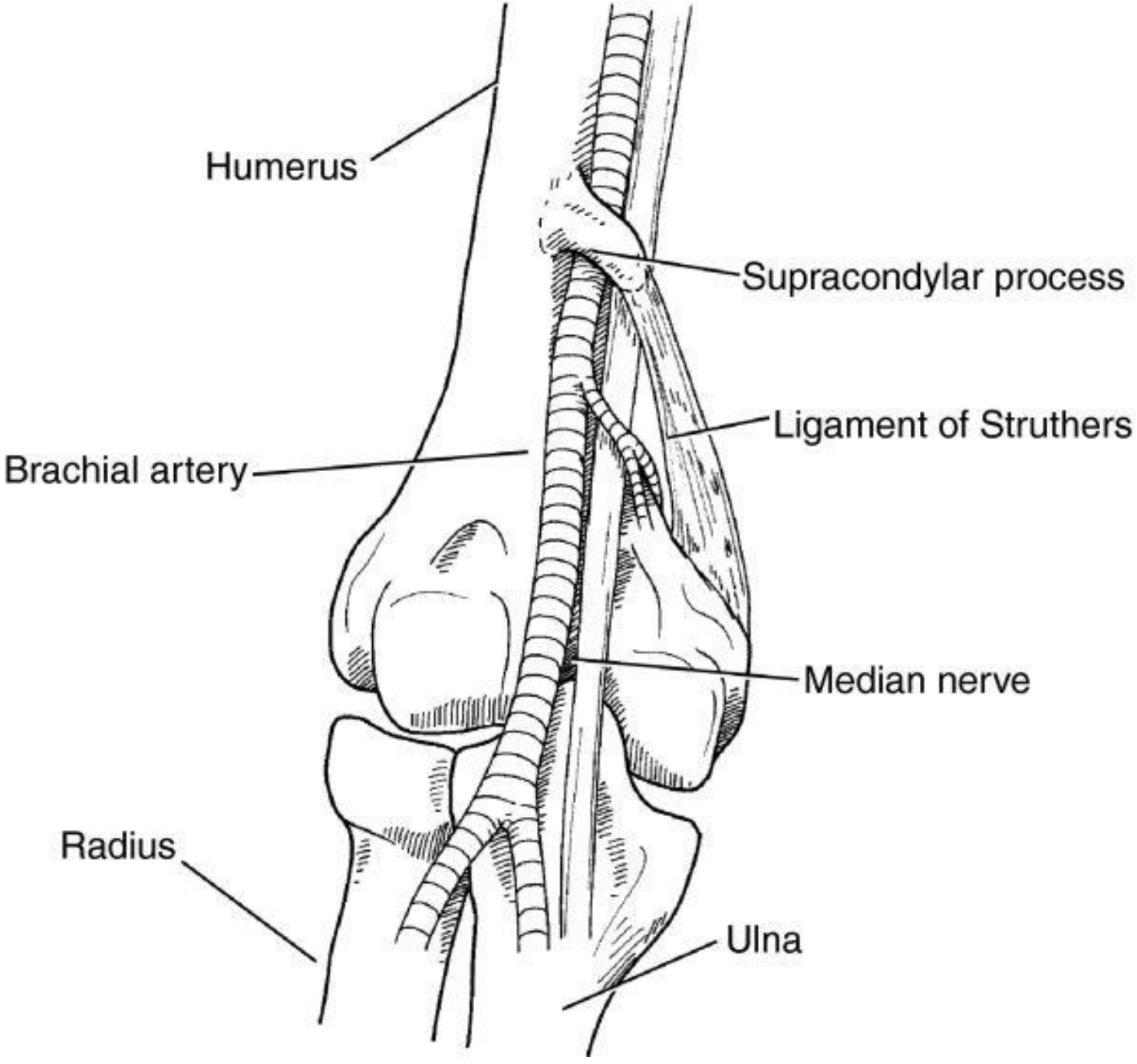
CTS – release outcome

- pinch strength → 6 weeks
- grip strength → 3 months

- Persistent symptoms after release →
  - Incomplete release
  - Iatrogenic median nerve injury
  - Missed double-crush phenomenon
  - Concomitant peripheral neuropathy
  - Wrong diagnosis

Pronator Syndrome

- Median nerve compression at arm/forearm (5 potential sites of compression)
- Symptoms →
  - Aching pain over proximal volar forearm
  - sensory symptoms → palmar cutaneous branch
  - Lack of nigh pain


Humerus
Supracondylar process
Ligament of Struthers
Brachial artery
Median nerve
Radius
Ulna

Pronator Syndrome

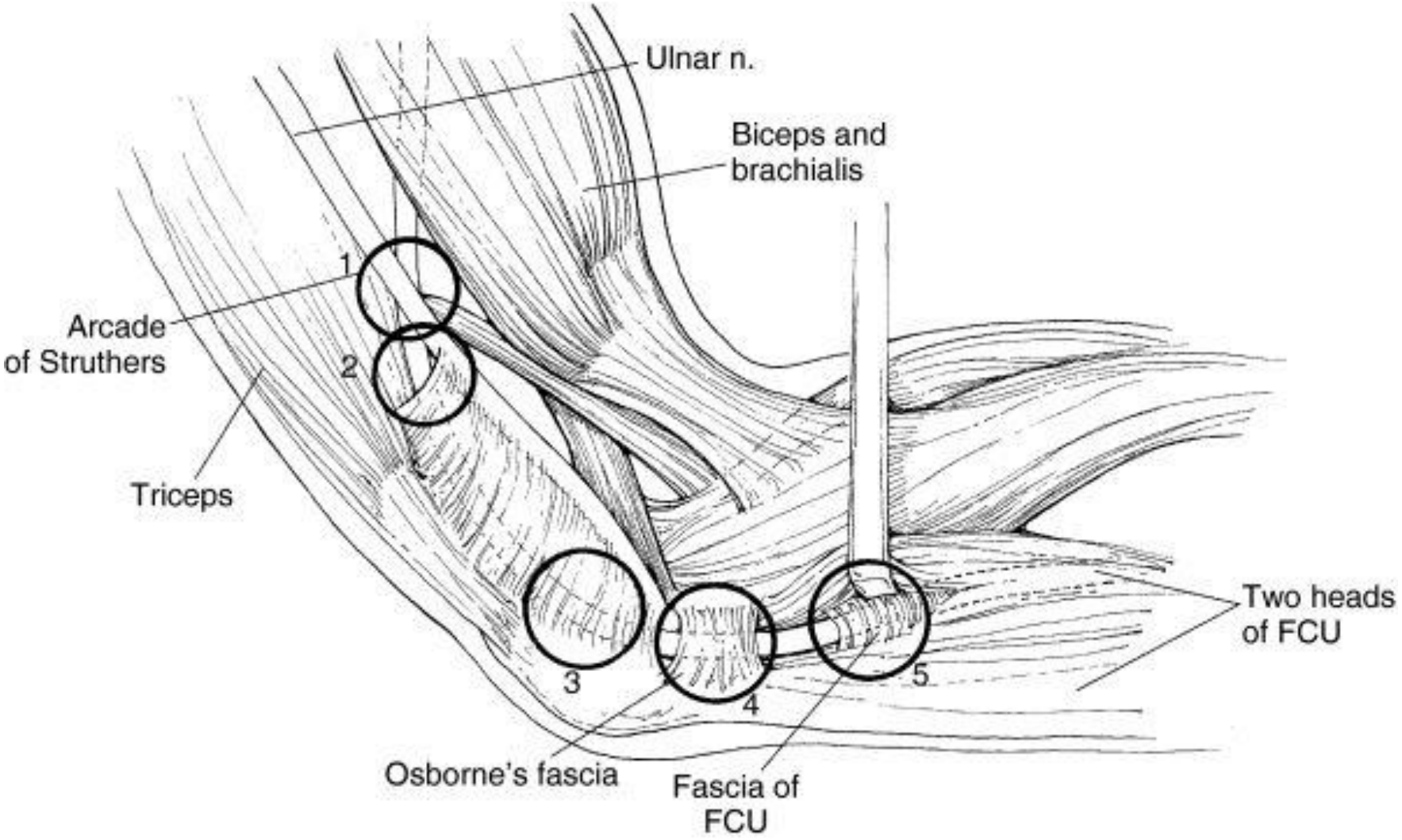
- Diagnosis:
  - History
  - Physical examination
  - NCS/EMG
- Treatment:
  - Non-operative: splints/ NSAIDs
  - Operative

Ulnar Nerve Compression Neuropathy

- Cubital Tunnel Syndrome
- Ulnar Tunnel Syndrome

Cubital Tunnel Syndrome

- ***Second*** most common compression neuropathy of the upper extremity
- Cubital tunnel borders:
  - floor →MCL and capsule
  - Walls → medial epicondyle and olecranon
  - Roof → FCU fascia and arcuate ligament of Osborne


Ulnar n.
Biceps and brachialis
1
Arcade of Struthers
2
Triceps
3
4
5
Two heads of FCU
Osborne's fascia
Fascia of FCU

Cubital tunnel syndrome

- Symptoms:
- Numbness of ulnar half of ring finger and little finger.
- Pain in the elbow that extends into the forearm and hand
- Weakness of the hand and fingers

- Provocative tests →
  - direct cubital tunnel compression
  - Tinel's test
- Froment sign → thumb IP flexion (by FPL which is supplied by median nerve) during key pinch (weak adductor pollicis which is supplied by ulnar nerve)

Cubital Tunnel Syndrome - Treatment

- Electrodiagnostic tests → diagnostic
- Nonoperative treatment
  - activity modification
  - night splints → slight extension
  - NSAIDs

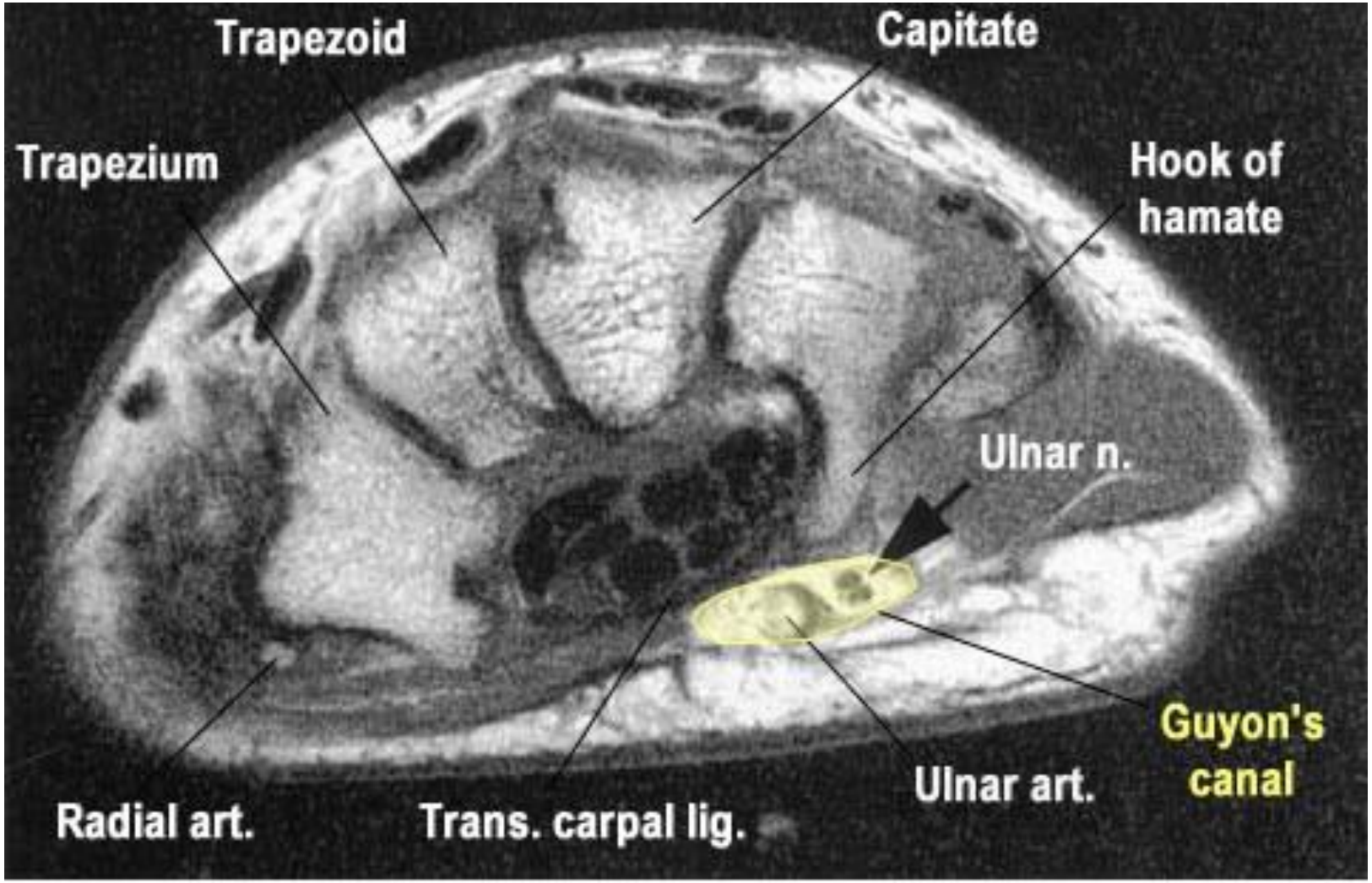
Cubital Tunnel Syndrome - Treatment

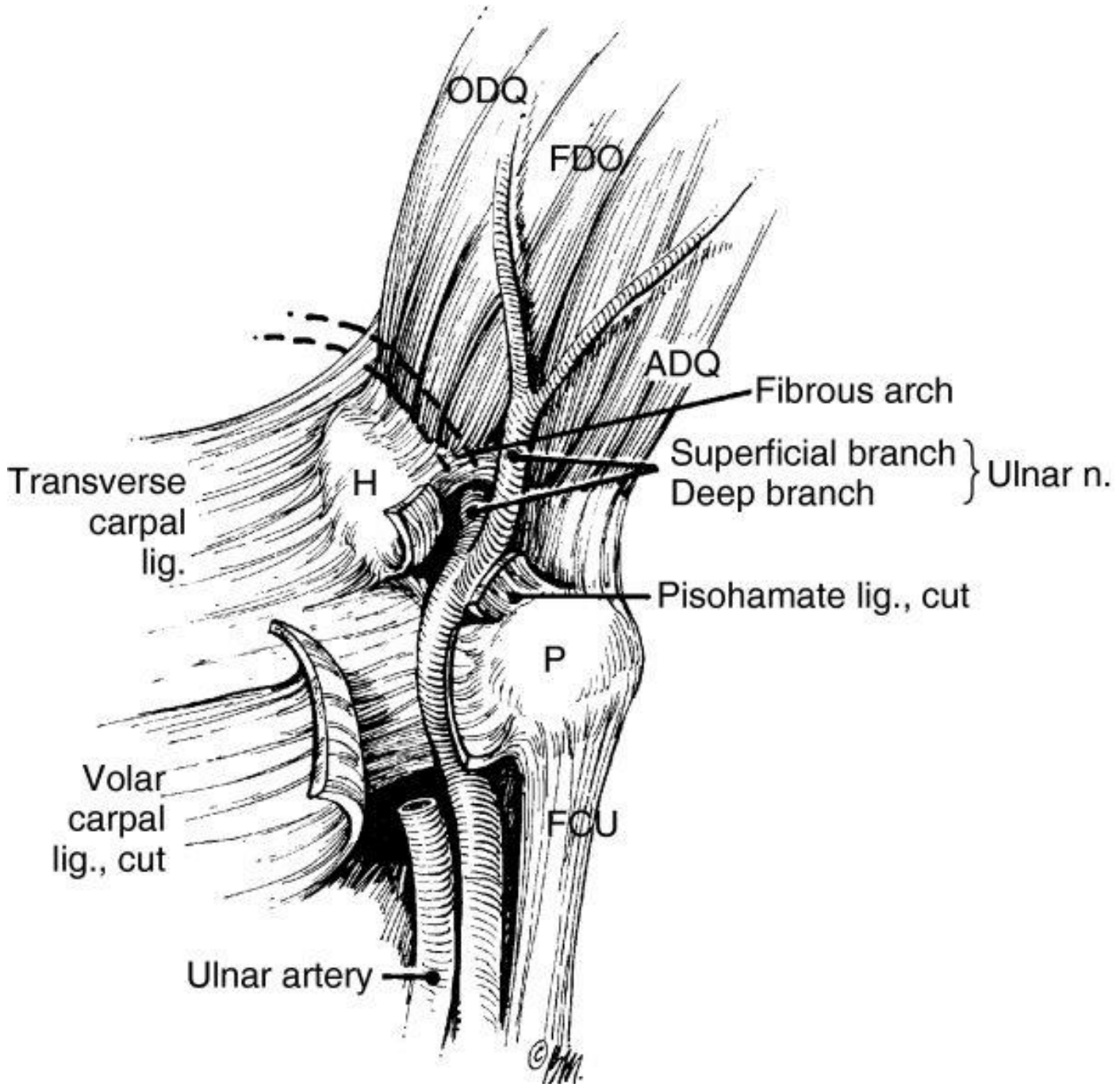
- Surgical Release → Numerous techniques
  - In situ decompression, Anterior transposition, Subcutaneous, Submuscular, Intramuscular, Medial epicondylectomy
- No significant difference in outcome between simple decompression and transposition

Ulnar Tunnel Syndrome

- Compression neuropathy of ulnar nerve in the Guyon's canal
- Symptoms:
  - Tingling sensation within the little finger and ring finger
  - Pain within the wrist
  - Difficulty gripping objects
  - Loss of ulnar nerve function

- Causes:
  - ganglion cyst : 80% of non-traumatic causes
  - hook-of-hamate nonunion
  - ulnar artery thrombosis or aneurysm
  - lipoma


Trapezoid
Capitate
Trapezium
Hook of hamate
Ulnar n.
Guyon's canal
Ulnar art.
Radial art.
Trans. carpal lig.


ODQ
FDQ
ADQ
Fibrous arch
Superficial branch
Deep branch
Ulnar n.
Transverse carpal lig.
H
Pisohamate lig., cut
P
Volar carpal lig., cut
FCU
Ulnar artery

Ulnar Tunnel Syndrome Investigations

- CT → hamate hook fracture
- MRI → ganglion cyst or lipoma
- Doppler ultrasonography → ulnar artery thrombosis or aneurysm

Ulnar Tunnel Syndorme

- Treatment success → identify cause
- Nonoperative treatment
  - Activity modification
  - Splints
  - NSAIDs
- Operative treatment → decompressing by removing underlying cause

Radial Nerve

- Radial nerve compression: rarely compressed and mainly motor symptoms

Peripheral nerve injuries

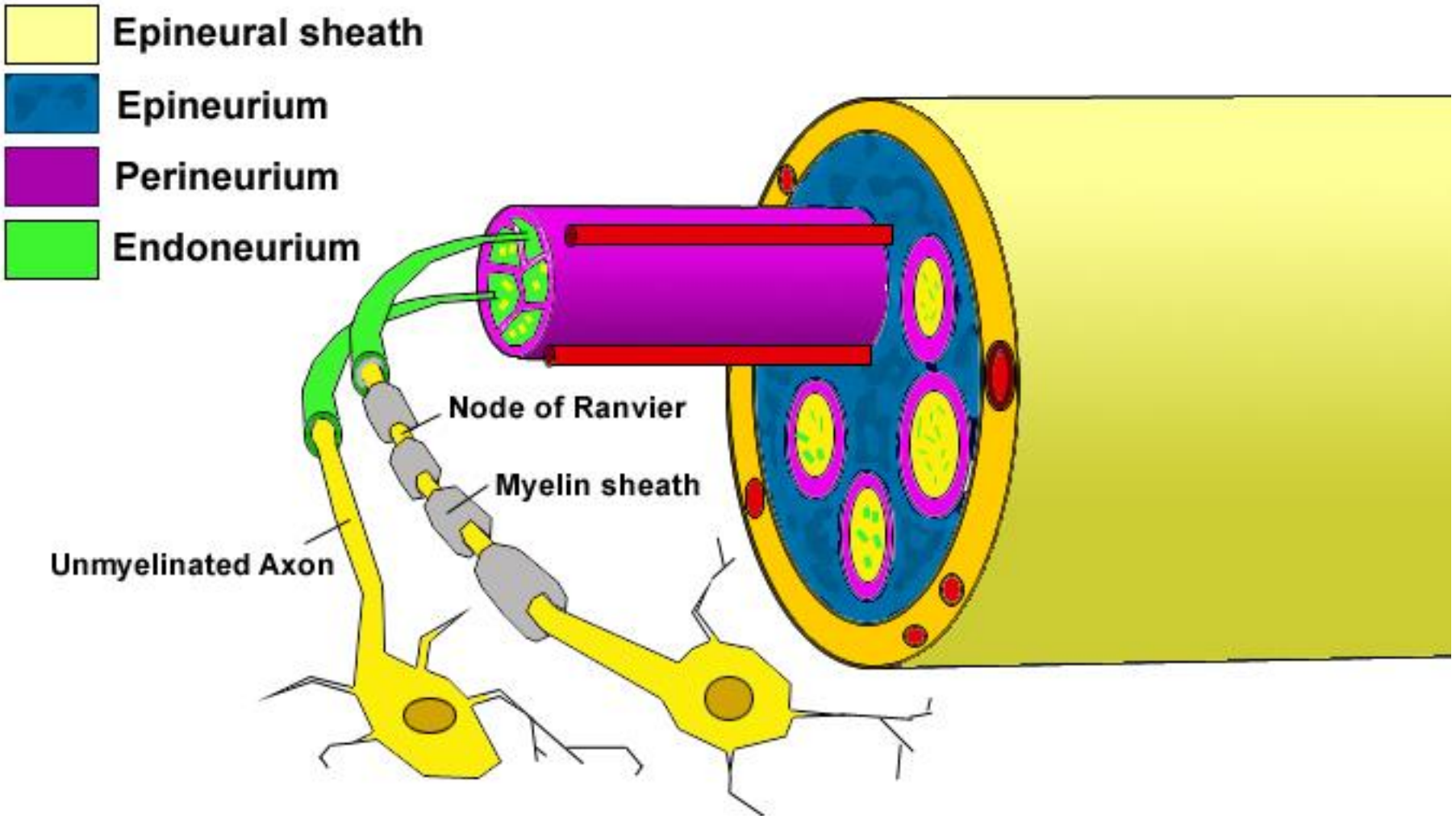
- causes →
  - compression
  - stretch
  - crush
  - transection
  - tumor invasion

Peripheral nerve injuries

- Good prognostic factors for recovery:
  - young age → most important factor
  - stretch/ sharp injuries
  - clean wounds
  - direct surgical repair
- Poor outcome
  - crush injuries
  - infected or scarred wounds
  - delayed surgical repair.

Classification

- Neuropraxia
- Axonotmesis
- Neurotmesis


Epineural sheath
Epineurium
Perineurium
Endoneurium
Node of Ranvier
Myelin sheath
Unmyelinated Axon

Neurapraxia

- Mild nerve stretch or contusion
- Focal conduction block
- Disruption of myelin sheath
- Epineurium, perineurium, endoneurium: intact
- Prognosis: excellent → full recovery

Axonotmesis

- Incomplete nerve injury
- Focal conduction block
- Wallerian degeneration distal to injury
- Disruption of axons
- Recovery unpredictable

Neurotmesis

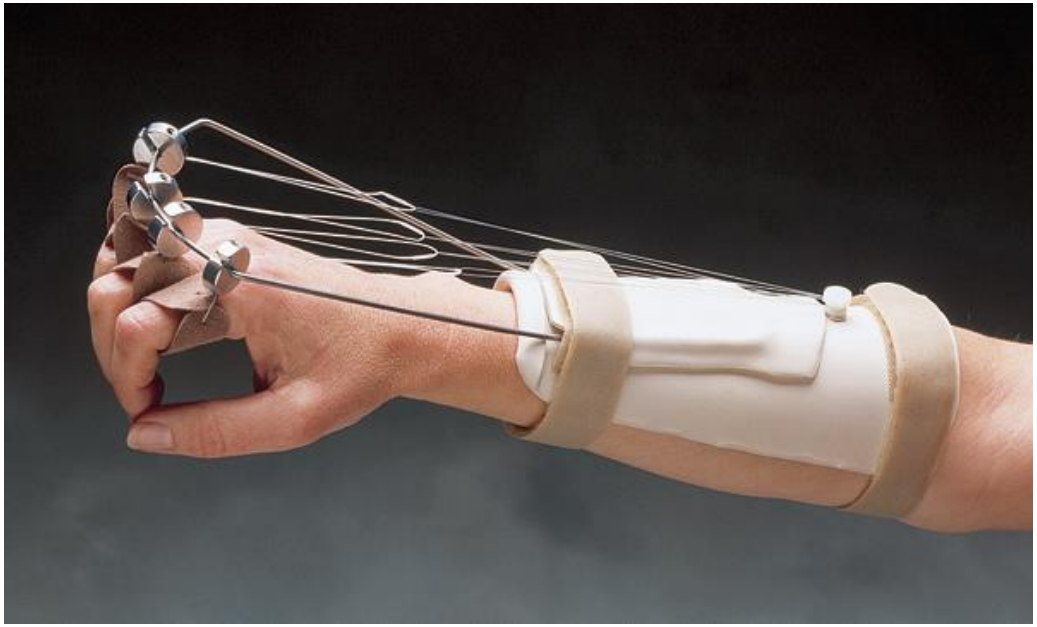
- Complete nerve injury
- Conduction block
- Disruption of all layers, including epineurium
- Proximal nerve end forms neuroma
- Worst prognosis

Surgical repair

- Best performed within 2 weeks of injury
- Repair must be free of tension
- Repair must be within clean, well-vascularized wound bed
- Nerve length may be gained by neurolysis or transposition

Surgical repair

- Direct end to end repair
- Larger gaps → grafting



Questions