

# Peripheral Nerve Injuries

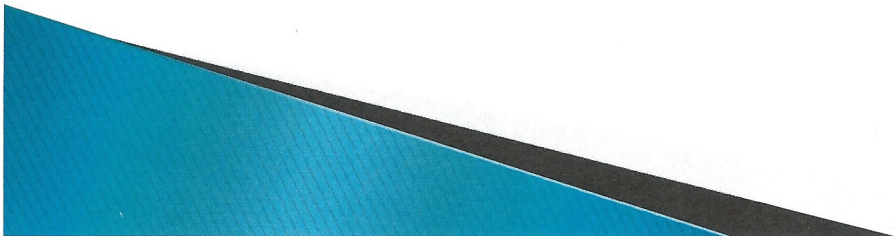
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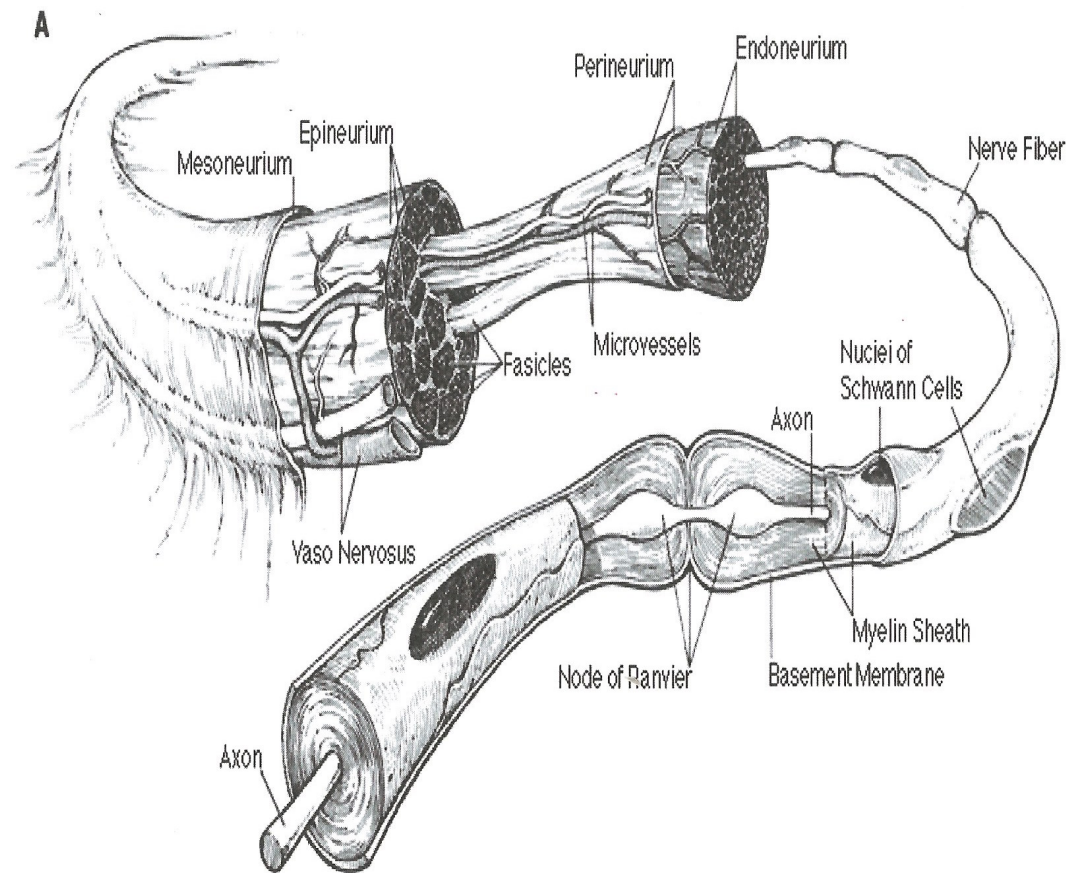


# Objectives

- ▶ Peripheral nerve anatomy
  - ▶ Classification of nerve injury
  - ▶ General management approach
    - Radial Nerve
    - Median nerve
    - Ulnar nerve
    - Brachial plexus
  - ▶ Examples of peripheral nerve injuries
- 

# Anatomy

- ▶ Cell body
- ▶ Axon
  
- ▶ Layers
  - Epineurium
  - Perineurium
  - Endoneurium



# Types of nerve Injuries

## ▶ Trauma

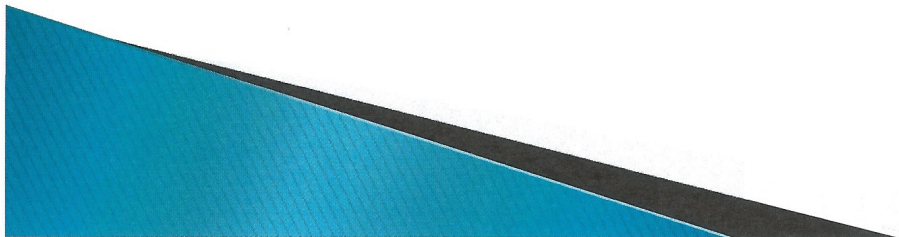
### ◦ Closed

- High velocity (Motor cycles, car accidents)
- Low velocity (sports, falls)

### ◦ Open:

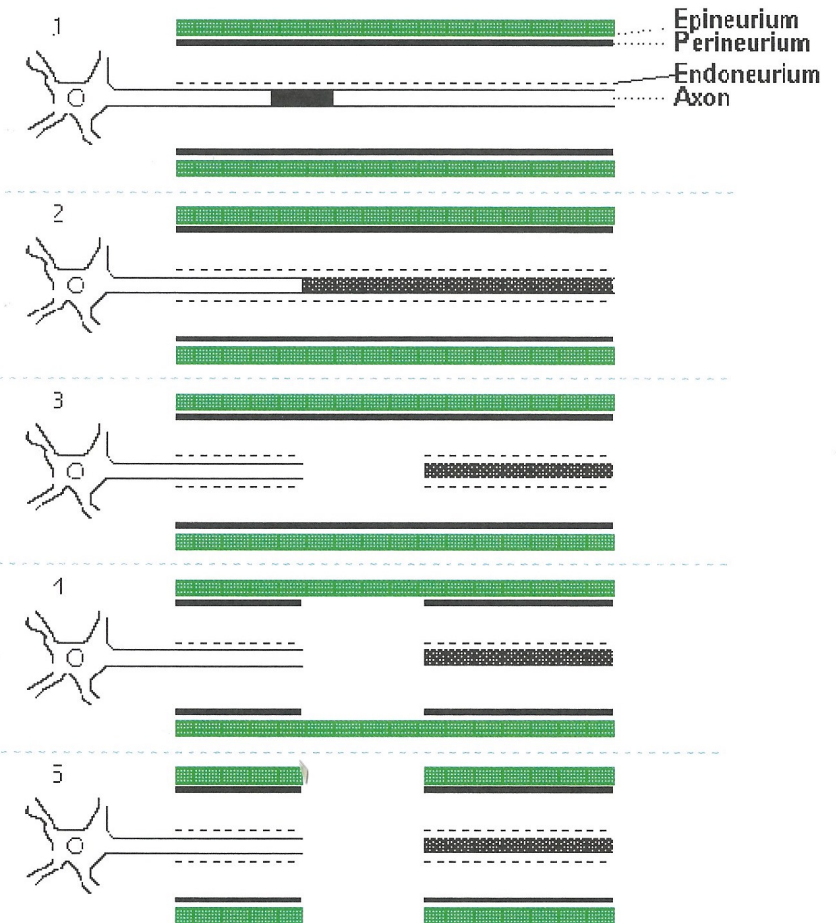
- Stabbing
- Gunshot

## ▶ Compression



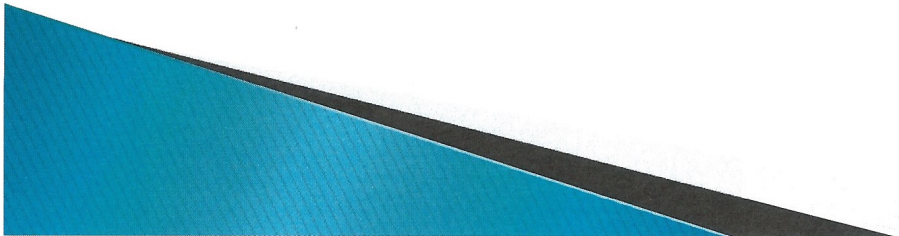
# Classification

Seddon	Sunderland	Disrupted	Prognosis
Neurapraxia	1 <sup>st</sup> Degree	Axon (minimal)	Complete recovery in days/months
Axonotmesis	2 <sup>nd</sup> Degree	Axon (total) – Wallerian degeneration	Complete return in months
	3 <sup>rd</sup> Degree	Axon, endoneurium	Mild/moderate reduction in function
	4 <sup>th</sup> Degree	Axon, endoneurium, perineurium	Moderate reduction in function
Neurotmesis	5 <sup>th</sup> Degree	All structures	Marked reduction in functional return

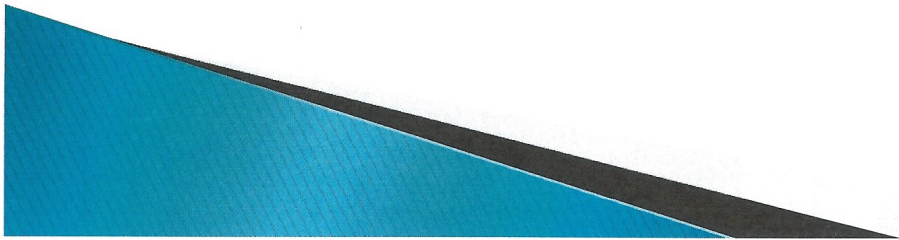


# General Approach

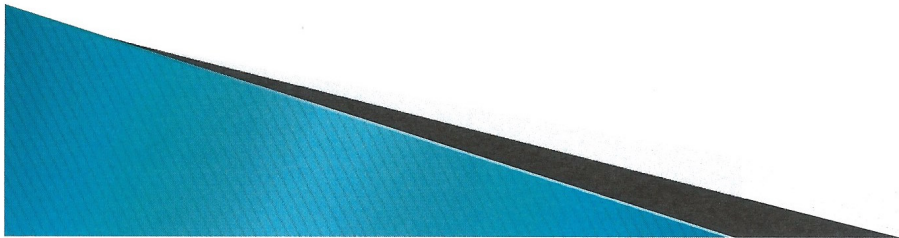
- ▶ Hx
- ▶ PEx
- ▶ DDx
- ▶ Ix (if needed)
- ▶ Consult (if needed)
- ▶ Treatment
  - Non-surgical
  - surgical



- ▶ Radial Nerve
- ▶ Median nrve
- ▶ Ulnar nerve
- ▶ Brachial plexus



- ▶ Common Template for all Peripheral Nerve





# History

## ▶ ID:

- Hand dominance
- Occupation
- Hobbies

## ▶ HPI

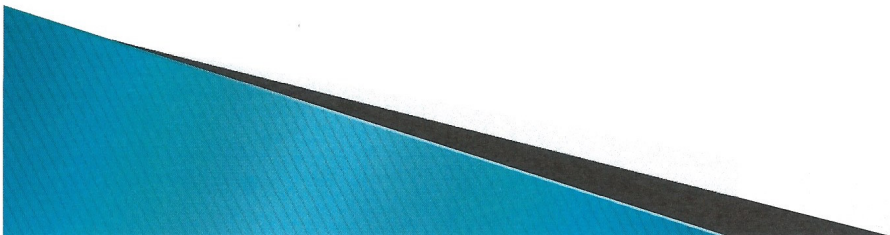
- Main complaint
  - Loss of sensation
  - Motor weakness
  - Pain
- Risk factors
  - Pathological (previous trauma or surgery)
  - Idiopathic (anatomical compression)

## ▶ Main complaint

- When (time of onset)
- Where ( site of Numbness/ pain )
- Why ( Mechanism of the injury)
- How long ( duration )
- Symptoms Progression
- What has been done so far

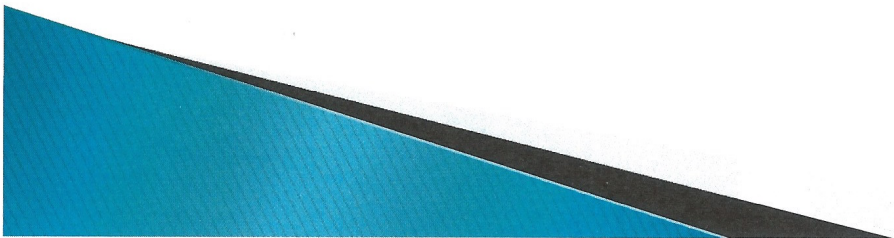
# History

- ▶ PMH
- ▶ PSH
- ▶ Meds.
- ▶ Social Hx (smoking)
- ▶ Allergy Hx



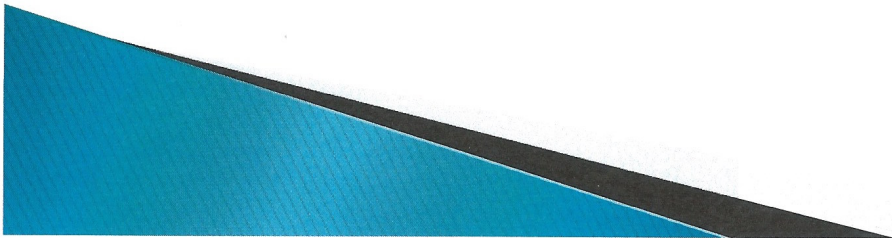
# Physical Exam

- ▶ Sensory deficit
- ▶ Motor deficit
- ▶ Tests (e.g. Tinel sign)



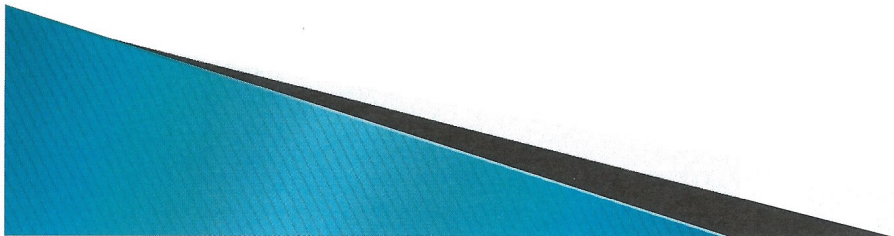
# Investigation

- ▶ NCS/EMG
- ▶ MRI (SOL)



# Consultation

- ▶ OT (splinting)
- ▶ PT(ROM)



# Treatment options

- ▶ Non-surgical

- Splint(night)
- NSAID
- Rest
- Change life style

- ▶ Surgical (for N compression)

- Nerve Decompression
- Nerve transposition
- Tendon transfer

- ▶ Surgical(for N trauma)

- Nerve repair
- Nerve graft
- Nerve transfer
- Tendon transfer



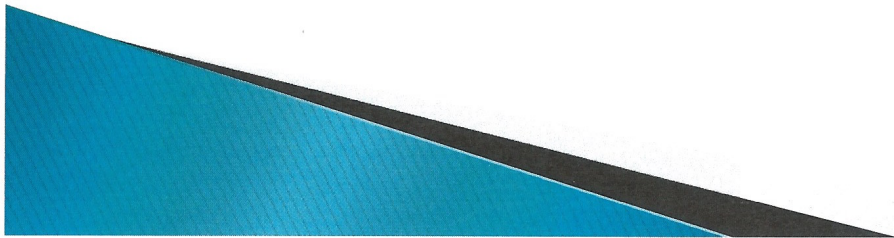
# Treatment Algorithm

Non-surgical

Surgical if :

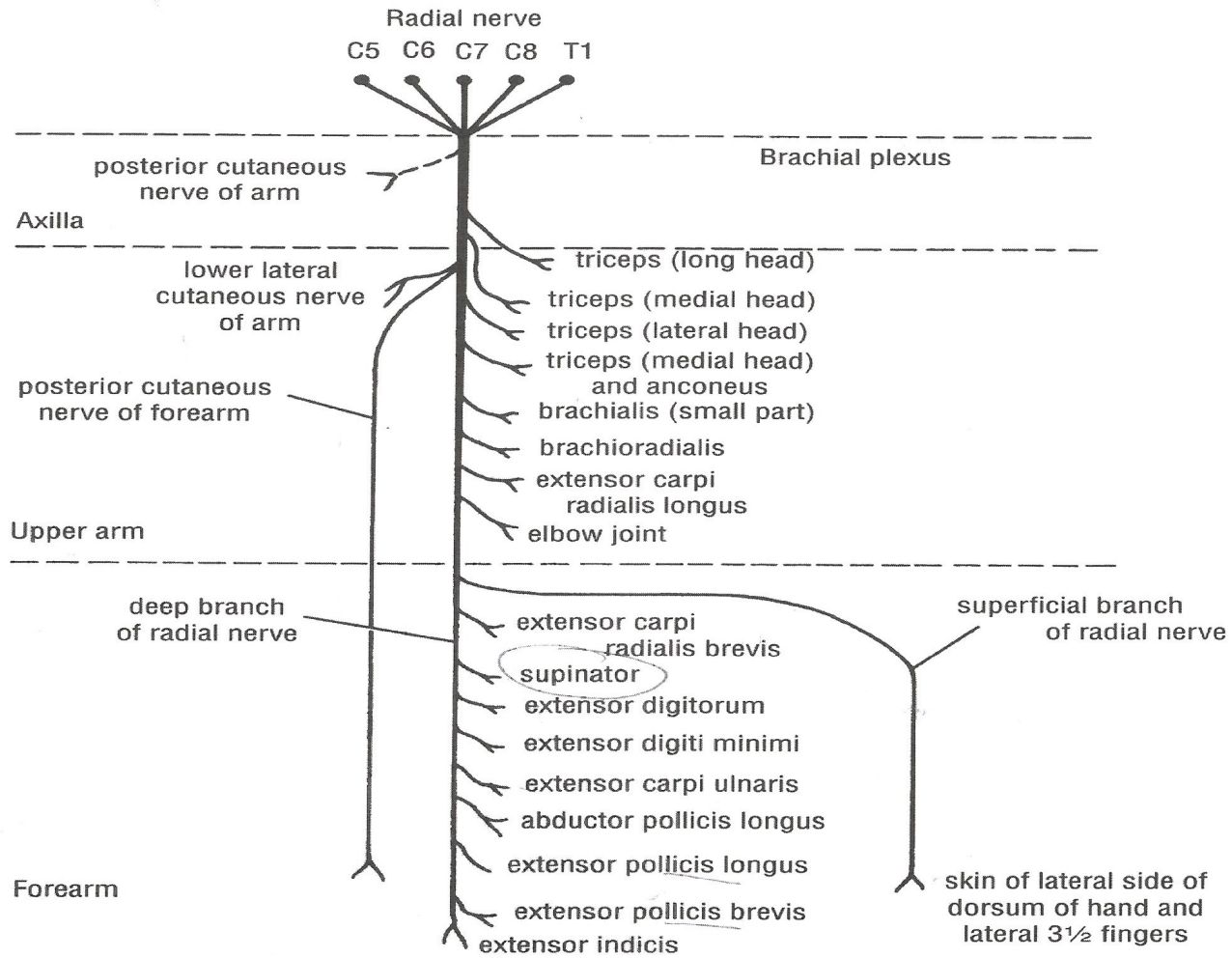
- No improvement in 3 months
- Functional loss
- Trauma

## ▶ Radial Nerve





# Anatomy



**FIGURE 9-82** Summary diagram of main branches of radial nerve.

# History

## ▶ ID:

- Hand dominance
- Occupation
- Hobbies

## ▶ HPI

- Main complaint
  - Sensory deficit
    - Radial nerve distribution
  - Motor deficit
    - weakness
    - Inability to extend
      - Elbow (axilla)
      - Wrist(arm)
      - Digits(forearm)
  - Pain

## ▶ Main complaint

- When (time of onset)
- Where ( site of Numbness/ pain )
- Why ( Mechanism of the injury)
- How long ( duration )
- Symptoms Progression
- What has been done so far

# History

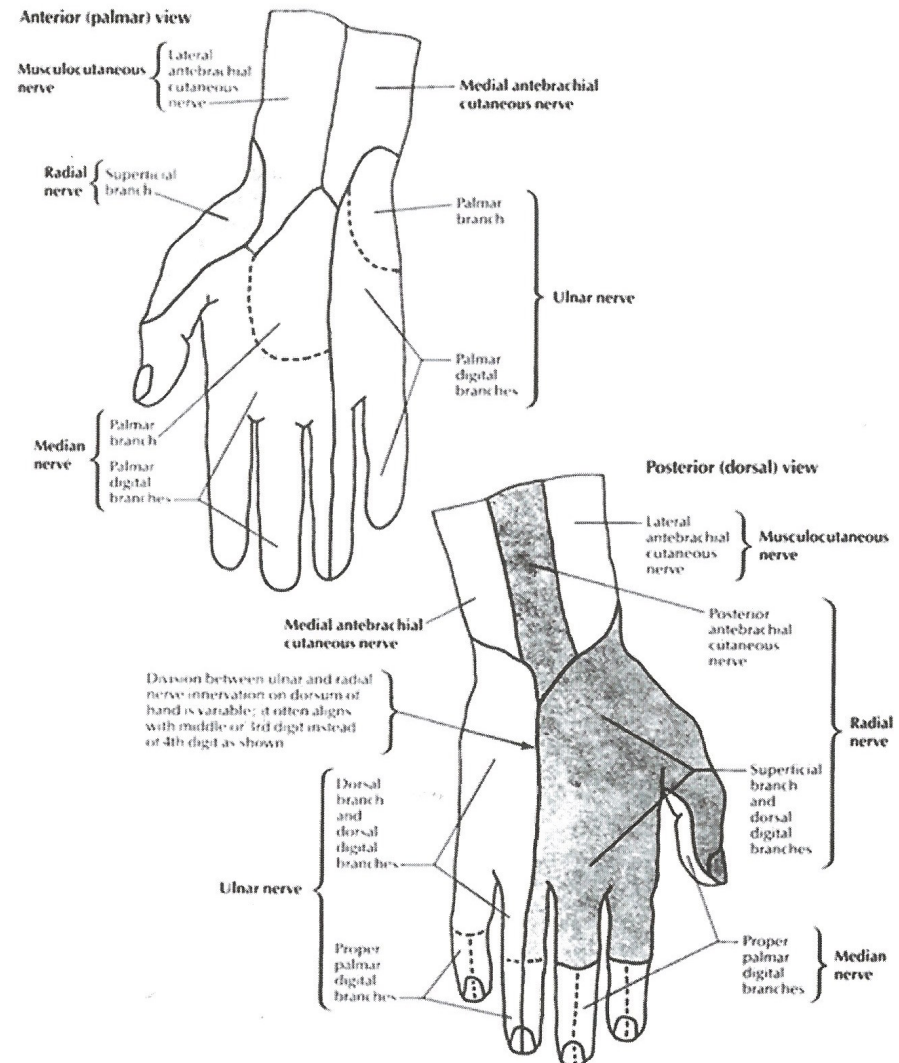
## ▶ HPI

- Risk factors
  - Anatomical (compression)
  - Pathological (trauma)
    - *Humerus shaft fracture* (high radial nerve injury) (Arm)
    - *Stab wound* forearm (low radial nerve injury) (Forearm)

- ▶ PMH
- ▶ PSH
- ▶ Meds.
- ▶ Social Hx (smoking)
- ▶ Allergy Hx

# Physical Exam

- ▶ Sensory deficit
- ▶ Motor deficit
  - Inability to extend
    - Elbow (axilla)
    - Wrist (arm/forearm)
    - Digits (forearm)
- ▶ Tests (e.g. Tinel sign)



# Physical Exam

- ▶ Sensory deficit
- ▶ Motor deficit
  - HIGH RN injury (arm)
    - Inability to extend
      - Wrist
      - Digits
  - LOW RN injury (forearm)
    - Inability to extend
      - Digits
- ▶ Tests (e.g. Tinel sign)

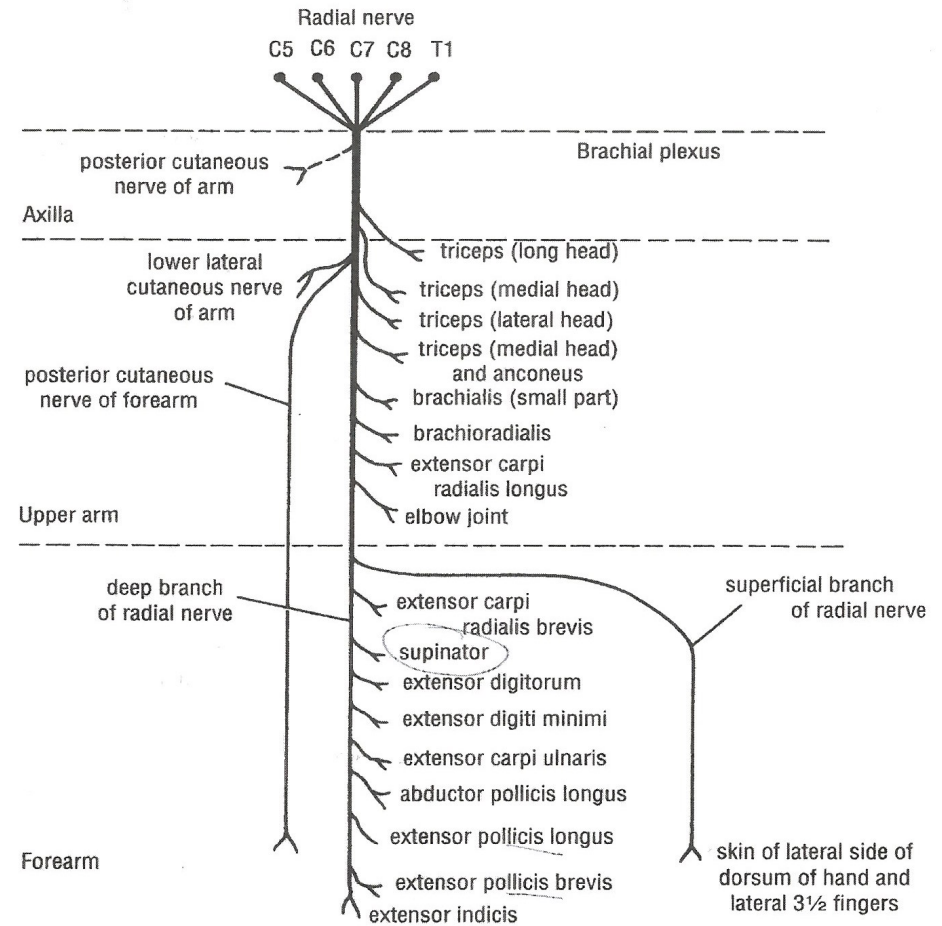
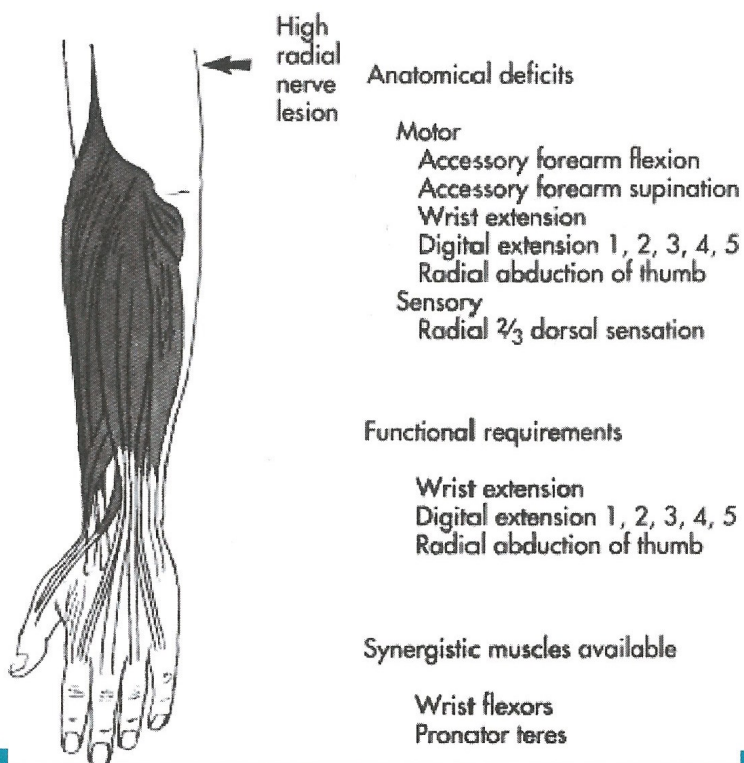
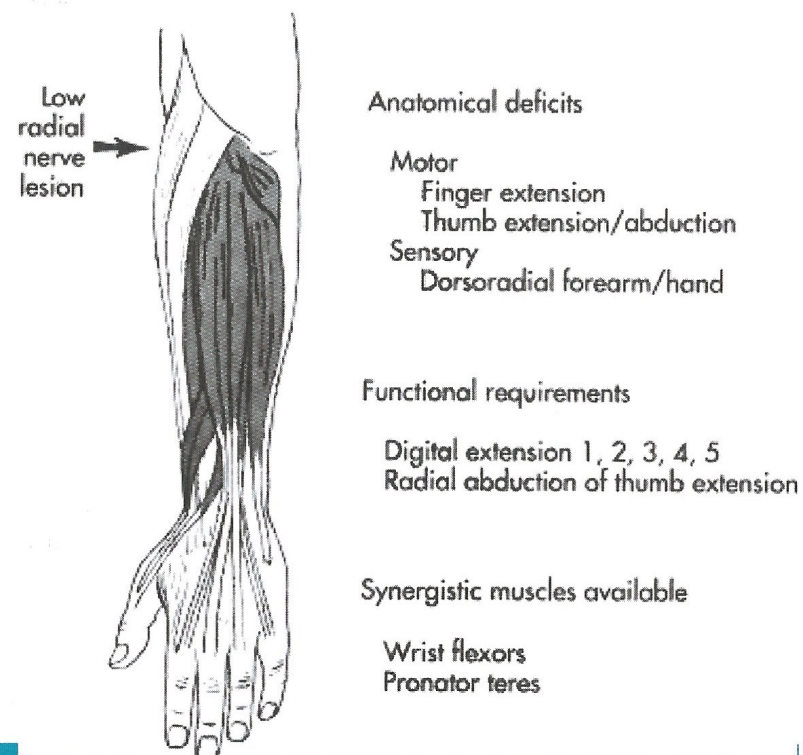


FIGURE 9-82 Summary diagram of main branches of radial nerve.

# Physical Exam



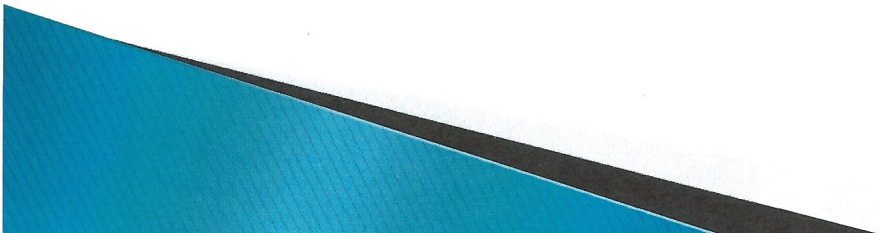
High RN palsy



Low RN palsy

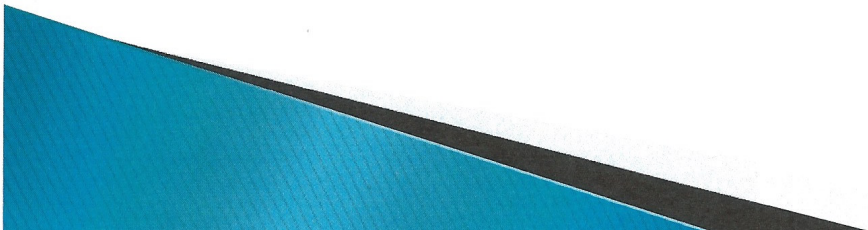
# Investigation

- ▶ NCS/EMG
- ▶ MRI (SOL)



# Consultation

- ▶ OT (splinting)
- ▶ PT(ROM)





# Treatment (RN Compression)

## ▶ Non-surgical

- Splint(night)
- Physiotherapy
- NSAID
- Rest

## ▶ Surgical (for N compression)

- Nerve Decompression
- Nerve transposition
- Tendon transfer



# Treatment Algorithm

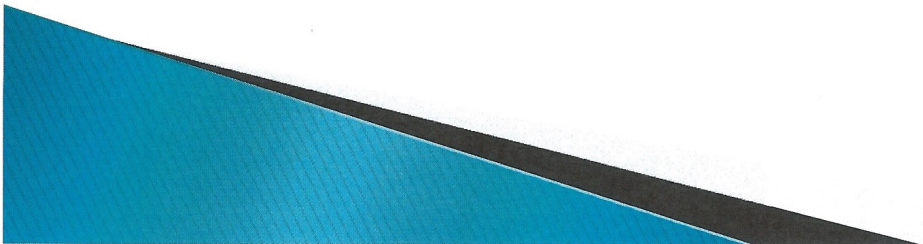
Non-surgical

Surgical if :

- No improvement in 3 months
- Functional loss
- Trauma

# Treatment (RN laceration)

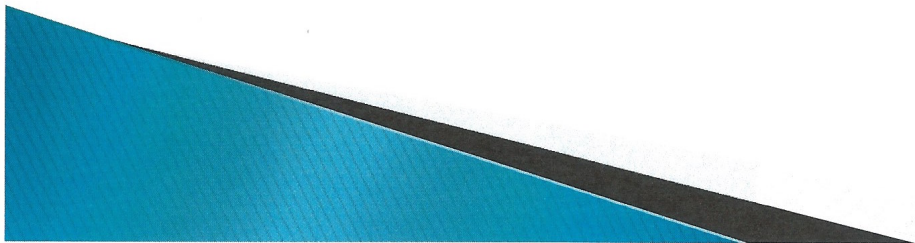
- ▶ Surgical
  - Nerve repair
  - Nerve graft
  - Nerve transfer
  - Tendon transfer



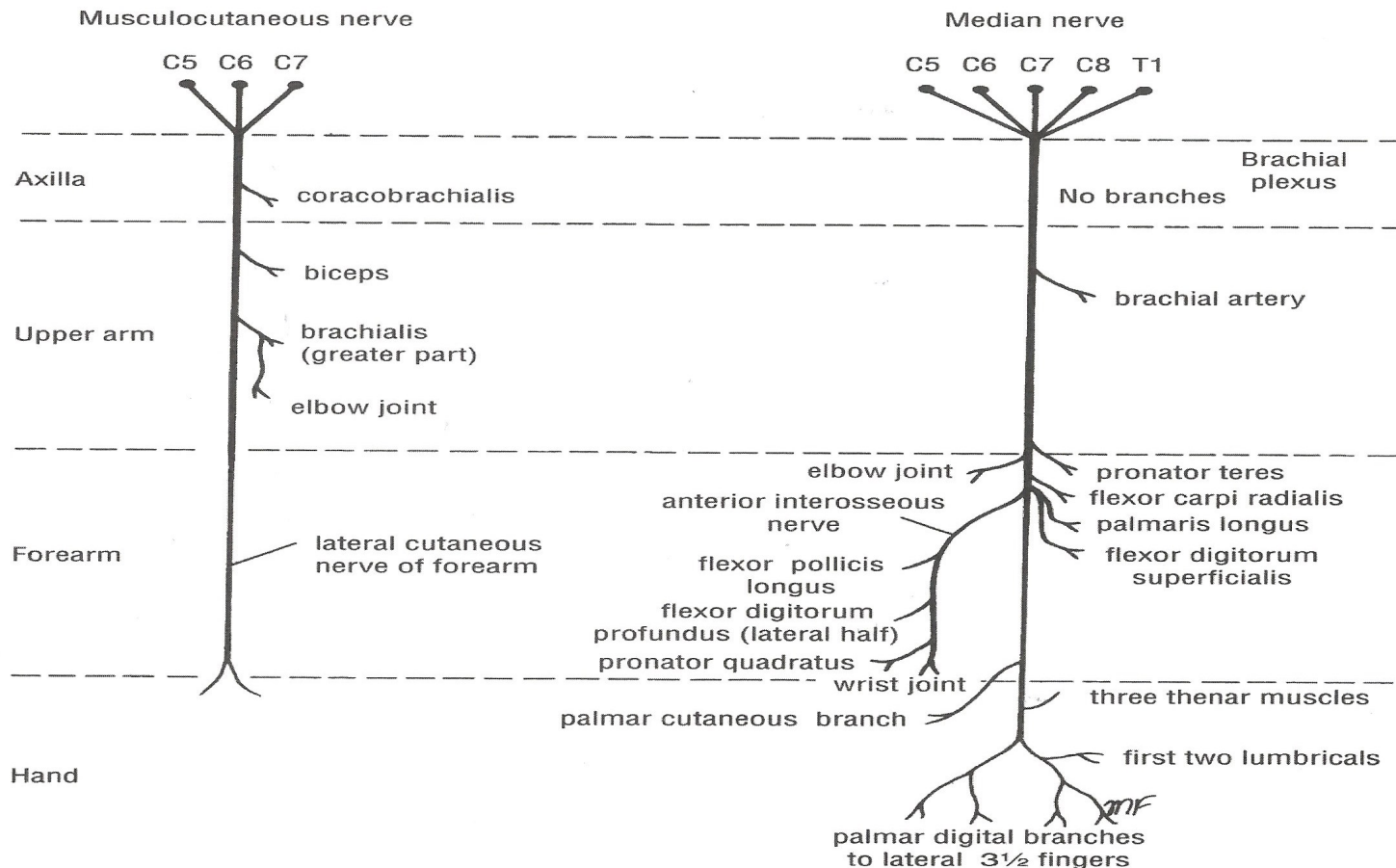
# Case 1



## ▶ Median Nerve



# Anatomy



**FIGURE 9-85** Summary diagram of main branches of musculocutaneous and median nerves.

# History

## ▶ ID:

- Hand dominance
- Occupation
- Hobbies

## ▶ HPI

- Main complaint
  - Sensory deficit
    - Median nerve distribution
  - Motor deficit
    - Hand weakness
  - Pain

## ▶ Main complaint

- When (time of onset)
- Where ( site of Numbness/ pain )
- Why ( Mechanism of the injury)
- How long ( duration )
- Symptoms Progression
- What has been done so far

# History

## ▶ HPI

- Risk factors
  - Anatomical (compression)
  - Pathological (trauma)

## ▶ PMH

## ▶ PSH

## ▶ Meds.

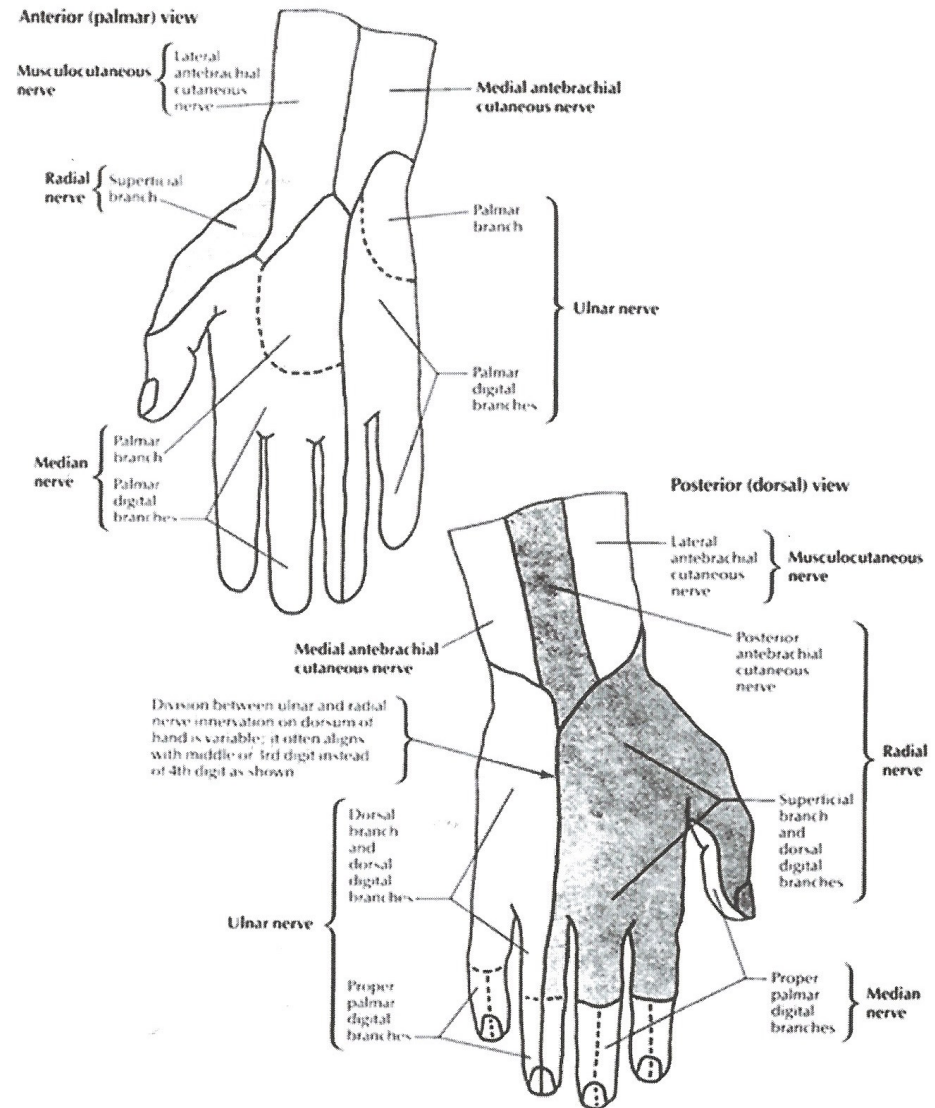
## ▶ Social Hx (smoking)

## ▶ Allergy Hx



# Physical Exam

- ▶ Sensory deficit
- ▶ Motor deficit
  - Inability to extend
- ▶ Tests (e.g. tinel/phalen signs)



# Physical Exam

- ▶ Sensory deficit
- ▶ Motor deficit
  - HIGH MN injury (arm)
  - LOW MN injury (Distal forearm/wrist)
- ▶ Tests (e.g. tinell/phalen signs)

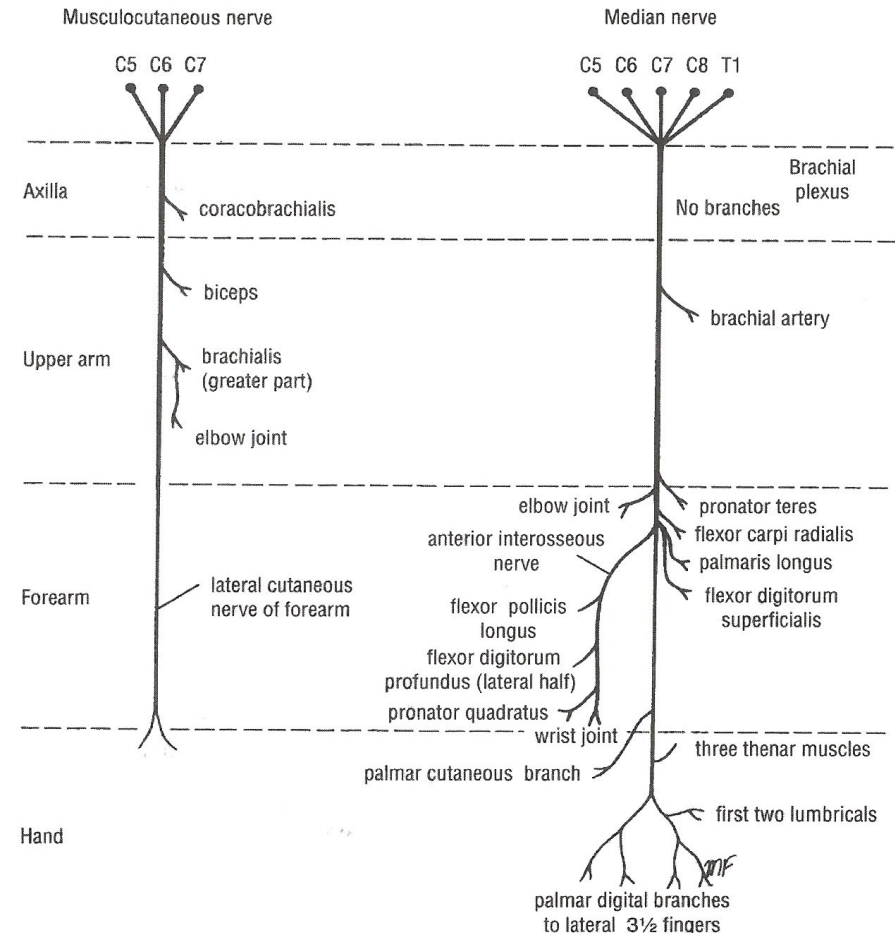


FIGURE 9-85 Summary diagram of main branches of musculocutaneous and median nerves.

# Physical Exam



## Anatomical deficits

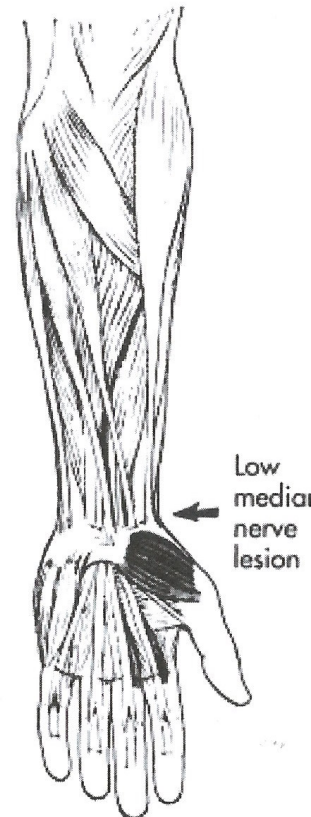
- Motor**
  - Pronation
  - Radial deviation of wrist
  - Finger flexion 1, 2, 3
  - Opposition of thumb
- Sensory**
  - Radial 2/3 volar sensation

## Functional requirements

- Finger flexion 1, 2, 3
- Opposition of thumb

## Synergistic muscles available

- Wrist extensors
- Proprii extensors
- Flexor profundus (ulnar 1/2)
- Flexor carpi ulnaris



## Anatomical deficits

- Motor**
  - Opposition of thumb
- Sensory**
  - Radial 2/3 volar sensation

## Functional requirements

- Opposition of thumb  
(Island flap thumb?)

## Synergistic muscles available

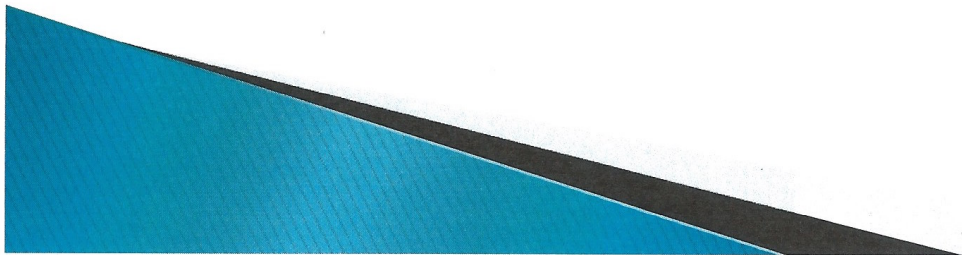
- Wrist extensors
- Flexor digitorum sublimis

High MN palsy

Low MN palsy

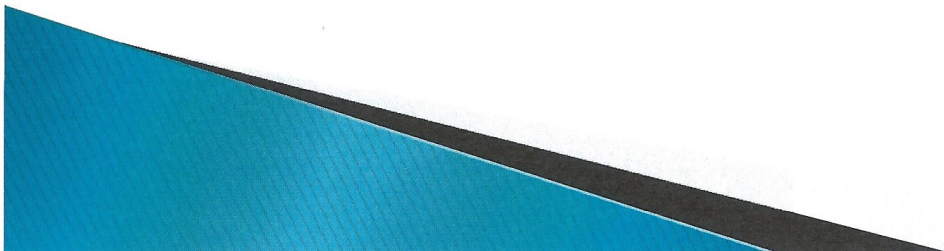
# Investigation

- ▶ NCS/EMG
- ▶ MRI (SOL)



# Consultation

- ▶ OT (splinting)
- ▶ PT(ROM)



# Treatment (MN Compression)

## ▶ Non-surgical

- Splint(night)
- Physiotherapy
- NSAID
- Rest

## ▶ Surgical (for N compression)

- Nerve Decompression
- Nerve transposition
- Tendon transfer

# Treatment Algorithm

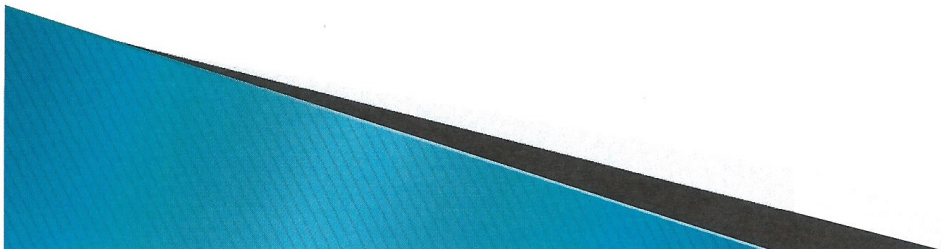
Non-surgical

Surgical if :

- No improvement in 3 months
- Functional loss
- Trauma

# Treatment (MN laceration)

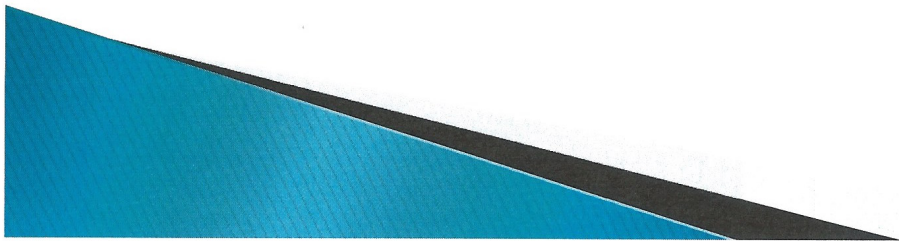
- ▶ Surgical
  - Nerve repair
  - Nerve graft
  - Nerve transfer
  - Tendon transfer





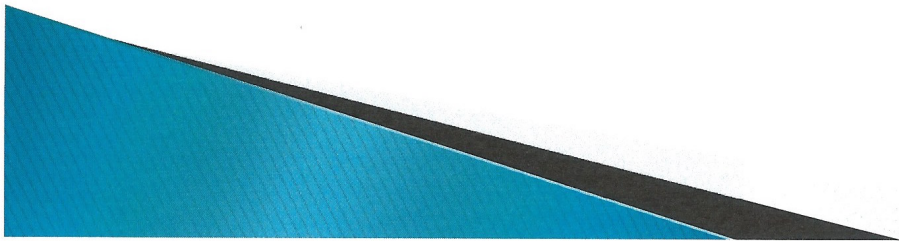
# Carpal Tunnel Syndrome

- ▶ Def : Compression of the median nerve in the carpal tunnel at the level of the wrist
- ▶ **LOW MN palsy**



# Carpal Tunnel Syndrom

- ▶ Treatment
  - Splinting (at night)
  - Lifestyle modification
  - Surgical decompression



# Carpal Tunnel Syndrome Rx

## ▶ Non-surgical

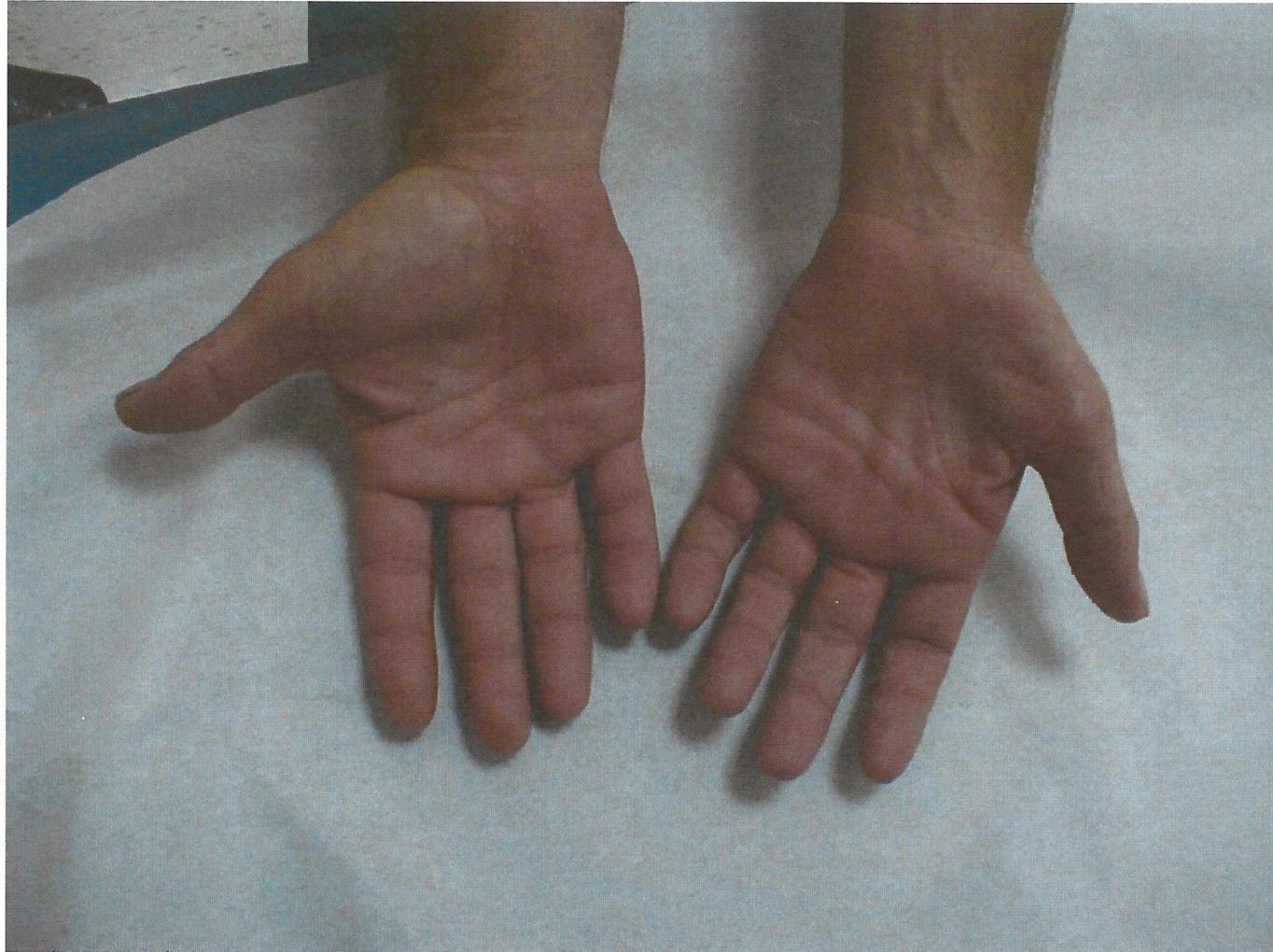
- Splint(night)
- Physiotherapy
- NSAID
- Rest

## ▶ Surgical

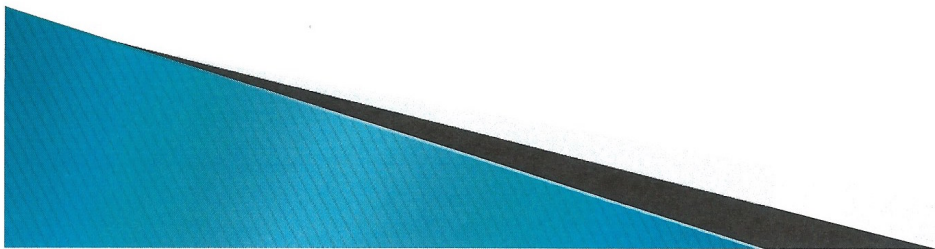
- Nerve Decompression



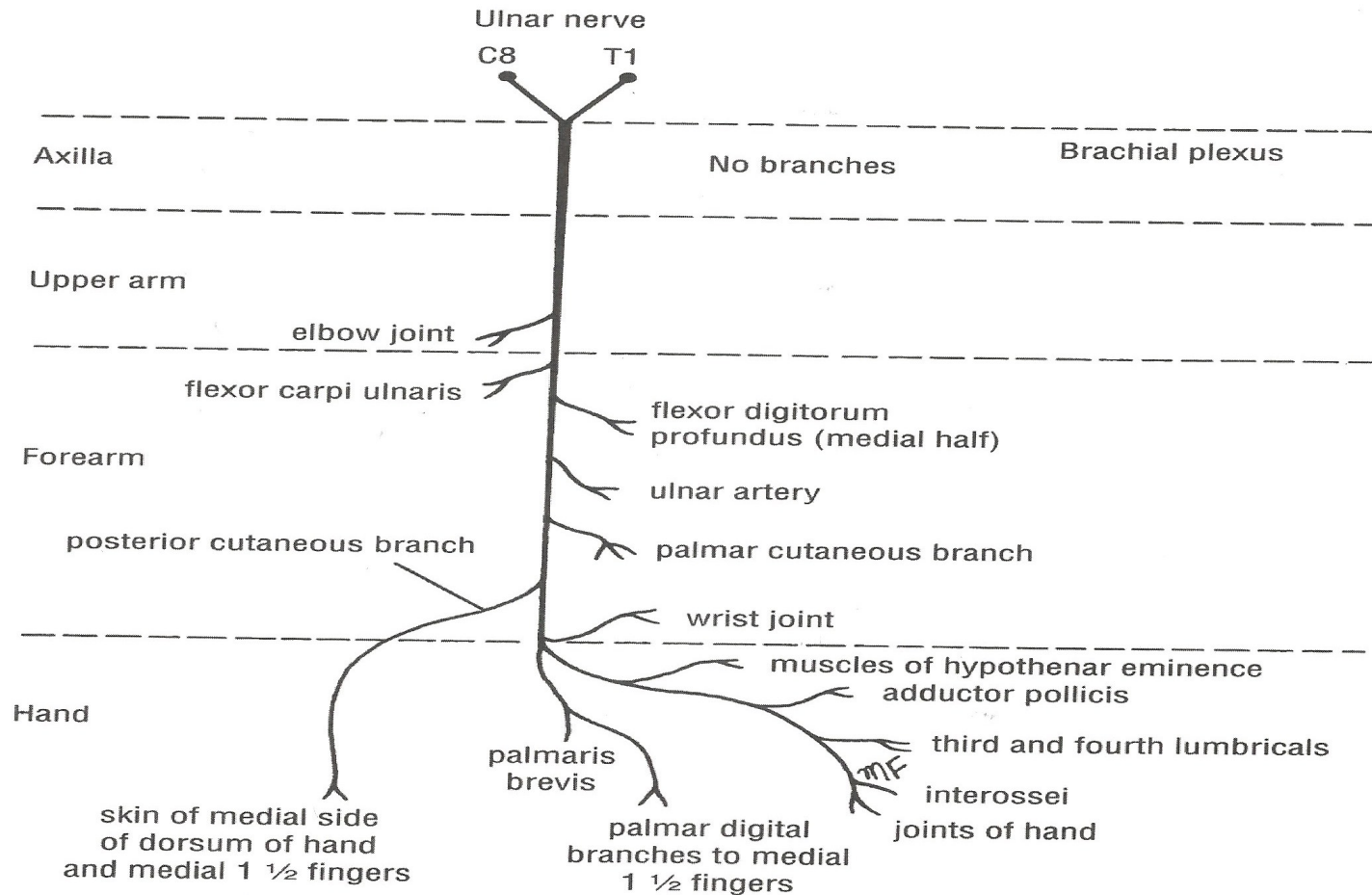
# Case 2



## ▶ Ulnar Nerve



# Anatomy



**FIGURE 9-87** Summary diagram of main branches of ulnar nerve.

# History

## ▶ ID:

- Hand dominance
- Occupation
- Hobbies

## ▶ HPI

- Main complaint
  - Sensory deficit
    - Ulnar nerve distribution
  - Motor deficit
    - Hand weakness
  - Pain

## ▶ Main complaint

- When (time of onset)
- Where ( site of Numbness/ pain )
- Why ( Mechanism of the injury)
- How long ( duration )
- Symptoms Progression
- What has been done so far

# History

## ▶ HPI

- Risk factors
  - Anatomical (compression)
  - Pathological(trauma)

## ▶ PMH

## ▶ PSH

## ▶ Meds.

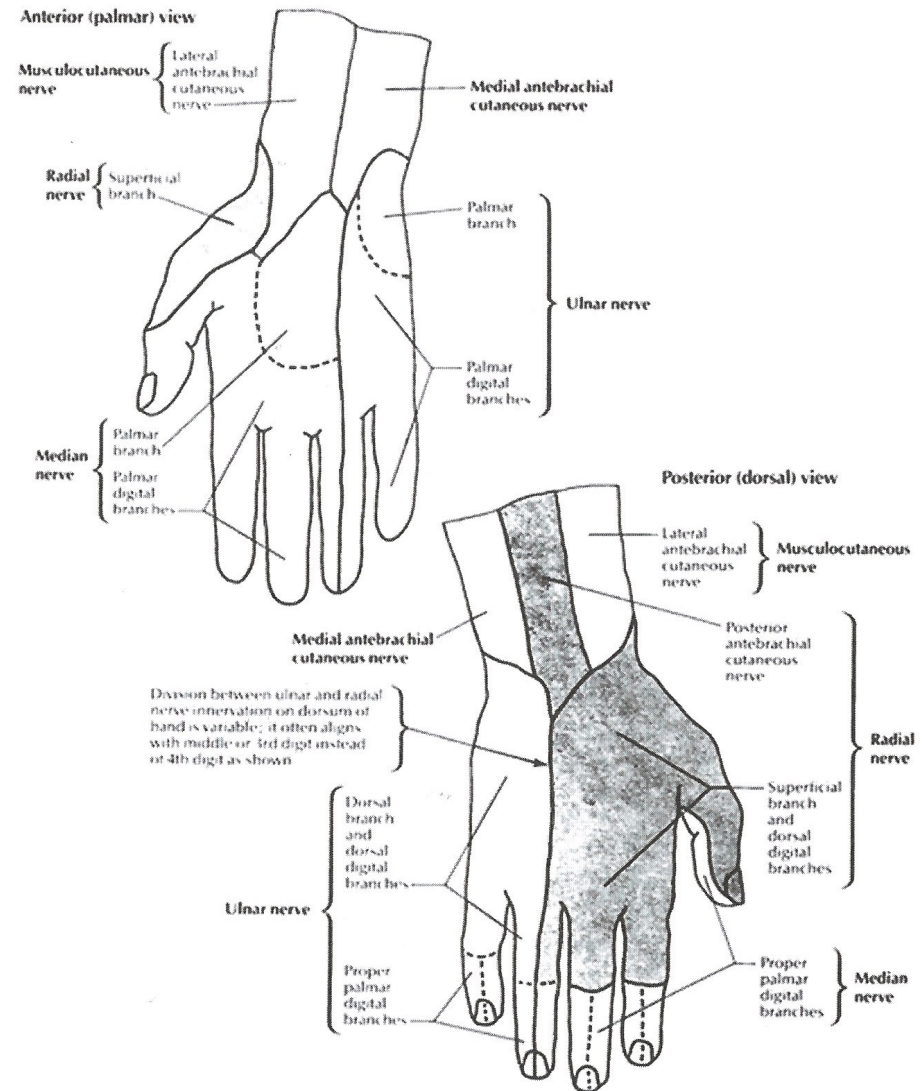
## ▶ Social Hx (smoking)

## ▶ Allergy Hx



# Physical Exam

- ▶ Sensory deficit
- ▶ Motor deficit
  - Inability to extend
- ▶ Tests (e.g tinel/phalen signs)



# Physical Exam

- ▶ Sensory deficit
- ▶ **Motor deficit**
  - **HIGH MN injury**  
(arm/proximal forearm)
  - **LOW MN injury**  
(Distal forearm/wrist)
- ▶ **Tests** (e.g tincl sign)

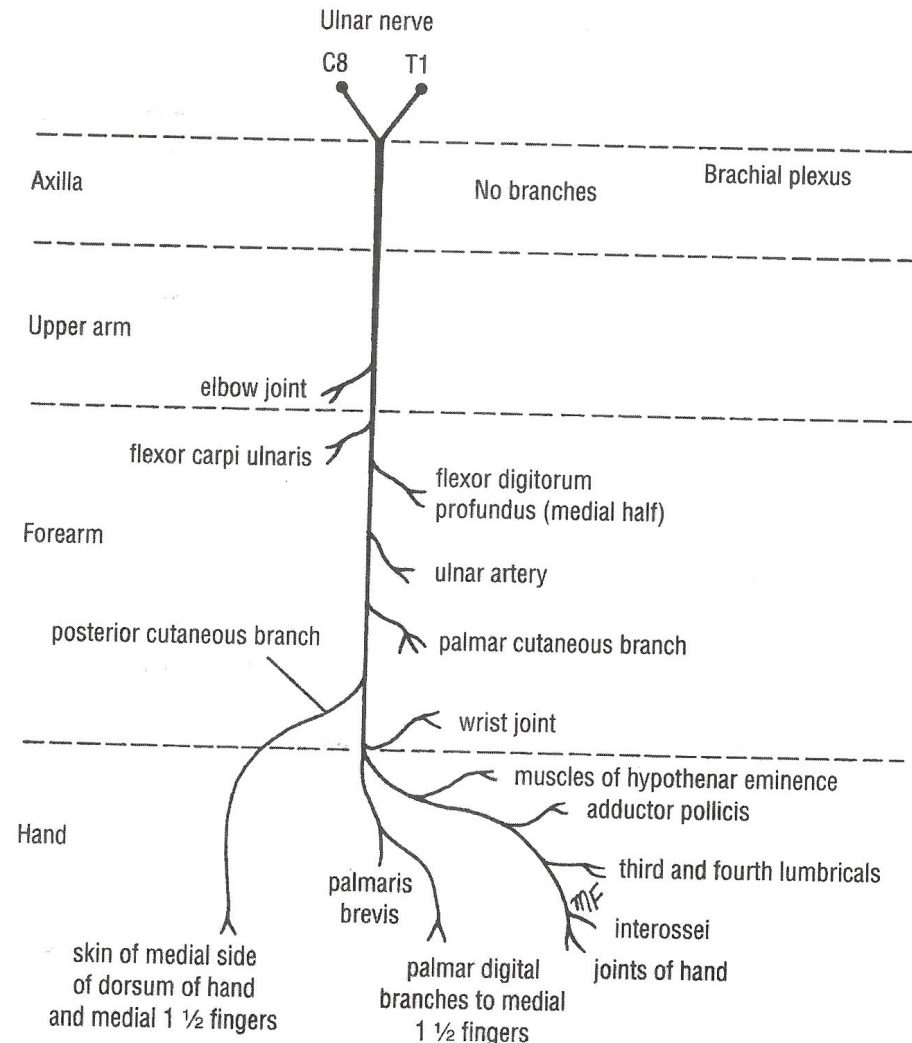
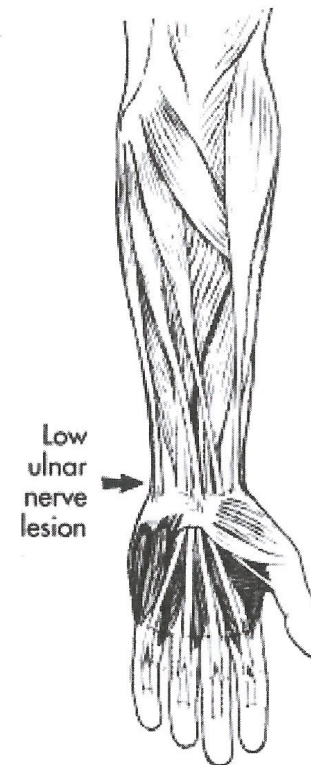


FIGURE 9-87 Summary diagram of main branches of ulnar nerve.

# Ulnar Nerve

<i>Motor Deficit</i>
Same as low palsy; Plus FDP D4,5; Power grip weakening, FCU (not usually a problem as FCR flexes wrist and ECU deviates ulnarly), Claw hand less likely a problem
<i>Sensory Deficit</i>
Same as low palsy with the addition of the dorsal-ulnar aspect of palm and dorsal side of D5



## Anatomical deficits

- Motor**
- Finger abduction/adduction
- Thumb adduction
- Sensory**
- Medial 1 1/2 digits

## Functional requirements

- Articular ring/small
- (Intrinsic substitution 2 ?)
- Thumb adduction

## Synergistic muscles available

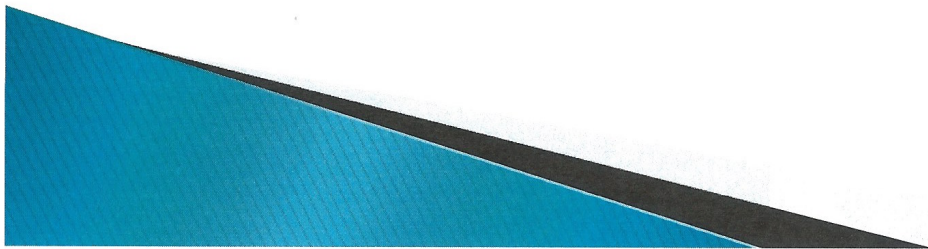
- Wrist extensors
- Flexor digitorum sublimis
- Proprii extensors

High UN palsy

Low UN palsy

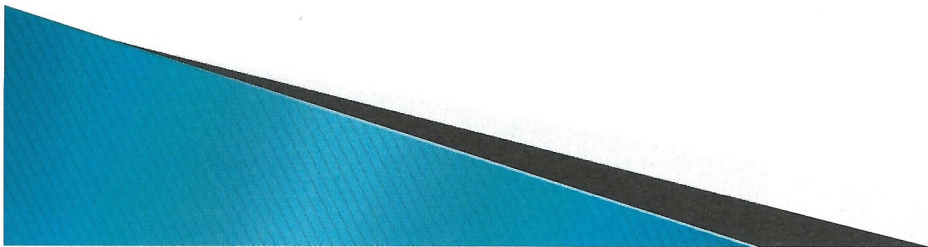
# Investigation

- ▶ NCS/EMG
- ▶ MRI (SOL)



# Consultation

- ▶ OT (splinting)
- ▶ PT(ROM)



# Treatment (UN Compression)

## ▶ Non-surgical

- Splint(night)
- Physiotherapy
- NSAID
- Rest

## ▶ Surgical (for N compression)

- Nerve Decompression
- Nerve transposition
- Tendon transfer



# Treatment Algorithm

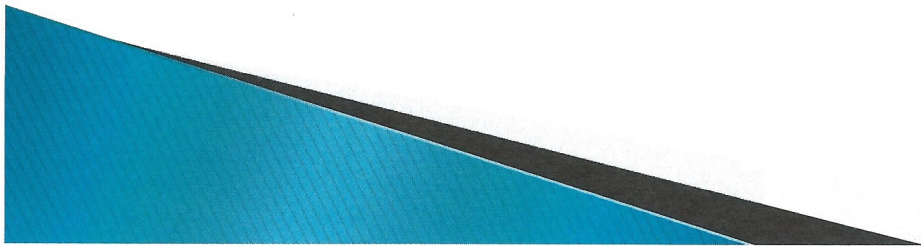
Non-surgical

Surgical if :

- No improvement in 3 months
- Functional loss
- Trauma

# Treatment (UN laceration)

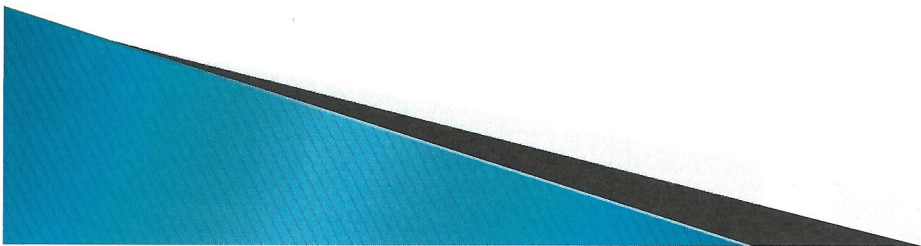
- ▶ Surgical
  - Nerve repair
  - Nerve graft
  - Nerve transfer
  - Tendon transfer





# Cubital Tunnel Syndrome

- ▶ Def: Compression of the ulnar nerve in the cubital tunnel (medial aspect of the distal arm/proximal forearm around the elbow)
- ▶ High MN palsy



# Cubital Tunnel Syndrome Rx

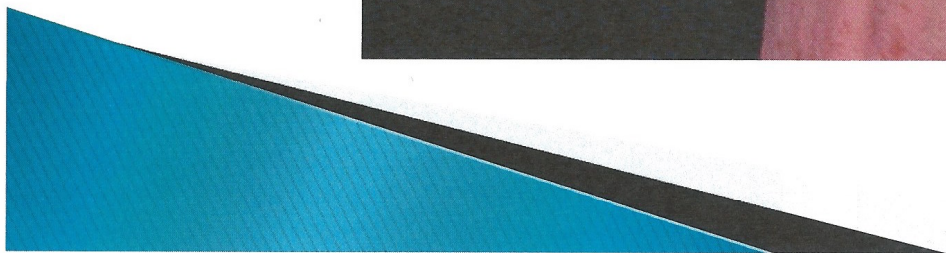
## ▶ Non-surgical

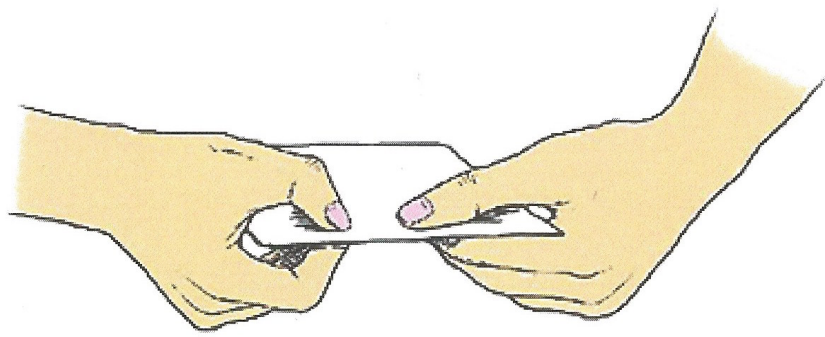
- Splint(night)
- Physiotherapy
- NSAID
- Rest

## ▶ Surgical (for N compression)

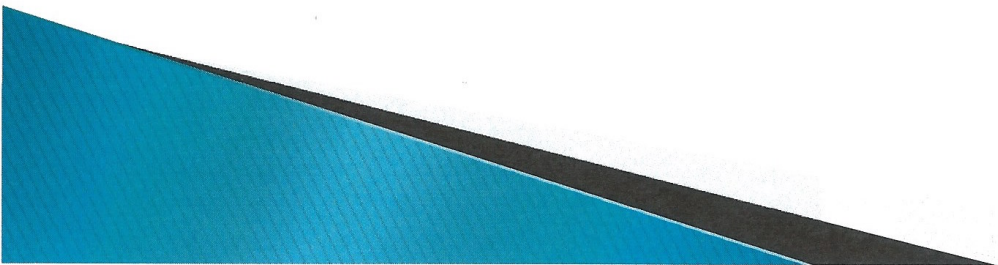
- Nerve Decompression
- +/- Nerve transposition

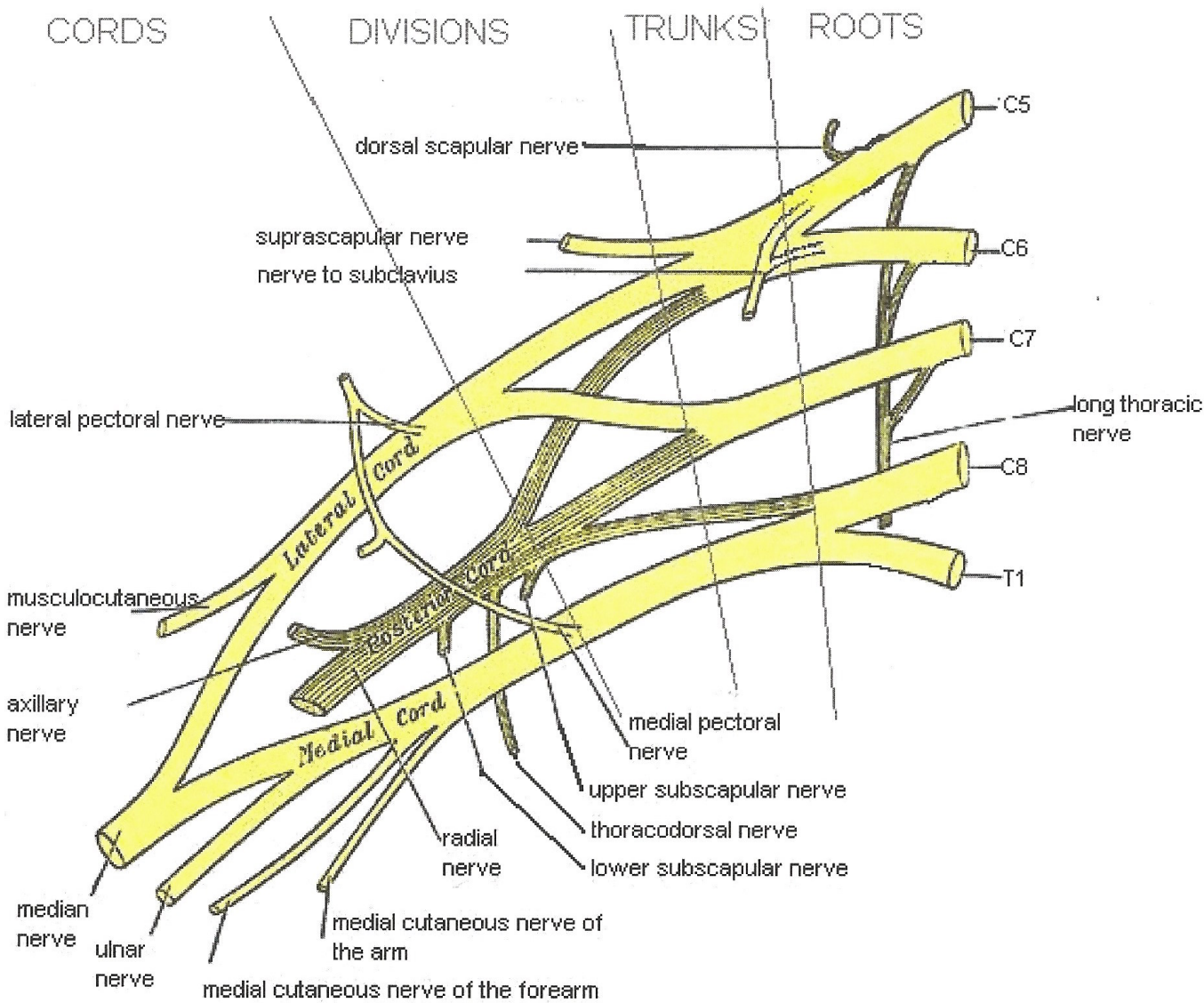
# Case 3





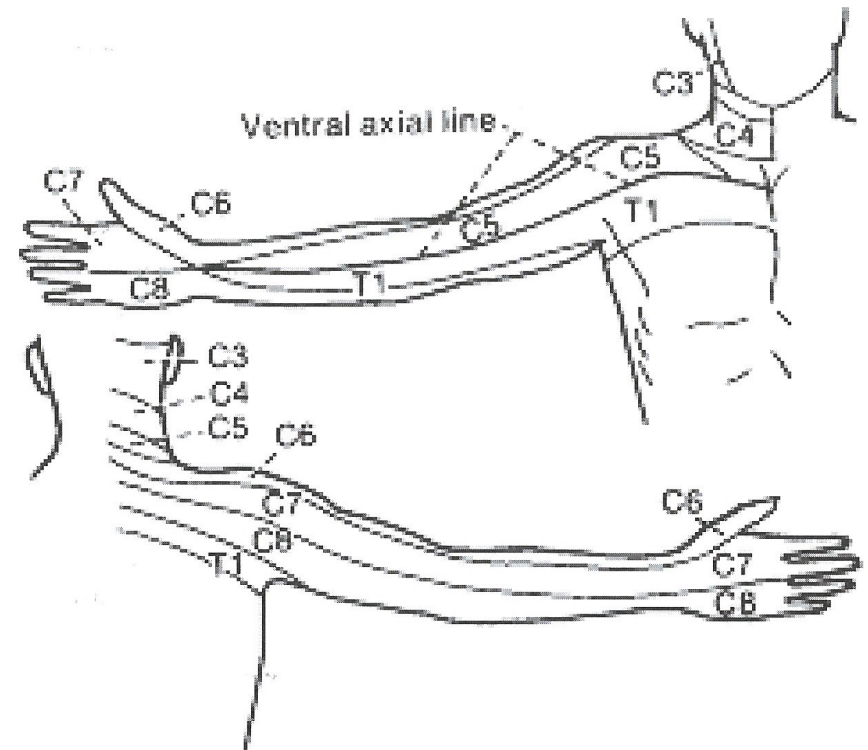
## ▶ Brachial Plexus





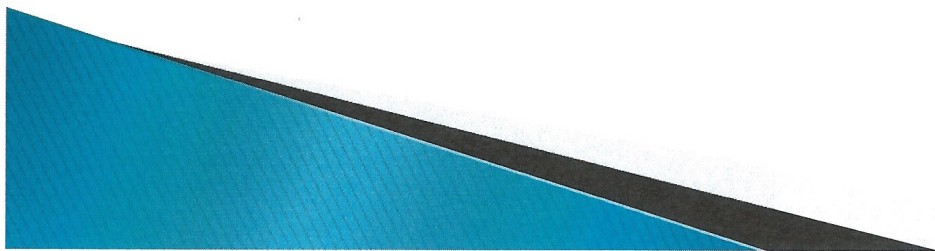
# Dermatomes

- ▶ C5 → lateral (radial) side of the antecubital fossa proximal to the elbow
- ▶ C6 → dorsal surface of the proximal phalanx of the thumb
- ▶ C7 → dorsal surface of the proximal phalanx of the middle finger
- ▶ C8 → dorsal surface of the proximal phalanx of the little finger
- ▶ T1 → medial (ulnar) side of the antecubital fossa to the medial condyle of the humerus



# Brachial Plexus Injuries

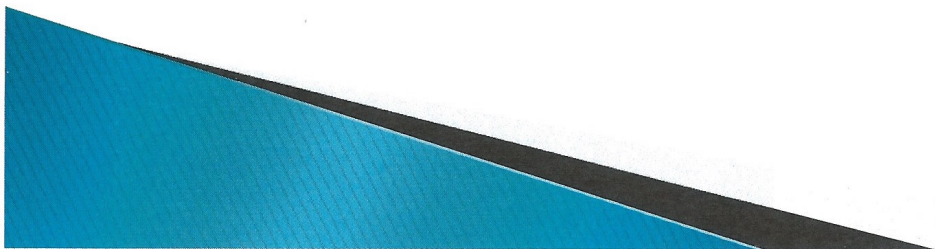
- ▶ Obstetrical brachial plexus palsy
  - Risk factors
    - Diabetic mother
    - High birth wt
    - Difficult deliver
    - Breech presentation
    - Instrumental delivery (forceps, suction ...)
- ▶ Traumatic brachial plexus injuries





# Brachial Plexus Palsy

- ▶ Erb's palsy (C5,6,+/- 7)
- ▶ Klumpke's (C8, T1)
- ▶ Total (C5,6,7,8 &T1)



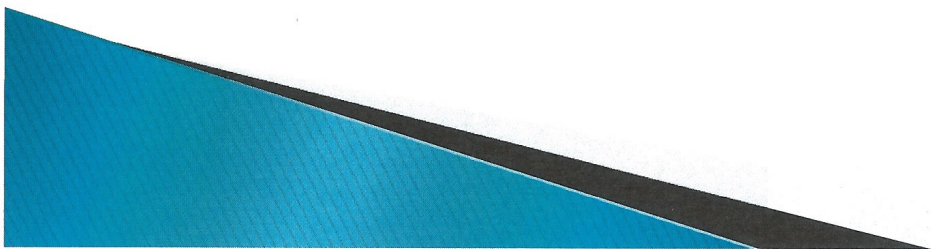
# Erb's Palsy

- ▶ Waiter's tip position
- ▶ Loss of shoulder abduction/  
external rotation
- ▶ Loss of elbow flexion
- ▶ Loss of wrist extension
- ▶ Good hand function



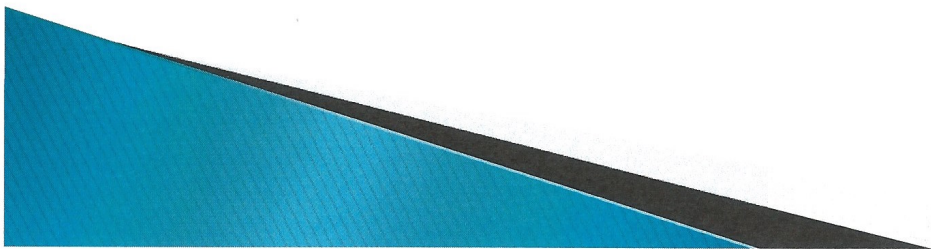
# Klumpke's Palsy

- ▶ Good shoulder and elbow
- ▶ Loss of hand/ finger flexion/extension



# Management

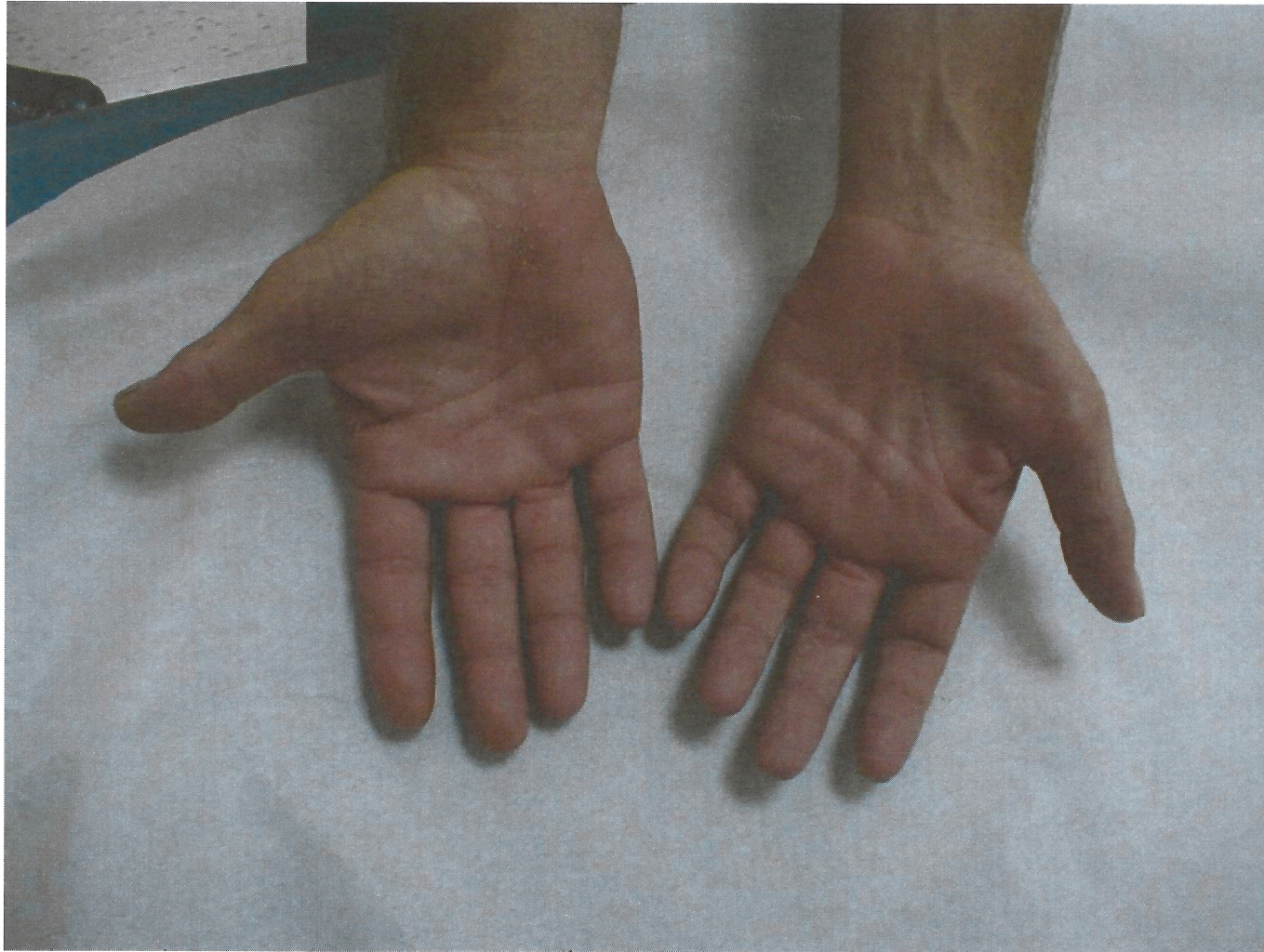
- ▶ Observation and stretching exercises of the shoulder for the first 3 months
- ▶ Surgical exploration if no recovery by 3–6 month
- ▶ Surgery:
  - Exploration and nerve graft or nerve transfer



# Case 1



# Case 2



# Case 3

