

## Median Nerve Palsy

**Common clinical scenarios**

**Scenario 1:** A 36-year-old lady, right hand dominant housewife presents with pain, tingling and numbness of right hand of 4 months duration. There is weakness and loss of strength in the right hand. She has a history of assault injury to her right arm which was treated with simple skin suturing (Figs 27.1A and B).



**Fig. 27.1A and B:** Scenario 1

**Scenario 2:** A 59-year-old lady, right hand dominant housewife presents with pain, tingling and weakness in her right hand of 1 year duration. She incidentally also has similar complaints in the opposite side, though less severe. There is an ulcer in the right middle fingertip. She is a diabetic on treatment with oral hypoglycemic drugs (Fig. 27.2).



**Fig. 27.2:** Scenario 2

### What an examiner expects and how will you proceed?

- **History:** The examiner expects you to tell which nerve is involved, at what level, what is the type of nerve injury and how will you manage the condition based on patient factors including age, occupation, demands, duration and status of the underlying pathology.
- **Presentation:** Median nerve injury usually presents either as a high or low median nerve palsy. Both of them have a very typical presentation (Table 27.1). Median nerve injury usually presents as either post-traumatic or with varied etiology (Table 27.2).

**Table 27.1: Differences between low median and high median nerve palsy**

<i>Low median nerve palsy</i>	<i>High median nerve palsy</i>
<ul style="list-style-type: none"> <li>• Median nerve injury below proximal one-third forearm</li> <li>• Forearm muscles are spared</li> <li>• Thenar muscles are affected</li> <li>• Pen test to check abductor pollicis brevis (APB)</li> </ul>	<ul style="list-style-type: none"> <li>• Median nerve injury at proximal one-third forearm and above</li> <li>• Entire median nerve function affected</li> <li>• Loss of pronators, FCR, PL, FDS, FDP (1 and 2), FPL, lumbricals I and II and thenar muscles (APB, FPB partly, opponens pollicis)</li> </ul>

**Sensory loss is present in both the type of injury-loss of sensation at palm and palmar side of radial 3½ digits including the sensory loss of these digits beyond proximal interphalangeal at the dorsum of hand.**

**Table 27.2: Etiology of Median nerve palsy (apart from trauma)**

<ul style="list-style-type: none"> <li>• Idiopathic carpal tunnel syndrome (CTS) CT can also be due to malunited distal radius fracture causing compression apart from various other causes</li> <li>• Anterior interosseus nerve entrapment (Kiloh-Nevin syndrome, common cause: Gantzer's muscle which is accessory head of FPL); There is pure motor weakness of PQ, FPL and FDP 1 and 2</li> <li>• Pronator teres syndrome: Compression by ligament of Struthers and lacertus fibrosus (bicipital aponeurosis)</li> </ul>	<ul style="list-style-type: none"> <li>• Inflammatory (rheumatoid flexor tenosynovitis)</li> <li>• Infective (Hansen's, post-polio sequelae)</li> <li>• Neoplastic (schwannoma/neurofibroma)</li> </ul>
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- **Examination:** The first step is to establish that it is median nerve which is involved. In addition, check for other nerve injuries involving radial and ulnar nerve especially in post-traumatic cases. Differential diagnosis should be kept in mind and checked (Table 27.3).

**Table 27.3: Differential diagnosis**

- Trauma to musculotendinous unit (long finger flexors)
- Lower trunk injury (Klumpke's palsy)
- Cervical spine pathology (C5,C6 disc disease)
- Spinal cord disease (motor neuron disease, syringomyelia)

- **Remember the aberrant anastomoses between median and ulnar nerves which may give a confusing picture in clinical presentations—Martin-Gruber anastomoses in forearm and Riche-Cannieu anastomoses with connection between recurrent branch of median nerve and deep branch of ulnar nerve in the hand.**

- Expose the patient all the way till the neck and cervical spine when you start examination and compare all your findings on the opposite normal side when possible.

## Core clinical examination

### Inspection

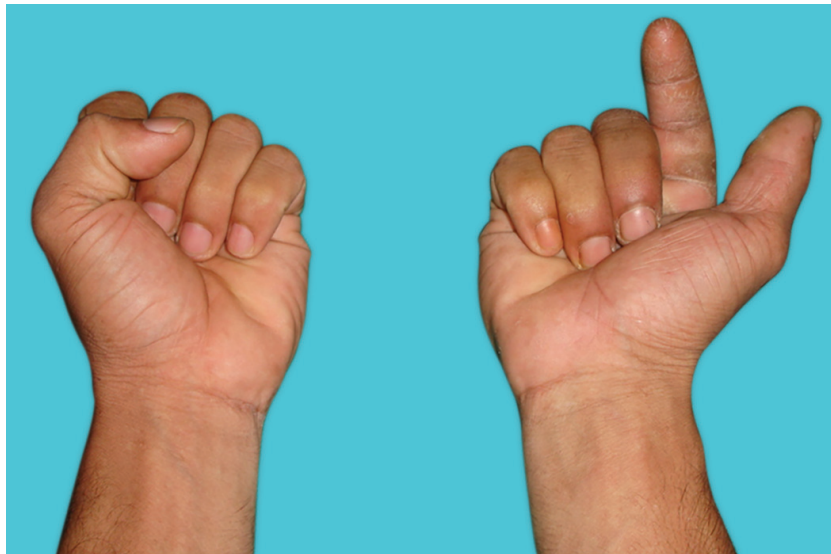
#### Attitude and deformity

- In high median nerve palsy, there is apparent loss of normal cascade of the hand with thumb being in line with fingers called **ape thumb deformity** (normally the thumb lies abducted and extended at an angle to the fingers) and the index finger is extended and points out (Fig. 27.3).

**Pointing index** will be seen on attempting flexion of the fingers and clasping both hands. **This test is called Oschner's clasp test.** The candidate should remember that both index finger and middle finger FDP is supplied by median nerve along with FDS of all fingers. Hence both index and middle fingers won't

be able to flex at IP joints in high median nerve palsy as both FDS and FDP are paralysed and ideally both fingers should point out.

**However, it is only the index finger which points out because the index FDP origin is separated very proximally in the forearm and is in a separate sheath anatomically. The middle finger shares a common sheath with ring and little finger FDP supplied by ulnar nerve and hence is flexed by a mass action of ring and little fingers when the patient clasps his/her hand. This is the rationale behind pointing index sign.**

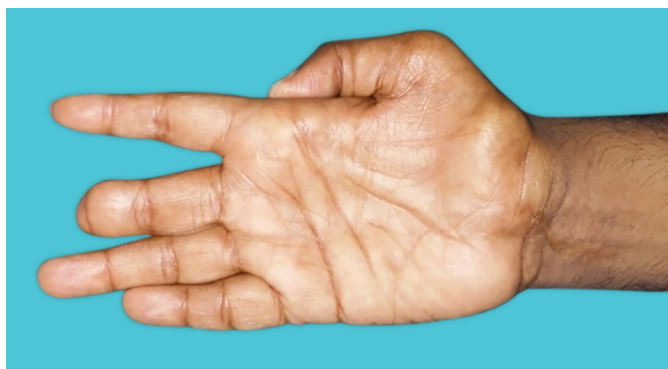


**Fig. 27.3:** Pointing index

- **The hand of benediction or benediction sign or Preacher's hand:**  
This is asked by many examiners. This refers to the inability to flex the 2nd and 3rd digits as MCP, PIP and DIP joints of these fingers cannot flex in median nerve injury. However, if someone tried to make a fist, the pointing index described above happens and not the benediction sign.

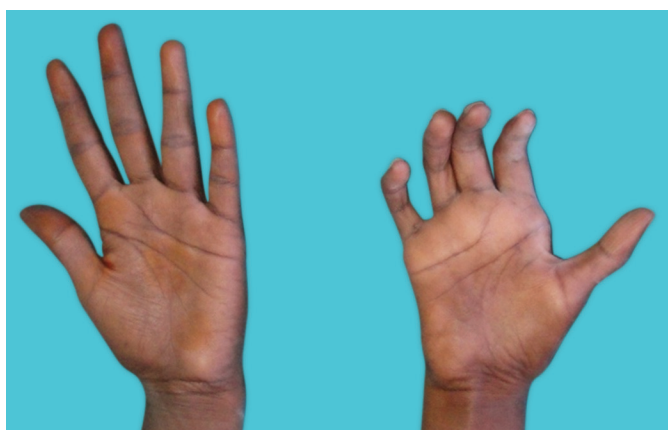
There is also a controversy as to whether the sign originally represented an ulnar nerve neuropathy with claw like features which shows similar hand deformity. Hence, pointing index is a better sign for median nerve palsy.

- In low median nerve palsy and in early stages **ape thumb deformity** may not be apparent. The motor function is compensated well due to intact ulnar nerve innervated flexor pollicis brevis (FPB) muscle. In combined nerve palsy with ulnar nerve or if the FPB is predominantly supplied by median nerve, the ape thumb deformity becomes apparent, compounded by loss of abductor pollicis brevis (APB) and then the thumb lies in the plane of the palm (Fig. 27.4).



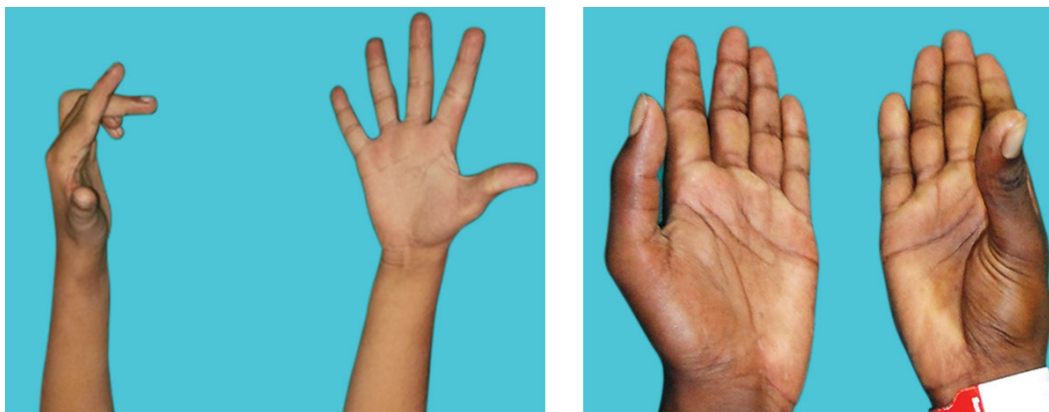
**Fig. 27.4:** Ape thumb deformity

- Total clawhand with ape thumb deformity will be seen in the presence of associated ulnar nerve injury (Fig. 27.5).



**Fig. 27.5:** Total clawhand: Note clawing of index and middle fingers

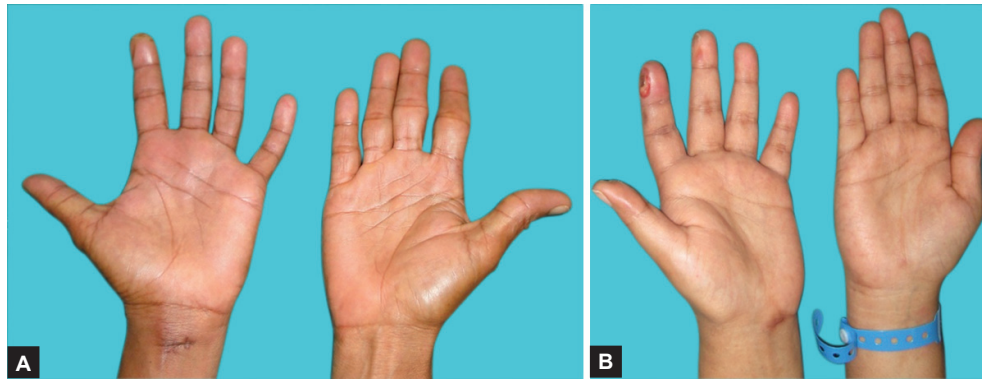
- **Muscle wasting:** Is seen in the forearm particularly at the common flexor origin and thenar area (Figs 27.3, 27.5–27.7).



**Figs 27.6 and 27.7:** Note the wasting at common flexor origin and thenar eminence, respectively

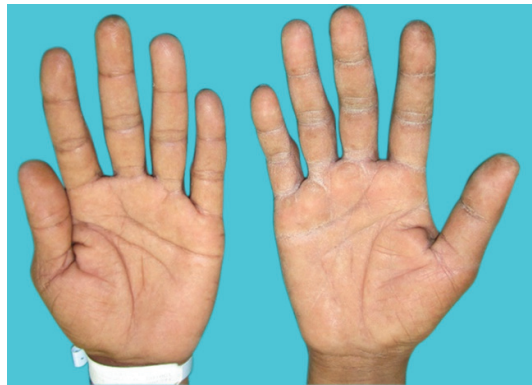


- **Swelling:** Check for visible swelling. If present in the median nerve territory, it could be due to flexor tendon tenosynovitis, nerve abscess or neoplasm.
- **Scar:** Check the site of scar or injury. Look for the tell-tale signs of healed wounds along the course of the nerve (Fig. 27.8A and B).



**Fig. 27.8A and B:** Note the skin ulcer at fingertip/erythematous skin color/thenar wasting/ the tell-tale healed scar at wrist typically in the course of median nerve

- **Trophic changes:** Changes in skin, hair, nail and sweating (Figs 27.8–27.10). There will be erythema in early injuries and dryness of skin in late cases.



**Fig. 27.9:** Dryness and loss of normal color in the right hand



**Fig. 27.10:** Nail changes

### Palpation

This will involve soft tissue and bony palpation at all the regions along the course of nerve.

### Soft tissue

- Check for temperature in the hand. It will be normal or increased in early injuries but decreased in late injuries.
- Check for tenderness at the scar site. There may be painful paresthesia due to presence of neuroma. Describe and define the scar or site of injury.

- If a swelling is present, describe it as in a case of a swelling. Check the plane of the swelling.
- Palpate the nerve for thickening and tenderness throughout its course. This is useful in Hansen's disease to rule out neuritis and acute reaction status.
- Nerve abscess can be palpated in Hansen's disease especially when it becomes superficial just proximal to the carpal tunnel.
- Check the Tinel's sign. Describe its relation with the site of scar or injury.

### Bone

Bony palpation becomes important in the presence of additional injury involving the bone along the course of median nerve. Look for thickening/irregularity/step/gap/tenderness/implant *in situ*.

### Movements

- Check the movements particularly the joints involving the thumb.
- In long standing cases, check for fixed deformities of the thumb at CMC, MP and IP joints.
- Check active movements followed by passive movements of the CMC, MP and IP joints.
- For CMC joint of thumb, check for movements in the plane of palm (flexion/extension) and perpendicular to palm (abduction and adduction) (Fig. 27.11A to D).
- Check flexion and extension at MP and IP joints.

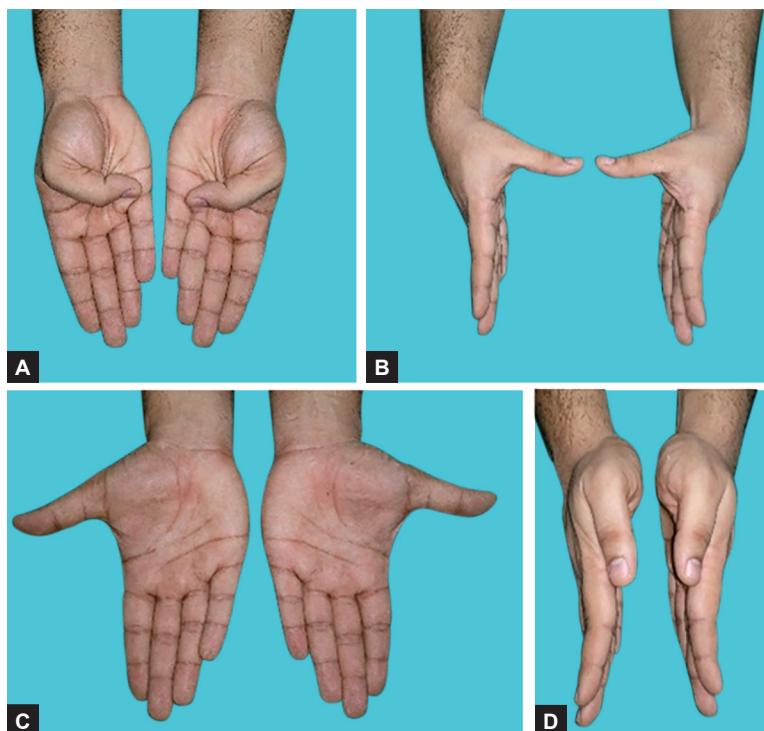


Fig. 27.11A to D: (A) Flexion at CMC joint; (B) Abduction; (C) Extension; (D) Adduction

### Measurements

- Wasting of muscles in forearm.
- Limb length discrepancy in case of trauma to the limb involving bones or joint surfaces or dislocations.
- First web space contracture is common and its measurement is important in management. This should be done between the 1st and 2nd metacarpal with thumb in full abduction (Fig. 27.12A and B).

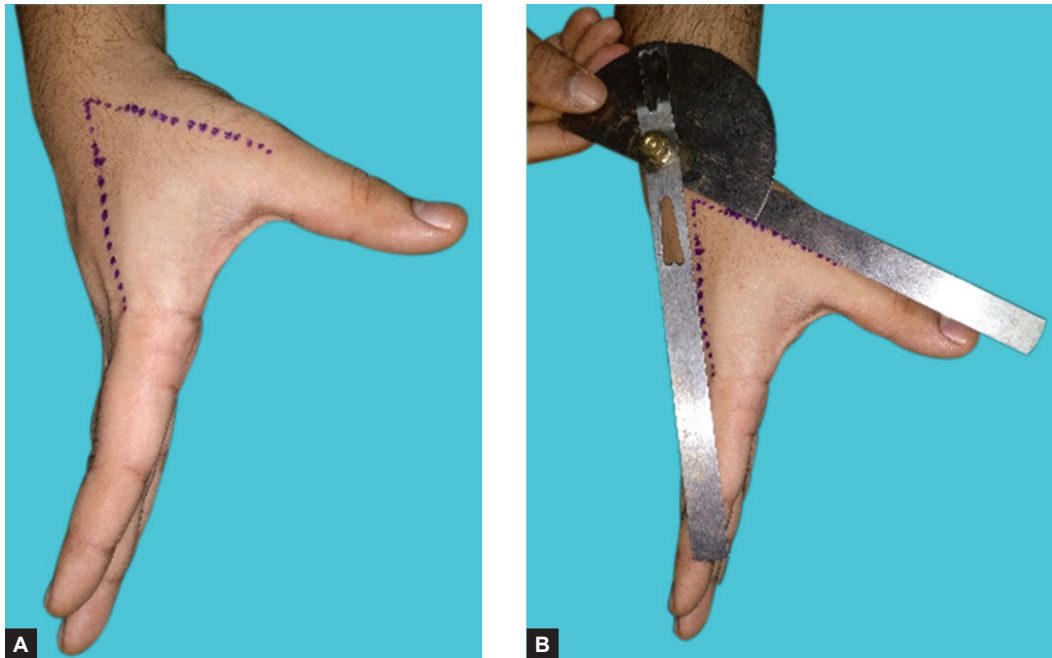


Fig. 27.12A and B: Measuring first web space contracture

### Neurological examination

**Motor examination:** Tone, bulk, power

- **Power:** Check the power of the following muscles. Follow the rule of 2.

2 forearm muscles	PT, PQ
2 wrist flexors	PL, FCR
2 finger flexors	FDS, FDP
2 thumb motors	FPL, APB (2 others: FPB and opponens pollicis cannot be assessed)

- Refer to the rules of muscle testing in the section: 'A Systematic Approach to Peripheral Nerve Injuries'. The student should know the MRC grading for testing the muscles mentioned above.



- *Oschner's clasp test is the first test to be done to differentiate between high and low median nerve palsy. If this is negative (which means the long flexors are working and there is no pointing index sign), then it is low median nerve palsy. The candidate should proceed to pen test to check APB muscle.*

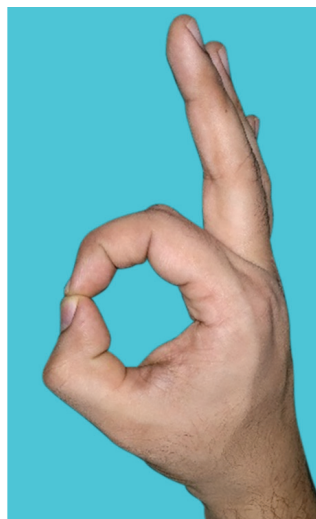
**Two other important tests are worth mentioning in muscle testing for median nerve:**

- For index finger, the FDP has independent action and hence, its FDS has to be checked by pinching the index with thumb. Index finger is kept in extension at DIP joint and at the same time flexing the PIP joint (Fig. 27.13A).



**Fig. 27.13A:** Checking for Index FDS

- The integrity of anterior interosseous nerve can be checked by making a circle (O) by tip-to-tip pinch using the thumb and index finger (Fig. 27.13B).



**Fig. 27.13B:** Note the action of FDP of index and FPL of thumb. Both are supplied by anterior interosseous nerve

### Sensory examination

- Radial three and half fingers on palmar side of hand, the thenar area and also up to the PIP joint on the dorsal side. The autonomous zone for median nerve is the pulp of index finger (Fig. 27.14A and B).

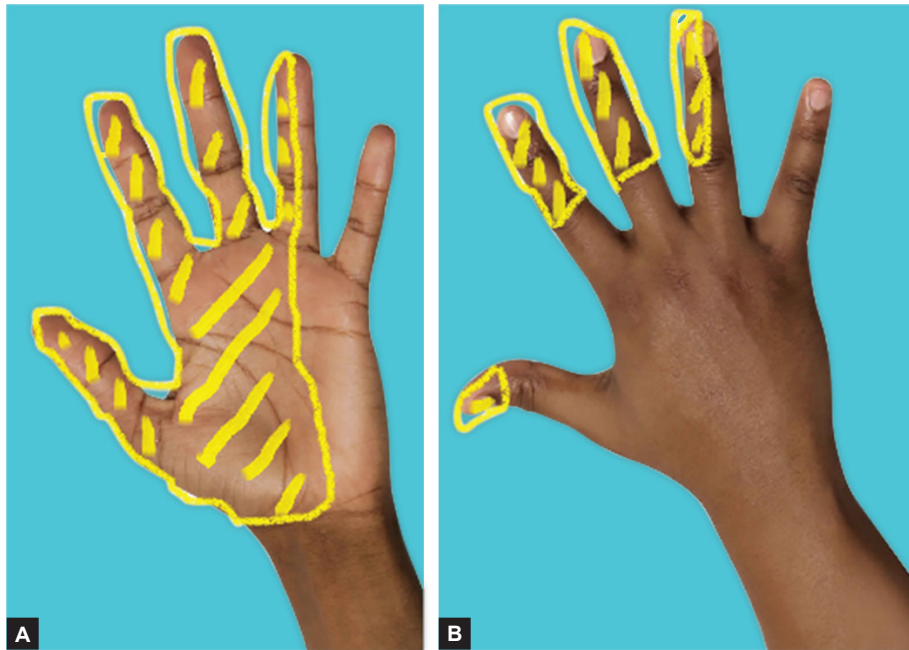


Fig. 27.14A and B: Sensory innervation of median nerve

- When checking for sensation by light touch use your fingertips or a cotton wisp. Give simultaneous continuous stimuli on both normal and abnormal side of the hand with patient's eyes closed.
- Ask three questions during the above testing. 1. Does the patient feel the sensation both sides? 2. If yes, is there a difference or is it same 3. If there is a difference, ask what is the difference in sensation. Let the patient tell the difference (hypo, hyper, para or anesthesia) and it should not be suggested by the examiner.

### Vascular examination

- Radial and ulnar pulse: Compare with opposite side for rate, rhythm and volume.
- Capillary refill time in all fingers.
- Allen's test in traumatic injuries.

### Special tests

These are described for carpal tunnel syndrome.

- Phalen's test:** This is unforced complete palmar flexion of the wrist for 60 seconds. It is said to be positive if the patient complains of paresthesia before 60 seconds (Fig. 27.15).



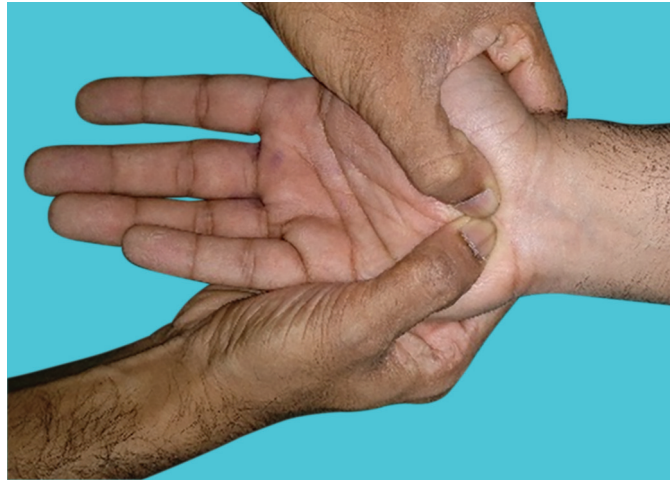
**Fig. 27.15:** Phalen's test

- b. **Reverse Phalen's test:** The opposite position of Phalen's test can also demonstrate similar findings in select patients. This is known as the reverse Phalen's test. The test is done in the same way but keeping the wrist in dorsiflexion (Fig. 27.16).



**Fig. 27.16:** Reverse Phalen's test

- c. **Durkan's test:** This is the carpal compression test where both the thumbs are used to apply even pressure at the carpal tunnel just distal to wrist on the flexor retinaculum for 30 seconds. It is said to be positive if the patient complains of paresthesia before 30 seconds (Fig. 27.17).



**Fig. 27.17:** Durkan's test

d. **Tinel's sign:** In carpal tunnel, the Tinel's sign is not similar to the classical test we do for recovering nerve injuries. Here the tingling is to demonstrate more of a compressed irritated nerve rather than any discontinuity and regeneration. It is neither sensitive nor specific test in this condition.

### **Other relevant examinations**

Based on the etiology, additional examinations should be done for the following.

#### **1. Cervical disc disease**

- a. Features of neck pain, with radiating pain in the arm and forearm.
- b. Range of movement at neck may be restricted due to pain and spasm.
- c. If C5, C6 roots are affected, similar sensory symptoms is seen in hand but wasting will be seen only at shoulder and never in the hand.

#### **2. Thoracic outlet syndrome**

- a. Motor-related symptoms will be more profound at the shoulder and sensory symptoms will affect more of little and ring fingers.
- b. The classical special tests of Adson's, Roos and Wright's test will be positive.

#### **3. Hansen's disease**

*Examine for*

- a. Hypopigmented anesthetic patches
- b. Thickening of the commonly affected nerves
- c. Signs of neuritis

**4. Lower brachial plexus lesion** can lead to combined median, ulnar and even radial nerve palsy. Check the MRC grading of the long finger and thumb extensors. In these cases, there may be weakness of the long thumb extensors as they may have significant contribution from C8–T1. Extensor indicis action may be absent also. Look for additional sensory loss in the territory of the medial cutaneous nerve of the forearm and arm.



Always examine possible donor muscles and their power and document it to show the examiner that you have thought about the management of the case if required.

In this case, extensor indicis, EDM, ring finger FDS (in low median nerve palsy) are common donors for opponensplasty.

**Final diagnosis: Age and occupation of patient/side/median nerve palsy: Etiology/level of injury (anatomic)/type of injury (pathologic)/duration/complications**

**Scenario 1:** This is 36-year-old housewife presenting with right-sided post-traumatic high median nerve palsy, a neurotmesis at the level of axilla of 4 months duration.

*Points in favor*

- History suggestive of trauma, open injury and hence neurotmesis
- Presence of axillary scar
- Typical attitude: Benediction sign
- All the muscles supplied by median nerve are affected with involvement of its sensory distribution.
- **Tinel's sign will give a vital clue in traumatic cases whether it is neurotmesis or axonotmesis. In neurotmesis, the Tinel's sign will be observed at the site of scar/injury and will not progress distally unless a good neurotomy has been done.**

In axonotmesis the Tinel's sign would be observed at variable distance distally depending on the duration since injury (remember in Wallerian degeneration the axon progresses 1 mm/day approximately during regeneration).

**Scenario 2:** This is 59-year-old right hand dominant housewife with diabetes presenting with right-sided low median nerve palsy due to carpal tunnel syndrome of more than 1 year duration with neuropathic ulcer in the middle finger.

- Insidious onset of progressive pain and tingling in the hand
- Progressive decrease in the strength with clumsiness of hand function
- Numbness/tingling in the night. Patient flicks/shakes the hand in the night for symptomatic relief. This is called flick sign.
- Wasting in the thenar eminence, ulcer in the median nerve territory
- Tinel's sign elicited at carpal tunnel. Phalen and Durkan's will be variably positive depending on the severity.
- Sensory loss in the median nerve territory. Long flexor tendon function will be intact, but the pen test for APB will demonstrate loss of its function.

**What will you do?**

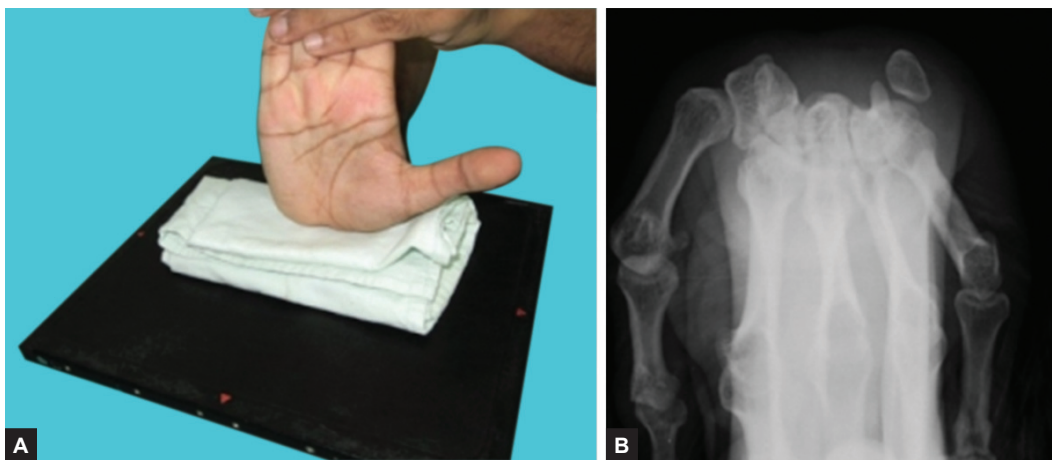
**Answer:** I would like to confirm my diagnosis and then plan my management.



### Investigations

X-ray, NCV, USG, specific investigations based on etiology (MRI, skin biopsy, etc.)

- X-ray: Useful in cases of malunited distal radius fractures or carpal dislocations which may reduce the tunnel size and cause median nerve compression. Otherwise, X-rays are required to see the status of the underlying bones along the course of the nerve in post-traumatic injuries.
- Special view: Carpal tunnel view is taken to see the floor of the tunnel where any bony projection like malunion or carpal dislocation can compress the median nerve (Fig. 27.18A and B).



**Fig. 27.18A and B:** Carpal tunnel view. The fingers are pulled into extension and wrist dorsiflexed. The radiographic beam is angled 30° to long axis of the hand

- NCV is the gold standard to note the latency, amplitude and duration of compound motor and sensory action potentials at various areas along the course of the nerve. It also tells the level, type of injury and recovery pattern.
- EMG may show APB denervation in severe cases.
- USG: Tells the nerve continuity and delineates anatomy of a scar tissue if patient has been operated earlier. It may guide about the gap in the nerve and where the cut ends are lying if only skin was sutured without nerve repair in neurotmesis (common scenario in our country).
- MRI may be required in a few cases to know the detail anatomy of the nerve especially in tumours or compression neuropathies in proximal areas.

### Principles of treatment

- Neuropraxia and axonotmesis: Wait and watch.
- During the waiting period: Splint (thumb in palmar abduction, or a first web spacer), passive and assisted mobilization of all joints, vitamin B<sub>12</sub> and electrical stimulation of paralysed muscles.
- Neurotmesis: Primary epineural repair (neurorrhaphy) when possible. If patient presents late graft in used exploration and repair if possible or use

nerve grafting if there is a gap (graft is used when the gap is more than 1 inch, if not, the suturing will be under tension leading to fibrosis at the repair site and failure of the procedure).

- **In axonotmesis or in neurotmesis (post-repair), when there is no progression in recovery, then reconstructive procedures have to be done after a reasonable waiting period which is usually by 6–9 months.**

### **Reconstructive procedures**

In high median nerve palsy three motor functions need to be restored.

1. Weakness of FDP of index: Plication of FDP to ulnar nerve innervated FDP is sufficient.
2. Weakness of FPL: Brachioradialis transfer is an acceptable choice.
3. Opponensplasty: The extensor indicis or EDM is a standard choice for transfer.

**Opponensplasty is not a crucial procedure in isolated median nerve palsy as the loss of opposition is well compensated by patients when ulnar nerve is functioning (due to action of adductor pollicis and FPB) and also with functioning radial nerve (due to action of APL and EPL which also aid in initiation of opposition). Patients develop trick movements and perform their activities compensating for loss of thumb opposition.**

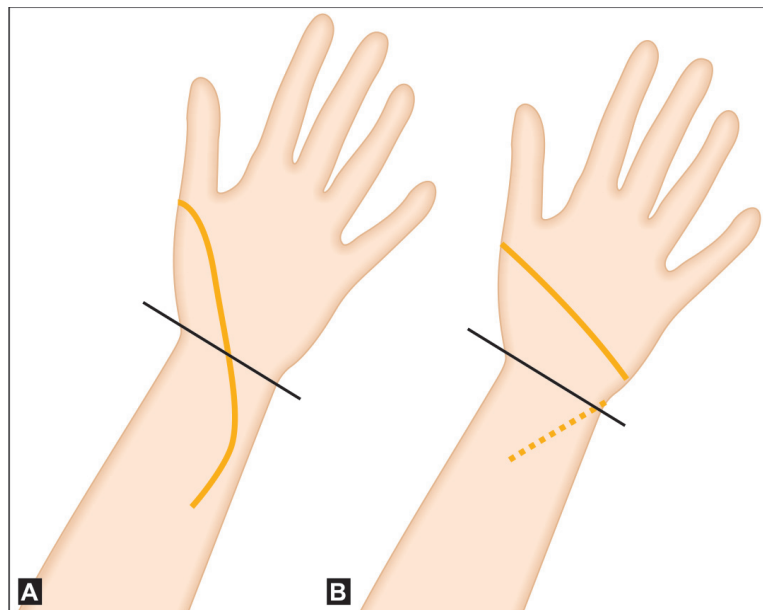
In low median nerve palsy, one must again assess the disability of the patient as APB loss is well compensated with residual FPB function. If disability is present, the same EI or EDM transfer is sufficient. Other choice is the use of FDS of ring finger. **In patients with severe carpal tunnel syndrome, transfer of palmaris longus (Camitz's transfer) is an excellent choice.**

**An important point to note for opponensplasty is that it requires a pulley at the wrist level where the transferred tendon passes from ulnar to radial side to get palmar abduction and the pulley increases the efficiency of the transfer (Fig. 27.19A).**

The pulley is kept proximal to wrist to get APB action. In cases where the FPB action is lost (total clawhand with ulnar nerve palsy or a rare scenario where FPB is exclusively supplied by median nerve), this pulley needs to be kept distal to wrist joint line to get additional action of FBP apart from APB (Fig. 27.19B).

**The tendon has to be finally inserted into the area of abductor pollicis brevis and to dorsal digital expansion.**

- In the presence of long-standing adduction/first web space contracture or in severe instability (e.g. poliomyelitis), 1st CMC joint fusion needs to be done in palmar abduction.



**Fig. 27.19A and B:** (A) Line of pull proximal to wrist; (B) Line of pull distal to wrist

- Restoration of sensation in the radial digits is mandatory and will require neurolysis/nerve repair or sural nerve grafting. These can be done even if patient presents very late as protective sensation can be gained even up to 5 years post-injury.

### Core clinical findings to be mentioned

1. Deformity
2. Typical pattern of sensorimotor loss
3. Level of injury based on muscle testing (loss of long finger flexors and wrist flexors suggestive of high median nerve palsy noted by clasp test and motor examination)
4. Findings on nerve palpation
5. Tinel sign
6. Joint stiffness (1st CMC joint)

### *A candidate should be able to answer the following questions after reading this chapter*

1. Why do you say it is median nerve palsy?
2. What is the possible etiology?
3. What is the level of injury?
4. Which muscle will you test first to know the level of injury?

5. What is the type of injury based on the history?
6. What are the compressive neuropathies involving the median nerve?
7. What are the complications you have noted?
8. What is the disability in median nerve palsy?
9. What are the options to restore the important functions lost in median nerve palsy?
10. What is the splint used in median nerve palsy?
11. When will you decide to do tendon transfer?
12. What is opponensplasty? What are the principle rules of opponensplasty? Give a few examples.