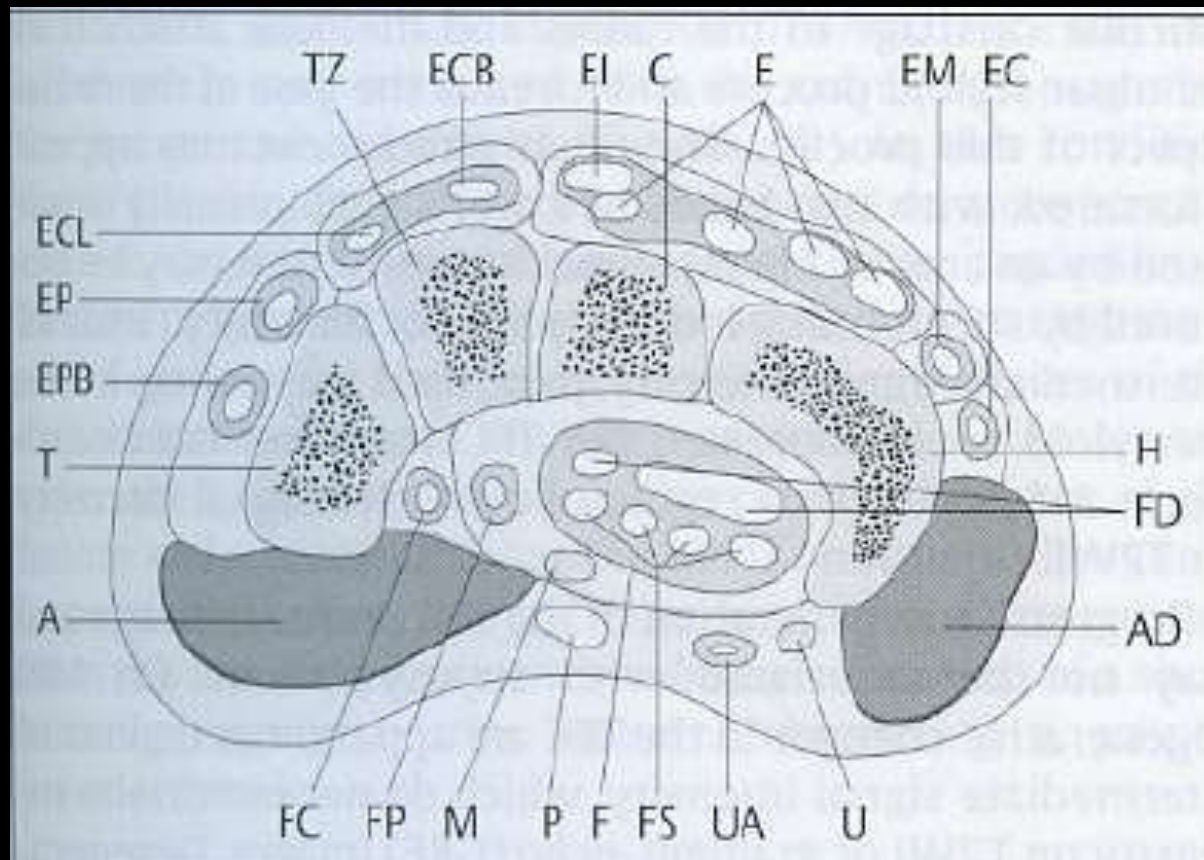


بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# **Wrist Joint Tunnels & Nerves MRI**

**Dr. Mohamad Hasan Alkousy  
Ass. Professor of Radiology  
Sohag University**

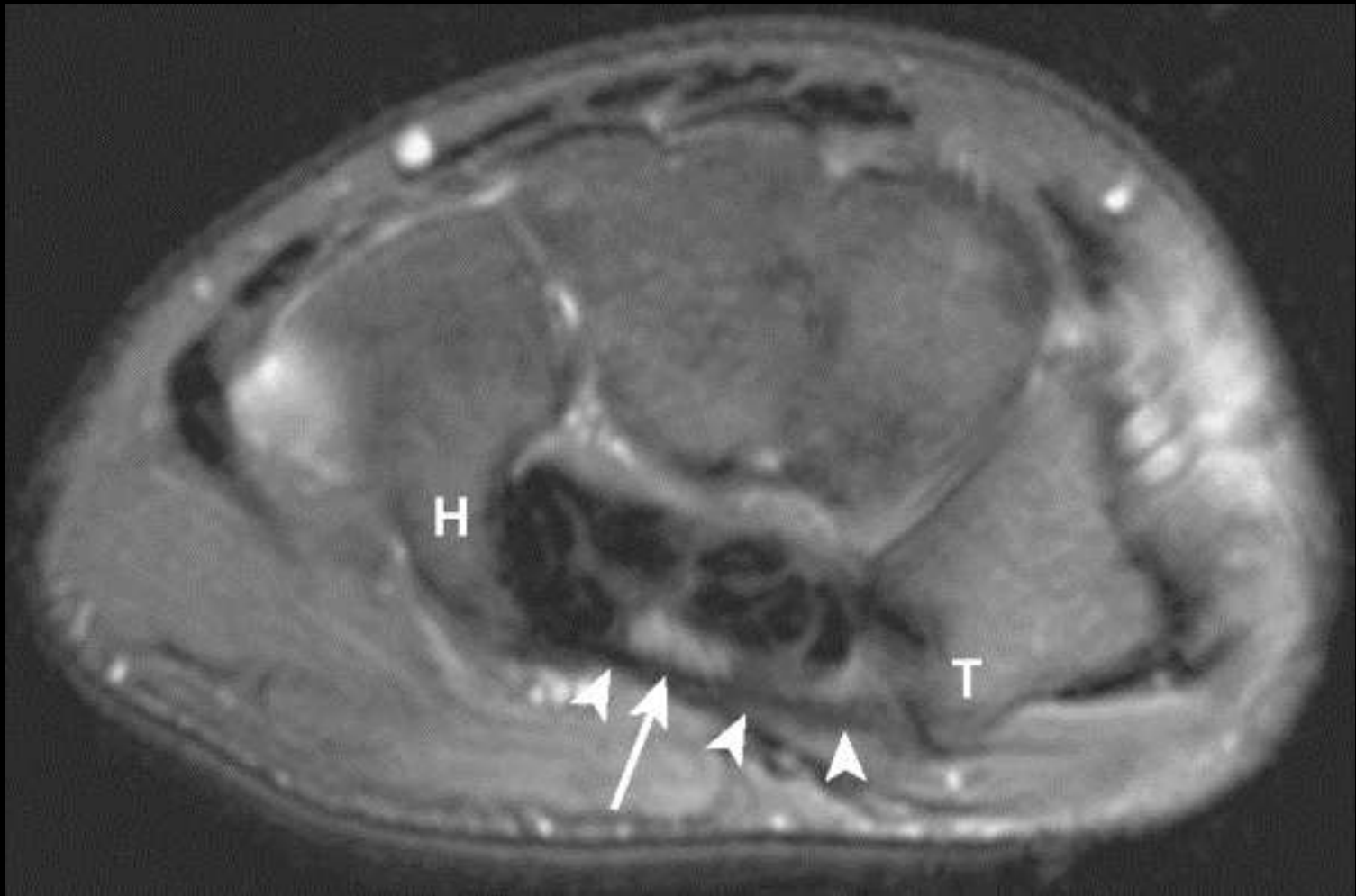
# **Carpal Tunnel & Median N.**



## Carpal tunnel

**A** = abductor pollicis brevis, **AD** = abductor digiti minimi, **C** = capitate, **E** = common extensor digitorum tendon, **EC** = extensor carpi ulnaris, **ECP** = extensor carpi radialis brevis, **ECL** = extensor carpi radialis longus, **EI** = extensor indicis, **EM** = extensor digiti minimi, **EP** = extensor pollicis longus, **EPB** = extensor pollicis brevis, **F** = flexor retinaculum, **FC** = flexor carpi radialis, **FD** = flexor digitorum profundus, **FP** = flexor pollicis longus, **FS** = flexor digitorum superficialis, **H** = hamate, **M** = median N., **P** = palmaris tendon, **T** = trapezium, **TZ** = trapezoid, **U** = ulnar N., **UA** = ulnar A.





**Carpal tunnel: normal anatomy (Axial FS T2)**

At the distal carpal tunnel at the level of the hook of hamate (H), tubercle of the trapezium (T), and flexor retinaculum (*arrowheads*). The median nerve (*arrow*) is fasciculated and intermediate to high signal.

- It is a fibro-osseous space.

### Formed by

- The concave volar aspects of the carpal bones on the dorsal surface.
- The flexor retinaculum on the volar surface.

### Contents

- Flexor tendons.
- Median N.
- Normally, very little fat (should be found only in the dorsal aspect).

## The flexor retinaculum

- It is a dense fibrous band.
- It normally shows slight palmar bowing.
- Attaches to
  - Scaphoid & tubercle of the trapezium on the radial side of the tunnel.
  - Pisiform and hook of hamate on the ulnar side of the tunnel.

## The bowing ratio

- Calculated by drawing a line from trapezium to hook of hamate on an axial image (length = TH).
- The distance from this line to the flexor retinaculum (palmar displacement = PD).
- PD is divided by the length TH.
- The normal ratio is up to 15%.
- In carpal tunnel syndrome, the ratio ranges from 14% - 26%.

## The median N.

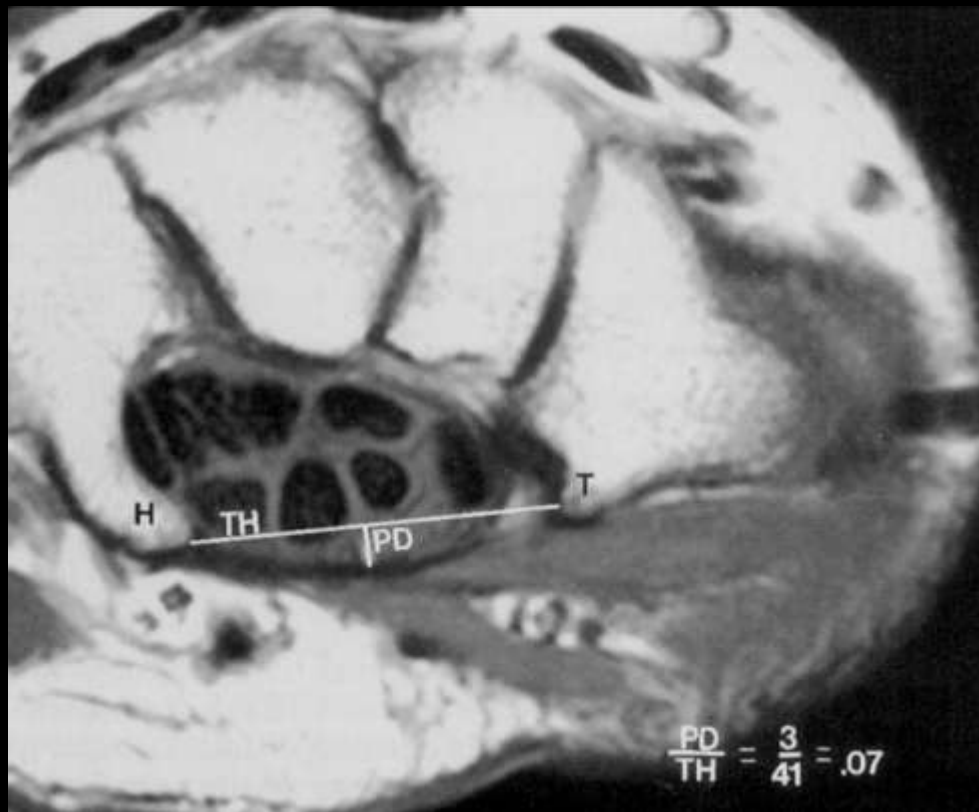
- Lies in the volar & radial aspect of the tunnel just deep to the retinaculum.
- Can be easily ddt from the low signal tendons that surround it.



### **Carpal tunnel syndrome (Axial GE) The bowing ratio**

C, At distal carpal tunnel, the N. (*arrowhead*) is significantly larger than on more proximal images. There is an abnormal bowing ratio. (The bowing ratio is calculated by drawing a line from the hook of hamate (h) to the tubercle of trapezium (t) and dividing that distance into the amount of palmar displacement (pd), which is the distance from line  $h \leftrightarrow t$  to the flexor retinaculum).





HT = Hamate / trapezium.

PD = Perpendicular distance.

Carpal tunnel syndrome



## Median Nerve

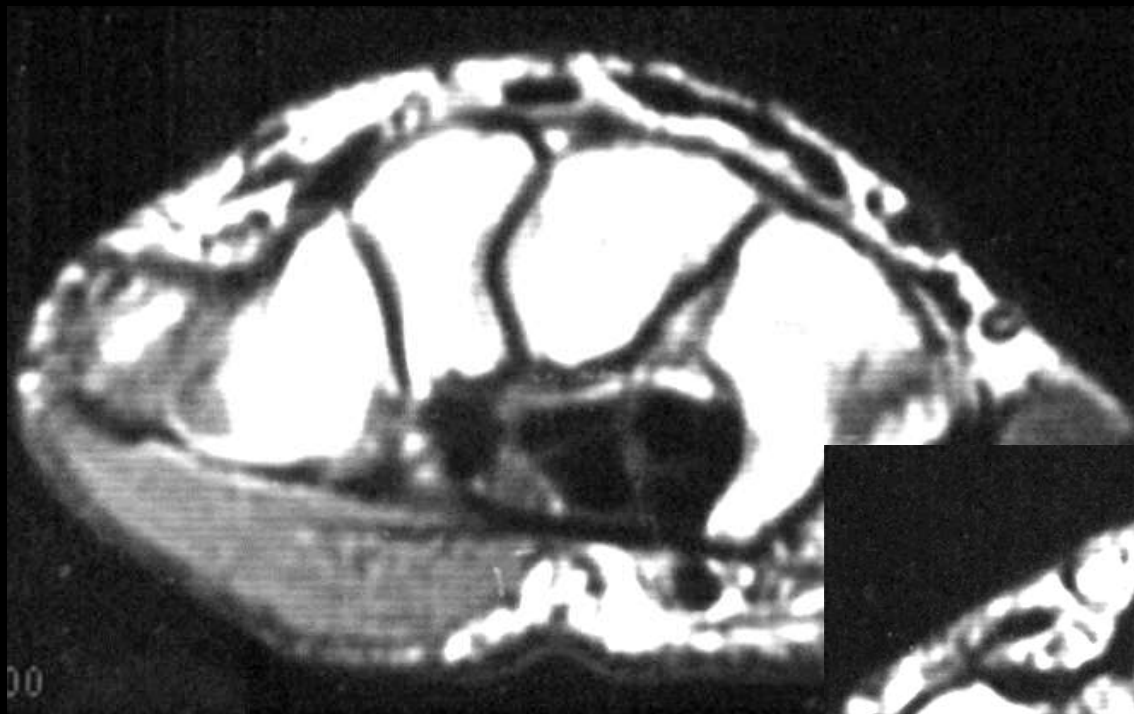
- Lies in the volar & radial aspect of the tunnel just deep to the retinaculum.
- Can be easily ddt from the low signal tendons that surround it.

### ddt from flexor tendons tendons

- It has higher signal & is more oval than tendons.

### Size

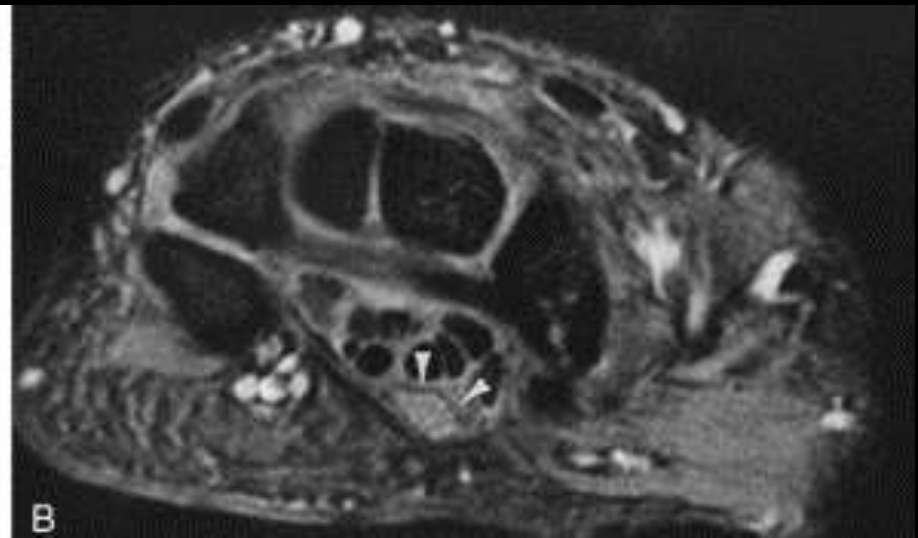
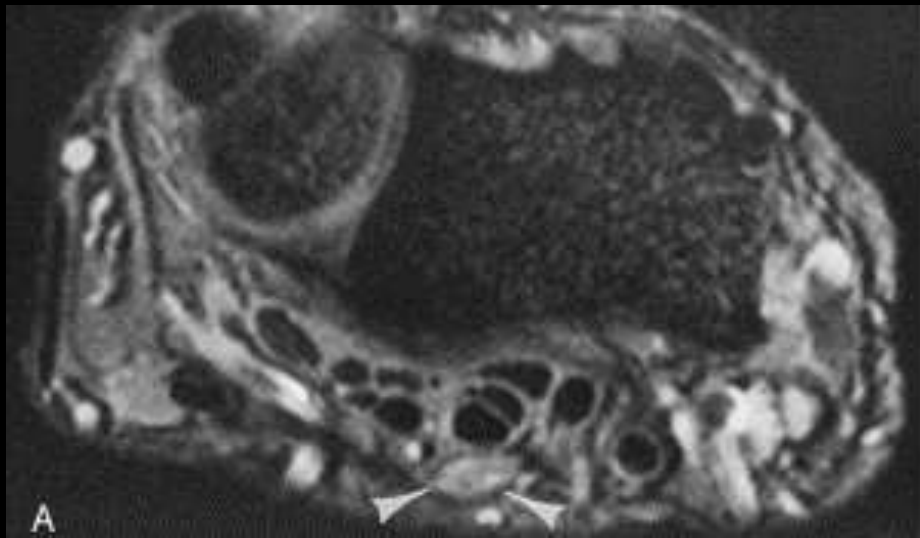
- Its size is maintained / slightly decreases as it progresses distally through the tunnel.
- The tunnel becomes progressively smaller from proximal to distal.
- The N. may have a flattened appearance at the level of hook of the hamate (the tunnel is most constricted) and is in close apposition to adjacent flexor tendons.



**Normal median nerve**

### **Carpal tunnel structures are evaluated at 3 sites on axial MRI**

1. Level of distal radio-ulnar J. (just before the median N. enters the tunnel).
2. Level of pisiform bone (in the proximal tunnel).
3. Level of hook of hamate (in the distal tunnel where it is most constricted).



### Carpal tunnel syndrome (Axial GE)

**A**, At distal radioulnar joint, the median N. (*arrowheads*) is normal at this level.

**B**, At pisiform, the median N. (*arrowheads*) is enlarged and has an angled or faceted appearance from pressure where it abuts the adjacent flexor tendons.

**C**, At distal carpal tunnel, the N. (*arrowhead*) is significantly larger than on more proximal images. There is an abnormal bowing ratio.



# **Carpal Tunnel Syndrome**

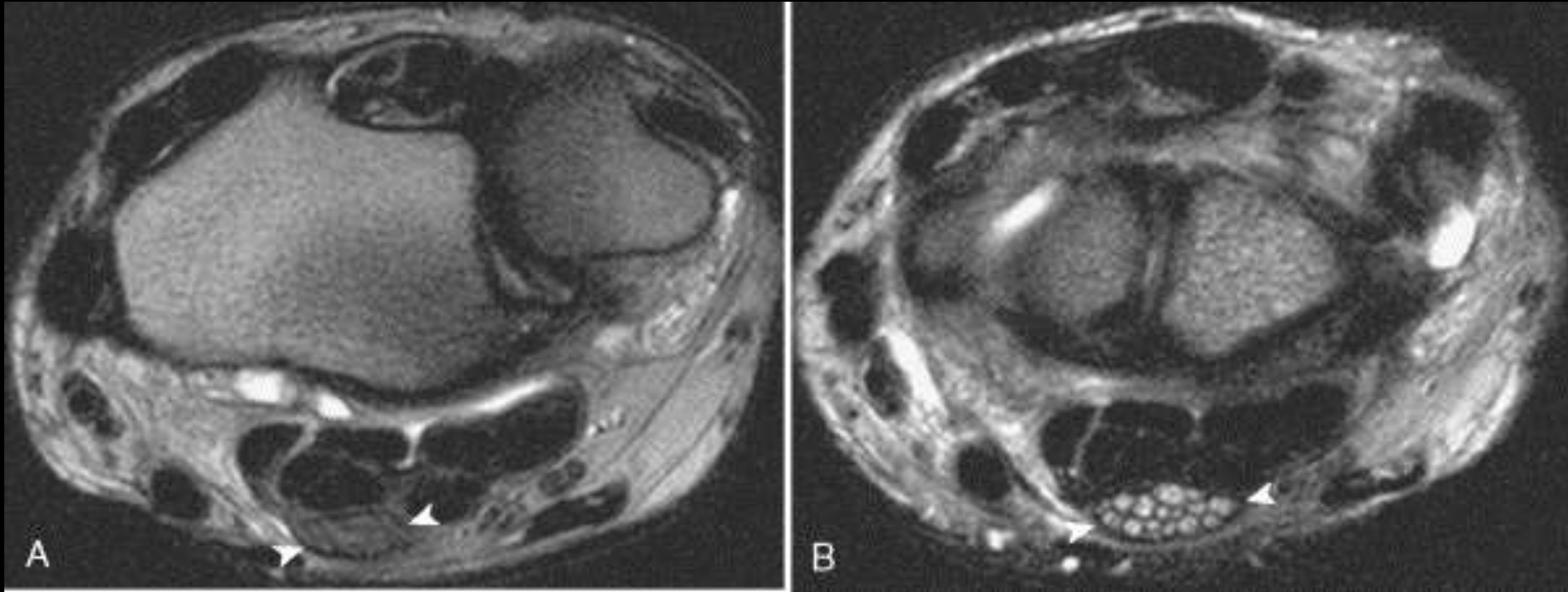
- There are many causes of carpal tunnel syndrome.
- Anything that increases the volume of the contents of the tunnel / narrows the tunnel lead to nerve entrapment.

## Causes

- Tenosynovitis of the flexor tendons (commonest cause).
- Idiopathic (++ with aging).
- Fractures → scarring and fibrosis within the tunnel.
- Inflammatory processes: RA, gout, granulomatous infection.
- Tumors of the median N.: neurofibroma, hamartoma, fibrolipoma.
- Tumors inside the tunnel: ganglia, lipomas, hemangioma.
- ↑ Volume in the tunnel: acromegaly, hypothyroidism, DM, SLE.

## **MRI (axial) (4 signs)**

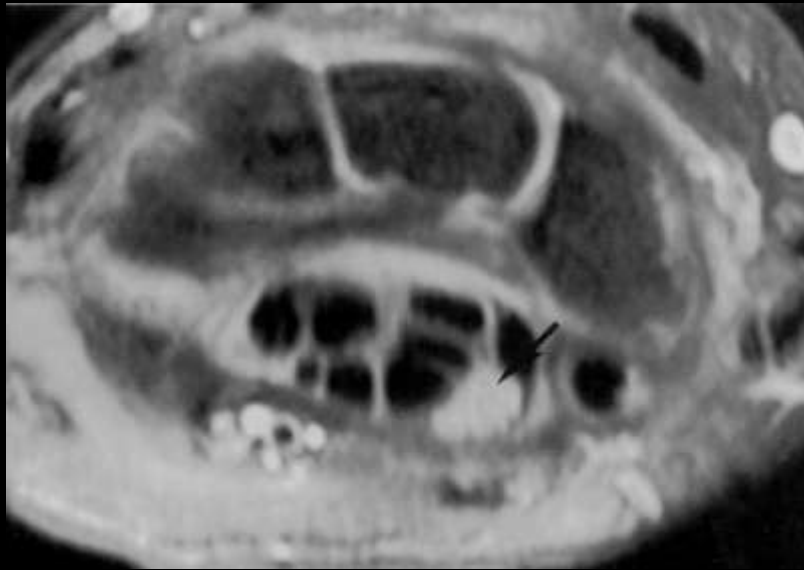
- 1-** Swollen median N. (larger at level of pisiform than at distal radio-ulnar J.).
- 2-** Flattened median N. (evaluate at level of hamate hook).
- 3-** Increased signal of N. on T2
- 4-** Bowing of flexor retinaculum (bowing ratio  $\uparrow$ 15%).



### Carpal tunnel syndrome

**A**, Axial T2 at the distal radioulnar joint, the median nerve (*arrowheads*) is identified before entering the carpal tunnel.

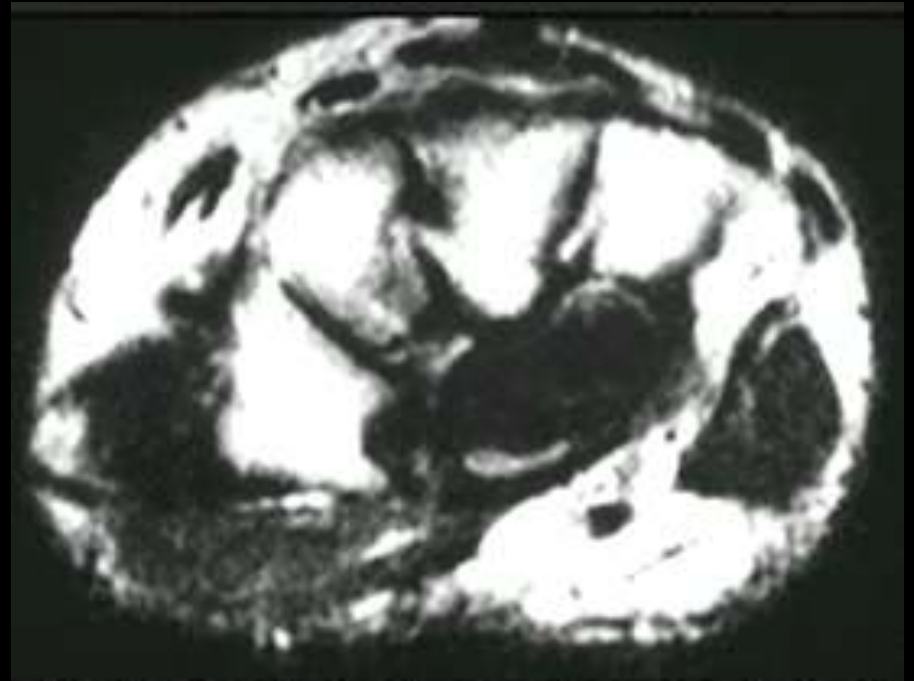
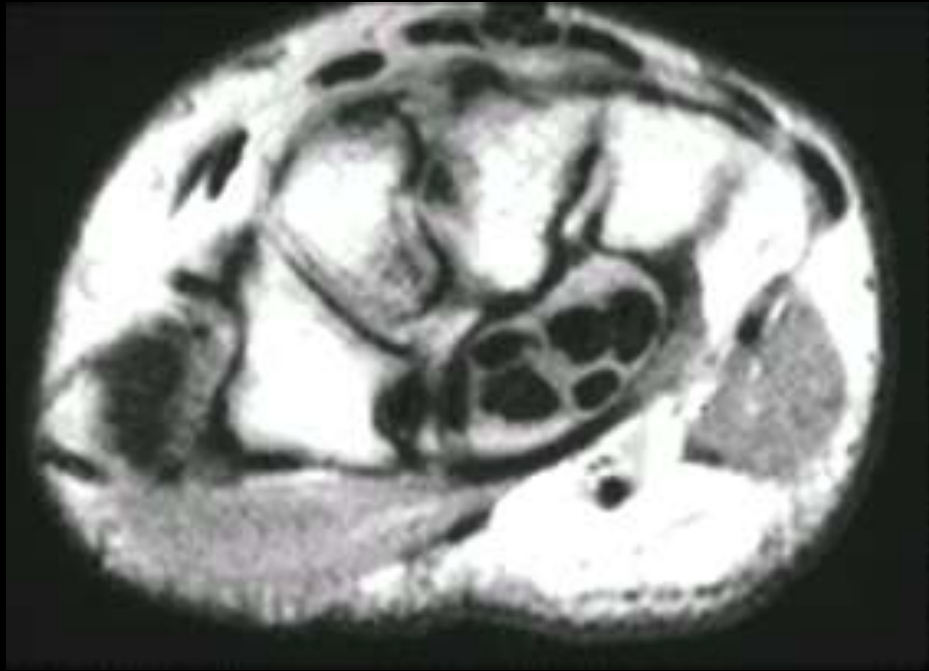
**B**, Axial T2 at the proximal carpal row, the median nerve (*arrowheads*) is enlarged and shows high signal. The flexor retinaculum is bowed volarly.



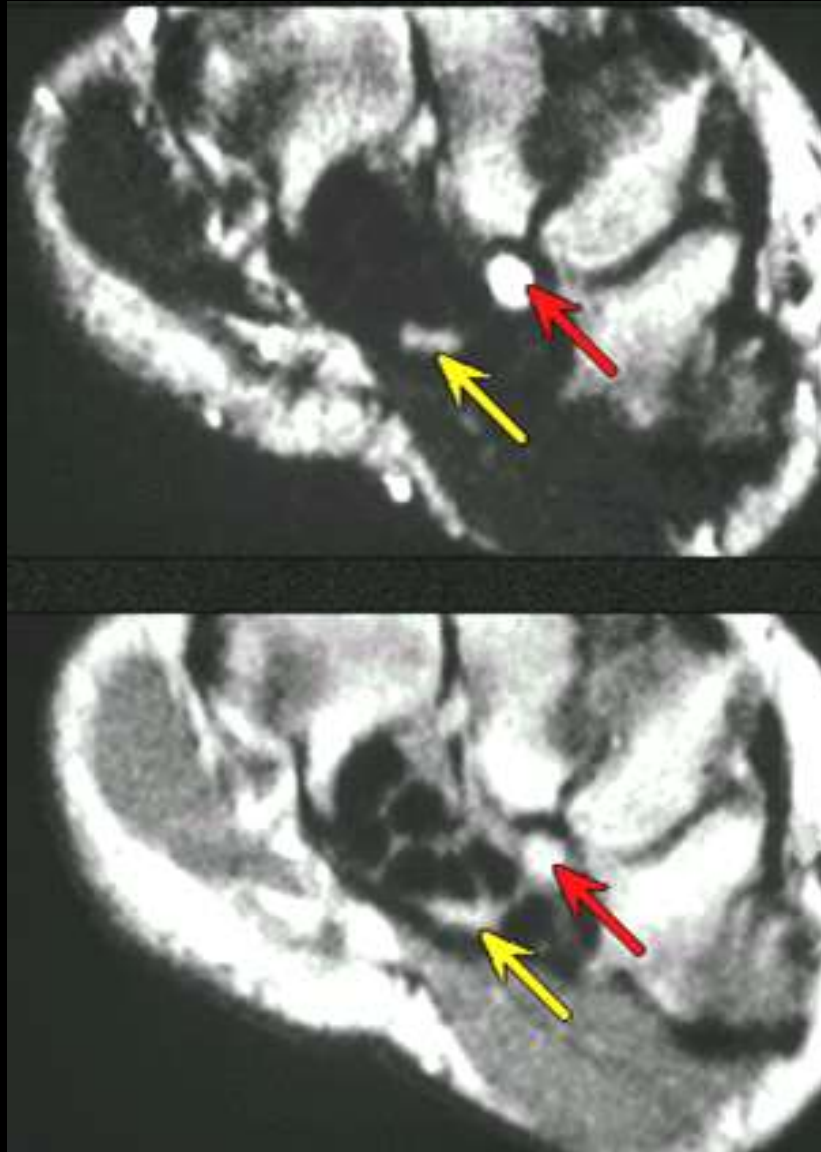
### **Carpal tunnel syndrome**

Swelling , deformity , abnormal signal of the median nerve.

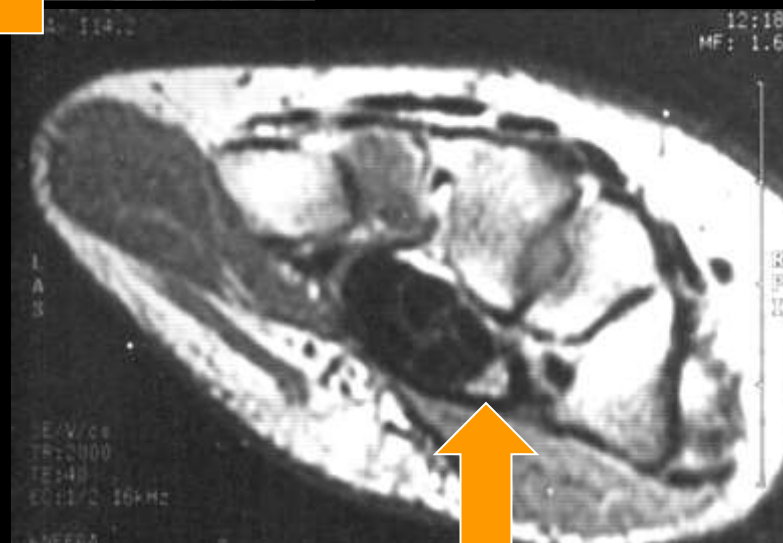
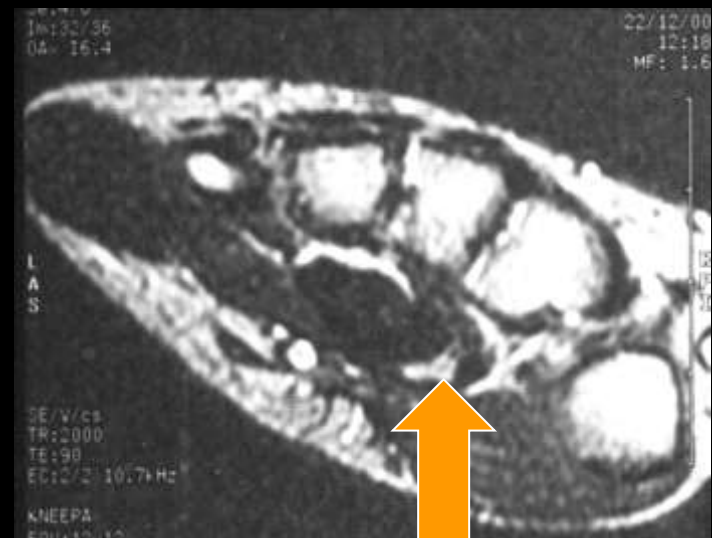
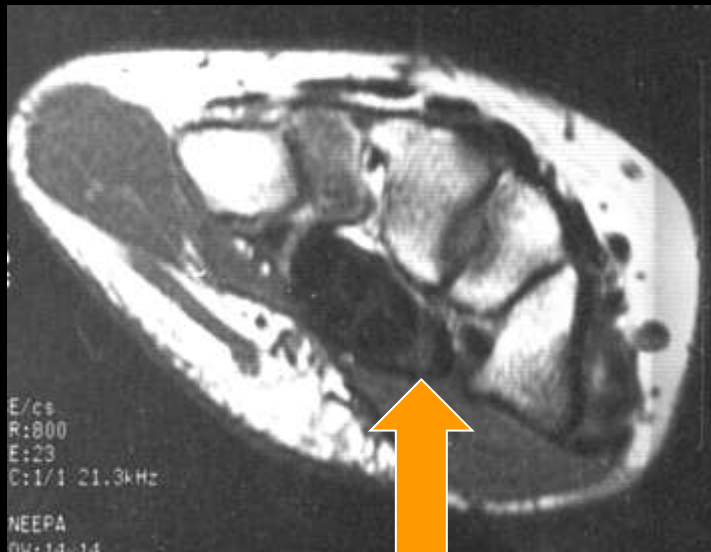




**Carpal tunnel syndrome (axial PD & T2)**

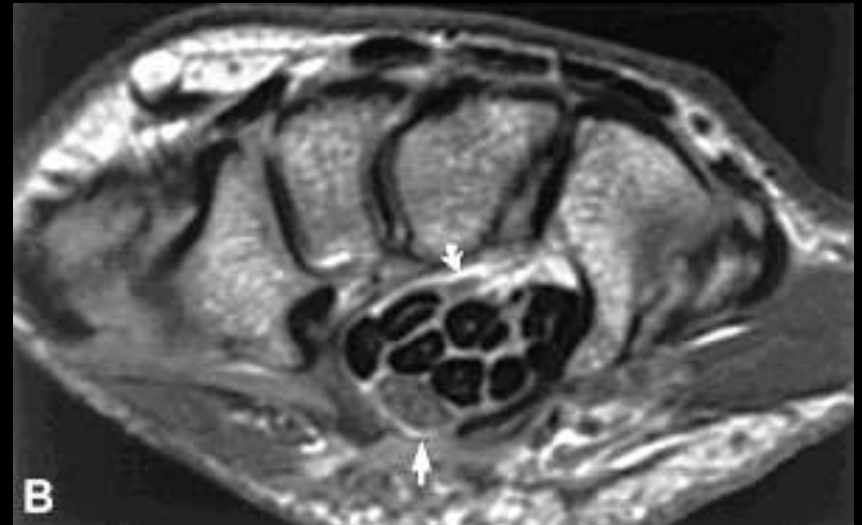
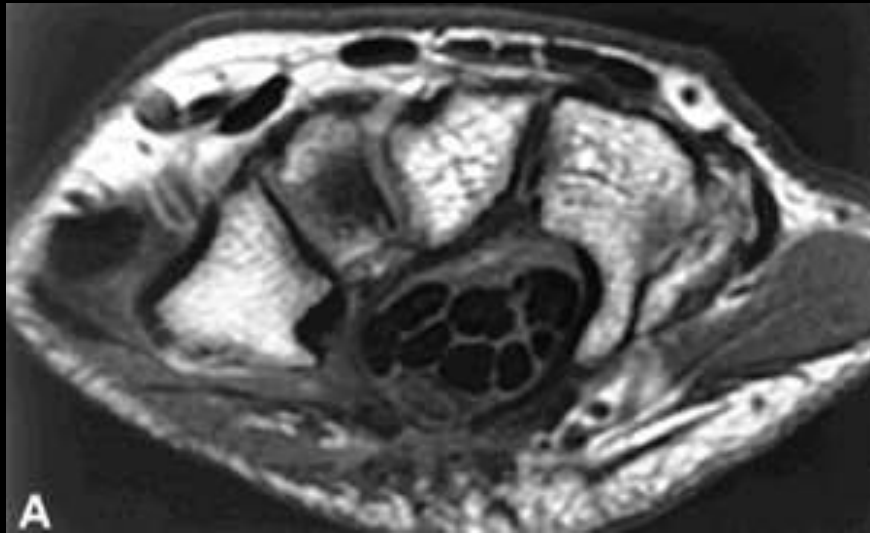


**Carpal tunnel syndrome**



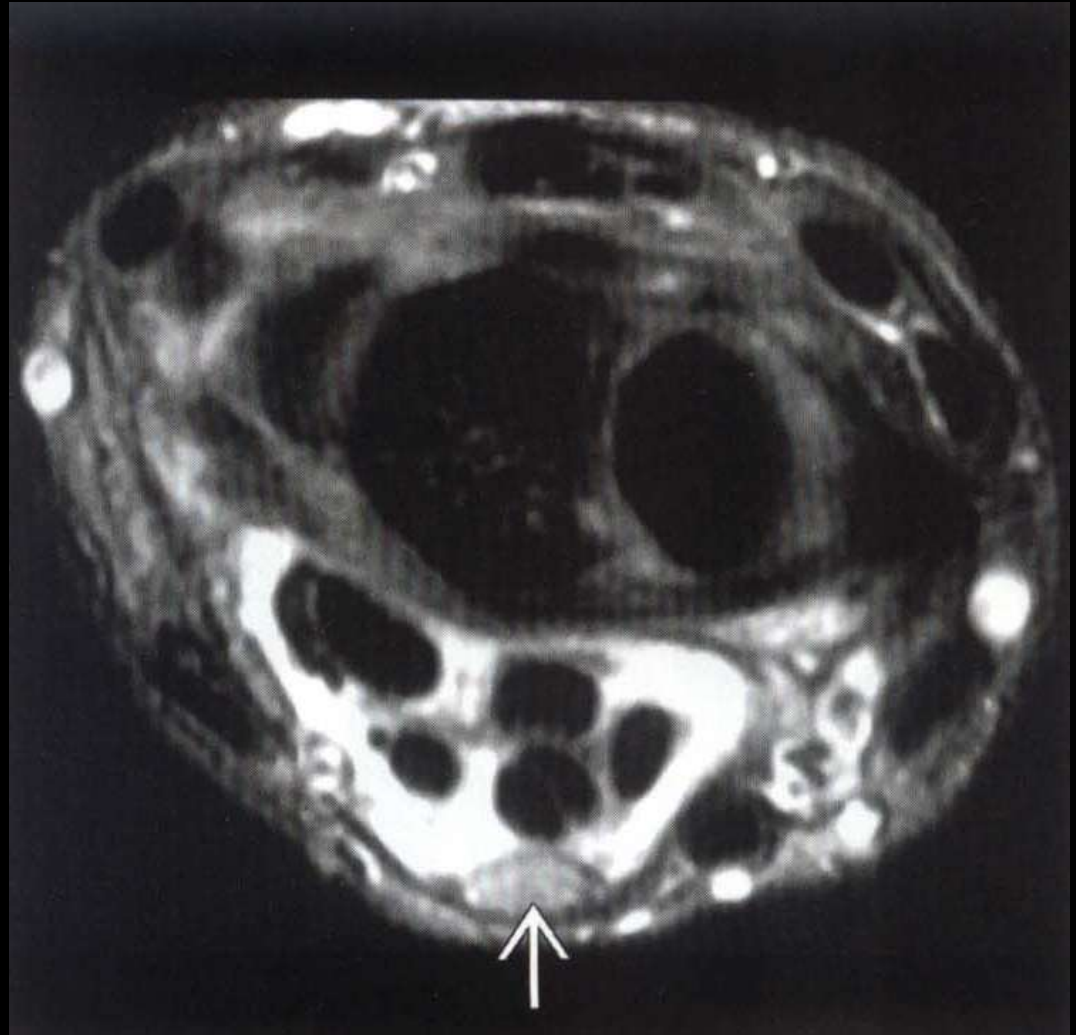
**Carpal tunnel syndrome**

**CTS due to tenosynovitis**



**Endoscopic release of FL with enhancing tenosynovitis**

CTS due to tenosynovitis



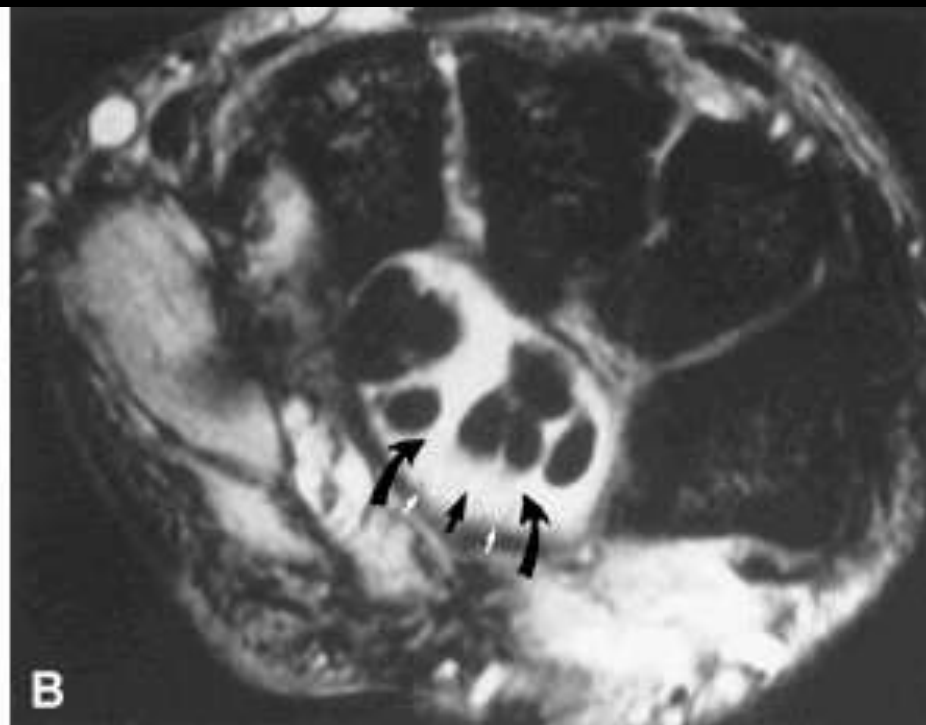
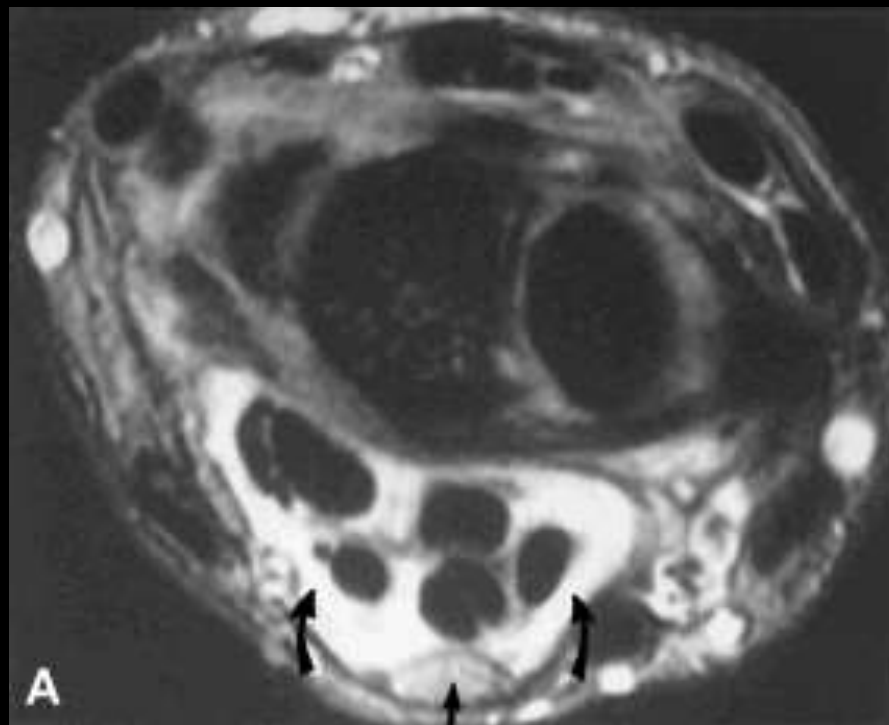
### Carpal tunnel syndrome

Tenosynovitis of flexor tendons with compression of median N.

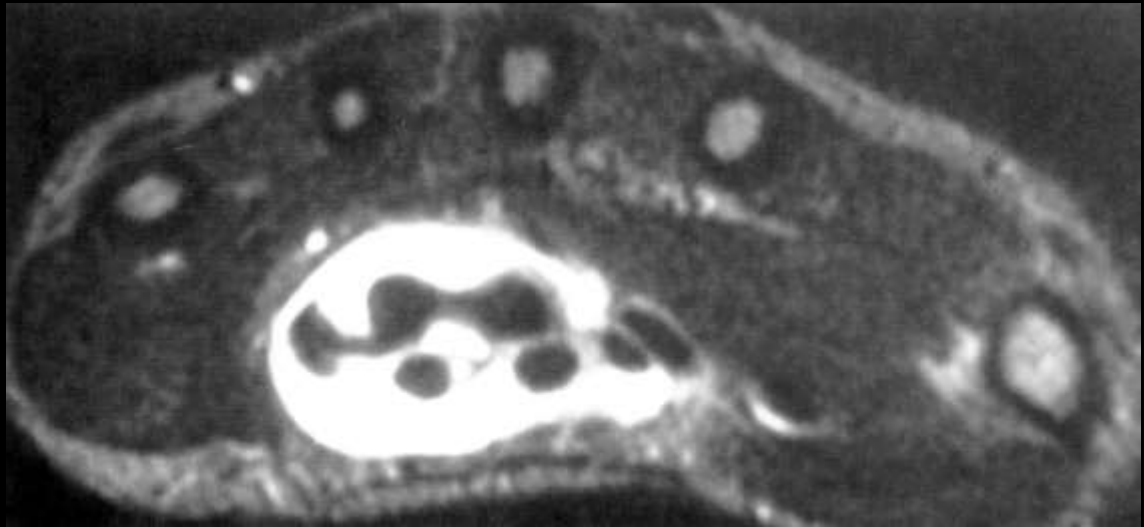
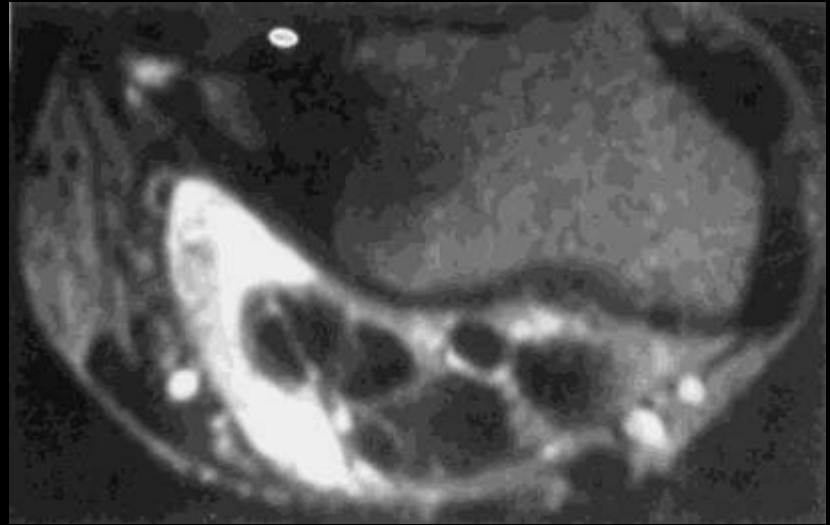
The nerve is swollen and hyperintense. (axial PD & T2)



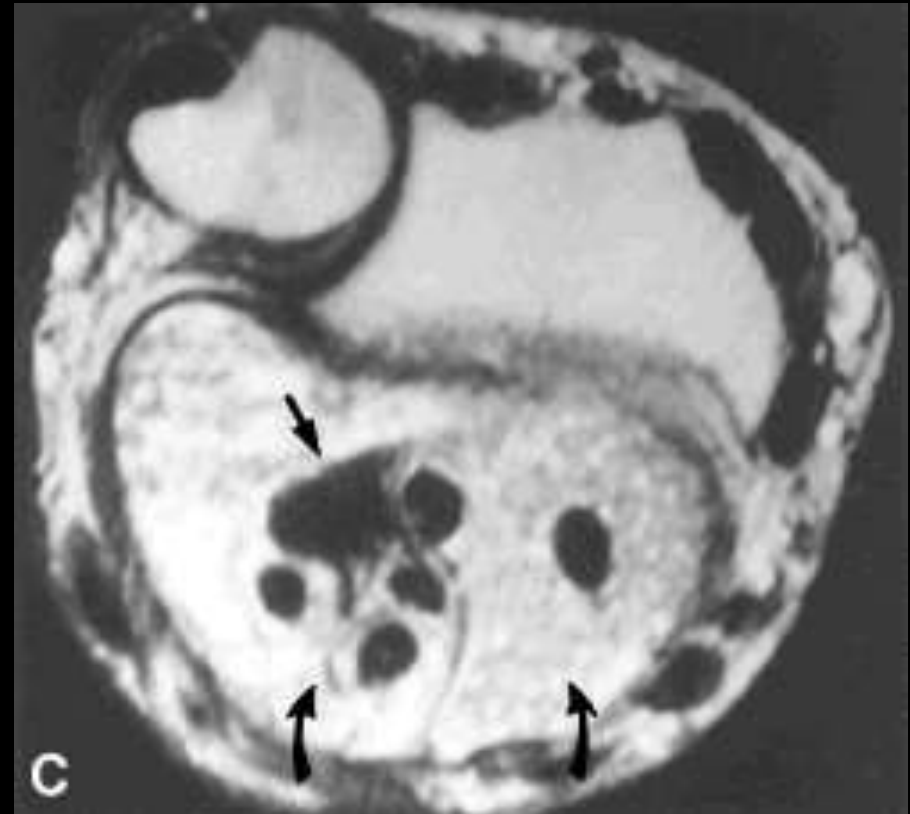
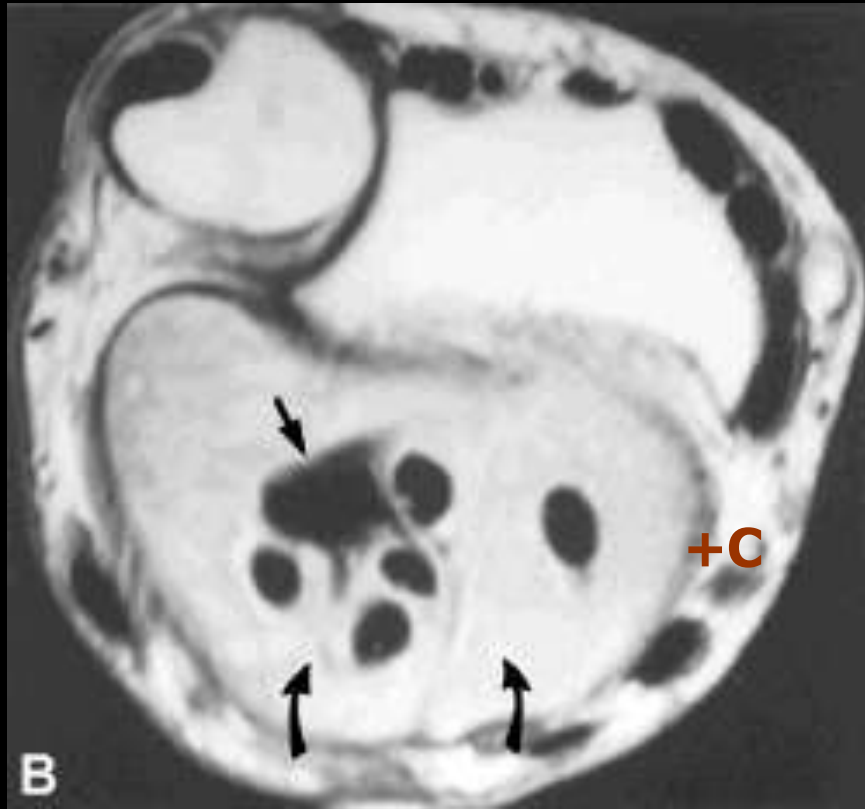
CTS due to tenosynovitis



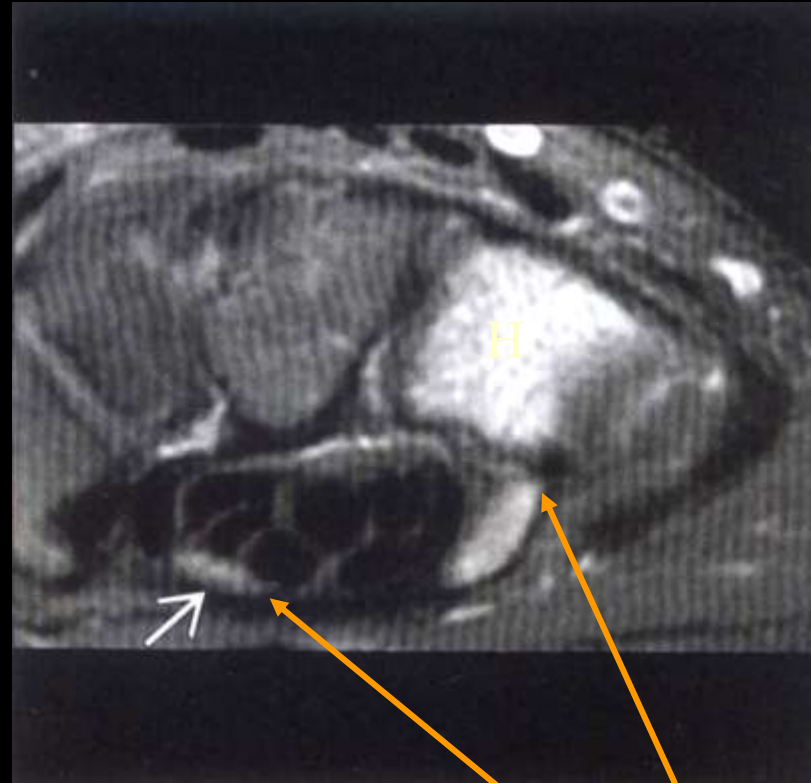
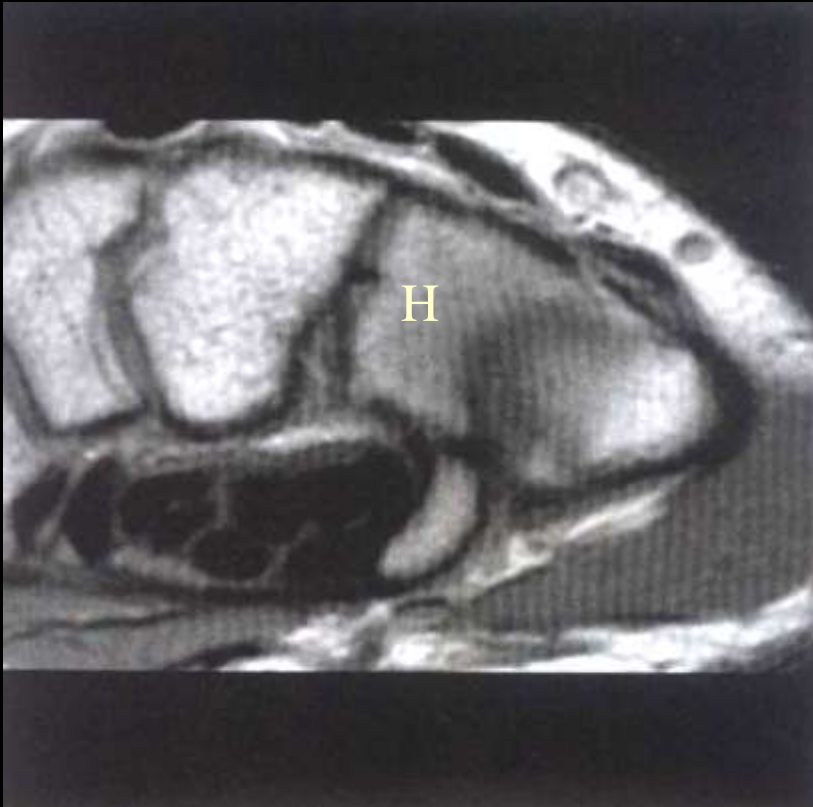
CTS due to tenosynovitis



CTS due to granulomatous tenosynovitis

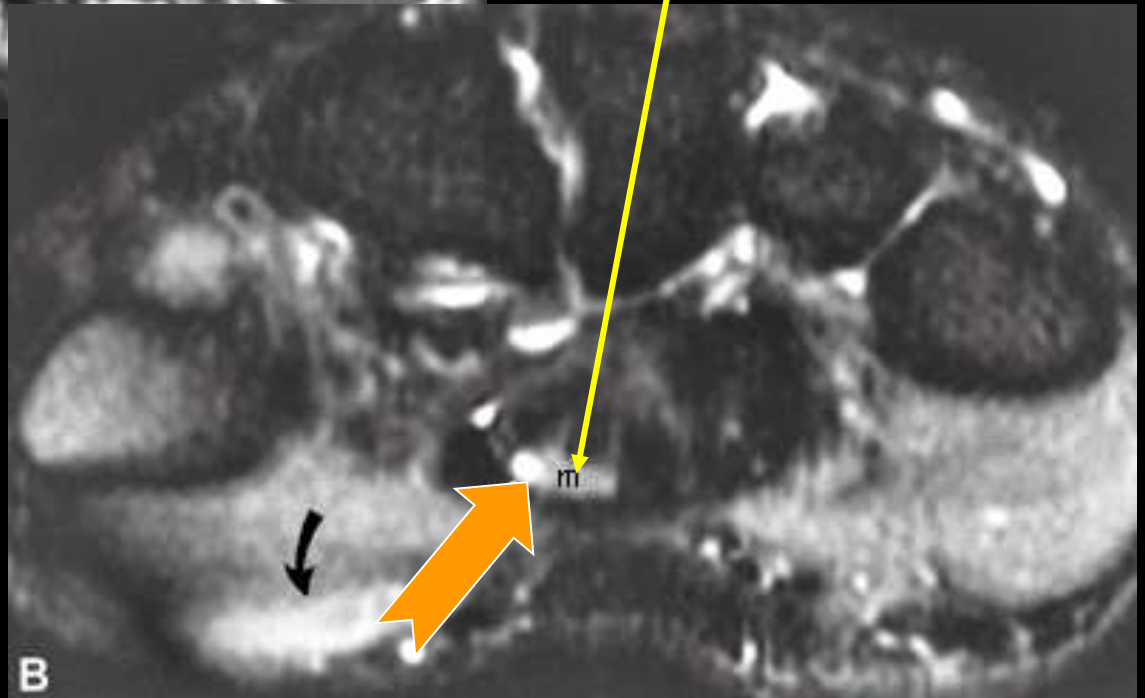
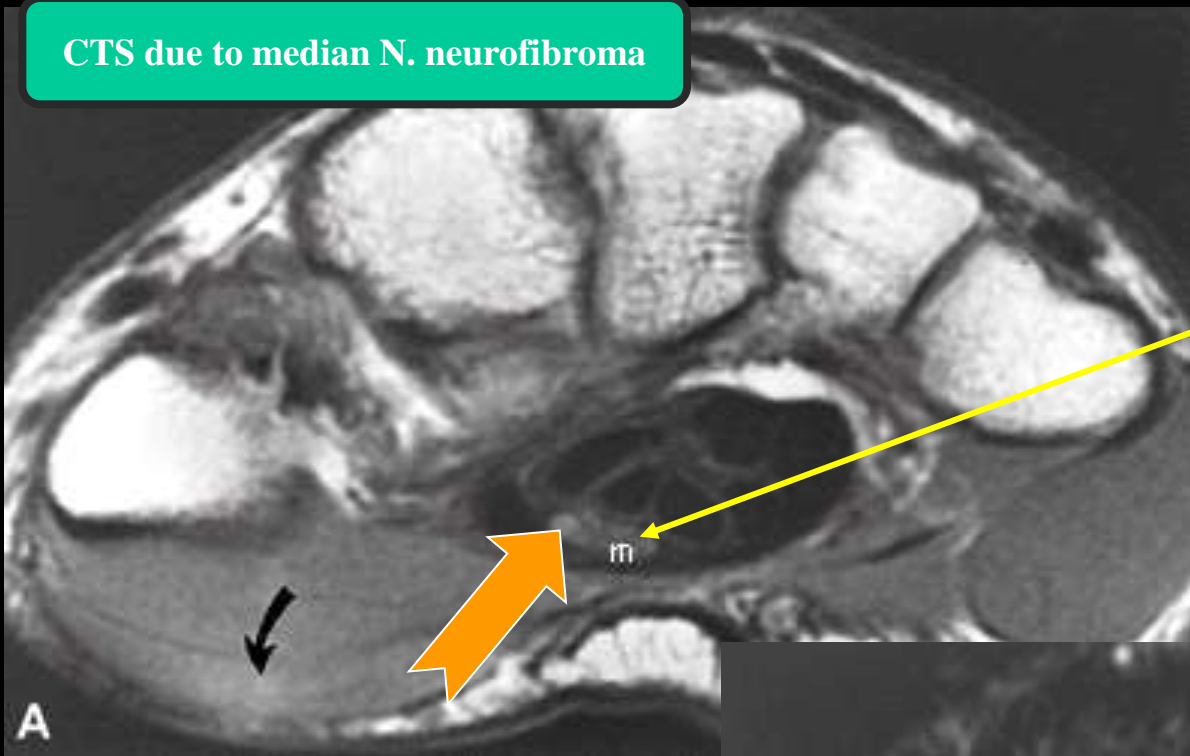


**CTS due to fracture**



**Fractured hook of hamate impinging on the carpal tunnel with flattening of median N. & hamate marrow oedema.**

CTS due to median N. neurofibroma





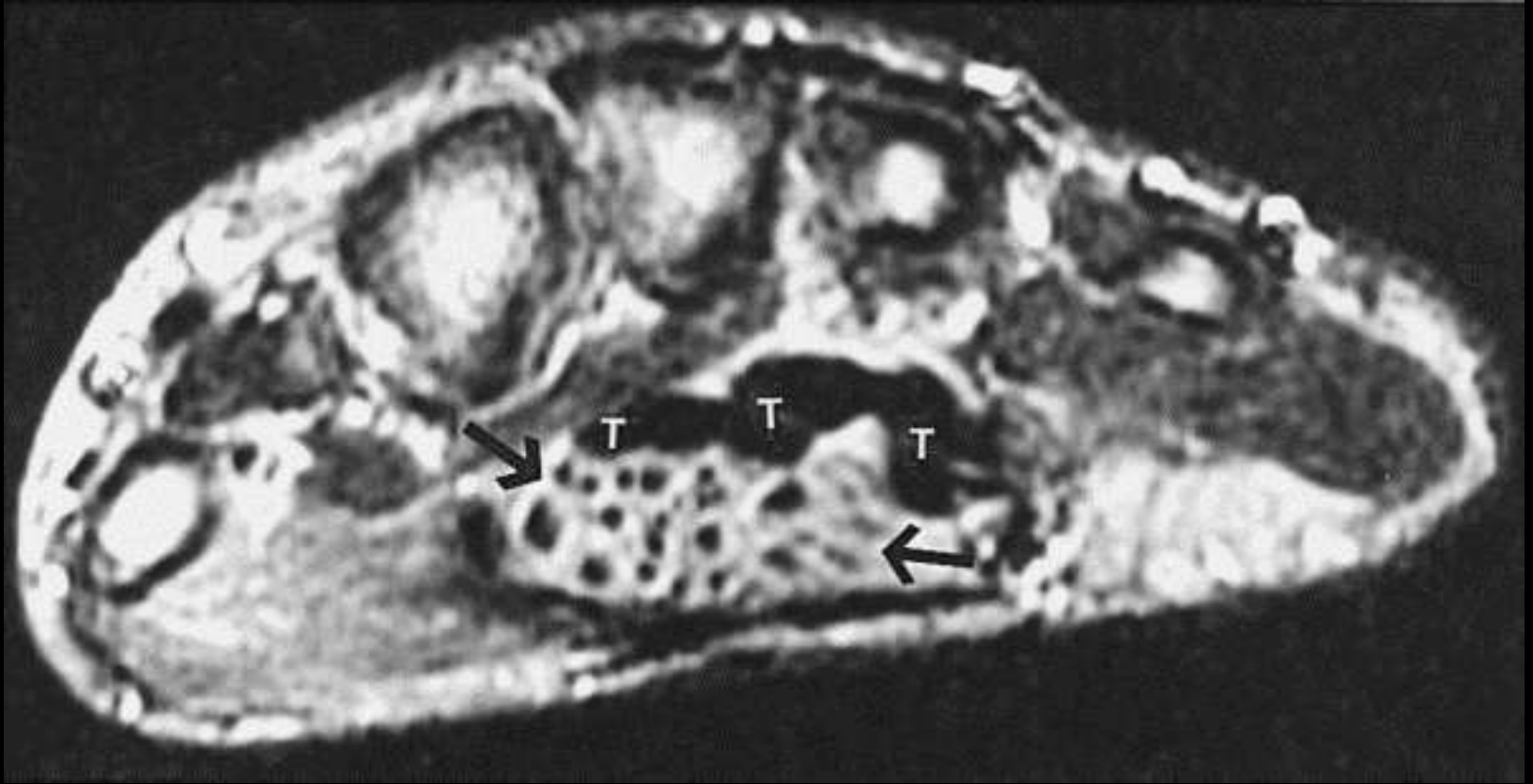
## **Median N. fibrolipomatous hamartoma**

- The median N. in the wrist is the most common N. in the body to be affected.

### **MRI**

- Mass along the course of median N.
- Tubular low signal structures (N. fascicles surrounded by perineural fibrosis) within a background of high signal fat.

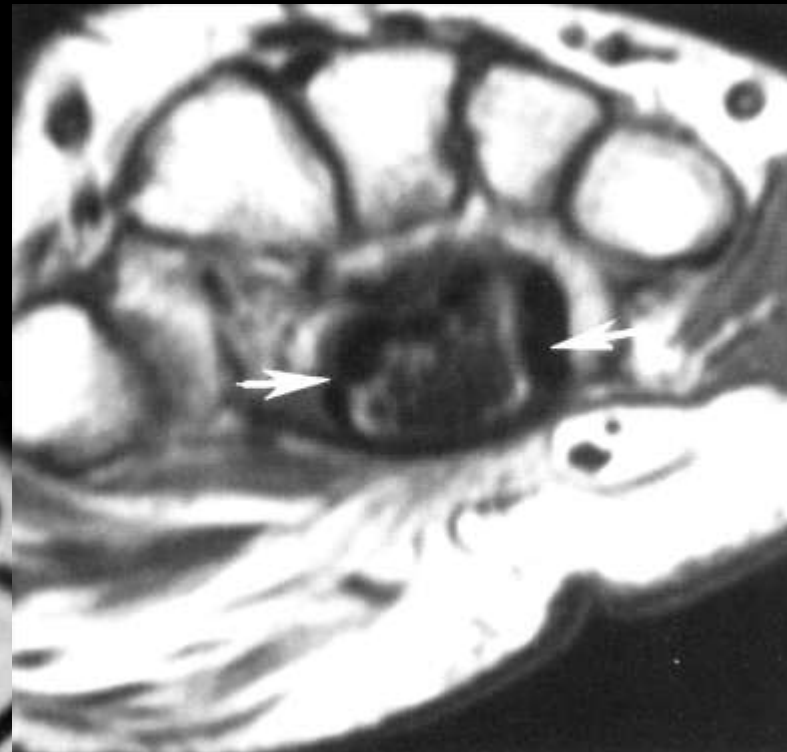
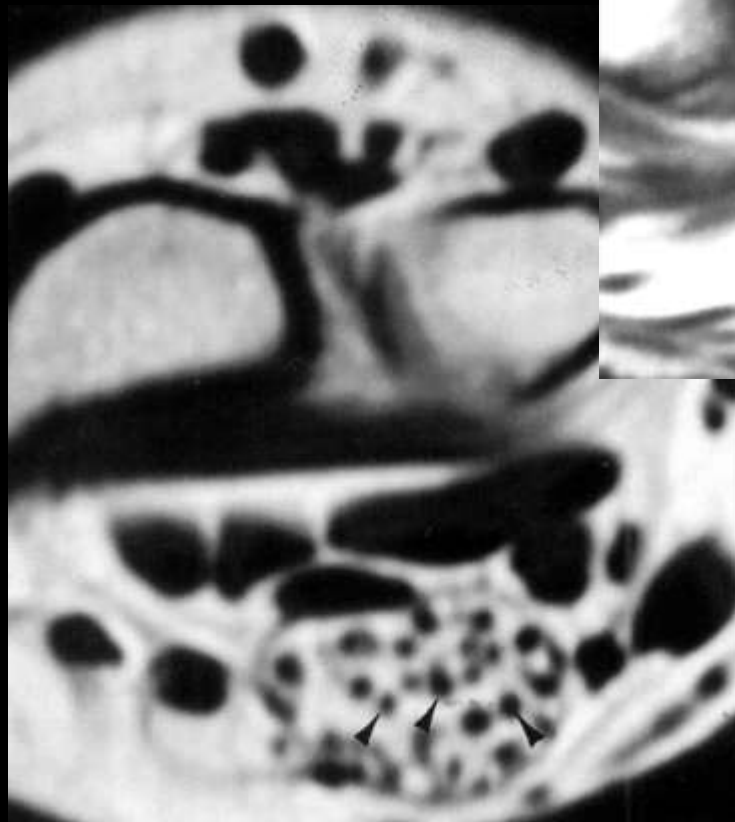
## CTS due to median N. fibrolipomatous hamartoma



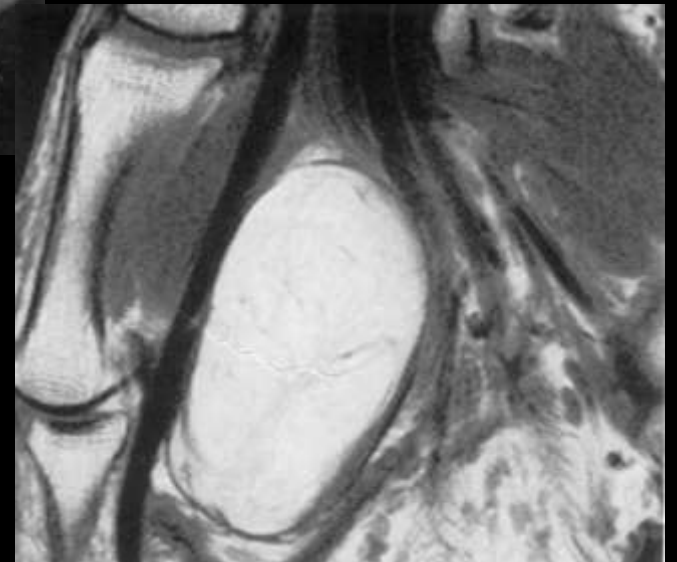
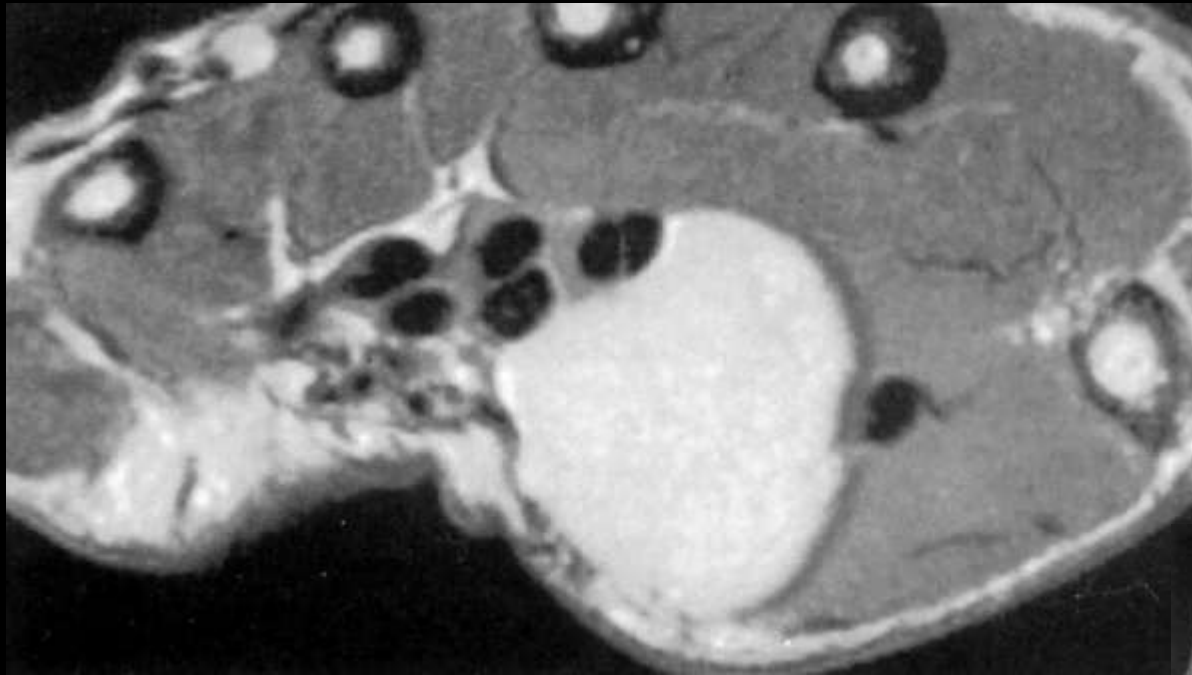
### Fibrolipomatous hamartoma (Axial SE T2)

The stippled area (*arrows*) volar to the flexor tendons (T) is a gigantic median N. The low signal stippled appearance is due to enlarged nerve fascicles and fatty tissue infiltrates around the fascicles.

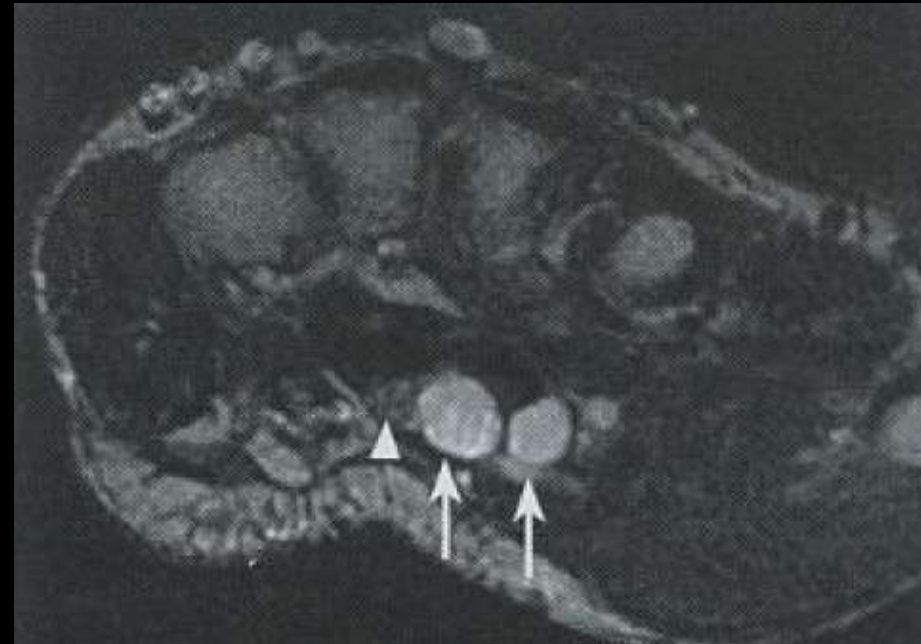
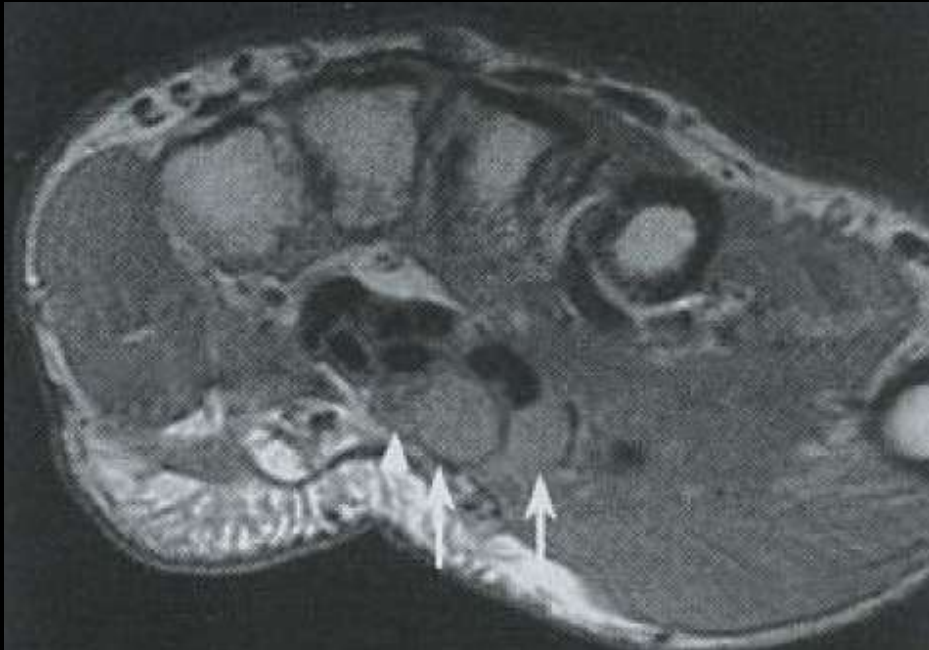
CTS due to median N. fibrolipomatous hamartoma



## CTS due to tunnel lipoma



## CTS due to ganglion cyst



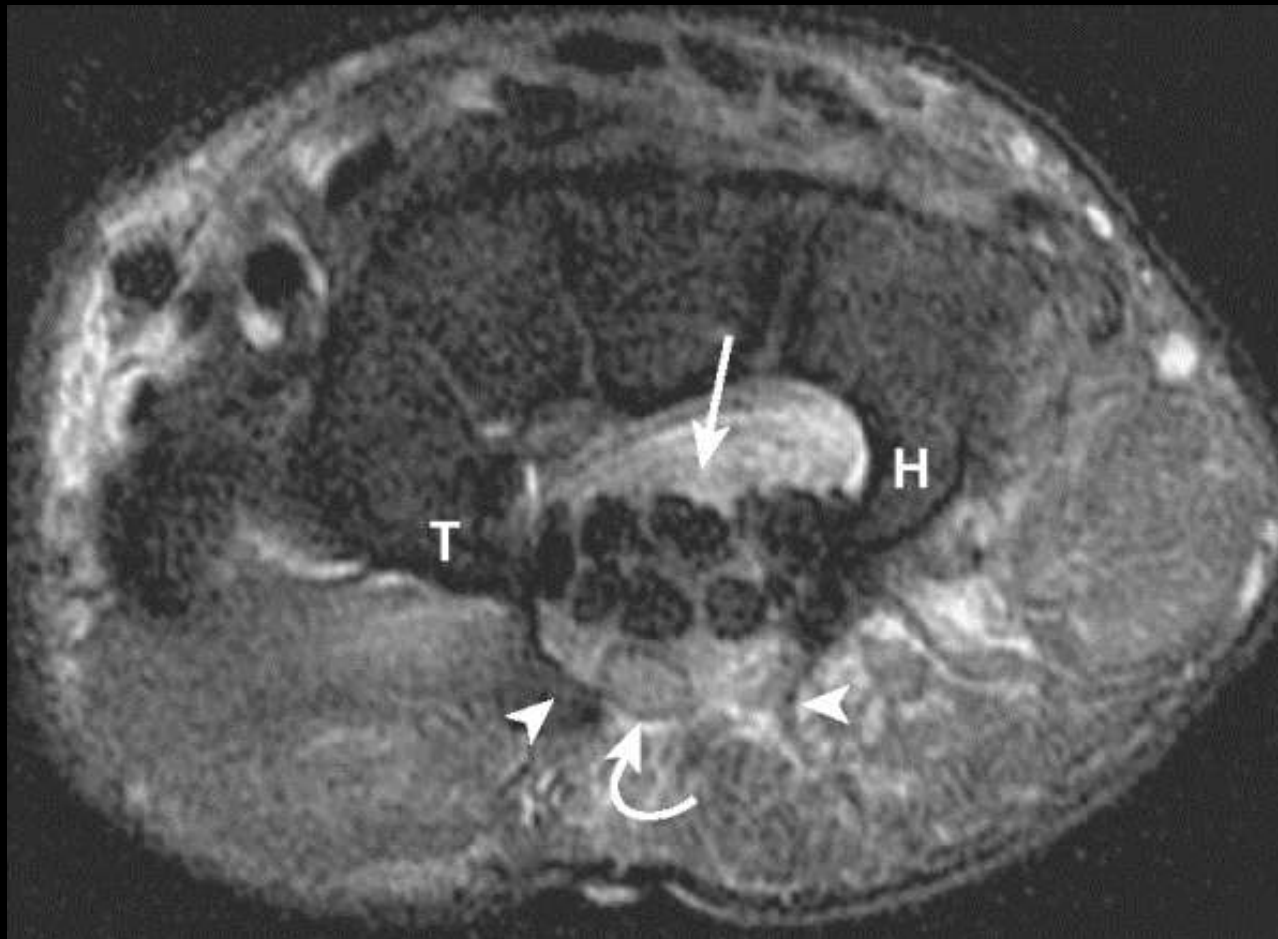
## Carpal tunnel syndrome (Axial PD & T2)

Multiloculated ganglion (arrows) abuts the median N. (arrowhead).

## **Normal Post op. appearance after carpal tunnel release**

- Retinaculum is invisible.
- The free ends of the retinaculum are displaced in a volar direction.
- The flexor tendons are displaced in a volar direction.





**Normal postoperative appearance of the carpal tunnel (Axial T2)**

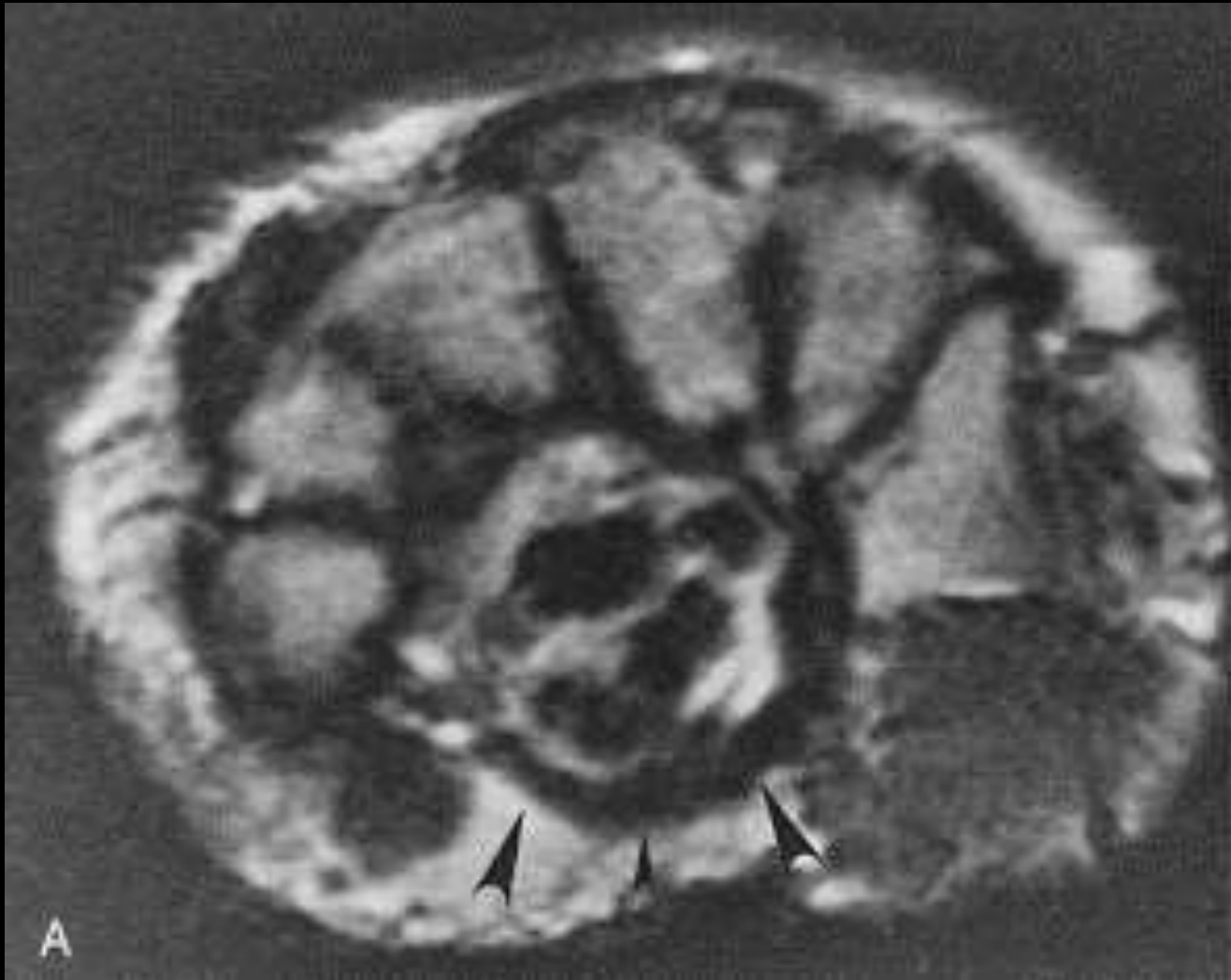
The flexor retinaculum is partially missing, the free ends of the retinaculum are displaced volarly (*arrowheads*), and the contents of the tunnel (flexor tendons—*straight arrow*, median N.—*curved arrow*) are displaced volarly. H, hook of hamate; T, trapezium.

## **Post op. failure**

- Several causes, the most common is incomplete release of the flexor retinaculum.

## **MRI signs of op. failure**

- Detection of an intact portion of the flexor retinaculum.
- Low signal fibrotic scarring around median N.
- Proximal swelling of the nerve.
- Persistent or recurrent mass lesion in the carpal tunnel.



### **Failed carpal tunnel release**

**A**, Axial PD, incomplete release of the flexor retinaculum, which is thickened and bowed (*arrowheads*).



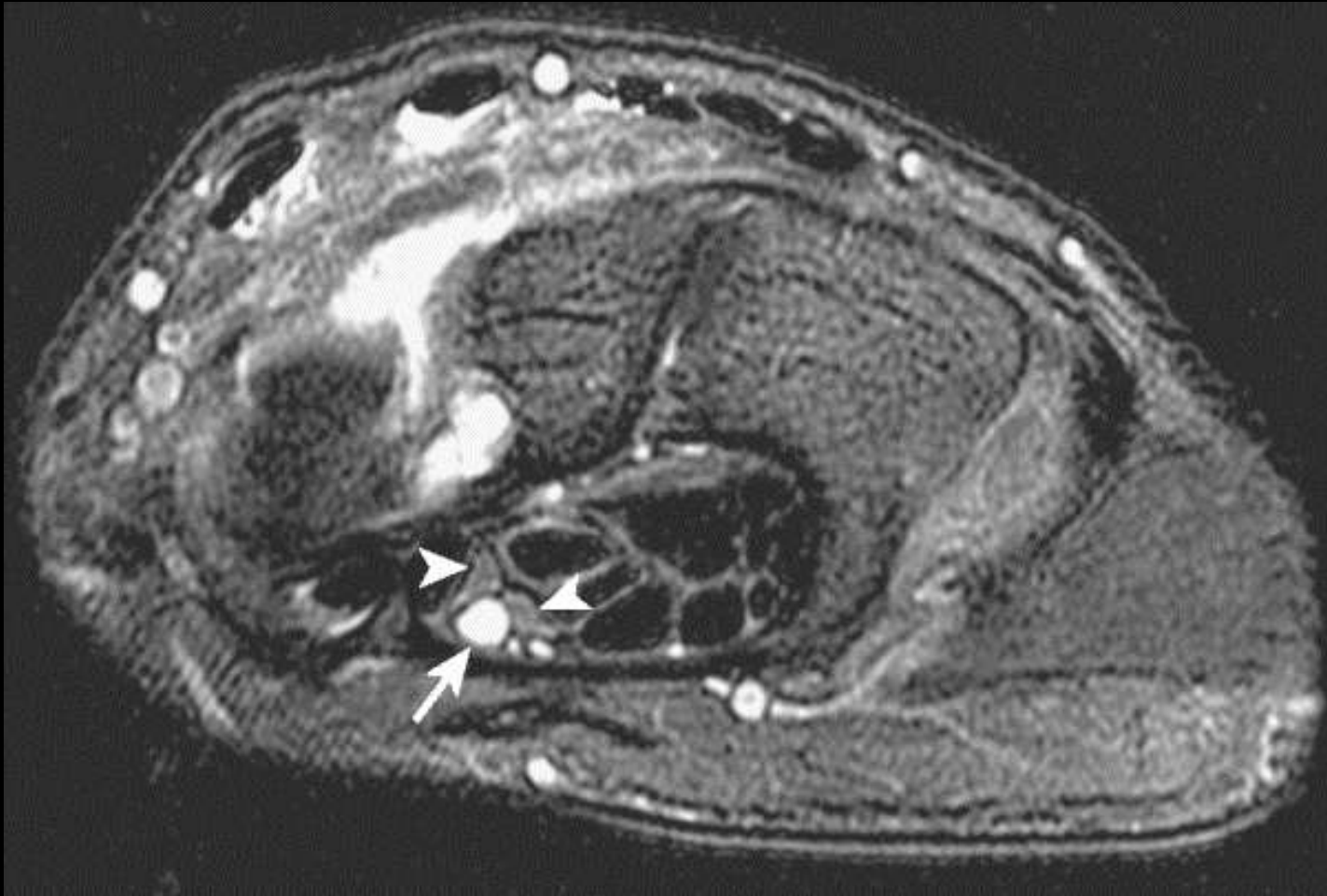
### **Failed carpal tunnel release**

**B**, Axial T1, the median nerve (*curved white arrow*) is huge, and its volar surface is surrounded by scar (*black arrows*) from previous surgery.



### **Failed carpal tunnel release**

C, Axial PD, recurrent carpal tunnel syndrome 2ry to the development of rice bodies in the tendon sheaths surrounding the flexor tendons (t). The rice bodies give the stippled appearance in the carpal tunnel surrounding the tendons and create a mass effect on the nerve.



**Persistent median artery** (Axial T2)

The median N. (*arrowheads*) is split by a vessel (*arrow*) within the carpal tunnel.

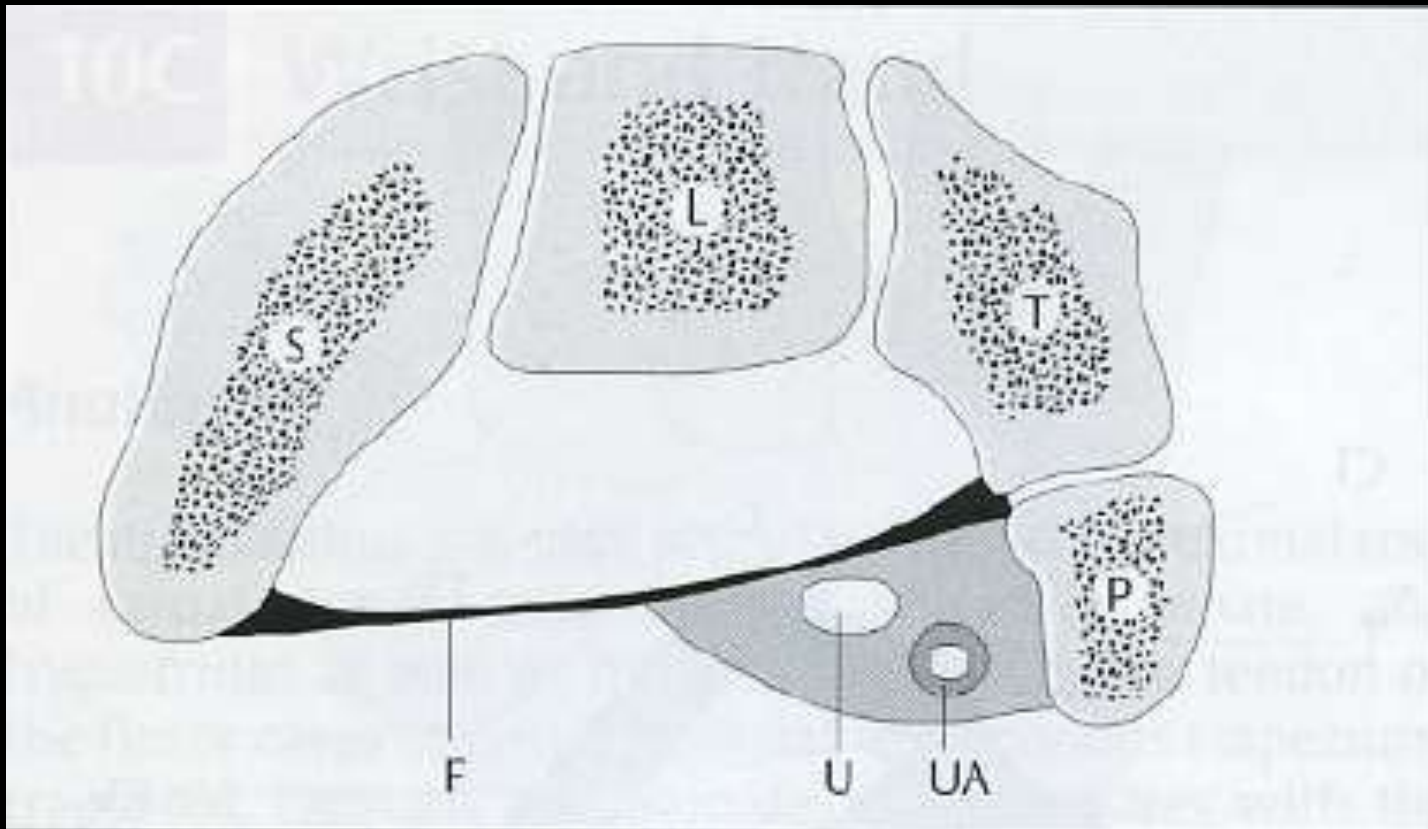


# Ulnar Tunnel & Ulnar N.

- The ulnar N, A & V pass through Guyon's canal on ulnar side of the wrist.

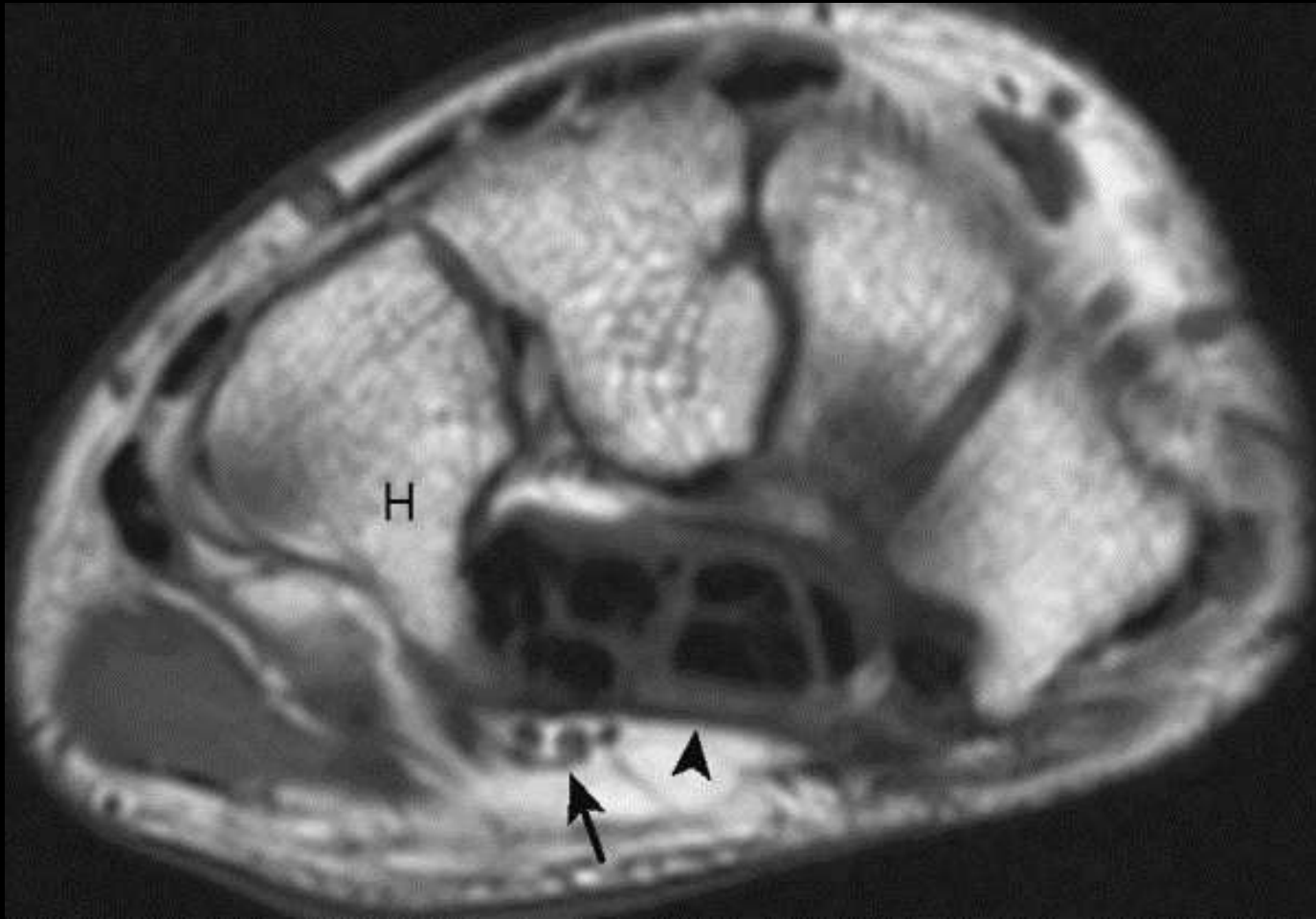
### **The canal is formed by**

- Flexor retinaculum and hypothenar musculature.
- The volar aspect is formed by a layer of fascia.
- The pisiform and hook of hamate form the osseous margins of the canal.



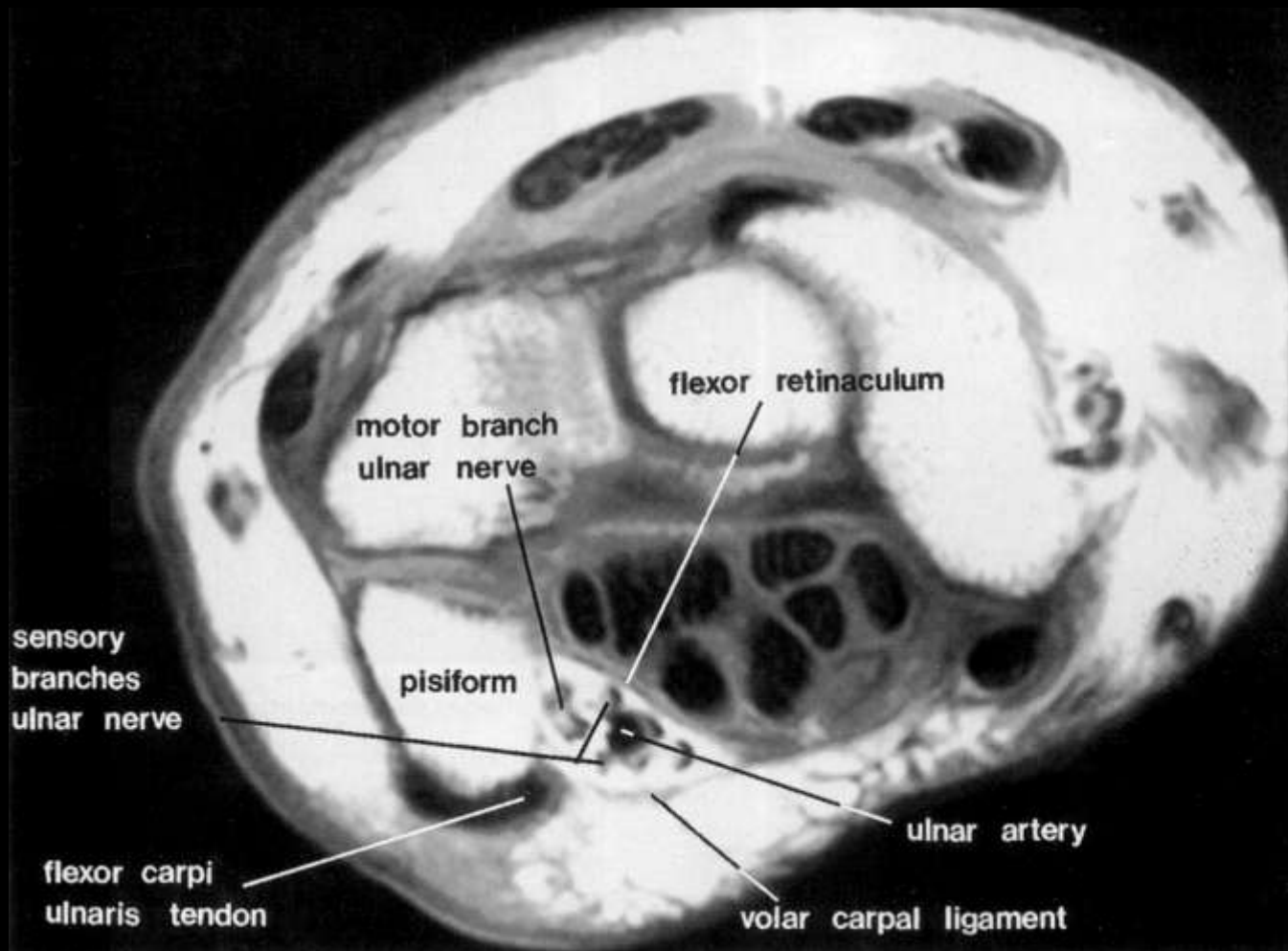
### Guyon`s canal (Ulnar tunnel)

**F** = flexor retinaculum, **L** = lunate, **P** = pisiform, **S** = scaphoid, **T** = triquetrum, **U** = ulnar N., **UA** = ulnar A.

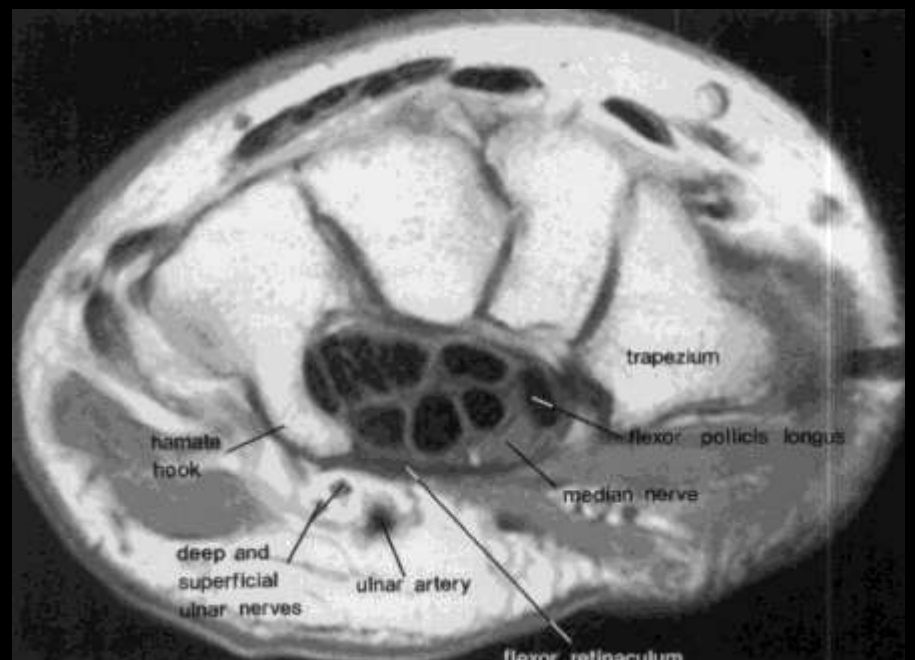
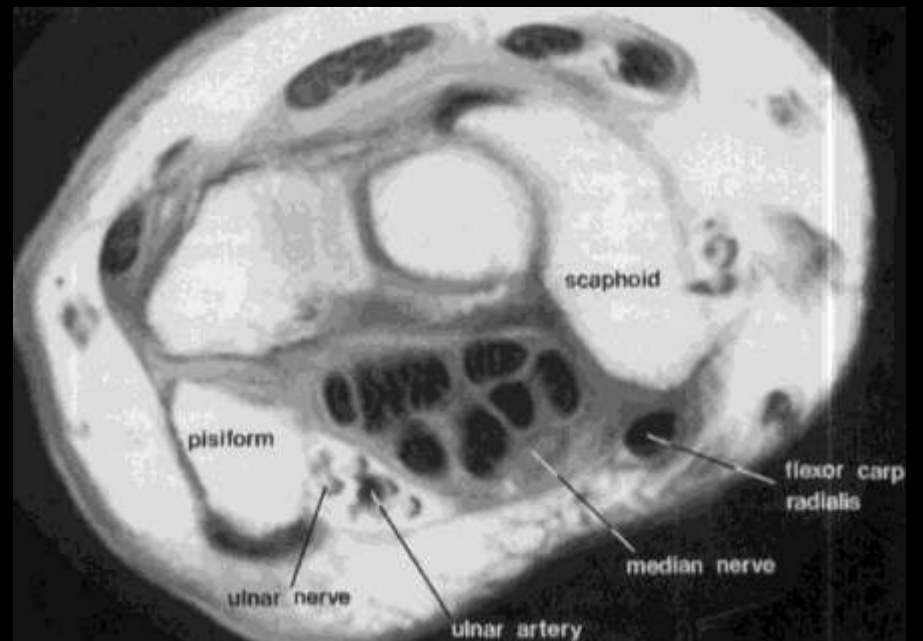
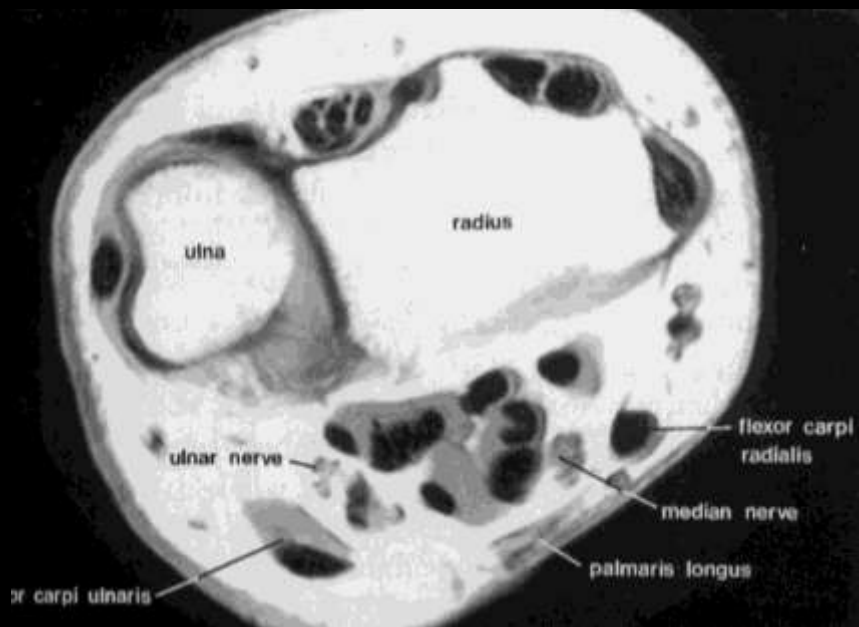


### Guyon's canal (Axial T1)

The ulnar tunnel (Guyon's canal) is formed by the flexor retinaculum (*arrowhead*), hypothenar musculature, and pisiform and hook of hamate bones. The ulnar nerve, artery, and vein pass through the tunnel (*arrow*). H, hamate.



**Guyon's canal**



**Ulnar N. anatomy**

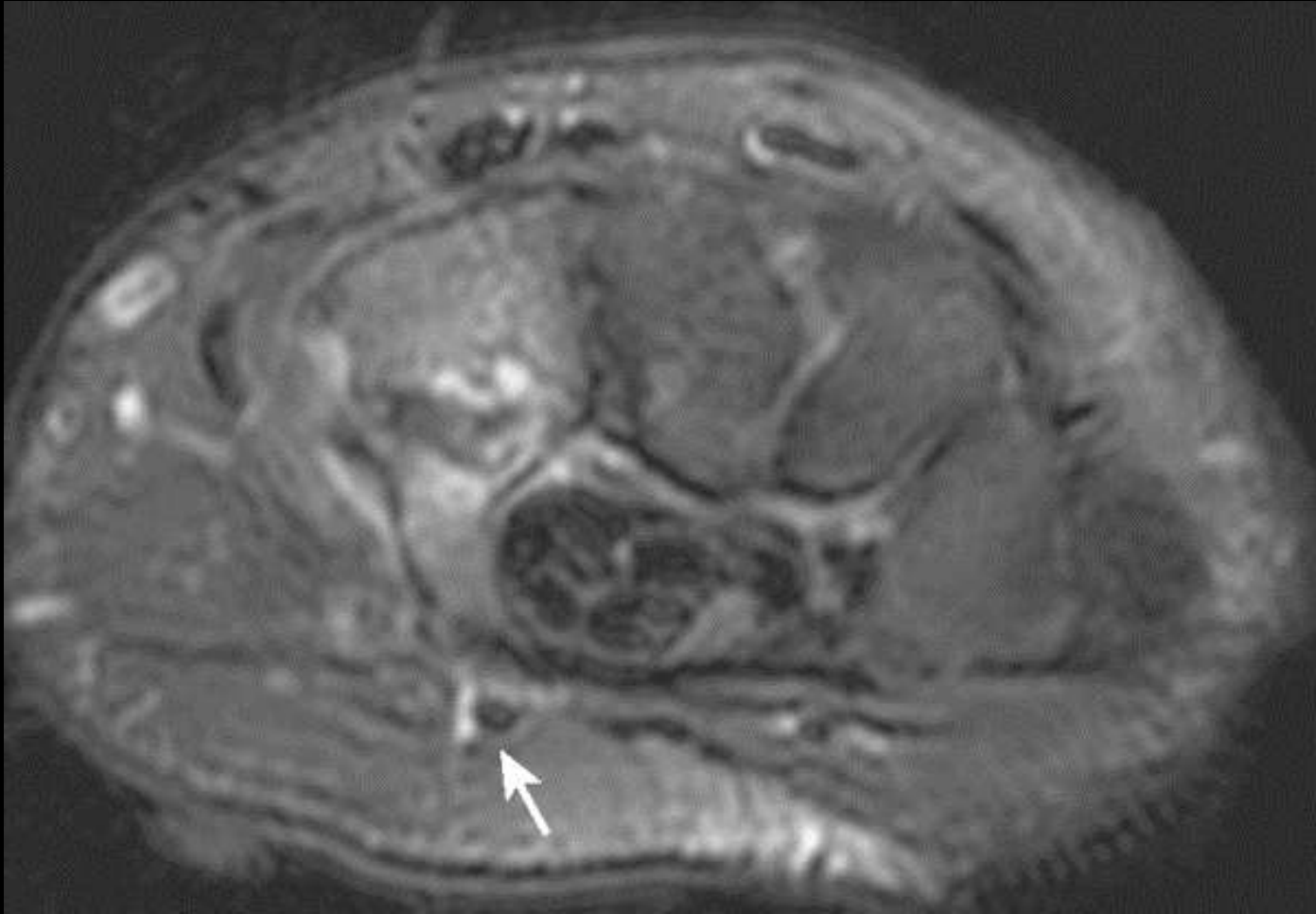


# **Ulnar Tunnel Syndrome**

- The ulnar N. may become compressed along Guyon's canal.

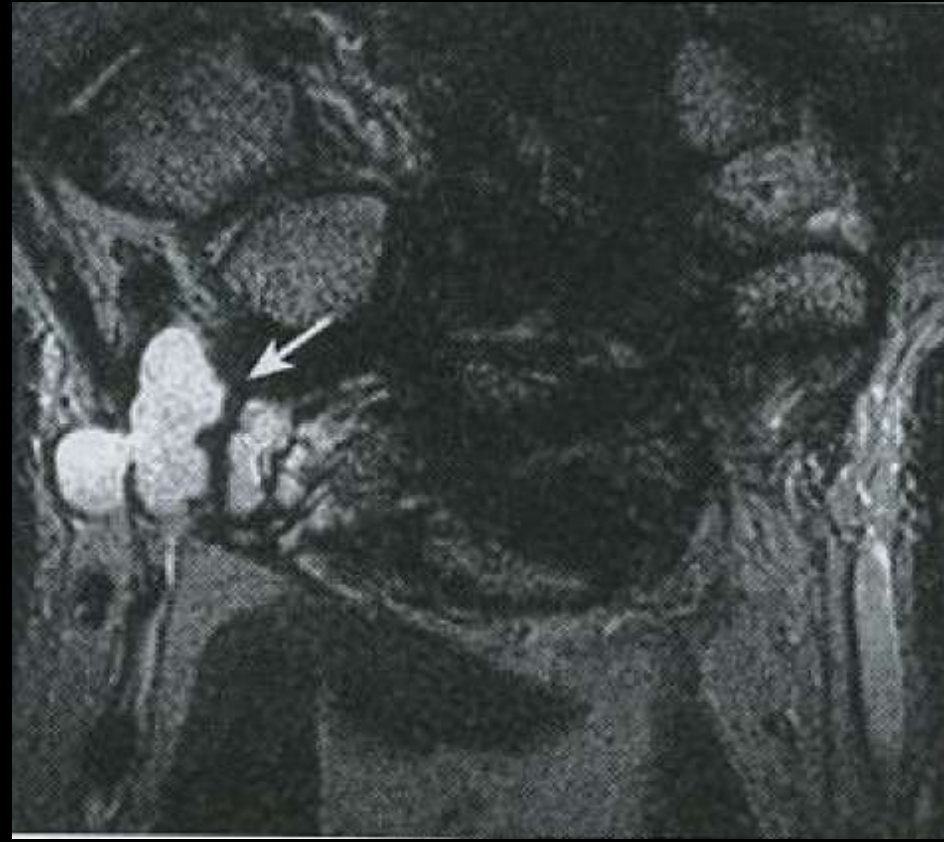
### Causes

- Ganglion cysts / other masses.
- Hamate fracture.
- Repetitive trauma.



**Ulnar tunnel syndrome** (Axial GE)

Ganglion cyst (*arrow*) in the ulnar tunnel adjacent to the hook of hamate, causing a compressive neuropathy of the ulnar N.



**Guyon's canal syndrome (Coronal PD & T2)**

Compression of the ulnar N. due to a large multilocular ganglion (arrow) which shows medium signal in PD and high signal in T2.

A full-page background image featuring a vibrant sunset or sunrise. The sky is filled with layers of clouds, some of which are illuminated from below by the sun, creating a mix of orange, pink, and purple hues. The sun itself is partially visible as a bright, glowing orb behind a cloud layer. In the foreground, the dark, silhouetted outlines of rolling hills and mountains are visible against the lighter sky. The overall mood is peaceful and contemplative.

**Thank You**