

Hand Injury

Dr. Adnan G. Gelidan FRCSC, FACS
Assistant Professor KSU
Consultant Plastic &
Reconstructive Surgeon

Surgery team 429

Notes are in red

- History & examination

1. Infections

- A. Paronychial infection
- B. Phelon
- C. Herpetic Whitlow
- D. Collar abscess
- E. Flexor Tenosynovitis
- F. Hand bites

2. Necrotizing fasciitis

3. Flexor tendons

- A. Anatomy
- B. Mechanism of injury
- C. Zones
- D. Pully system
- E. Examination
- F. Repair
- G. Splints

Contents

4. Replantation

- A. Indications and contraindications
- B. General principles
- C. Complications

5. Fractures

6. Carpal tunnel syndrome

- A. Incidence
- B. Atiology
- C. Symptoms
- D. Clinical features
- E. Investigations
- F. treatment

History

- 5 Important Questions
 - Hand dominance
 - Occupations
 - Weather the patient needs his hand for working like drivers and painters
 - Previous hand trauma or injury
 - Smoking
 - Patients who smoke have vasoconstriction of blood vessels and that makes connecting an amputated finger have a high chance of failing so the doctor must know before he goes into the OR
 - no point in wasting time, this procedure takes 6-8 hr so if pt smoker from beginning say u can't
 - Tetanus
 - Make sure the patient is vaccinated, if not give him vaccination
 - Any open wound there is risk of infection (tetanus)

History

- Acute or chronic
 - Acute e.g. Trauma, burns, laceration, fractures, dislocation, infection
 - Chronic e.g. Lumps , Carpal tunnel syndrome and nerve compressions, arthritis
- Mechanism of injury, and complaint
 - Trauma, Laceration, Swelling or lump, Arterial or Venous injury, Dislocation, Infection, Numbness

Examinations

- 1. inspection
 - Look
 - Compare both hands (always compare to a normal hand)
 - Dorsum then volar surface
 - Skin (Ulcers or lesions or color)
 - Swelling
 - Wasting
 - Position normal position of hand if u put it on table : flexion cascade “the flexor tendons are stronger then extensor tendons”. If someone can’t do this >injury to flexor tendons .
- 2. palpation
 - Feel Tenderness, sensation, temperature, Cap refill (capillary refill)

Examinations

- 3. check movement:
 - Move Range of Motion
 - Passive, Active
 - Examine FDS, FDP, & extensor tendons
 - Test Specific Nerves
 - Median (sensation to lateral three and a half volar side)
 - Ulnar (sensation to medial one and a half on the volar and dorsal side)
 - Radial (lateral three and a half dorsal)
 - Sensory and motor

Note

- The ulnar nerve is the most important nerve in the hand because it controls all action except opposition of the thumb by the median nerve
 - Ulnar supplies all muscles except thumb muscles (Abductor pollicis brevis, flexor pollicis brevis , Opponens pollicis) and 2 lumbricals by the median nerve
 - BUT Adductor pollicis supplied by ulnar nerve .
- There are no intrinsic muscles on the dorsum of the hand all of them are on the volar surface
- Radial nerve doesn't give any motor supply to hand only sensation
- 2 groups of hand muscles:
 - Extrinsic
 - Originate from the forearm and insert in the hand
 - Intrinsic
 - Originate and insert in the hand

1. Hand infections

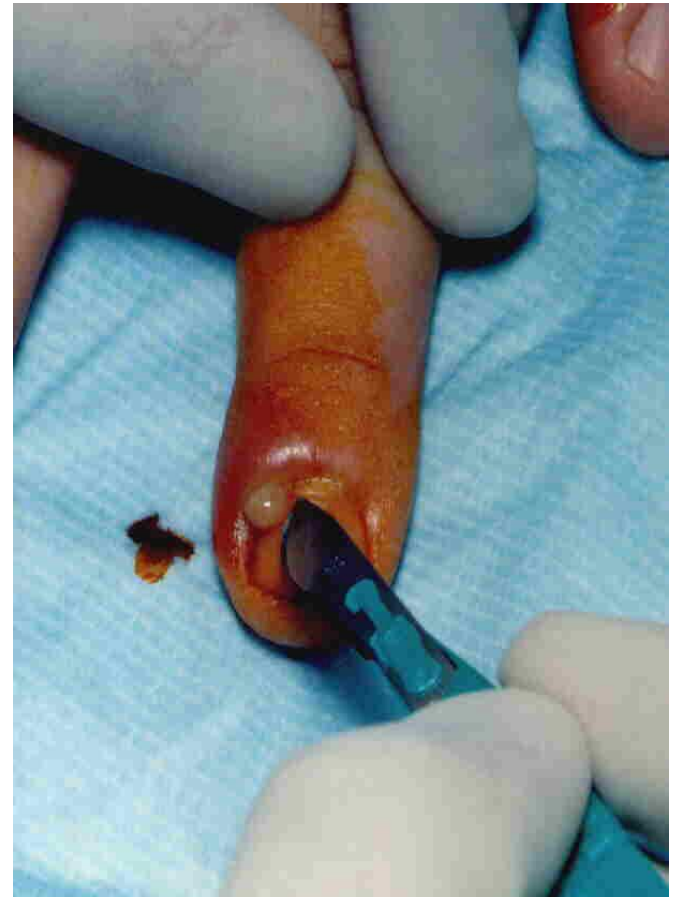
A. Paronychial infection

- Most common hand infection
- Infection of the nail bed or nail plate
- Present with redness around the nail
- Could be just cellulitis and redness or abscess
- Most common organism is staph aureus
- Treatment:
 - Antibiotics + warm saline soaking
 - If there is no response in 48 hours you must do Incision and drainage
 - If there is an abscess then you must do incision and drainage



cont...

- If someone gets paronychia infection frequently (6 times a year) think of chronic infection
 - Most common cause of chronic infection is candida (fungi)
 - Treatment:
 - Suspect Candida so send swab
 - If + give oral antifungal or topical
 - If no response then remove the skin and clean then graft



Example for incision and drainage

1. Hand infections cont...

B. Felon

- Infection of the finger pulp
- This area is very sensitive because it has many nerve endings
- 2 point discrimination is maximal at this area
- So when it develops an abscess between it and the skin it causes nerve compression and SEVERE PAIN
- Treatment:
 - Antibiotics
 - If no response incision and drainage
 - Incision must be from the side to not lose sensation



1. Hand infections cont...

C. Herpetic whitlow

- HSV type 1 vesicular eruption of the fingertip
 - Vesicles that contain clear fluid
- Happens to children and dentists
- Very painful
- Very contagious
 - patients need isolation
- Treatment by acyclovir (antiviral medication)



1. Hand Infection

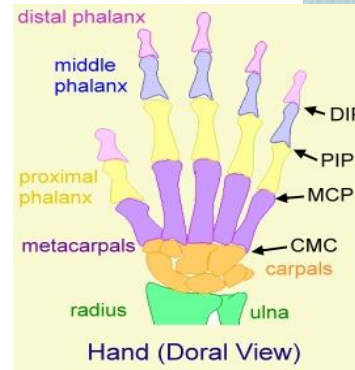
D. Collar Abscess

- Abscess of the hand web-Space
 - Connection between the volar and dorsal parts
- Present with redness and swelling and abducted fingers
- Treatment:
 - Antibiotics if early with observation as in or out patient
 - Incision and drainage in the OR (complex area)



E. Flexor Tenosynovitis

- Each finger has 2 flexor tendons one moves PIP (attached to middle phalanx), other DIP (attached to distal phalanx).
- infection of the flexor tendon sheath
- Can extend to the forearm
- 4 signs:
 - Sausage shape
 - Flexed position
 - Pain with passive extension
 - tenderness along the tendon
- Treatment:
 - Treatment is immediate !!! Because of high risk of sepsis and, necrosis and amputation
 - **You have to** do incision and drainage
 - Antibiotics
 - Catheter irrigation (irrigate the sheath with saline)
 - If the infection is bad can cause thrombosis of artery , ischemia of nerve and insensate finger.



Catheter irrigation

- You pass a catheter between 2 ends of the flexor sheath and you keep it there until the area is clean
- Until you clean out all the pus, if you are not happy leave this catheter in, take the patient to the ward and nurses will irrigate every 6hr and u will take it out after 48-72 hr,
- if you are still not happy with the wound open the whole finger and clean then close loosely never close infected wound completely.

Hand infection

F. Hand bites:

- The problem with bites is that the saliva is full of bacteria
- Human: Staph, Strep, Eikenella
- Dog:
 - Pasteurella Multocida (**very dangerous**), Staph, Strep
 - Street dogs most likely the cause is rabies
 - All must get rabies treatment: IgG and rabies vaccine (5 injections in abdomen at day 1,3,7,14,28)
- Cats:
 - More dangerous than dog bites (more concentration of bacteria within the saliva)
 - Pasteurella Multocida
- All of them should be admitted for IV antibiotic
- **Most of dog & human bites respond well to Augmentin**

Hand infections: bites

- Patient had a fight and got bit 10 times
- He sustained an infection and fracture
- He did not improve on antibiotics on 24 hours
- OR and irrigation of everything and finger fixation



2. Necrotizing Fasciitis

- Flesh eating disease of the soft tissue
- Occurs in diabetics with low socioeconomic status
- Present with: infection, unstable (hypotension , tachycardia, ALOC and low urine output)
- Caused by Group A B hemolytic strep
- Infection of the fascia
- Skip lesions on the skin
- Has high mortality rate



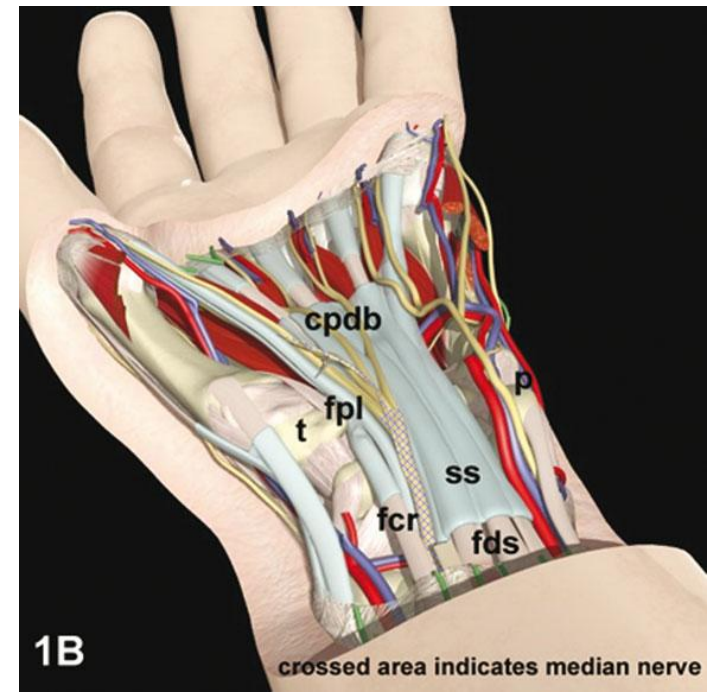
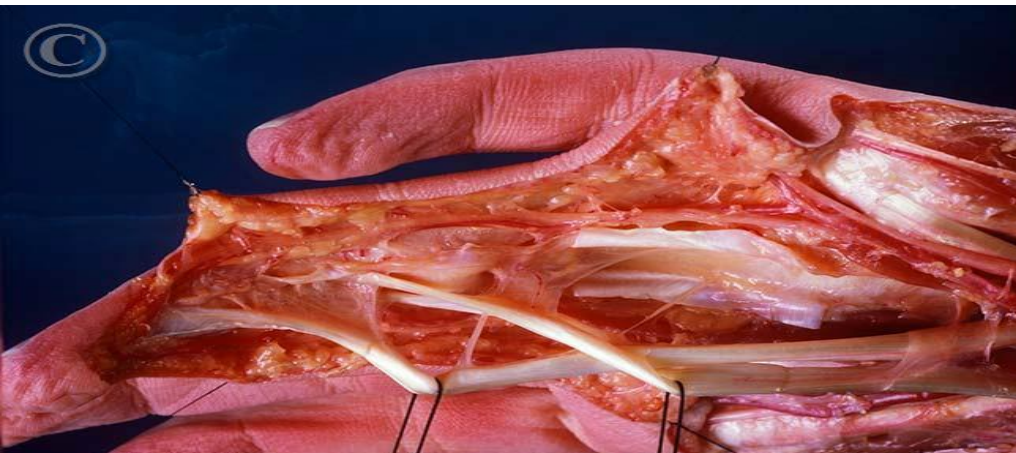
Treatment of necrotizing fasciitis

- Patient needs to be intubated and admitted to ICU
- Need extensive debridement and IV Antibiotics
- So stabilize pt , take him to OR , open all the infected area and u see the fascia looks gray and has bad smell (infected) and once u see healthy area > skip and make open again to be sure that there's no extension.
- Some patient don't respond to one or two times debridement > amputation !

3. Flexor Tendons

A. Anatomy

- There is 8 muscles with almost 12 tendons in the flexor side, (4FDS, 4FDP, FPL FCU, FCR, PL)
 - FCU,FCR, PL: flex the wrist
 - 4FDS: flex PIP joint
 - 4FDP: flex DIP joint
 - FPL: flex thumb



Flexor tendons

- Origin
 - Medial epicondyle to the forearm then develops tendons and go through the carpal tunnel to insert in the hand and fingers
- Nerve Supply
 - All of them by the median nerve
 - Except: FCU and medial ½ of FDP

Flexor Tendon

B. Mechanism of Injury

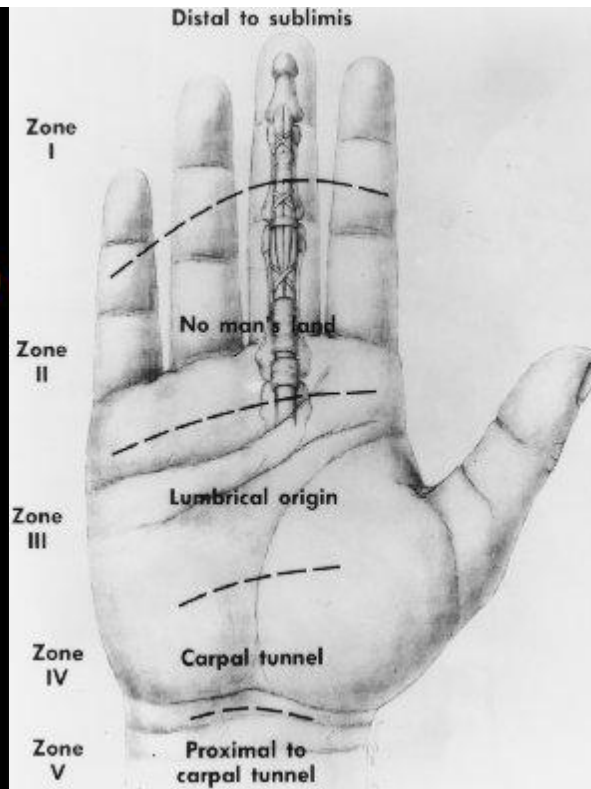
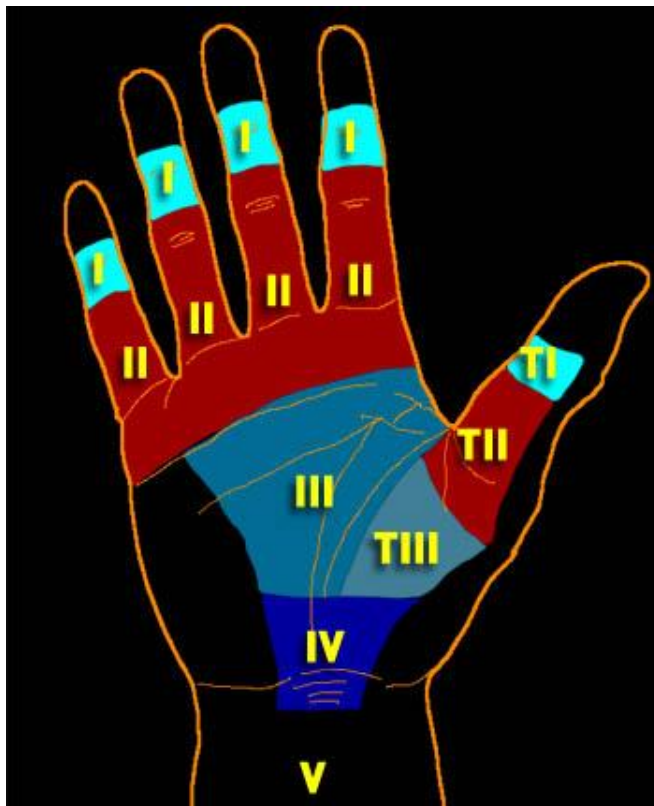
- Closed Vs. Open
- Closed:
 - Completely flexed (like in American football) and then sudden severe hyperextension
- Open
 - Knife is the most common tool for the injury
 - Crush injury
 - Degloving injury

Note : no muscles in finger (only tendons) so it will survive in case of ischemia more than 6 hr

Flexor Tendon

C. Zones

- Verdan's 5 Zones (check next slide)



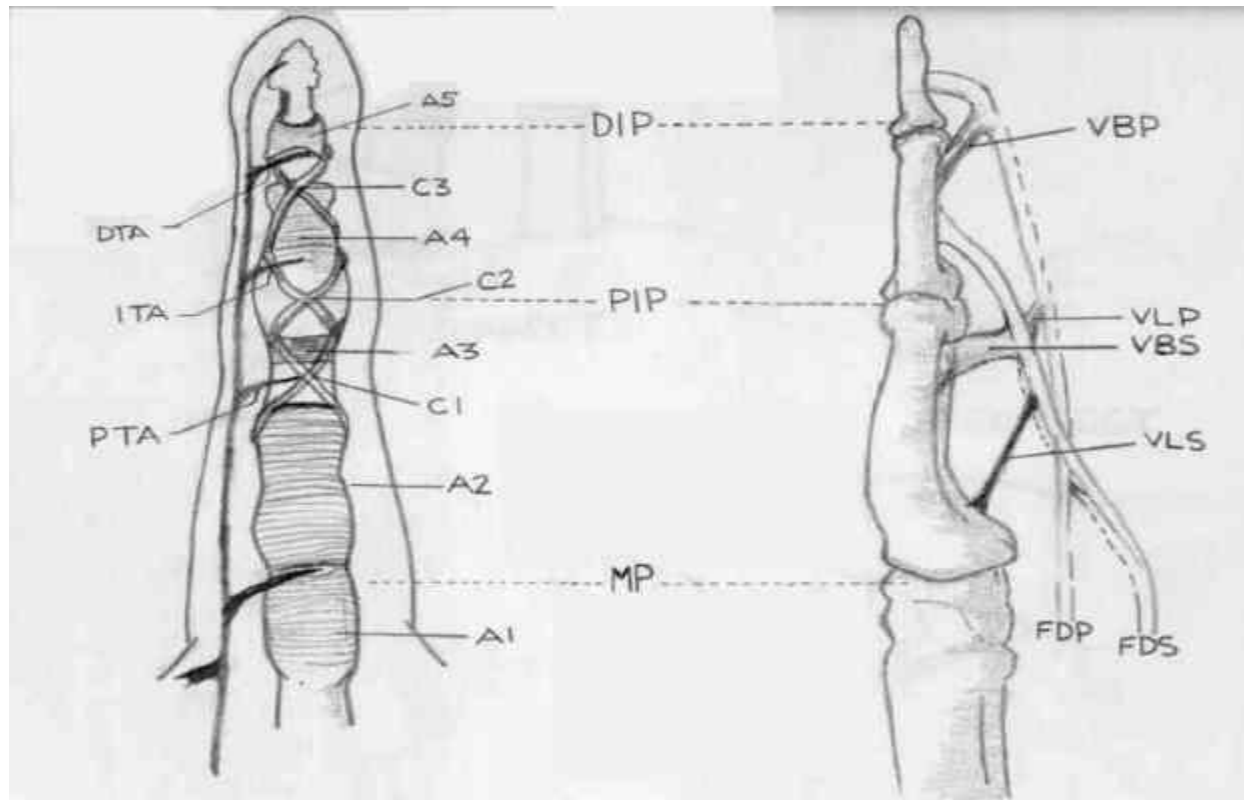
Verdan's 5 zones

- Zone 1: only affects the FDP
- Zone 2:
 - FDP&FDS
 - extend from MCP joint to insertion of FDS
- Zone 3:
 - from distal area of carpal tunnel to MCP joint
 - dangerous because it also affects nerves and arteries
- Zone 4: area under carpal tunnel
- Zone 5: the distal forearm

Flexor Tendon

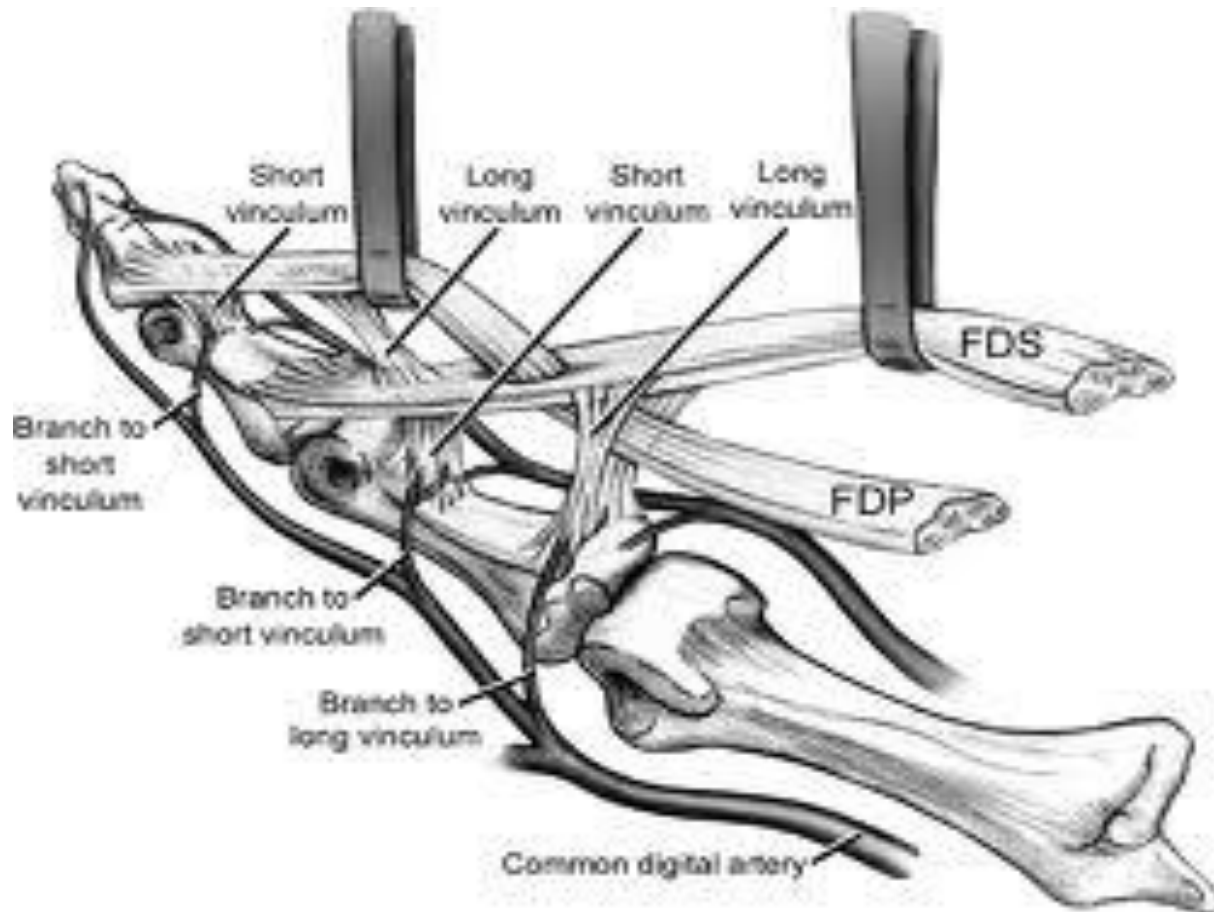
D. Pulley System and Tendon Blood Supply

Small Ligaments in front of tendon to hold it in place (A1-A5,C1-C3) , each tendon has bl. Supply.



Flexor Tendon

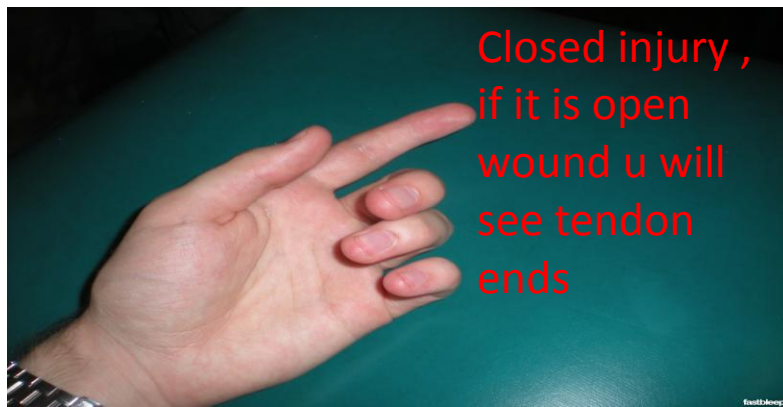
Pully System and Tendon Blood Supply



Flexor Tendon

E. Clinical Examination & Finding

- Loss of flexion cascade
- Open wound most commonly
- Tendon could be visible in the wound
- Inability to flex the digit at PIP or DIP
- If pt cuts only FDS>he'll be able to flex both joints by FDP so to check only FDS hold his fingers straight and ask him to flex if he injured the FDS he will not be able to flex



How to Examine FDS , FDP ?

- The flexor digitorum superficialis (FDS) inserts into the middle phalanx of each finger. It is tested by blocking the finger MCP joint and asking the patient to flex the PIP joint. To block the MCP joint, hold the proximal phalanx in extension just distal to the MCP joint, so that the MCP joint is unable to bend when the patient tries to flex the finger.

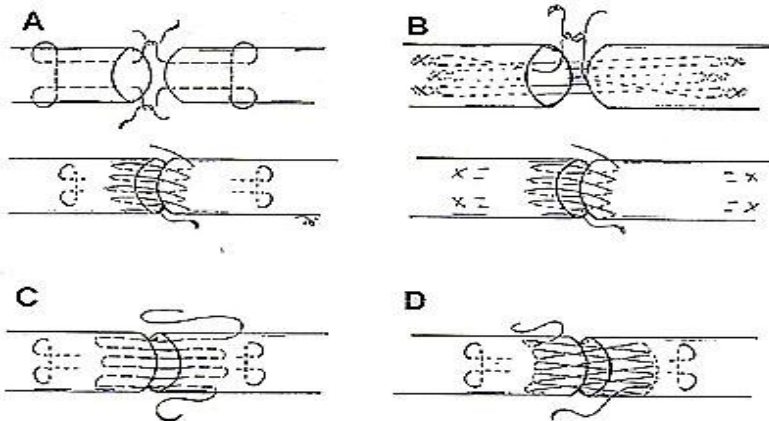


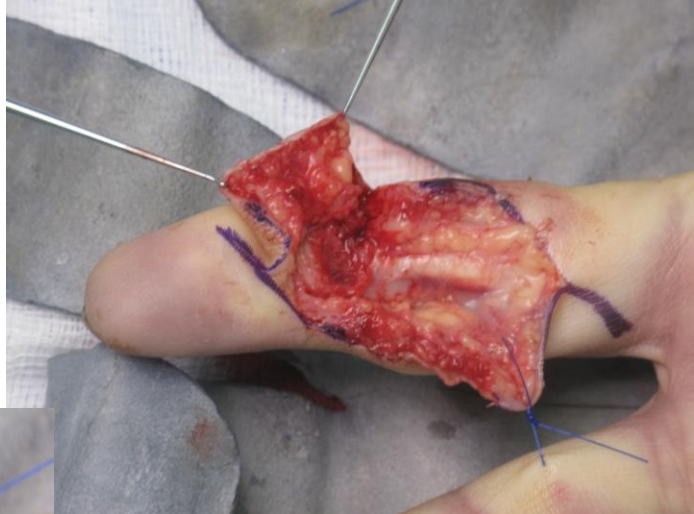
- The flexor digitorum profundus (FDP) inserts into the distal phalanx of each finger. It is tested by blocking the finger PIP joint and asking the patient to flex the DIP joint. To block the PIP joint, hold the middle phalanx in extension just distal to the PIP joint, so that the PIP joint is unable to bend when the patient tries to flex the finger.



F. Flexor Tendon Repair

- Explore the wound in zigzag fashion
 - in OR because this area has nerves and blood vessels
 - Zigzag not straight cut why? It'll cause flexion contraction
- Find the 2 ends of the cut tendon
- Repair : > 25 different technique for the repair
- Non absorbable suture

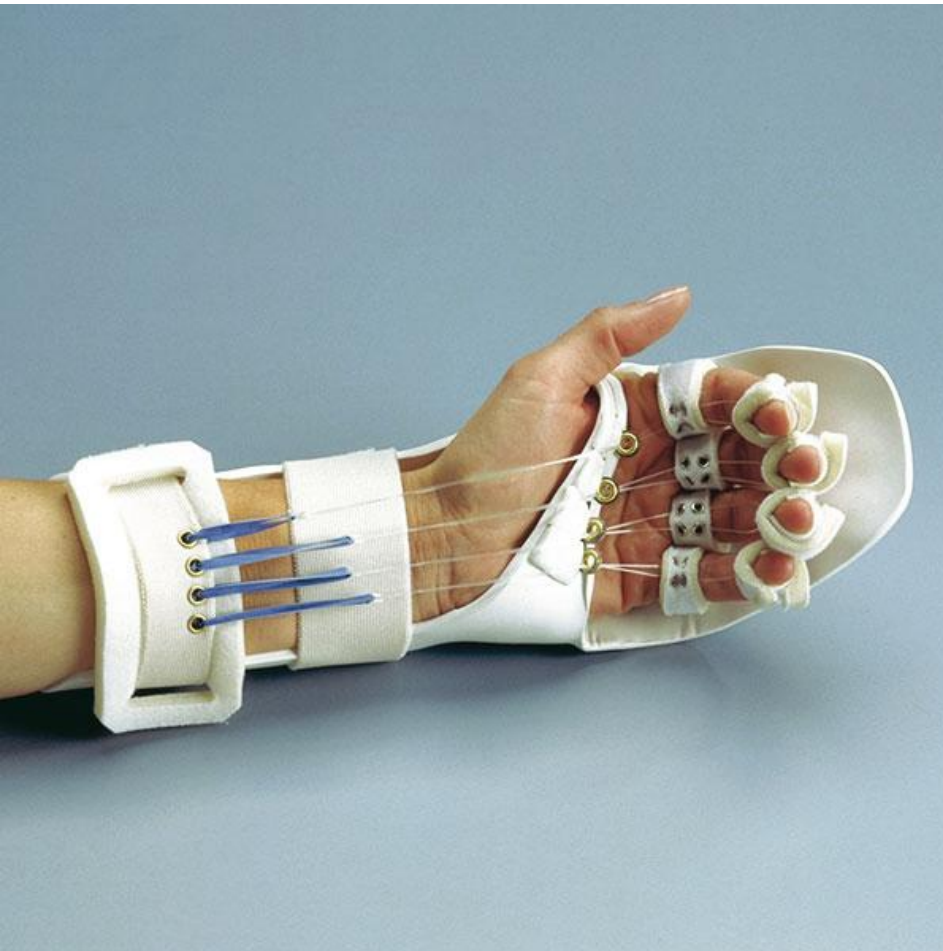




G. Flexor Tendon Splints:

you can't let patient use his hand the repair will be cut !

Also to keep it in the functional position to make sure adhesions will not damage function



The wires allows pt to move fingers without tension. U don't want cause adhesion if u let it 3-4 weeks without movements.

4. Replantation

A. Indication & Contraindication

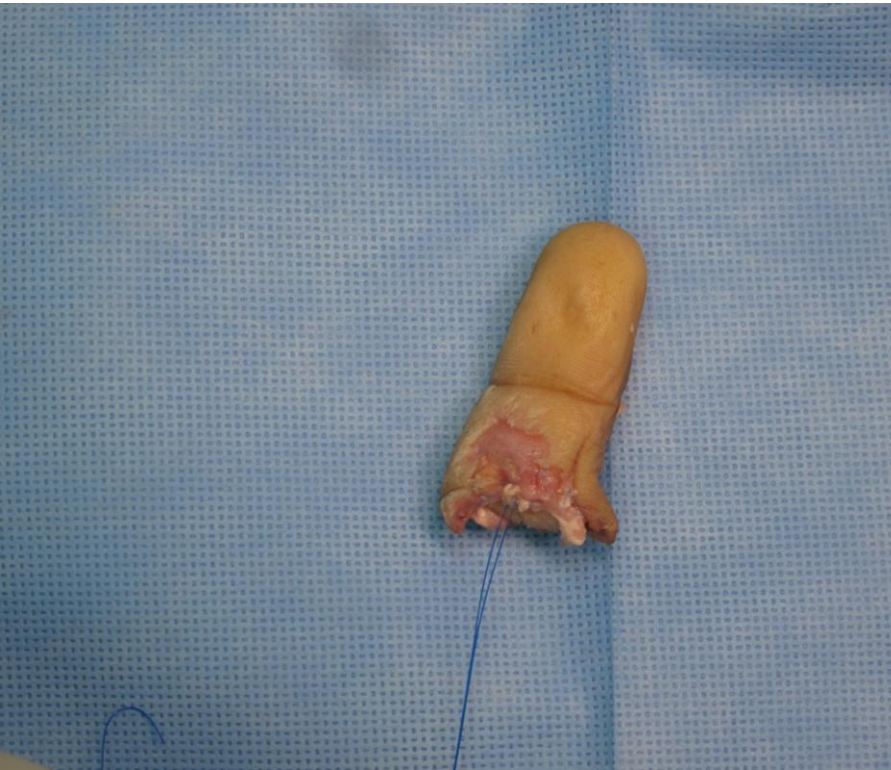
- Indications

- Amputated Thumb: it provides 50% of hand Function
- Children: the risk of loss higher than adults because vessels are very small & more difficult.
- Multiple digits: you try to fix 2-3 so he can hold things.
- Partial or whole hand because they have a lot of Function problems.

- Contraindications

- Life threatening injury, you want to save patient life more imp.
- Sever chronic illness
- Multilevel injury
- Severely crushed injury
- Single digit because patient will not have functional defect .
- Sever contamination
- Avulsion injury: avulsion the nerves and tendons from inside.

Put finger in cold water not directly on ice (frostbite)> successful replant after 28 hour



Duration of surgery 6-8 hours
40% might failure
Can't work 3-6 months

Replantation

B. General Principles

- Resuscitate the patient
- Keep amputated part in moist gauze
- X-ray the hand and the amputated part
 - make sure no fractures because in that case you can't replant it
- Consent for vein, nerve, tendon, skin graft
- Prepare the amputated part
- 1st Shorten the bone
- Arthrodesis
- 2nd Repair flexor and extensor tendon
- Repair 3rd Digital artery 4th vein and 5th nerve
- 6th Skin closure +/- skin graft

Replantation

C. Complication

- White finger
 - No blood Flow
 - technical or non- technical
 - If patient smoker don't bother to replant
 - Ensure pt is warm
 - Full with fluid
 - Prevent hypotension
 - Loosen dressing
 - Remove sutures
 - If all the above done and still white: Re-Explore and check arteries
- Blue finger
 - Veins are not draining
 - Elevate limb
 - Loosen dressing
 - Remove sutures
 - Leeches
 - Remove nail
 - Heparin injections
 - Re-Explore

Leech, in case of venous congestion,
these animals suck blood



5. Hand Fractures (most common)

- Unstable fracture
 - Cannot be reduced closed or cannot be held reduced without fixation
- Antibiotics
 - 30% risk of infection in open fracture including open Distal Phalanx fracture
 - Reduce to 3% with antibiotics
- The distal phalanx fracture with subungual haematoma (bleeding in nail) should be considered open fracture
- Healing 4/52's for phalangeal fracture 5-6/52's for metacarpal fracture

Hand Fractures

- Acceptable hand fractures
 - Tuft distal phalanx
 - AP displaced metaphyseal fracture in children
 - MC (metacarpal) neck fracture
 - <15 in index and middle finger
 - <30-40 in ring and little finger
 - MC (metacarpal) base fracture
 - Adult < 20 angulation
 - Children < 40 angulation

Hand Fracture

- Unacceptable phalangeal fractures (need fixation)
 - Rotational angulation
 - Sever dorsal angulation
 - Lateral angulation

Child patient: growth plate in base of phalanx and
head of metacarpals.
Classify the fractures different in children



Pediatrics Hand Fracture

Solter harris Classifications

- Type I – A transverse fracture through the growth plate 6%.
- Type II – A fracture through the growth plate and the metaphysis, sparing the epiphysis 75% incidence, away from joint.
- Type III – A fracture through growth plate and epiphysis, sparing the metaphysis 8% goes to joint
- Type IV – A fracture through all three elements of the bone, the growth plate, metaphysis, and epiphysis 10% , above and below joint.
- Type V – A compression fracture of the growth plate (resulting in a decrease in the perceived space between the epiphysis and diaphysis on x-ray) 1%
- Fracture in child (growth plate) will affect grow, if the fracture in one side after 6 years pt will come with angulation of finger b/c one side grow and other didn't.



Type I

Physis fracture



Type II

Metaphysis and
physis fracture



Type III

Epiphysis and
physis fracture



Type IV

Epiphysis to
Metaphysis
fracture



Type V

Crush fracture

Salter-Harris Epiphyseal Fracture Classification

*Physis (growth plate) is highlighted in blue. Fracture line is black or red.

Hand Fracture

Indication for Fixation Non-Articular

- Angulation
- Rotation
- Shortening



- No growth plate : adult patient
- 1. Transverse fracture of proximal phalanx.
- 2. Spiral fracture
- 3. Gun shot and bone loss





-Fractures of metacarpal bone

- Head
- Shaft
- Base
- Ask pt where is the area of maximum tenderness ,look to this area in X-ray



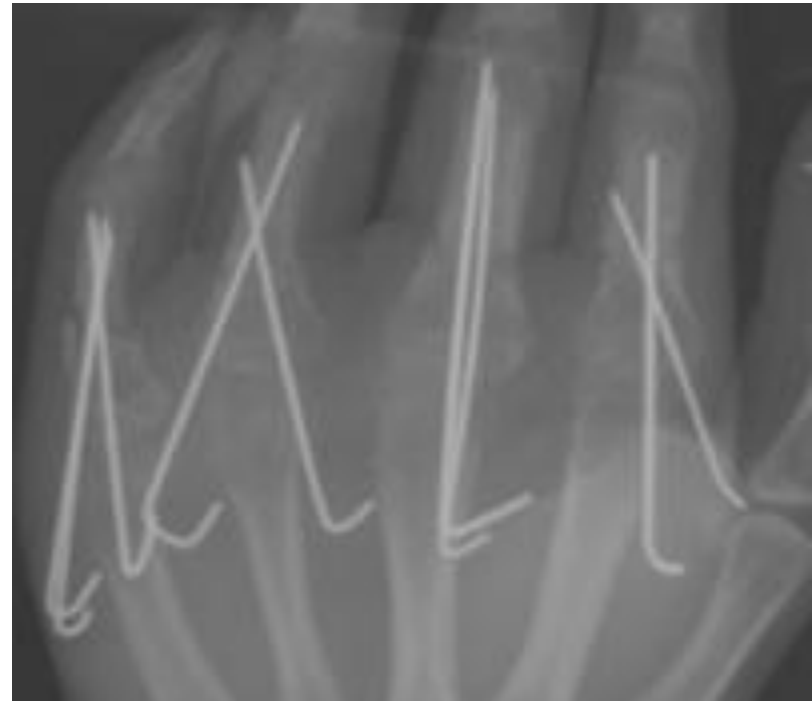
Hand Fracture

Technique of Fixation

- 1st Close reduction splint , do x-ray if its reduced you don't need to fix it
- if it doesn't stay in place 2nd Close reduction K-Wire fixation
- ORIF (**O**pen **R**eduction **I**nternal **F**ixation)
 - Lag Screw
 - Plate
 - Circulage wire



Circulage wire & K-Wire



- Metacarpal & phalanges fractures fixed with K-Wire fixation,
- you put 2 to prevent rotation
- Under X-ray



- Lag Screw , usually used in spiral fractures

6. Carpal Tunnel Syndrome

A. Incidence

- The most common nerve compression in the upper limb 1 – 10% of the population
- ? As high as 60% in people with repetitive hand movement: **because of hand swelling**
- Anatomy
 - Base (**floor**) is the bony carpal arch
 - Bridge (**roof**) is the flexor retinaculum
 - **Borders: scaphoid, trapezium, pisiform, triquetral.**
 - Has 9 flexor tendons and the median nerve

Carpal Tunnel Syndrome

B. Aetiology

- Due to increase volume of the content or reduction of the tunnel size
 - Acromegaly
 - Trauma
 - OA
 - Ganglion, Lipoma
 - Inflammation Tenosynovitis, gout
 - DM, Thyrotoxicosis, Pregnancy
 - Congenital :
 - Abnormal muscle, Persistent median artery

Carpal Tunnel Syndrome

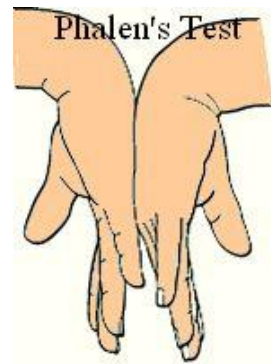
C. Symptoms

- Pain
- Numbness
- Paraesthesia in the median nerve distribution
 - Radial 3.5 digits
- Night pain
 - when patient sleep on his hand everything swells so he wakes up with more numbness in morning
- Pain radiate proximally to the shoulder
- Weakness
- Clumsiness

Carpal Tunnel Syndrome

D. Clinical Features

- Weakness, & wasting of the hand thenar muscles.
When they hold thing it falls.
- Altered sensation in the median nerve distributions
- Positive Tinel's sign
 - tap over the carpal tunnel area of the wrist 5 or 6 times> tingling or paresthesia in the median nerve distribution)
- Positive Phalen test
 - This position should be held for about 1 minute> numbness or tingling along the median nerve distribution
- Reverse phalan test
- The more severe the compression the faster the numbness



Carpal Tunnel Syndrome

E. Investigations

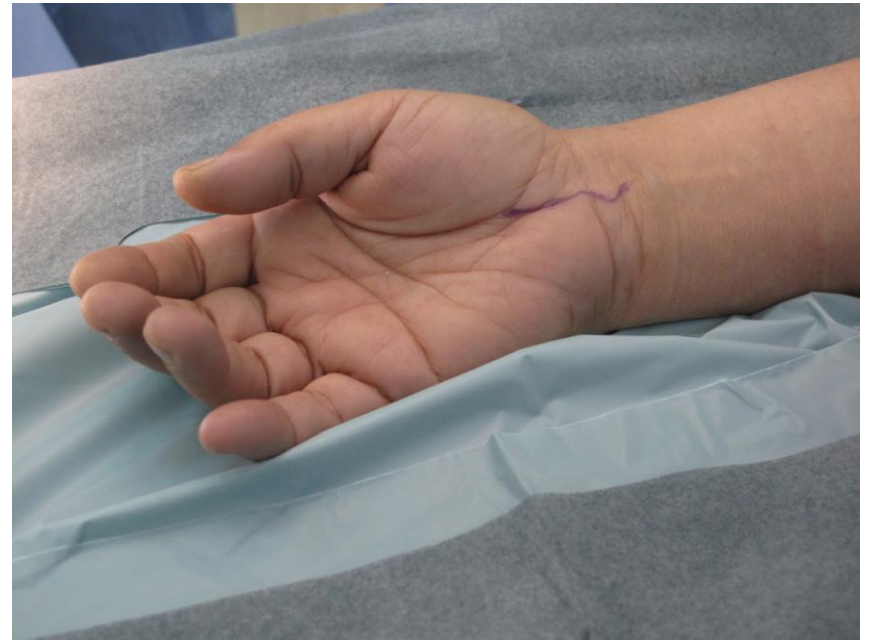
- X-Ray
- CT scan
- MRI
- Nerve conduction studies: most common test they use

Carpal Tunnel Syndrome

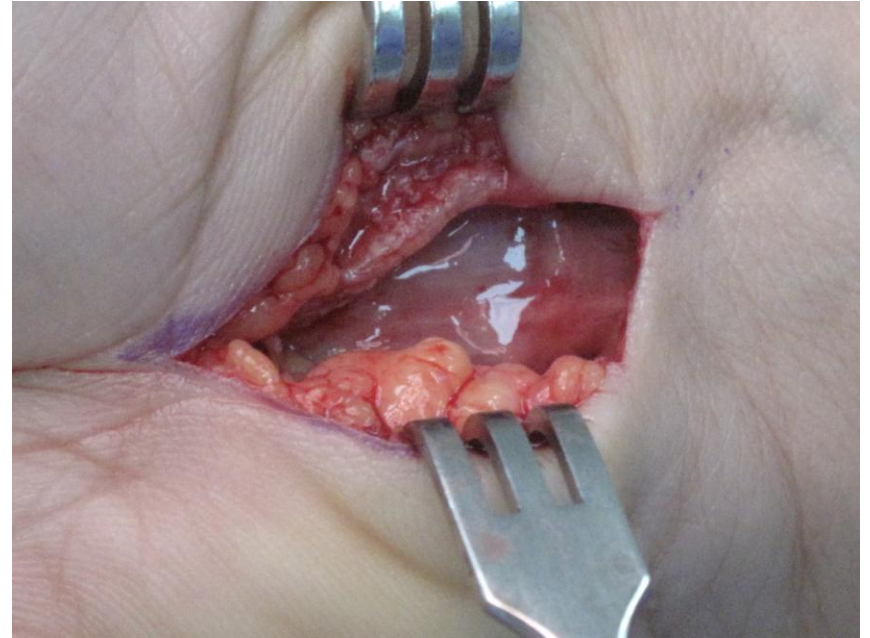
F. Treatment

- Non-Operative (Mild)
 - Splint
 - NSAID's
 - Steroid Injections
- Operative (Persistant)
 - All Open technique
 - Limited incision Technique
 - Endoscopic Techniques

Carpal Tunnel Syndrome Open Release

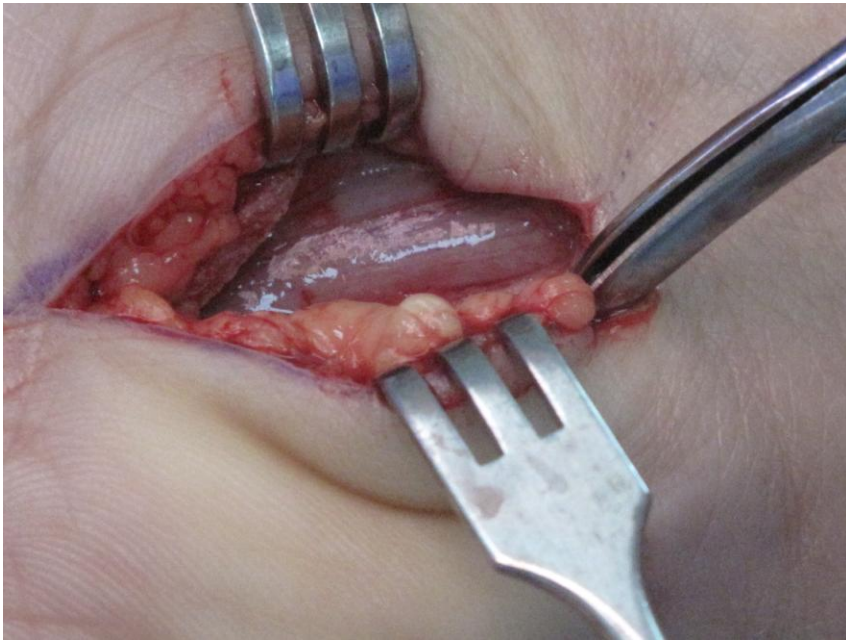


Carpal Tunnel Syndrome Open Release



Carpal Tunnel Syndrome

Open Release



- Thank you