

Management of hand injuries

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Epidemiology

- ▶ The hand is the most commonly injured part of the anatomy:
 - 20–35% of most reported injuries were to hands and
 - 20–30% of compensation payments are for hand injuries.

Causes

Industries

- ▶ Machinery
- ▶ Hand tools
- ▶ Glass
- ▶ Falling objects
- ▶ Explosives
- ▶ Burns

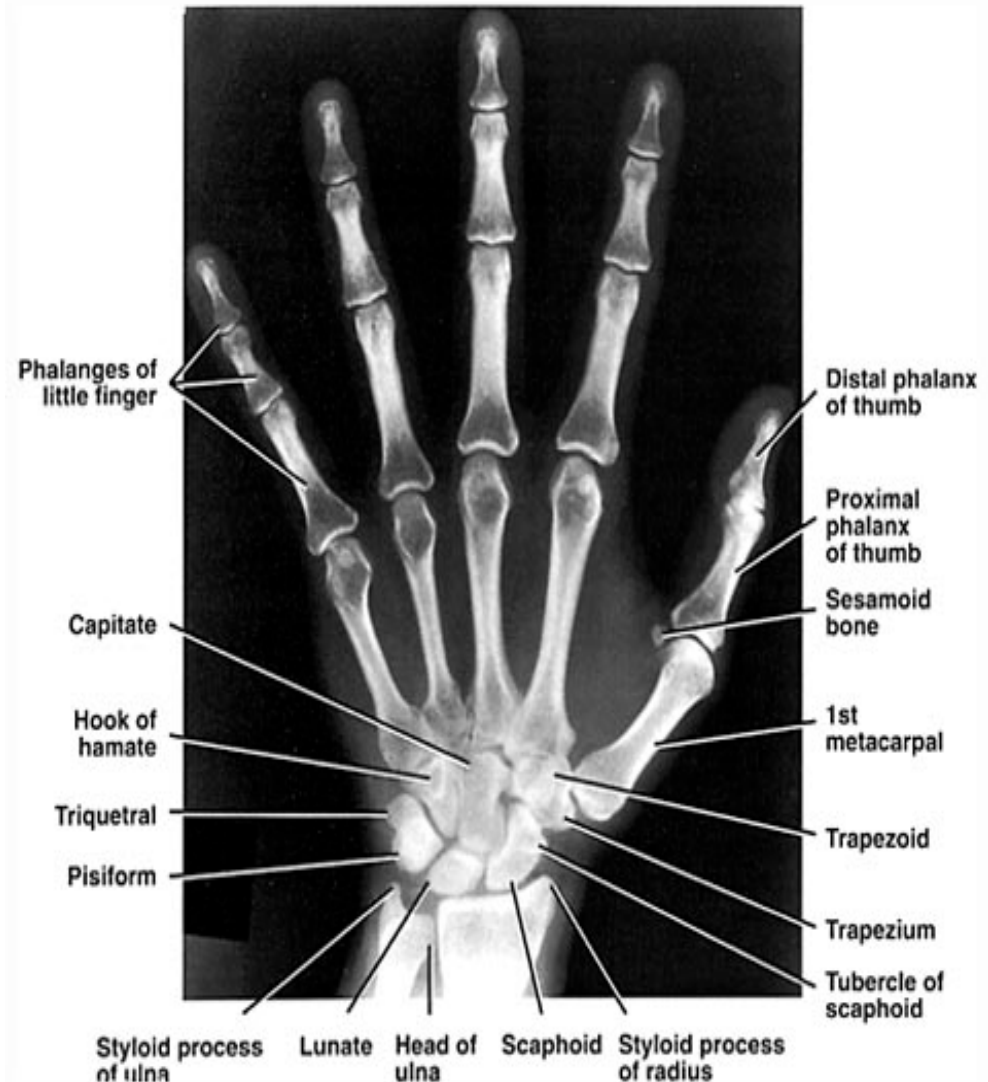
Home accidents

- ▶ Glassware
- ▶ Burns
- ▶ Cutting tools
- ▶ Knives
- ▶ Domestic machinery.

Hand Anatomy

▶ Hand consist of 27 bones:

- 14 Phalangeal bones
- 5 Metacarpal bones
- 8 Carpal bones
 - Carpal bones are made up of two rows of four bones bridged by flexor retinaculum which forms the carpal tunnel.
 - Carpal tunnel consist of the median nerve and the nine long flexor of the fingers



Hand Anatomy: Posture & the Skin

▶ Posture

- Posture of the hand at rest (position of rest)

▶ The skin

- Palmar skin is thick and cornified for enhanced grip. The dorsal skin on the other hand is thin, mobile and elastic to accommodate extension.

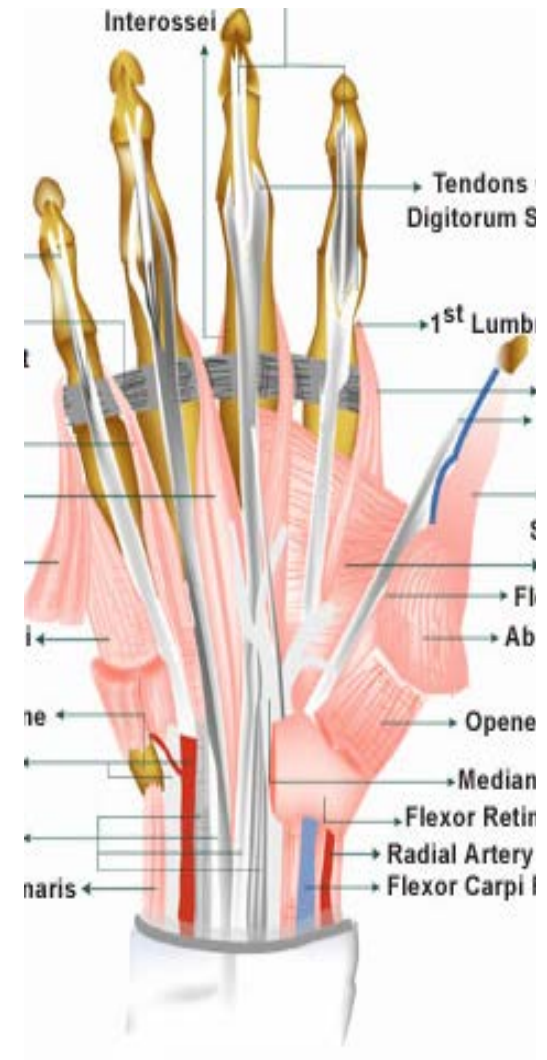


NOTE

From the second to the fifth finger, the fingers are flexed more and more. If a finger misaligns, it may be because the finger's flexor or extensor muscles have been injured.

Hand Anatomy

- ▶ Intrinsic muscles of the hand:
 - Have their origins and insertions within the hand.
 - Include the following:
 - Thenar, Hypothenar, adductor pollicis, the interossei and the lumbricals.



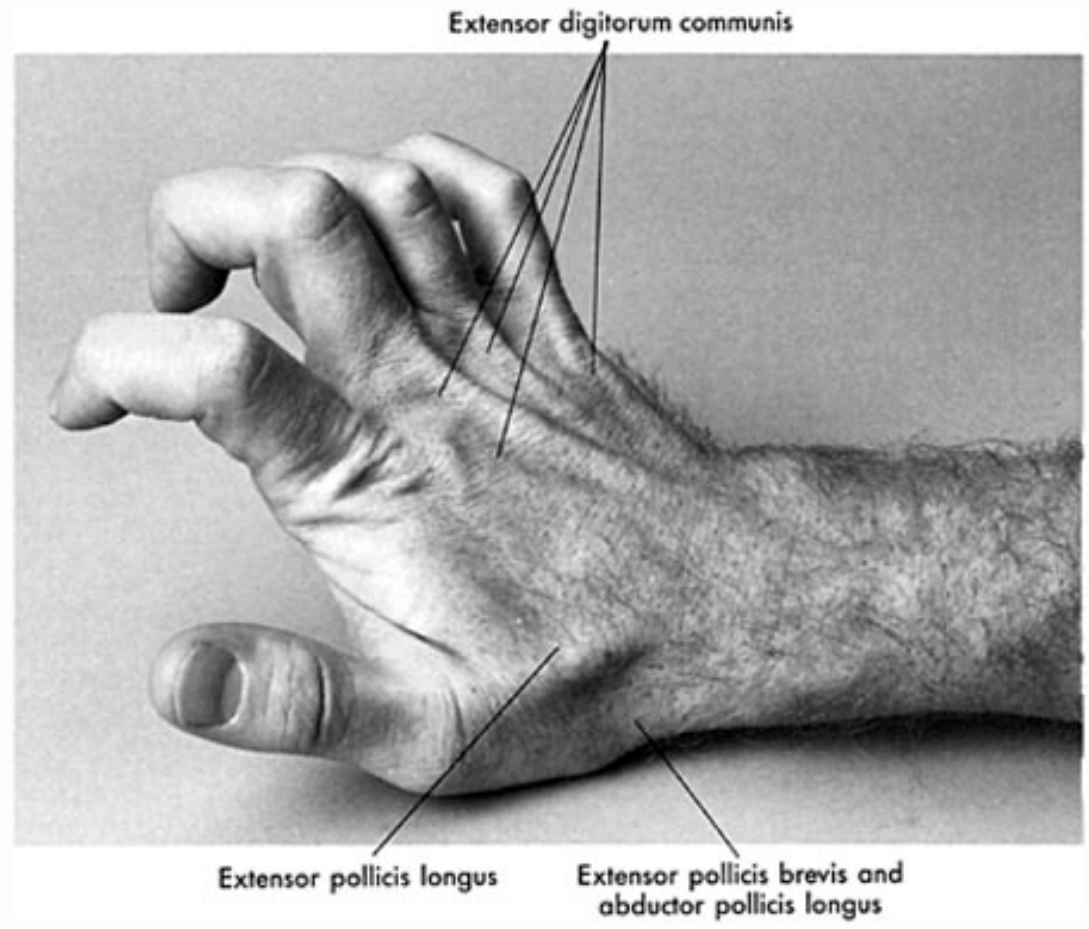
Hand Anatomy

▶ Extensor Tendons:

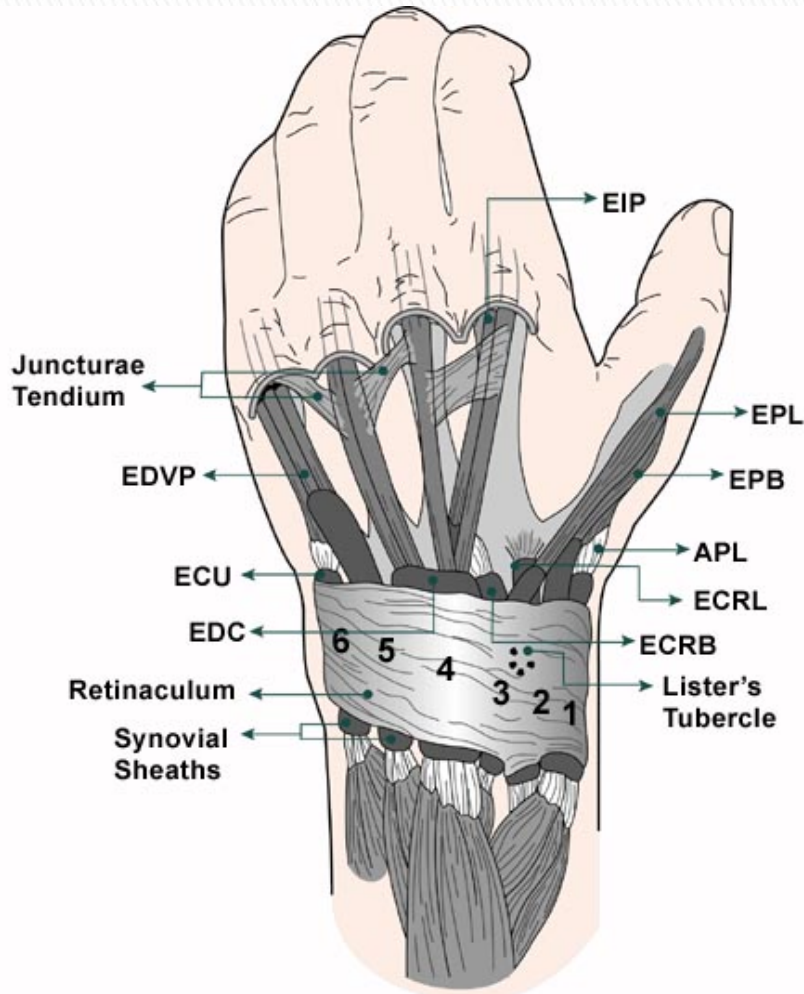
- Courses over the dorsal side of the forearm, wrist and hand.
- 9 extensor tendons pass under the extensor retinaculum and separate into 6 canals

Surface anatomy of the hand.

The tendons that are palpated with thumb abducted and extended form the anatomic snuff-box.



Hand Anatomy



- ▶ The extensor tendons gain entrance to the hand from the forearm through a series of six canals, five fibroosseous and one fibrous. The communis tendons are joined distally near the MP joints by fibrous interconnections called juncturae tendinum. Beneath the retinaculum, the extensor tendons are covered with a synovial sheath.

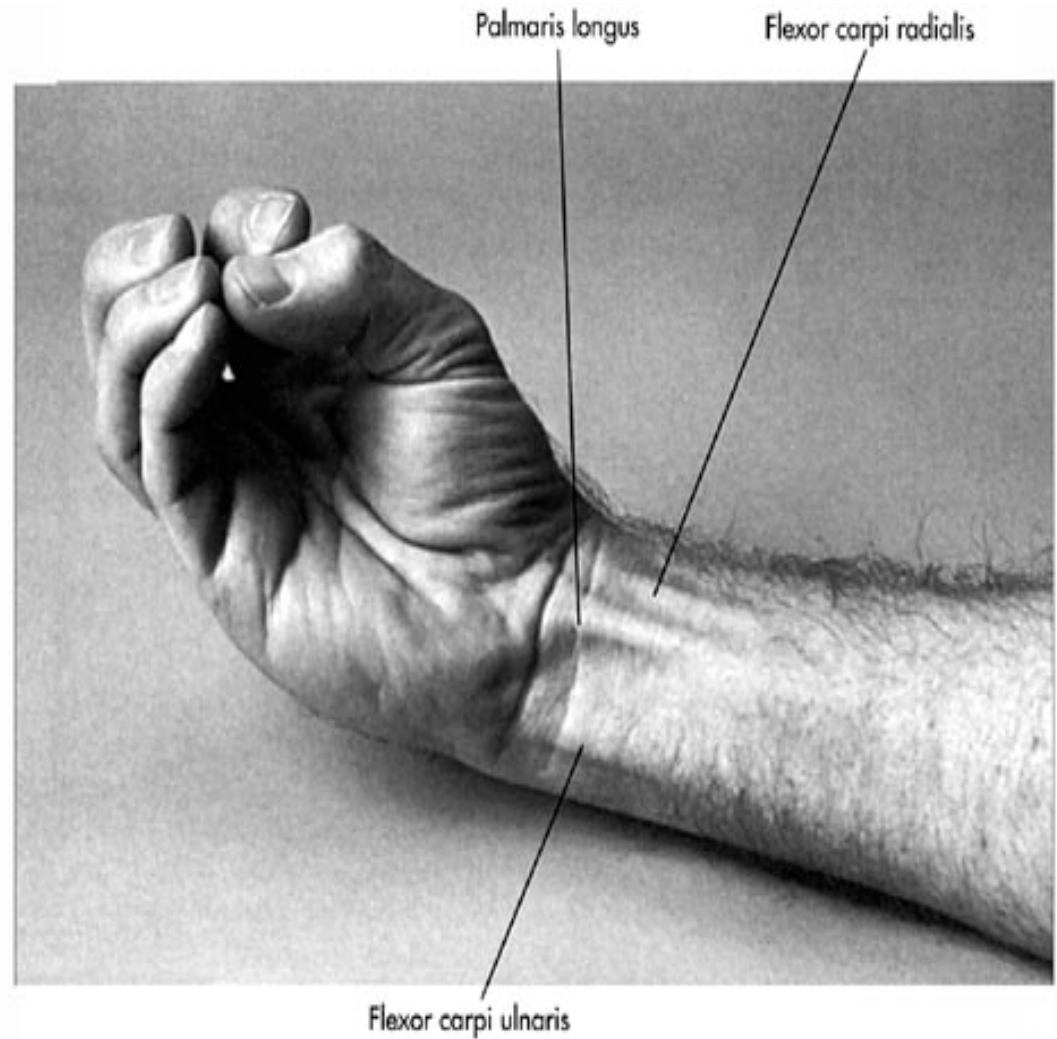
Hand Anatomy

▶ Flexor Tendons:

- Courses over the volar side of the forearm, wrist, and hand.
- Unlike the extensor tendons, the flexor tendons are enclosed together in synovial sheaths making them prone to deep space infections.

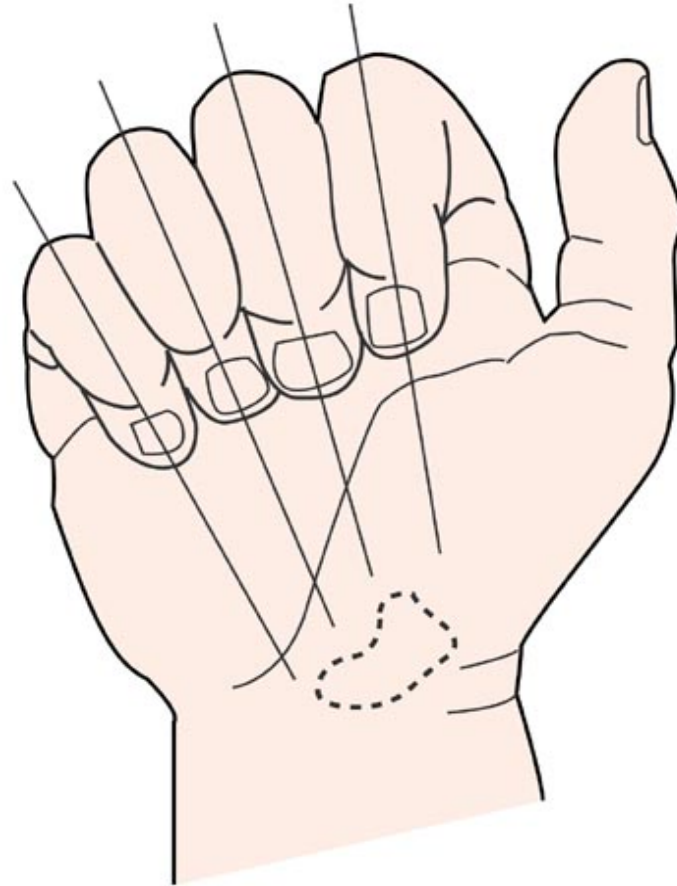
Hand Anatomy

- ▶ Flexor Tendons:
 - Flexor carpi radialis, flexor carpi ulnaris, and palmaris longus primarily flex the wrist



Hand Anatomy

Again, if any of the fingers fails to align, it may be injured



**Normal Flexion Of Fingers Pointing
Toward Region Of Scaphoid**

Hand Anatomy

Index Finger
is not in
alignment
with the other
fingers

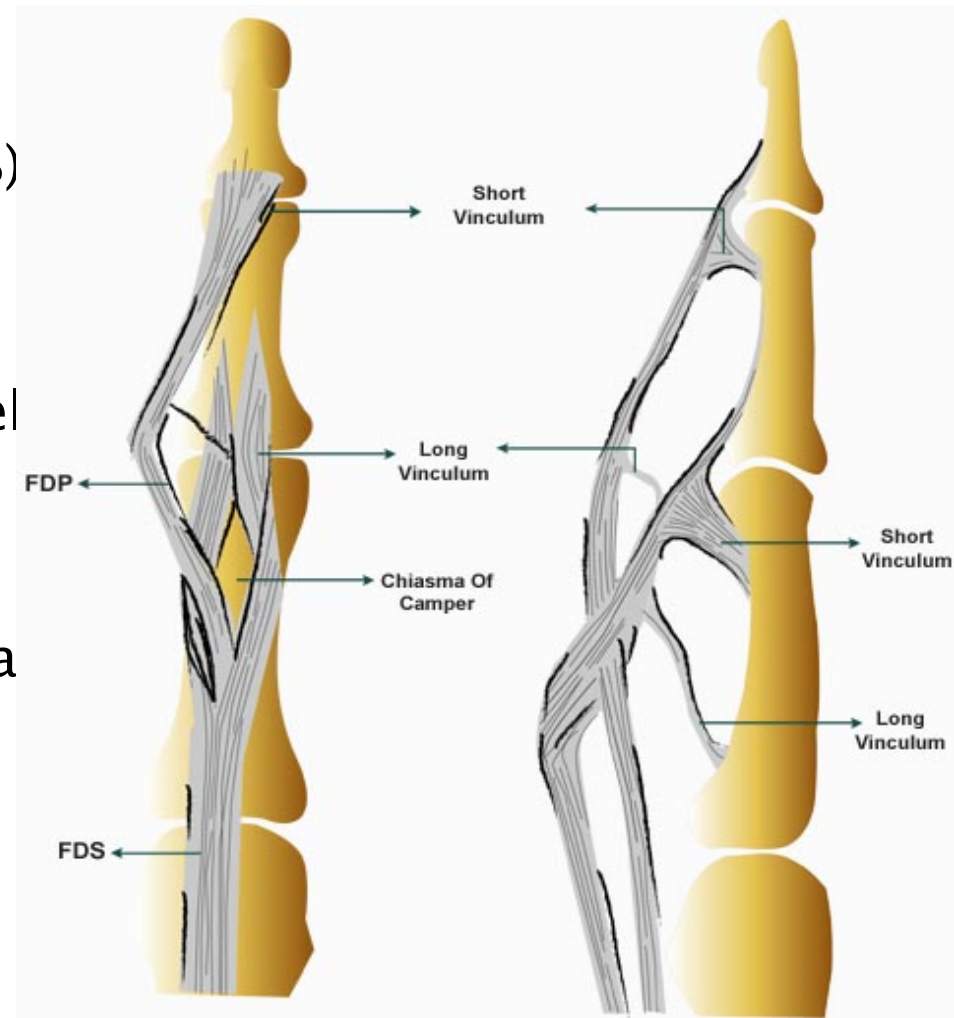


Hand Anatomy

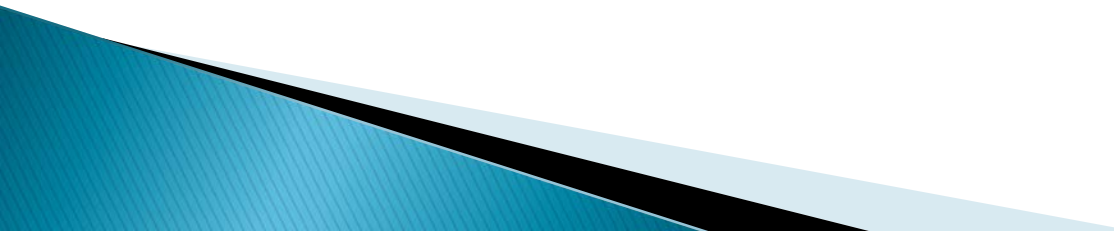
- ▶ 9 flexor tendons pass through the carpal tunnel:
 - 1 tendon goes to the base of the distal phalanx of the thumb
 - The remaining 4 digits each have 2 tendons. (Flexor Digitorum Superficialis / Flexor Digitorum Profundus).

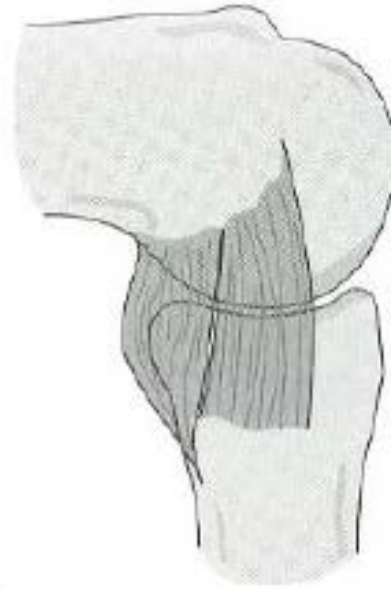
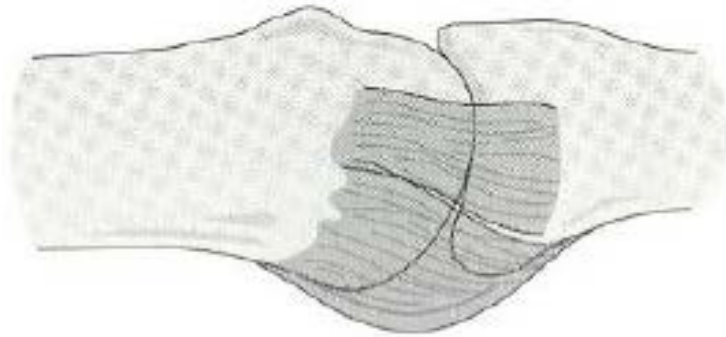
Hand Anatomy

- Flexor digitorum superficialis (FDS) insert into middle phalanx.
- Flexor digitorum profundus (FDP) runs deep to the FDS until the level of the MP joint where FDS bifurcates.
- FDP inserts at the base of the dista phalanx and acts primarily to flex the DIP joint as well as all other joints flexed by FDS

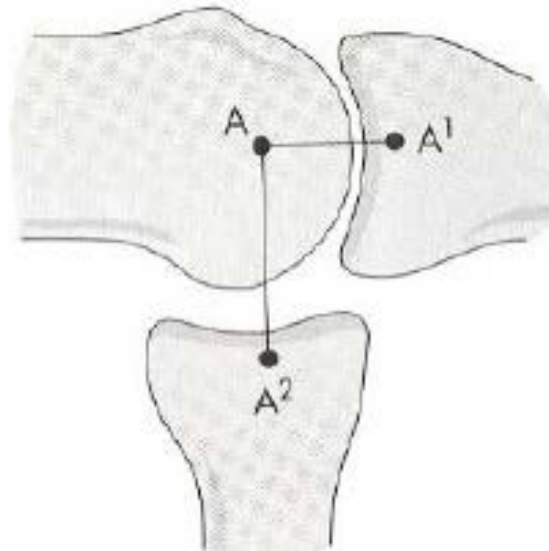


The joints

- Each finger has two IP joints. (The thumb has one).
 - The ligaments of IP joints are tight in extension and lax in flexion.
 - In contrast, those of the MP joints are lax in extension and tight in flexion.
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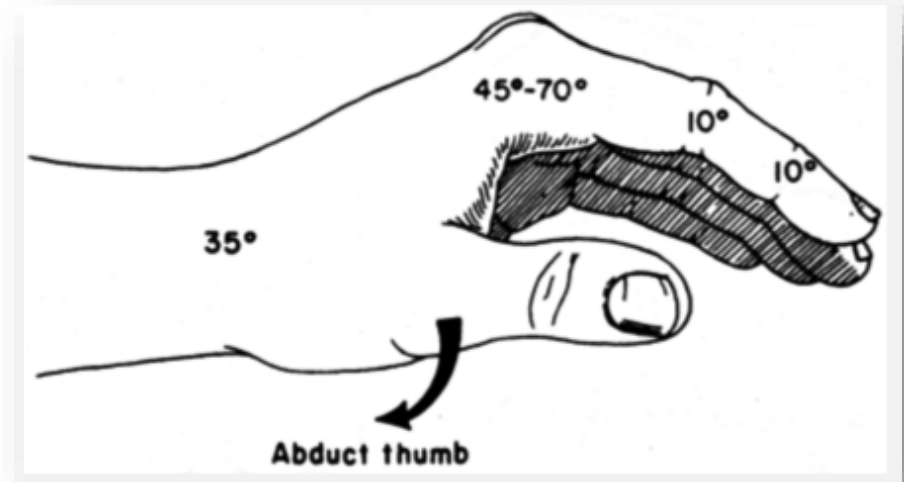


MCP joint ligaments are tighter in flexion than extension



Therefore, MCP joints are Splinted in Flexion (45-70 degrees)

Safe position for cast application



Hand Anatomy: Blood supply

▶ Blood Vessels

- Each finger is nourished by two digital arteries, each of which is located adjacent to its own nerve. Therefore, they may be injured concurrently.
- When one of the two main digital arteries stays intact after finger damage, the finger is still viable. When both are damaged, gangrene develops.



Hand Anatomy: Blood supply

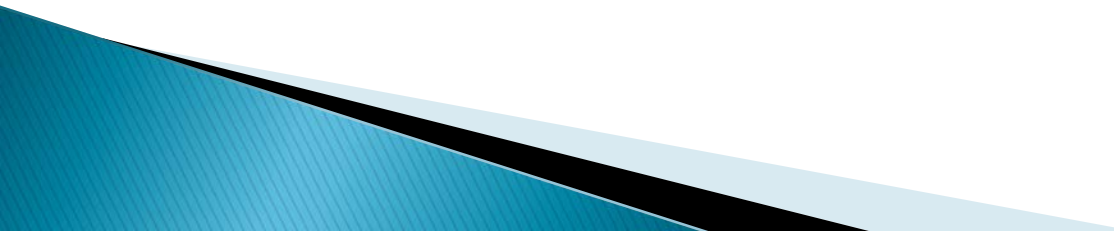
▶ Blood supply (BS):

- Hand and digits has dual BS with contributions from the radial and ulnar arteries.
- This ensures good collateral circulation
- Allen test is used to test for the patency of either ulna or radial artery to the hand



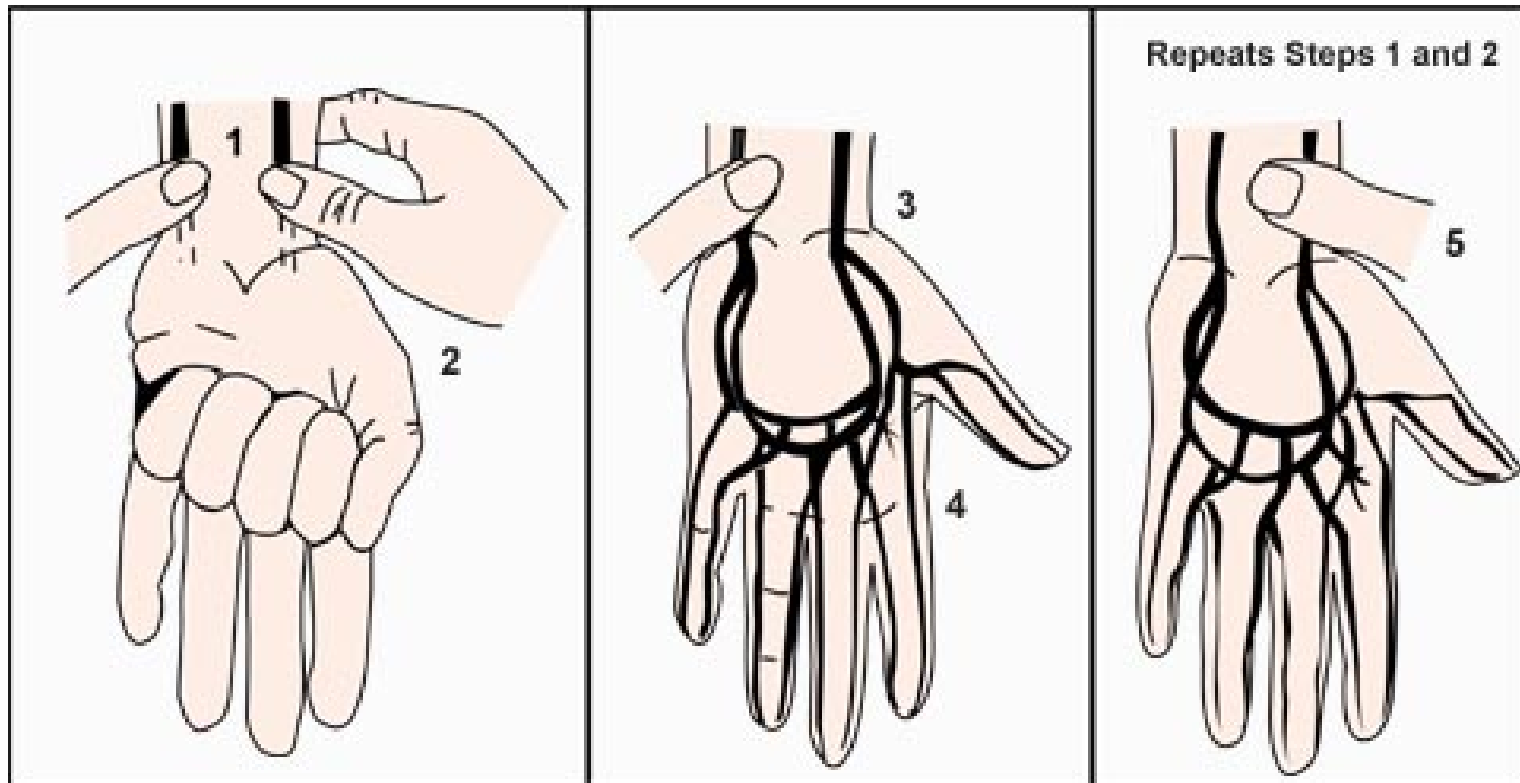
Hand Anatomy – Blood supply

Allen's test

1. Clench hand strongly
 2. Occlude radial and ulnar artery
 3. Open hand and observe for pallor
 4. Release ulnar artery and observe
 5. Return of flow indicates patent ulnar artery
 6. No return of colour indicates ulnar artery not patent
 7. Repeat steps 3–6 for radial artery patency
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Hand Anatomy – Blood supply

Allen's test

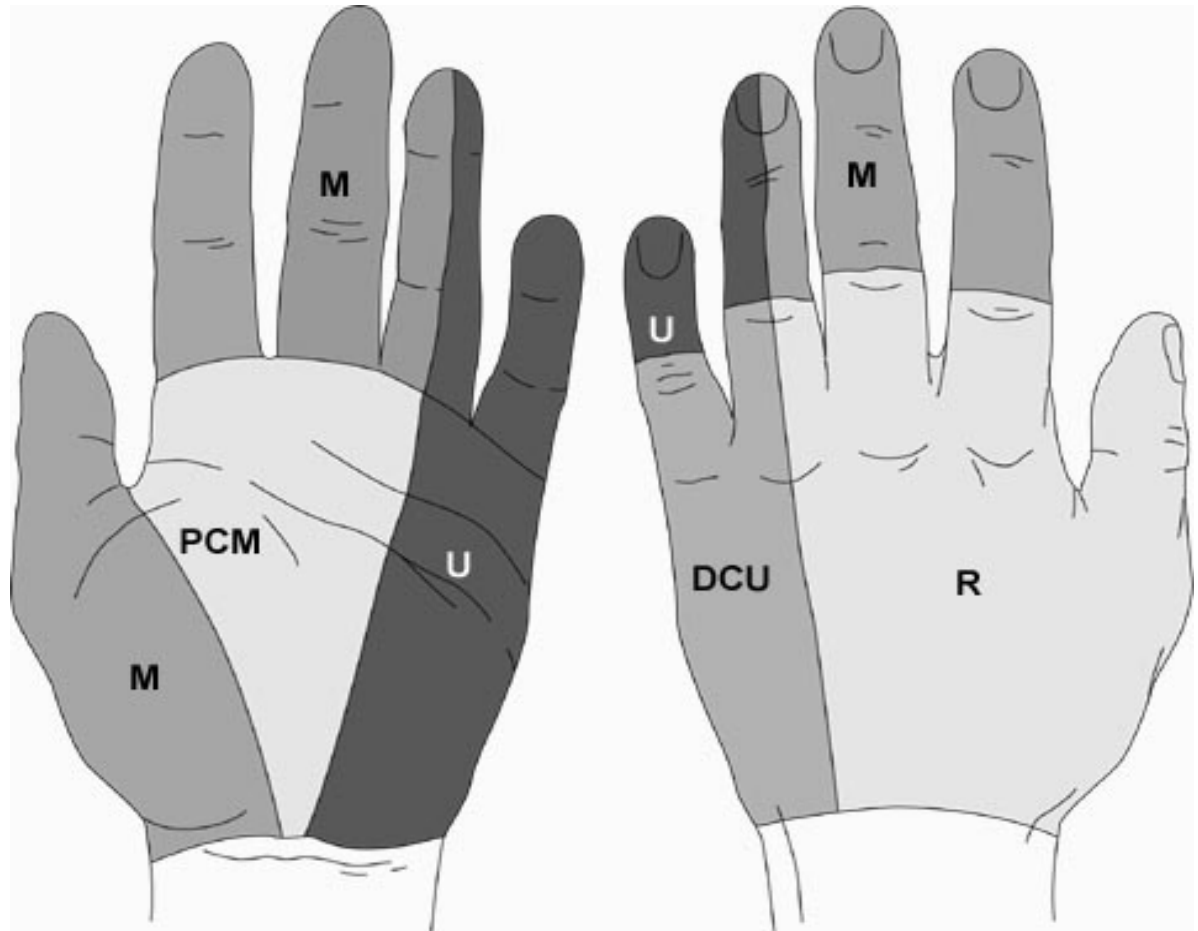


The Allen's test.

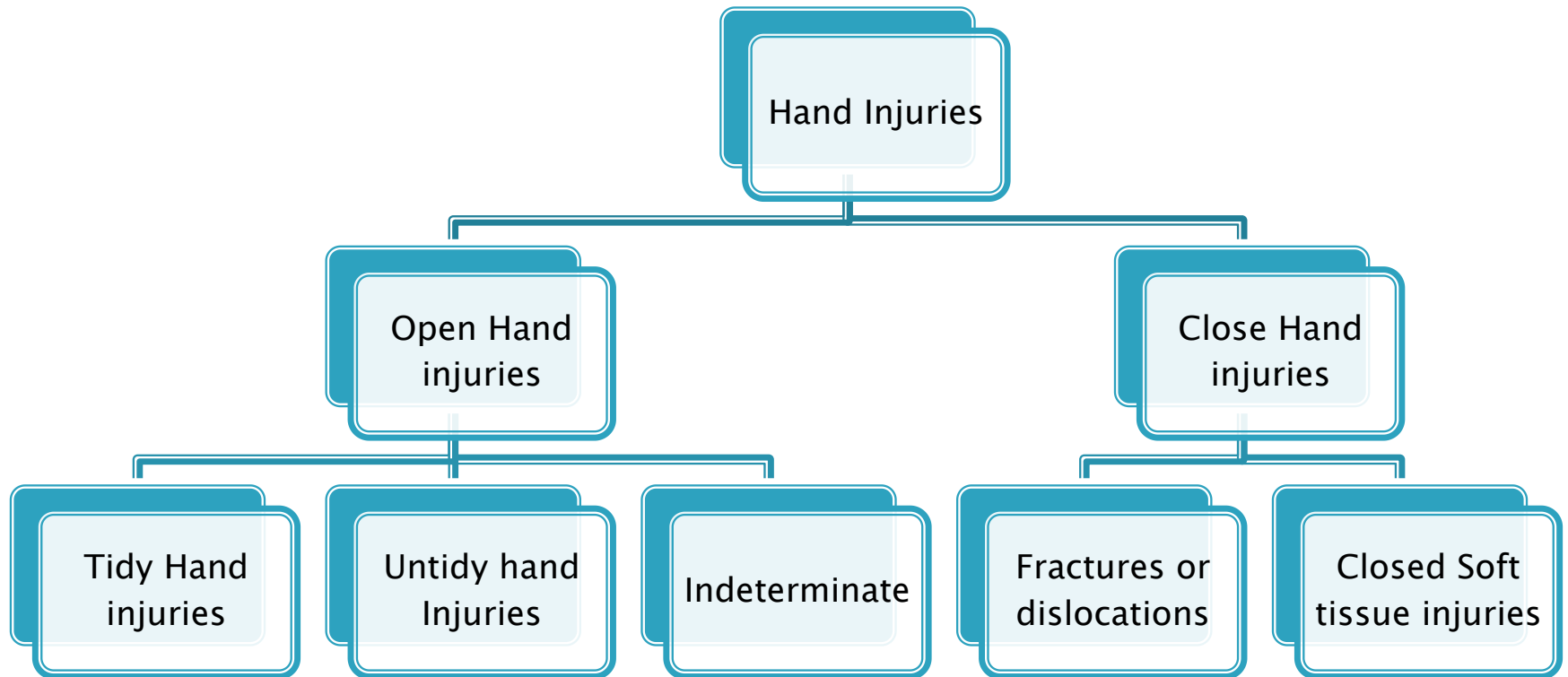
Hand Anatomy

The cutaneous nerve supply in the hand:

- *M*, median;
- *R*, radial;
- *U*, ulnar;
- *PCM*, palmar cutaneous branch of median nerve;
- *DCU*, dorsal cutaneous branch of ulnar nerve



Hand injuries: Classification



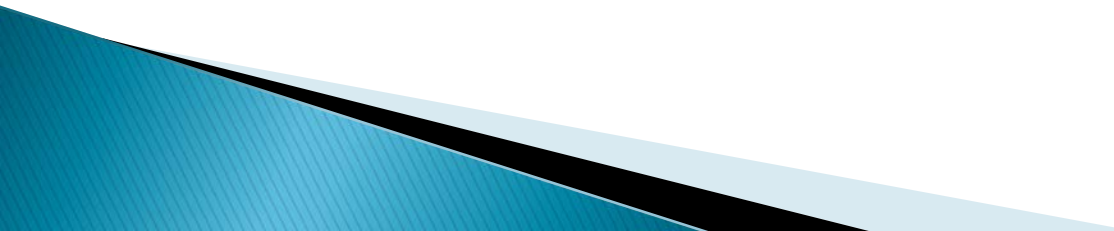
Hand injuries: Classification

	The “untidy” hand injury	The “tidy” hand injury.
Common causes	Mobile machinery e.g., power saws, presses, grinding machines etc	Household type accidents with blades & other cutting edges.
Nature <ul style="list-style-type: none">•Surface wound•Fractures•Tendons & nerves	Usually, multiple irregular avulsions Commonly multiple & comminuted Gross exposure common but frequently not divided	Usually single and clean cut. Uncommon Frequently cut.

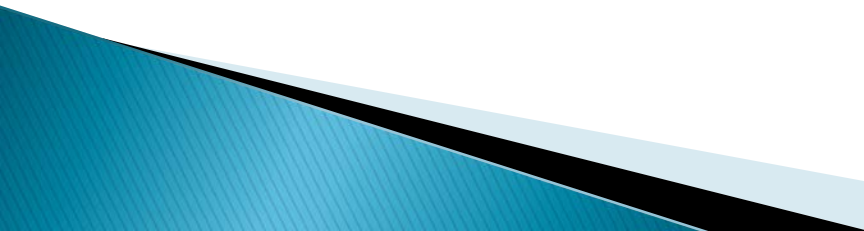
Principles of Evaluation: History

- Should include the time, the cause of the injury and evaluate for the possibility of crush, burn, or chemical exposure.
- The patient's occupation, prior hand injuries, and handedness should be documented

Principles of Evaluation: History

- ▶ The position of the hand at the time of injury should be determined.
 - ▶ Injuries with the digits in flexion may result in retraction of the cut end of the tendon when the digit is examined in neutral position.
- 

Principles of Evaluation: Examination

- ▶ **Should be done in two stages:**
 1. Pre-anaesthetic examination in the casualty preliminary to operation. This is the functional evaluation of the hand. Wound examination at this stage is basically to estimate its size, location and probable tissue injured.
 2. Operative assessment (examination under anaesthesia): this is concerned with the details of the wound itself.
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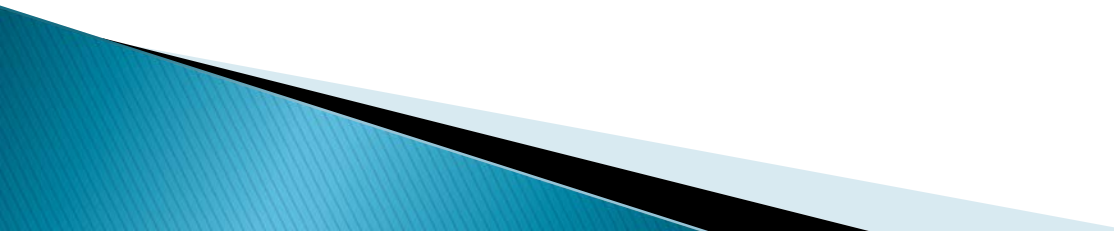
Principles of Evaluation: Examination

1. Assessment of circulation

- ▶ This is the priority
 - Check for
 - persistent copious bleeding (unusual),
 - colour,
 - warmth
 - Turgor
 - capillary filling.

Principles of Evaluation: Examination

2. Skin and soft tissues

- ▶ Size and depth of wounds
 - ▶ Skin flap viability
 - ▶ Bruising and swelling
 - ▶ Quality, condition, adequacy of skin coverage
- 

Principles of Evaluation: Examination

Bones and joints

- ▶ **Look** – hand posture, rotation, angulation, joint displacement
- ▶ **Feel** – palpate for tenderness, displacement, crepitus, joint stability, ligament laxity
- ▶ **Move** – range of motion passive and



Principles of Evaluation: Examination

4. Assessment of the nerves

○ Test the median nerve:

- Have the patient flex the distal phalanx of the thumb against resistance
- Test opposition by touching the tip of the thumb to the tip of the little finger
- **The patient will be unable to oppose against resistance if median nerve function is lost.**

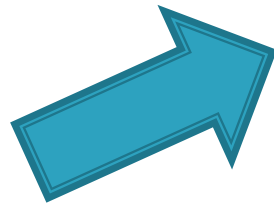
Principles of Evaluation: Examination

○ Test the ulnar nerve

- Spread the fingers apart against resistance and then try to push them together against resistance.
- Test the hypothenar muscle: extend the fingers and then try to move the fifth finger away from the fourth
- Test thumb adduction (ulnar nerve innervates the adductor pollicis muscles) bring the thumb tightly against the side of the index finger.
- Adductor strength can be further tested by interposing a piece of paper between the thumb and the index finger and then trying to pull the paper away

Principles of Evaluation: Examination

- Test the radial nerve:
 - Test for wrist drop by extend the fingers and wrist against resistant.
 - With the thumb in the hitchhiking position, test its resistance to further extension.

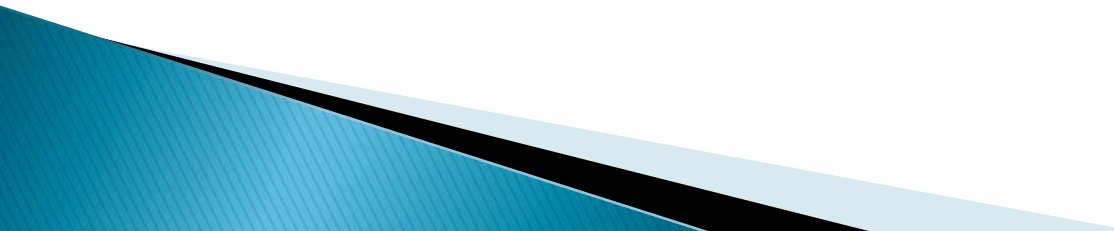


Principles of Evaluation: Examination

- ▶ **Nerve testing: Sensation**
 - Determined by 2–point discrimination.
 - Normal 2–point discrimination is <6 mm at the fingertips and is often <2 mm. Both injured and non–injured fingers must be compared.
 - Repeat 2–point discrimination testing 2 – 4 times on each side of the digit (80% accuracy is considered acceptable)

Principles of Evaluation: Examination

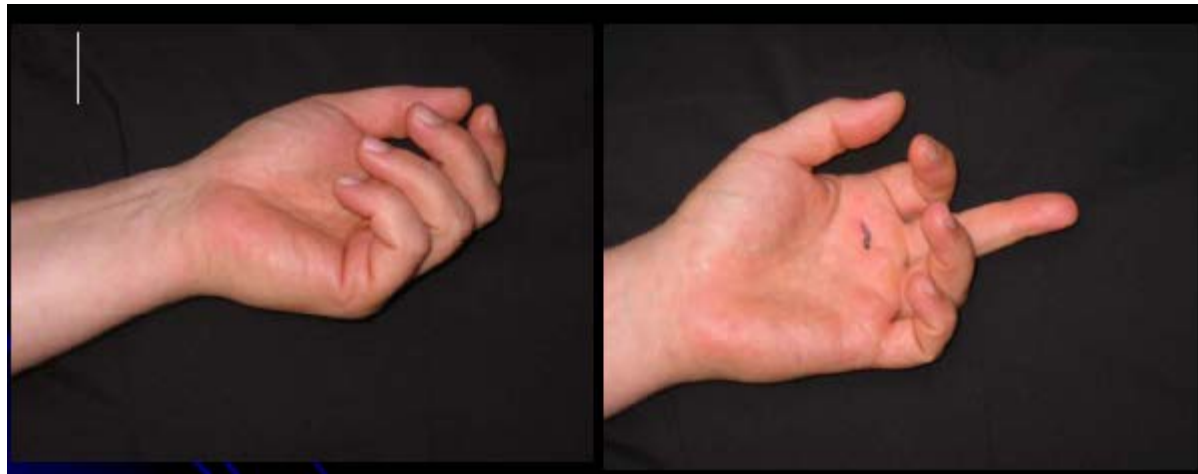
5. Assessment of tendons

- I. Position at rest
 - II. Posture with the wrist flexed.
 - III. Wrist tenodesis test
 - IV. Test for individual tendon actions
- 

Passive tests of tendons: Position at rest

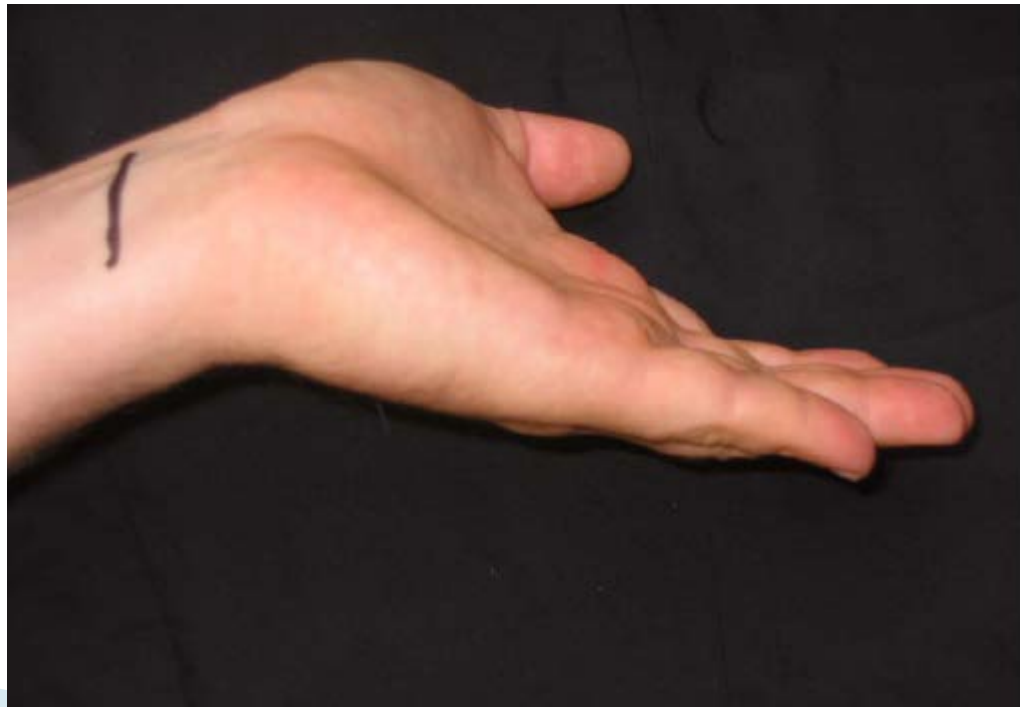
Normal

Abnormal: flexor tendon
Index finger injured



Passive tests of tendons: Position at rest

Injury to all flexor tendons at the wrist!



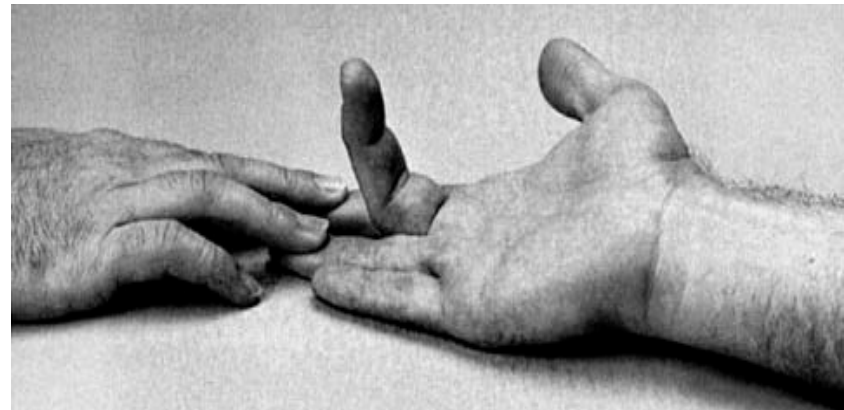
Passive tests of tendons

- **Muscle squeeze test** – pressure over the flexor muscles in the volar forearm normally produces finger flexion
- **Tenodesis effect** – gentle passive extension and flexion at the wrist should cause the fingers to flex and extend in a normal cascade fashion, whereas fingers with disrupted flexor tendons remain in an extended position

Principles of Evaluation: Examination

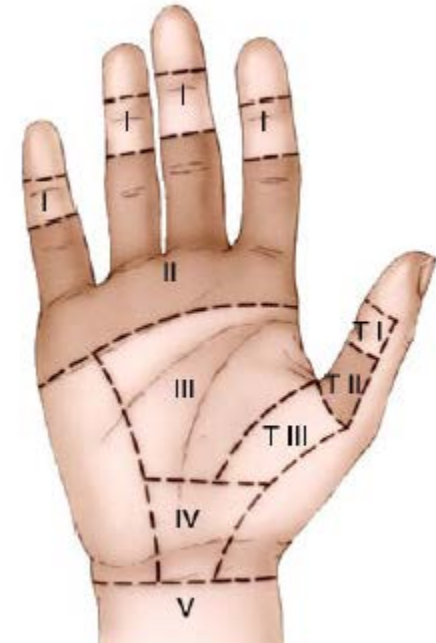
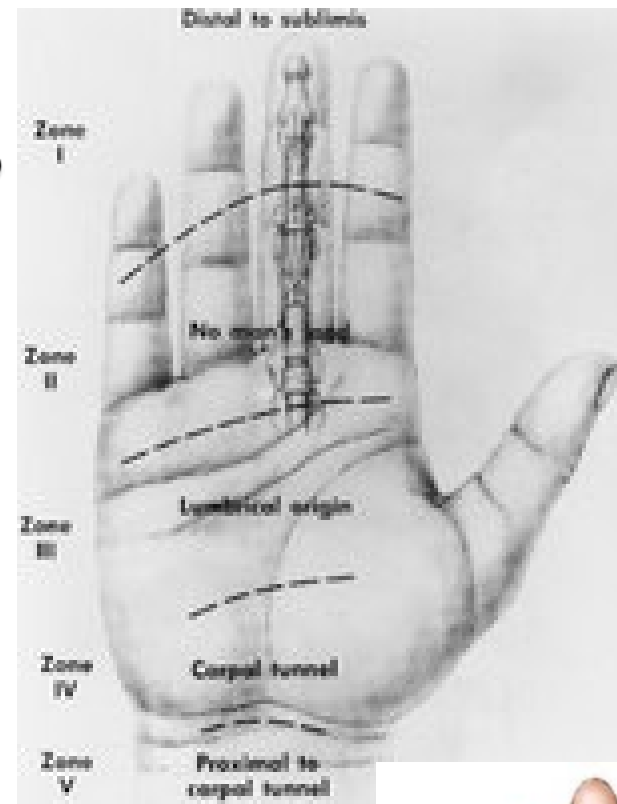
Test for individual tendons

- ▶ Tendon testing:
 - FDP is tested by flexing the DIP against resistance while the MP and PIP are held in extension.
 - FDS is tested by flexing the PIP against resistance while the remaining fingers are held.



Injuries: Tendons

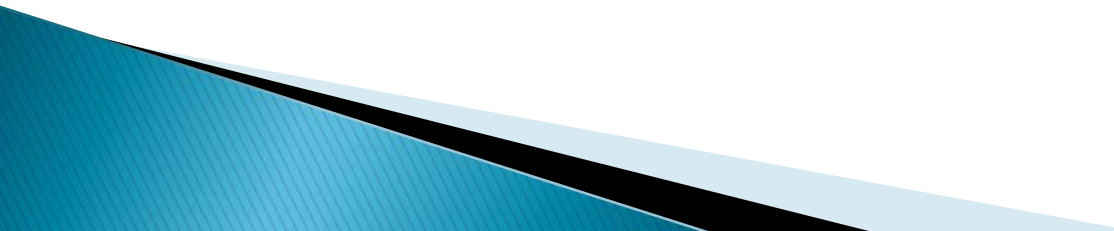
- ▶ Flexor tendons
 - Most common cause of flexor tendon injury is a laceration.
 - A distal to proximal five zone (I – V) classification system for flexor tendon injuries has been developed based on location, treatment considerations, and prognosis.



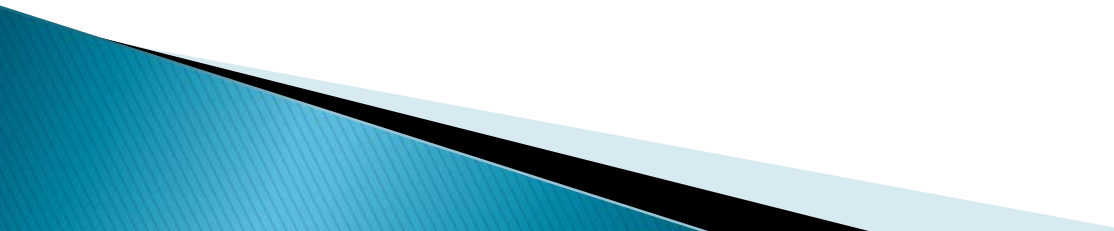
Flexor tendon injuries : Zones of the Hand

- ▶ **Zone I:** The FDP has emerged from beneath and between the decussating fibres of the FDS and travels to its insertion in the terminal phalange. Immediate repair of the tendon should be done.
- ▶ **Zone II:** this is where the 2 flexor tendons enter the fibro-osseous tunnel at the mid-palm level. Repair here is very difficult and the outcome usually poor. In fact, this area is referred to as the “no man’s land.”
- ▶ **Zone III:** this is at the mid-palm level. The tendons are free of sheath, but they are in close proximity to vital structures such as the superficial transverse vascular arch, the terminal sensory divisions of the median nerve and the motor divisions to the thenar muscles.
- ▶ **Zone IV:** The carpal tunnel. Injuries here usually involve many tendons.
- ▶ **Zone V:** At the level of the wrist. Common, and may be self-inflicted. Major nerve and vascular injuries are common associated injuries. Results of tendon repair here are usually good.

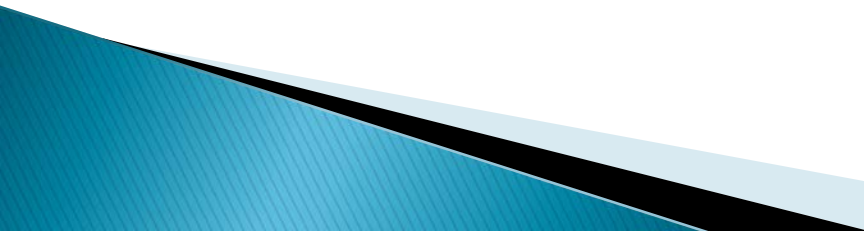
Investigations

- ▶ Radiology
 - ▶ Wound culture
 - ▶ Doppler flow meter
 - ▶ Fluorescein dye test
 - ▶ Compartmental pressure measurement.
- 

Treatment: First aid

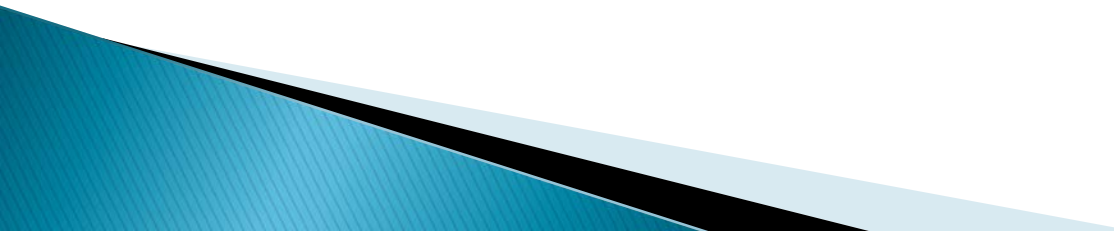
- ▶ Control haemorrhage—pressure dressing.
 - ▶ Cover the injured hand with clean dressing
 - ▶ Adequate splinting
 - ▶ Elevate
- 

Treatment: Casualty Reception

- ▶ Quick history and examination. Avoid repetitive examinations and dressing.
 - ▶ Give First aid, if not yet given.
 - ▶ Calm the patient by reassuring them
 - ▶ Analgesics
 - ▶ IV fluid
 - ▶ Tetanus immunoprophylaxis
 - ▶ Antibiotics when indicated.
 - ▶ Investigations especially X-rays
- 

Treatment: Definitive

Introduction

- ▶ Minor injuries: Emergency room theatre
 - ▶ Major injuries: Main operating room
 - ▶ Requires adequate anaesthesia
 - ▶ Tourniquets should be used except when contraindicated
- 

Treatment: Definitive

Anaesthesia: essential for adequate examination and treatment

Types:

- ▶ Axillary block
- ▶ Bier's block
- ▶ Wrist block
- ▶ Local infiltration for minor lacerations
- ▶ General anaesthesia

Treatment: Definitive

	The “untidy” hand injury	The “tidy” hand injury.
Appraisal of damage	Often can only be determined at operation	Can usually be determined before operation
Use of tourniquet	Contraindicated	Not contraindicated
First surgery	Reduce fractures; close all soft tissue wounds (plastic procedures frequently needed because this is usually difficult).	Repair tendons & nerves. Soft tissue wounds easily closed.
Subsequent surgeries	Repair tendons & nerves (reconstruction procedures frequently needed)	Not generally indicated
Healing	Problematic	Primary healing

Ligament and Dislocation injuries

Dorsal dislocation at the DIP joint without associated fracture

Volar dislocation of DIP joint of little finger.



Ligament and Dislocation injuries

Lateral dislocation of middle finger PIP joint.



Fractures

- ▶ Distal Phalanx:
 - Fractures at the base may be associated with flexor or extensor tendon involvement.
 - These fractures are treated as soft tissue injuries with protective splinting.



Fractures

Bennett's fracture

- Avulsion fracture of the articular surface of the first metacarpal with subluxation at the CMC joint.



Metacarpal fractures



High pressure Injection nozzle injuries

- ▶ Tiny entry wound, but serious injuries
- ▶ Industrial high high–pressure spray or gun with a fingertip
- ▶ Paint, grease and solvents penetrate the skin and spread throughout the underlying fascial planes
- ▶ Need emergency decompression and debridement of as much foreign material as possible
- ▶ Leave wounds open, immobilization, elevation and iv antibiotics



Crush Injuries

- ▶ Possible widespread damage to all the organ systems of the hand (e.g., intrinsic muscles and the deep fascial compartments)
- ▶ Edema, swelling and secondary necrotic changes
- ▶ Emergency fasciotomy may be required

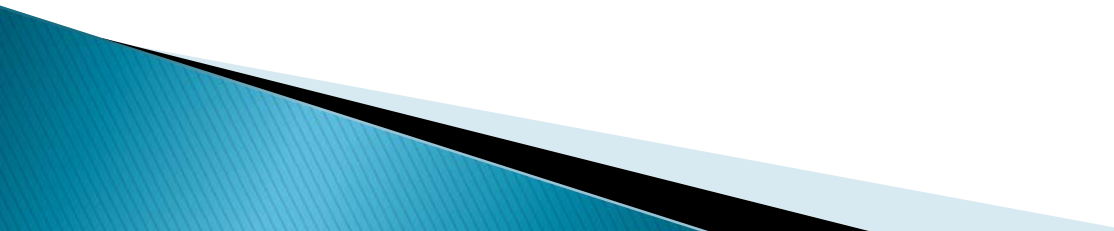


Gunshot wounds

Low –velocity projectiles

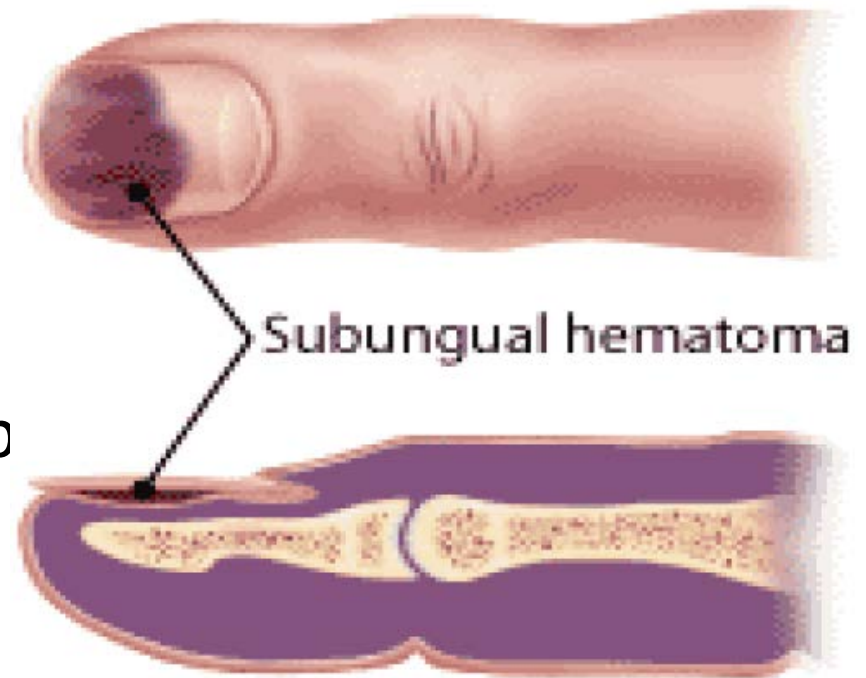
- ▶ Relatively simple wounds with a contained FB
- ▶ Remove FB or wait until edema settled

High –velocity projectiles

- ▶ Large amount of energy
 - ▶ Major internal injuries that are not apparent immediately
 - ▶ Urgent specialist treatment
- 

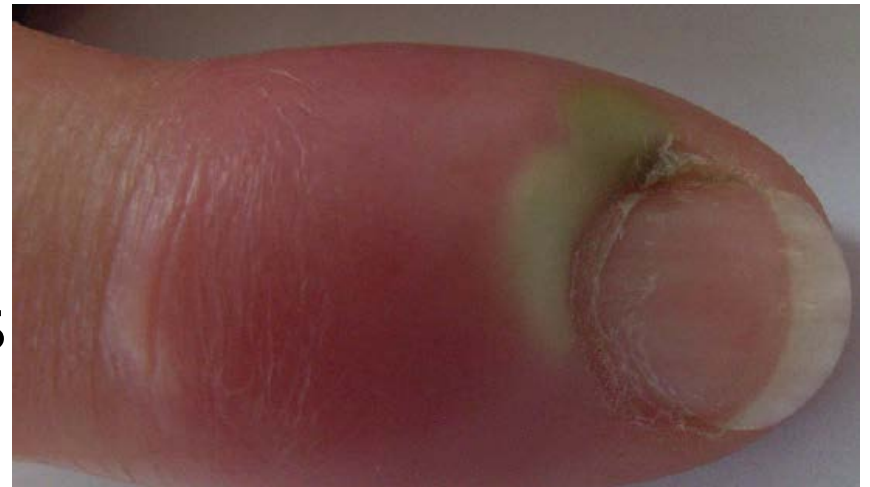
Subungual haematoma

- ▶ Visible hematoma under the nail
- ▶ Very painful, pulsates with every arterial pulsation
- ▶ Requires drainage:
 - Drill with Hot paper clip
- ▶ Think nail bed injury if hematoma greater than 50%
- ▶ Give tetanus toxoid!



Paronychia

- ▶ Infection at base of nail fold
- ▶ Often caused by Staph. Aureus
- ▶ Usually due to breaks in the skin such as from nail biting
- ▶ Requires drainage: I&D



The End

Thank You

