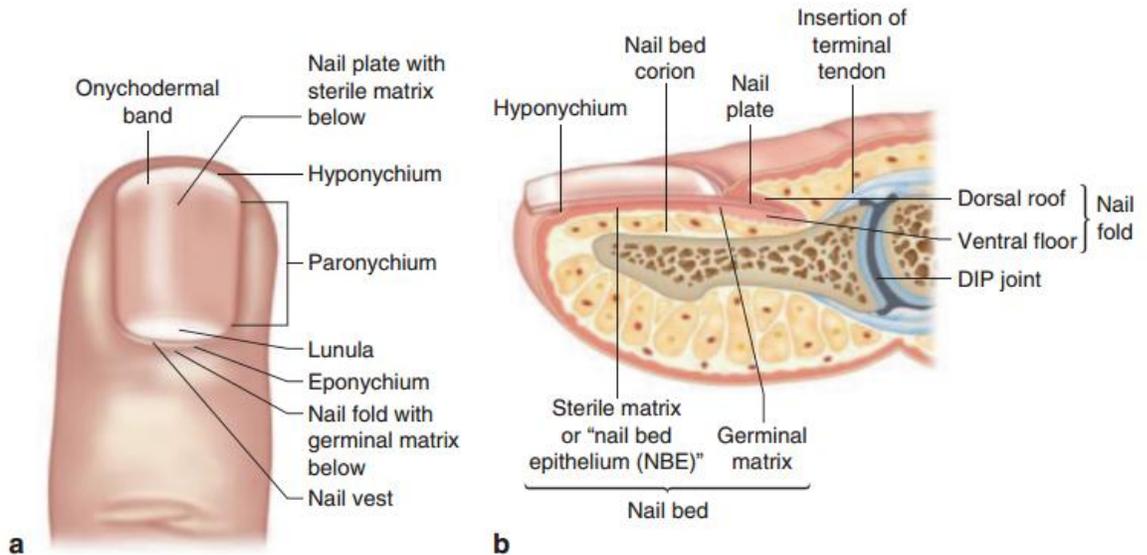


HAND TRAUMA

A. Fingertip injury:

The **fingertip** is the portion of the digit distal to the insertion of the FDP and extensor tendons.

- Fingertip and nail injuries account for 45% of all emergency department (ED) hand injuries.
- The middle fingertip is most commonly injured, followed by the ring fingertip. Thumb tip injury is least common.



Perionychial anatomy of the fingertip

EVALUATION

History:

Age: Children are treated differently from adults, and older patients have limited treatment options.

Gender: Aesthetic outcome is often more important to female patients.

Hand dominance: Dominant-hand injuries are treated more aggressively.

Occupation: A manual laborer might be treated differently from a musician.

Determine mechanism of injury.

Tobacco use: Random-pattern flaps are discouraged in smokers

Physical Examination:

Perform complete hand examination; do not neglect the rest of the hand.

Give special attention to the injured digit:

Assess the flexor and extensor tendons.

Measure defect size (in cm²).

Determine the composition of the missing or nonviable tissue (e.g., nail plate, nail bed, skin, pulp, bone).

Note the presence of exposed bone.

Evaluate the geometry of the injury to guide treatment.

Digit-specific radiograph:

Obtain AP and lateral films

TREATMENT PLANNING:

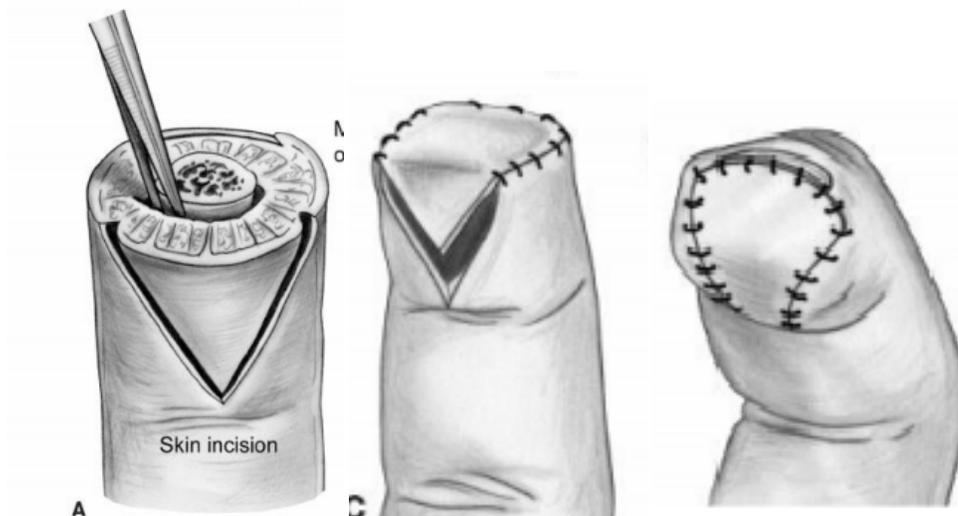
The general principles of treatment include preservation of digit length, maintenance of sensate fingertip pulp, prevention of joint contracture, and eventual pain-free use of digit.

a) If no exposed bone:

- **Secondary intention healing:** Indication: ≤ 1 cm²
- **Primary closure is an option only if tissue loss is minimal.**
- **Skin grafts**

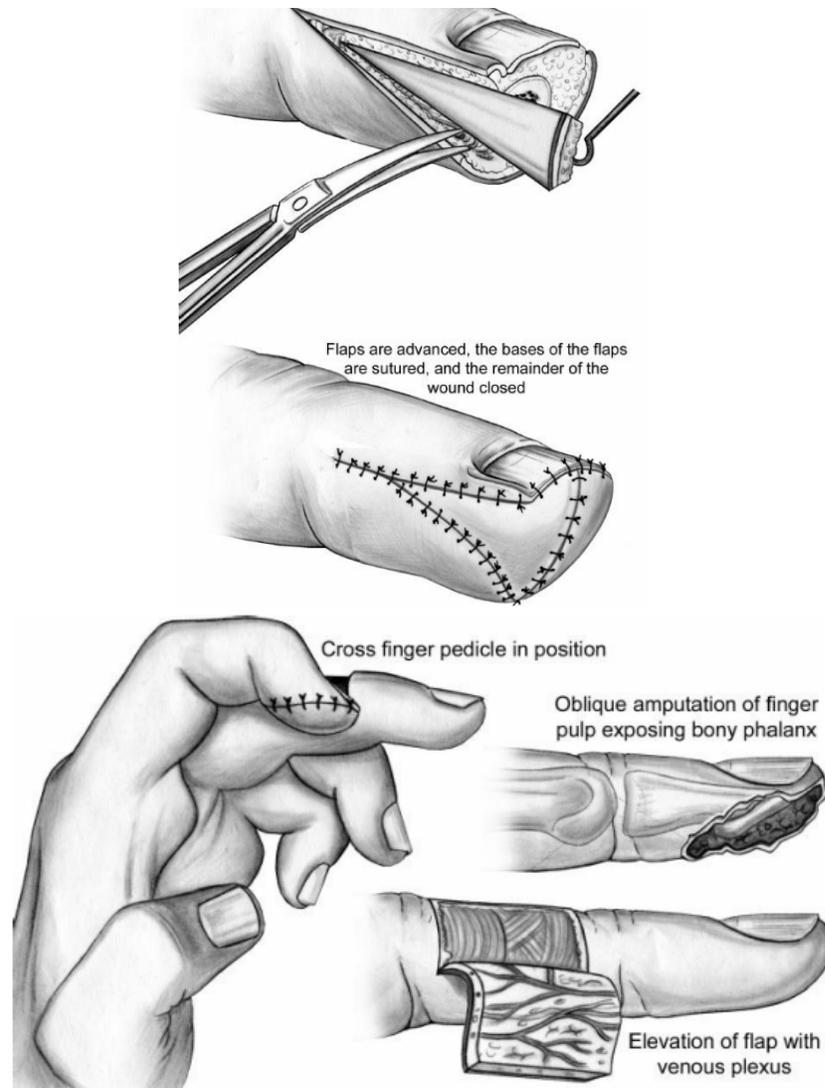
b) If bone is exposed:

- **Bone shortening and primary closure: should be avoided**
- **Fingertip flaps:**
 1. *Volar V-Y advancement flap*
 2. *Lateral V-Y advancement flap*
 3. *Cross finger flap*
 4. *Thenar flap*



Nail bed injury: The hallmark of injuries to the nailbed is the subungual hematoma.

- A small subungual hematoma constituting less than 50% of nail area may be treated without nail plate removal.
 - Nail plate should be perforated with a sterile needle.
- Subungual hematomas greater than 50% of nail area require nail plate removal for repair of underlying nail matrix lacerations with 6-0 or smaller absorbable suture.



B-Flexor tendon injury:

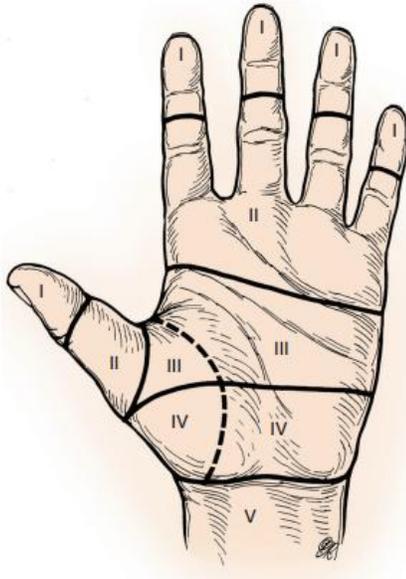
This injury usually results from volar lacerations, and concomitant neurovascular injury is common.

History and examination: see Lec.1

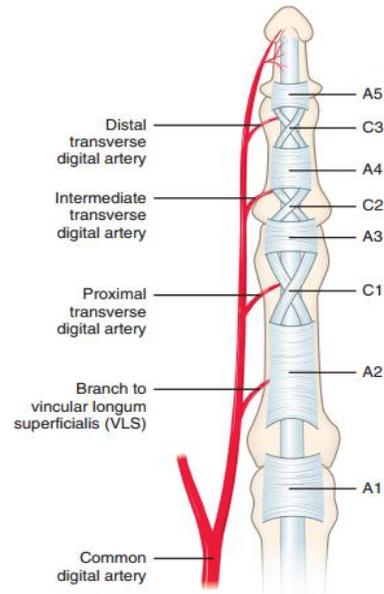
Zone of tendon system:

- Zone 1: from the insertion of the FDS tendon to the terminal insertion of the FDP tendon
- Zone 2: from the proximal reflection of the digital synovial sheath to the FDS insertion (within synovial sheath). It is called *no man land*
- Zone 3: from the distal margin of the transverse carpal ligament to the digital synovial sheath
- Zone 4: area covered by the transverse carpal ligament

- Zone 5: proximal to the transverse carpal ligament.



Zones of the flexor tendon system.



The tendon sheath contains the annular pulleys A1 to A5 and the cruciate pulleys C1 to C3.

Timing of Repair, and Treatment Options:

Primary Repair (<24 Hours): Preferred option when feasible

Delayed Primary Repair (>24 Hours but <2 Weeks): Reasonable option for heavily contaminated wounds

Secondary Repair: Early (2-5 weeks)

Late (.5 weeks): Best treatments: Tendon graft or tendon transfer

Treatment:

The tendon injury is treated surgically by core and epitendinous repair

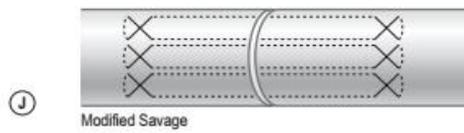
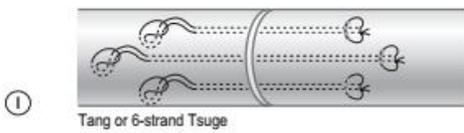
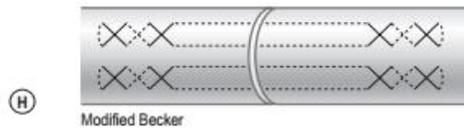
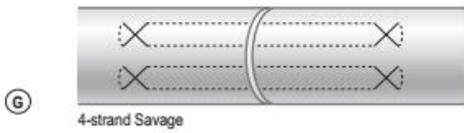
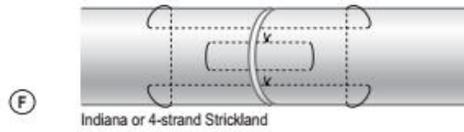
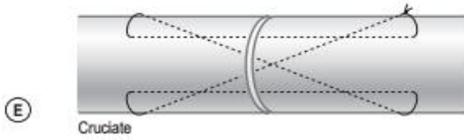
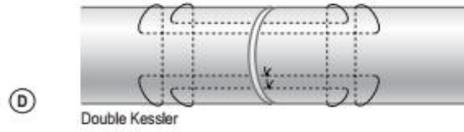
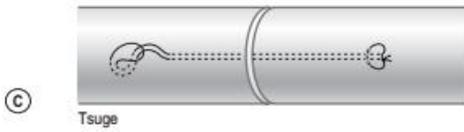
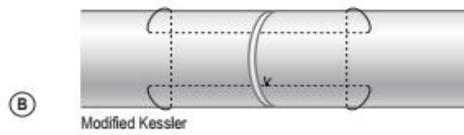
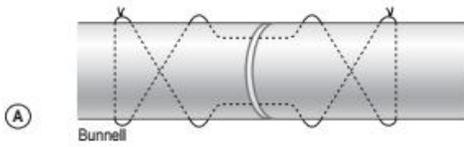
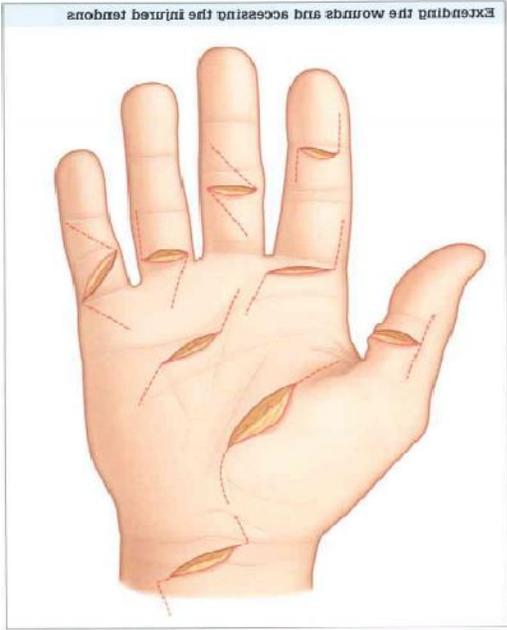
Basic principles:

1- Core repair:

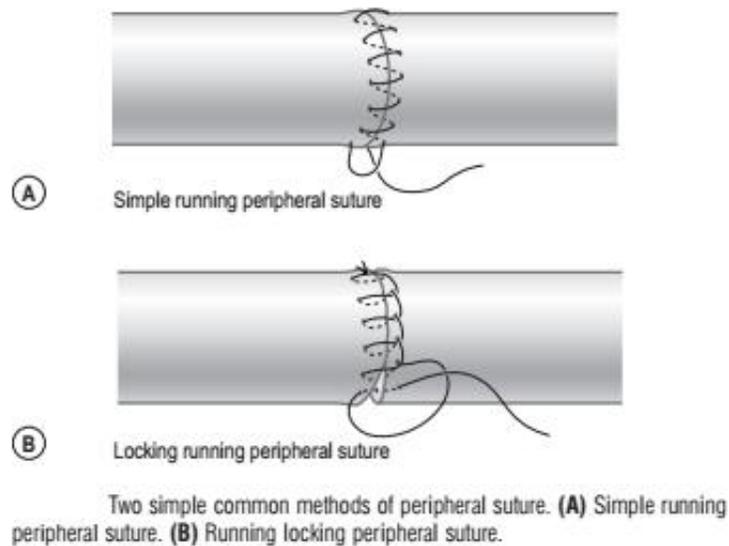
- More than two strands as the core repair – four or six strands are recommended (Strength of repair proportional to number of suture strands that cross repair site)
- Suture calibers: 3-0 or 4-0 Nylon, Ethilon, Prolene, and stainless steel wire

2- Epitendinous repair: increases overall strength by 10% to 50%. Consists of a continuous circumferential 5-0 or 6-0 monofilament polypropylene stitch.

3- To prevent tendon bowstringing, A2 and A4 pulleys should be preserved in digits and oblique pulley preserved in thumb.



Summary of methods used to make core sutures in flexor tendon repairs.



PARTIAL LACERATIONS

- A. Suspected if full range of motion (ROM) is present, but patient has weakness or pain with resisted flexion.
- B. Should be explored
- C. Repair laceration if greater than 60% of the tendon width, to prevent entrapment, late rupture, adhesions, and triggering.

Avulsion injuries: "Rugger jersey finger"

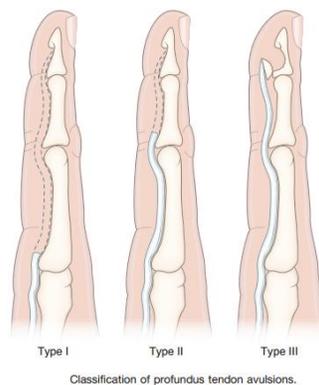
They occur because of forced extension during maximal profundus contraction. This is most common in the **ring finger**.

Leddy classification

Type I: FDP tendon retracts into palm with Repair is required within 1 week

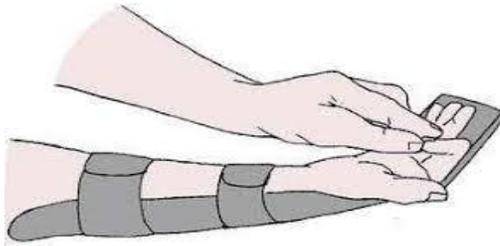
Type II: the tendon retracts to the level of the PIP joint (A3 pulley). Repair can be delayed up to 6 weeks.

Type III: held at A4 pulley , the repair can be performed at any time



POSTOPERATIVE THERAPY: Use one of the following protocol:

1. **Passive range of motion programs:** include the Duran and Kleinert protocols
2. **Active range of motion program:** preferable because stressed tendons heal faster, gain strength more rapidly, have fewer adhesions, and result in better excursion and function
3. **Cast immobilization** is necessary in children younger than 10 years of age
THESE protocols include the use of dorsal blocking splints with the wrist in 20° to 30° of flexion metacarpophalangeal joints at 70° to 80° of flexion, and the interphalangeal joint straight.

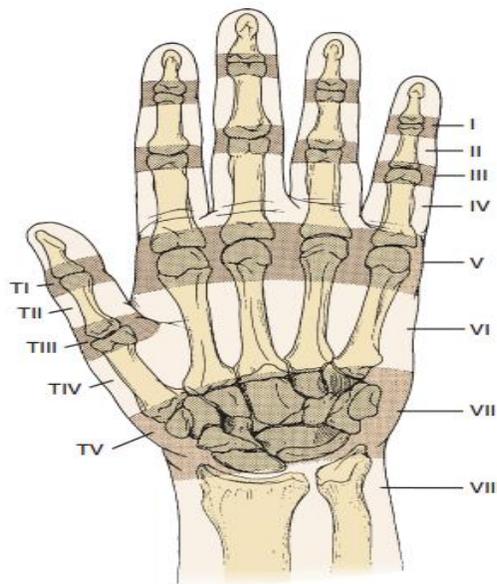


Duran



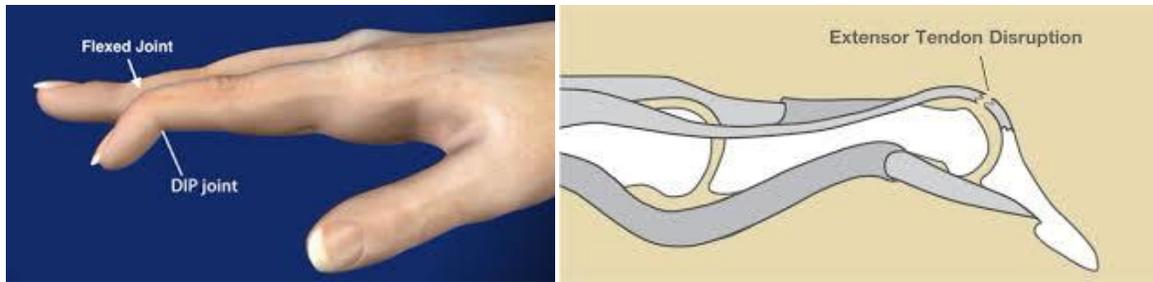
Kleinert

C-Extensor tendon injury:



Zones of the extensor tendon system.

Zone I injury (mallet finger): Disruption of terminal extensor tendon at or distal to DIP joint. Patient cannot actively extend at DIP joint, and finger remains in flexed posture.



Doyle classification systems.

- ❖ **Type I:** Closed injury with loss of tendon continuity. can be treated by splinting the DIPJ in extension for 6 to 8 weeks, followed by night splinting for another 2 weeks.
- ❖ **Type II:** Laceration at or proximal to distal interphalangeal (DIP) joint with loss of tendon continuity can be treated with wound debridement and repair of the skin and tendon (tenodermodesis)
- ❖ **Type III:** Deep abrasion with loss of skin, subcutaneous cover, and tendon substance and may require skin coverage and/or tendon grafts
- ❖ **Type IV**
 - A:** Transepiphyseal plate fracture in children.
 - B:** Fracture of 20%-50% of articular surface
 - C:** Fracture of more than 50% of articular surface, and volar subluxation of distal phalanx Tx : closed reduction with percutaneous pinning can be successful.

Zone II injury

- Occurs over middle phalanx of digit or over proximal phalanx of thumb.

Zone III injury (boutonnière)

Occurs over PIP joint of digit (central slip) or MCP joint of thumb.

Zone IV injury

Occurs over proximal phalanx of digit or over the metacarpal of thumb

Zone V injury

- Occurs over MCP joint of digit or over CMC joint of thumb.

Zone VI injury

Occurs over metacarpal and represents most frequently injured zone

Zone VII and VIII injuries

Zone VII injury occurs at the level of the wrist joint, and zone VIII injury occurs in the distal forearm at the musculotendinous junction.

D- Nerve Injuries

Causes: Common etiologies of peripheral nerve injury include penetrating trauma, traction, compression, electrical, and thermal Injuries.

There are two basic pathophysiologic responses to trauma: demyelination and axonal degeneration.

Classification:

Seddon divided peripheral nerve injuries into three subtypes: neurapraxia, axonotmesis, and neurotmesis.

Sunderland and Mackinnon classification.

First-degree injury (neurapraxia). A localized conduction block. axons are not injured. No Wallerian degeneration

Second-degree injury (axonotmesis). Axonal injury occurs and the distal segment undergoes Wallerian degeneration. The connective tissue layers are uninjured.

Third-degree injury: Wallerian degeneration is combined with some fibrosis of the endoneurium

Fourth-degree injury. The nerve is in continuity but with complete scar block resulting from injury to the endoneurium and perineurium.

Fifth-degree injury (neurotmesis). The nerve is completely divided.

Sixth-degree injury. This represents a combination of any of the previous five levels of injury

A first-degree injury recovers function quickly (within 3 months). A second-degree injury recovers slowly (1 inch per month) but completely, whereas recovery after third-degree injuries is slow and incomplete. Fourth- and fifth-degree injuries will not recover without surgical intervention.

History:

-injury

-Pain, Sensation & Motor dysfunction

Examination

- Motor function
 - Movements
 - muscle atrophy
- Sensory function
 - Tinel sign
 - Two point discrimination
 - Touch, vibration

Tinel sign peripheral tingling or dysaesthesia provoked by percussion of the nerve

> Positive in axonal injuries

Electrical stimulation tests

- EMG
 - Fibrillations
 - Appear as muscles are denervated
 - Onset 10-14 days after injury
- NCS

Timing of Repair

Primary repair: urgent surgery

- Immediate (within 3-5 days of injury)
- Indication: sharp transection= Neurotmesis . Best Results

Delayed primary repair

- At the Timing of Soft tissue Coverage (within 2-3 weeks)
- Good outcome

Secondary repair

After expectant treatment 12 weeks or more

- Neurolysis
- Transfer & Nerve repair
- Nerve Auto graft
- Nerve Other Grafts:
 - Allo/ Xenograft
 - Conduits Viens/ Synthetic
- Nerve transfer (Neurotization)

Median Nerve Lesion at the Wrist

- Motor: loss thenar function, loss of the FDS to all four fingers, loss of flexor pollicis longus (FPL) and index FDP function and loss forearm pronation but wrist flexion is maintained via the ulnar nerve innervated FCU.
Thenar muscles are paralyzed and atrophy so that the thenar eminence becomes flattened. Opposition and abduction of thumb are lost, and thumb and lateral two fingers are arrested in adduction and hyperextension position. “Apelike hand”
- Sensory: Loss of sensation from:
 - The radial side of the palm
 - Palmer aspect of the lateral 3½ fingers
 - Distal part of the dorsal surface of the lateral 3½ fingers
- Trophic Changes:
 - Dry and scaly skin
 - Easily cracking nails
 - Atrophy of the pulp of the fingers



ULNAR NERVE INJURY:

Adductor pollicis and first dorsal interosseous (FDI) function are lost. This is manifested by weak key pinch and a Froment sign (in which the thumb IP joint flexes during attempted key pinch as the FPL compensates for the loss of adductor pollicis function).

The patient also develops clawing (MCP hyperextension and IP flexion), particularly in the ring and small fingers. Finally, finger abduction and adduction are lost, and the patient loses the ability to spread or cross the fingers.

loss of sensation of ulnar aspect of palm and ulnar one and half fingers.



Radial nerve injury:

loss of wrist extension, finger MCP extension, thumb abduction, and thumb extension, loss of sensation of dorsum of hand.

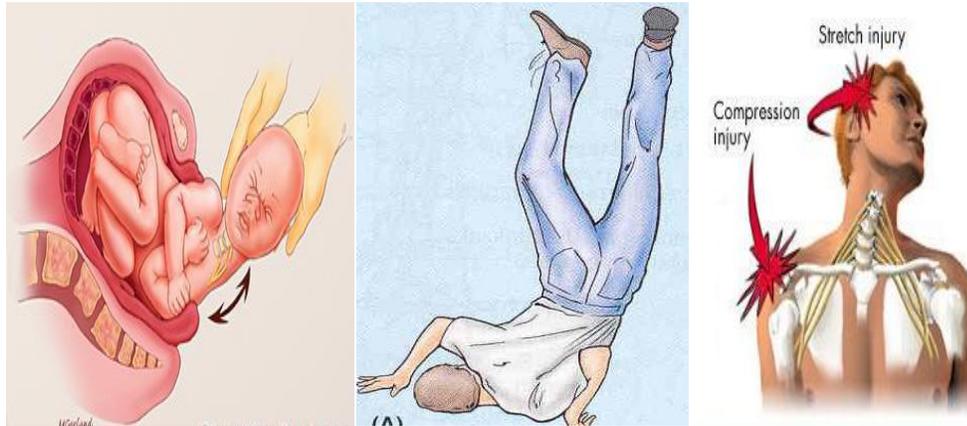
❖ Quick and simple" nerve exam.

- 1. Median nerve:** Sensation at the tip index finger (light touch and two-point discrimination); ability to make "OK" sign: Demonstrates FPL, FDP, and OP
- 2. Ulnar nerve:** Sensation at the tip of small finger; ability to abduct/adduct/cross fingers.
- 3. Radial nerve:** Sensation dorsal first web space; give "thumbs up" (EPL)

Upper Lesions of the Brachial Plexus (Erb-Duchenne Palsy) (WAITER'S TIP)

These are usually the result of traction & tearing of the 5th and 6th root of the brachial plexus
This may occur:

- In infants during a difficult delivery
- In adults following a fall on or a blow to the shoulder.



The muscles affected are:

- Abductors (supraspinatus & deltoid) and lateral rotators (Infraspinatus & teres minor) of the shoulder
 - Subclavius, biceps, brachialis & coracobrachialis
- Thus:
- The limb hangs limply by the side, and is medially rotated
 - The forearm is pronated and extended
 - There is loss of sensation down the lateral side of the arm & the forearm

Another name for this lesion is 'porters tip



Lower Lesions of the Brachial Plexus (Klumpke Palsy):

- These are usually caused by excessive abduction of the arm as a result of:
 - Someone clutching for an object when falling from a height
 - Difficult delivery in which baby's upper limb is pulled excessively.
 - Result of malignant metastases from the lungs in the lower deep cervical lymph nodes
 - A cervical rib



- Usually the lowest root (T1) of the brachial plexus is involved
- The fibers from this segment of the spinal cord supply the small muscles of the hand (interossei and lumbricals).
- Paralysis and wasting of small muscles of hand occurs
- There is also sensory loss along the medial side of the forearm, hand and medial 2 fingers
- Often associated with Horner's syndrome (drooping of upper eyelid & constricted pupil) due to traction of sympathetic fibers
- The hand has a clawed appearance due to:
 - Hyperextension of the metacarpophalangeal joints
 - Flexion of the interphalangeal joints

