



432 Surgery Team

17 Hand Injuries



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COLOR GUIDE: • Females' Notes • Males' Notes • Important • Additional

Objectives

Not Given

Hand Injuries

History:

- Hand dominance
- Occupation
- 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 a patient is a smoker from the beginning say you can't

- Tetanus

Make sure the patient is vaccinated, if not give him vaccination

Any open wound there is risk of infection (tetanus)

- Acute vs. 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

Examination:

Inspection

1. Compare both hands (always compare to a normal hand) ex: congenital anomalies or fractures
2. Dorsum then volar surface
 - Skin (Ulcers or lesions or color)
 - Swelling (Acute: trauma, If with high temperature > infection)
 - Wasting (If with nerve injury > chronic > carpal tunnel syndrome)

Note(s):

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.

Note(s):

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

- Position normal position of hand if u put it on table: flexion cascade “the flexor tendons are stronger than extensor tendons”. If someone can't do this >injury to flexor tendons. (Mainly tendon injury)

2. Palpation

- Feel Tenderness, sensation, temperature, Capillary refill

3. Check Movement

- **Move Range of Motion**
 - Passive, Active
 - Examine FDS, FDP, & extensor tendons
- **Test Specific Nerves (Sensory + Motor)**
 - 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)

Hand infections:

1/ PARONYCHIAL INFECTION

- Most common hand infections
- 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

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 >remove the skin and clean then graft



2/FELON:

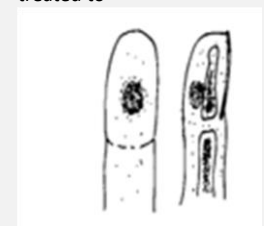
- 38% of all surgical infections (very common)
- Infection of the finger pulp (tip of the finger)
- This area is very sensitive because it has many nerve endings
- 2 point discrimination is maximal at this area So when it develops an abscess between it and the skin it causes nerve compression and



Note(s):

COMPLICATIONS of Felons

Results in increased pressure within the septal compartments and may lead cellulitis, flexor tendon sheath infection, or osteomyelitis if not effectively treated to



- Diagram of a felon

SEVERE PAIN(if paronychia infection not treated>affects nerve endings+fibers+not allow the space to be expanded)

○ **Treatment:**

Antibiotics + warm salt soaks

If **no response** incision and drainage Incision must be made from the side to not lose sensation



HERPETIC WHITLOW:

- HSV type 1 vesicular eruption of the **fingertip**
- Vesicles that contain clear fluid ,occupational period(5-7days)
- Happens to children (biting nails) and **dentists**
- Very painful
- **Very contagious** (patients need isolation)
- Treatment by **acyclovir 5-7 days** (antiviral medication)



COLLAR ABSCESS:

- Abscess of the hand **web-Space** (Connection point between the volar and dorsal parts)
- **Presents with redness, swelling and abducted finger**
- Treatment: Antibiotics if early with observation as in or out patient Incision and drainage in the OR(complex area)**Non surgical>2days follow up>no improvement>surgery(open web space)**



FLEXOR TENOSYNOVITIS

- Each finger has 2 flexor tendons; one moves PIP (attached to middle phalanx),the other DIP (attached to distal phalanx).
- Infection of the **flexor tendon sheath** due to trauma **by sharp material or piece of wood,it affects DM or immunocompromised pts**
- Can extend to the forearm
- **4 signs:**
 - Sausage-shaped fingers
 - Flexed position
 - Pain with passive extension
 - Tenderness along the tendon



Note(s):

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.

Treatment:

Must be IMMEDIATE because of high risk of sepsis, necrosis and amputation

You have to do incision and drainage (if no improvement)

Antibiotics (1st+Analgesia)

Catheter irrigation (Late) (irrigate the sheath with saline) If the infection is bad, it can cause thrombosis of artery, ischemia of nerve and insensate the fingers.



Note(s):

Kanavel signs of tenosynovitis: STEP

Symmetrical swelling of finger
Tenderness over flexor tendon sheath.

Extension (passive) of digit is painful

Posture of digit at rest is flexed.

HAND BITES:

The problem with bites is that the saliva is full of bacteria

Human: Staph, Strep, Eikenella (punching someone in mouth and teeth)

Dogs: Pasteurella Multocida (very dangerous), Staph, Strep

With street dogs, the most likely cause is rabies (unless provoked bites)

All must get rabies treatment: IgG and rabies vaccine (5 injections in abdomen at day 1,3,7,14,28)

Cats: More dangerous (sharper+longer teeth) than dog bites (more concentration of bacteria within the saliva Pasteurella Multocida)

All of them should be admitted for IV antibiotics

Most of dog & human bites respond well to Augmentin Tetanus

If given the antibiotics and there's no response in 48 hours, we do incision + drainage



NECROTIZING FASCIITIS

Flesh eating disease of the soft tissue

Occurs in diabetics with low socioeconomic status (immunocompromised)

Pt presents with infection and is 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:

Patient needs to be **intubated and admitted to ICU**

Needs extensive **debridement and IV Antibiotics**

So stabilize the pt, take him to the OR, and open all of the infected area in which the fascia will look gray with a bad smell.

Once you see a healthy area > skip and open again to make sure that there's no extension. Some patients don't respond to the 1st or 2nd debridement > amputation!

Flexor Tendons:

Anatomy:

There are 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

Origin:

Medial epicondyle to the forearm then develops tendons and goes through the carpal tunnel to insert into the hand and fingers

Nerve Supply:

All of them by the median nerve Except: FCU and medial 1/2 of FDP

MECHANISM OF INJURY

Closed vs. Open

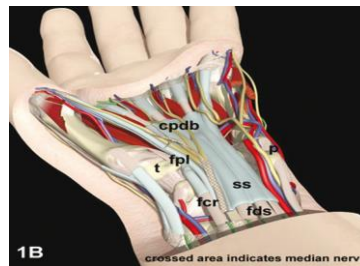
Closed: Completely flexed and then sudden severe hyperextension

Open: Laceration: Knife being the most common tool for it

Crush injury (in American football) and Degloving injury

Note(s):

No muscles in finger (only tendons) so it will survive in case of ischemia more than 6 hours.



Note(s):

Jeresy Finger can be thought of as an example of closed flexor tendon injury.

- Introduction
 - Refers to an avulsion injury of FDP from insertion at base of distal phalanx
 - a **ZONE I** flexor tendon injury
- Epidemiology
 - ring finger involved in 75% of cases
 - during grip ring fingertip is 5 mm more prominent than other digits in ~90% of patients
 - therefore ring finger exposed to greater average force than other fingers during pull-away
- Pathophysiology
 - FDP muscle belly in maximal CONTRACTION during forceful DIP extension
 - Physical exam
 - pain and tenderness over volar distal finger
 - finger lies in slight extension relative to other fingers in resting position
 - no active flexion of DIP
 - may be able to palpate flexor tendon retracted proximally along flexor sheath

VERDAN'S 5 ZONES

Classified mainly to get an idea of the expected outcome after repair

Zone 1: Only affects the FDP

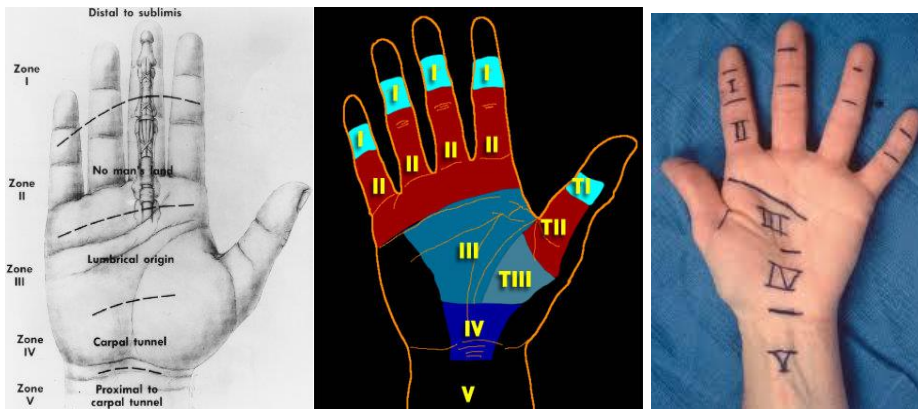
Zone 2: FDP&FDS. Extends from MCP joint to insertion of FDS

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

Zones 3,4 and 5 have a good chance; as you go distally (zone 2), chances of full recovery are less because of the small space



Note(s):

- Annular ligaments**

A2 and A4 are critical to prevent bowstringing

most biomechanically important

A1, A3, and A5 overlie the MP, PIP and DIP joints respectively

originate from palmar plate

A1 pulley most commonly involved in trigger finger

- Cruciate pulleys**

function to prevent sheath collapse and expansion during digital motion

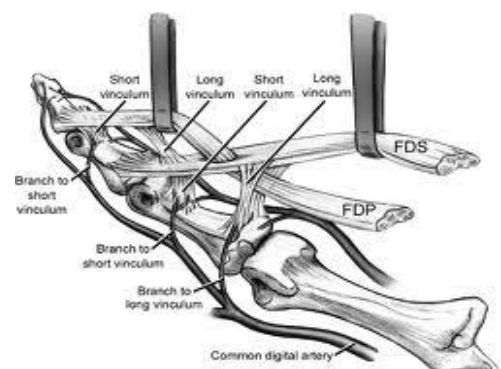
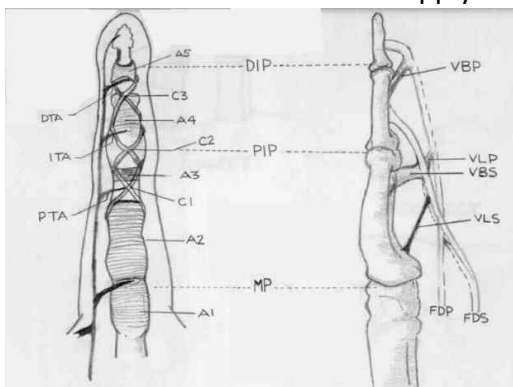
3 total at the level of the joints

PULLY SYSTEM AND TENDON BLOOD SUPPLY

Small ligaments are present in front of the tendons to hold them in place

(A1-A5, C1-C3) (These are the tunnels through which the tendons pass in the fingers, they have a surgical importance and hence the different

names). Each tendon has its own blood supply.



CLINICAL EXAMINATION AND 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

How to examine FDS and FDP?

FDS :

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.

FDP

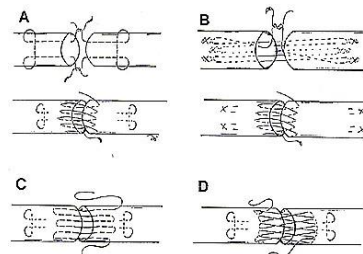
The Flexor Digitorum Profundus (FDP) inserts into the distal phalanx of each finger. It is tested by blocking the finger PIP joint and asking the patient to flex the DIP joint. To block the PIP joint, hold the middle phalanx in extension just distal to the PIP joint, so that the PIP joint is unable to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



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 and pull it out then insert needle Repair : > 25 different technique for the repair Non absorbable suture > because of the poor blood supply



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**



REPLANTATION

INDICATIONS AND CONTRAINDICATIONS

Indications

Amputated Thumb: It provides 50% of hand Function

Children: The risk of loss is 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 the pt's life it's more important.

Sever chronic illness

Multilevel injury

Severely crushed injury(Xray the amputated part to detect crush injuries)

Single digits: Because the pt will not have functional defects.



Severe contamination

Avulsion injury: Finger gets pulled out; artery needs to be reattached at wrist level

Duration of surgery 6-8 hours

40% chance of failure

Can't work 3-6 months

GENERAL PRINCIPLES

Resuscitate the patient

Preserve amputated part in cold water not directly on ice (frostbites)

Warm ischemia time > must operate within 6-8 hours. If cold > within 12-24 hours (longer)

Successful replant after 28 hours: The longer its preserved, the better.

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 and skin graft

Prepare the amputated part

1st Shorten the bone

Arthrodesis

2nd Repair flexor and extensor tendon

Repair

(3 rd) Digital artery(4th) vein and (5 th) nerve,6th Skin closure +/- skin graft

COMPLICATIONS

1/WHITE FINGER

No blood Flow (Low arterial flow)

Technical or non- technical

If patient is a smoker don't bother to replant

Ensure pt is warm

Well-hydrated

Prevent hypotension

Loosen dressing

Remove sutures

Re-Explore and check arteries if all doesn't work

2/BLUE FINGER

Veins are not draining (High venous flow)

Elevate limb

Loosen dressing

Remove sutures

Leeches

Remove nail

Heparin injections

Re-Explore



Leeches, in case of venous congestion, suck the blood relieving the congestion

HAND FRACTURES

1/UNSTABLE FRACTURE

Cannot be reduced closed or cannot be held reduced without fixation

30% risk of infection in open fracture including open Distal Phalanx fracture

Reduced to 3% with antibiotics

The distal phalanx fracture with subungual hematoma (bleeding in nail) should be considered an open fracture

Healing 4/52's for phalangeal fracture whereas 5-6/52's for metacarpal fracture

2/ ACCEPTABLE HAND FRACTURES

Tuft distal phalanx

AP displaced metaphyseal fracture in children

MC (metacarpal) neck fracture

Adult < 20 angulation

Children < 40 angulation

3/UNACCEPTABLE PHALANGEAL FRACTURES (NEED FIXATION)

Rotational angulation(Always needs surgery)

Sever dorsal angulation

Lateral angulation



PEDIATRICS HAND FRACTURES – SOLTER HARRIS

CLASSIFICATIONS

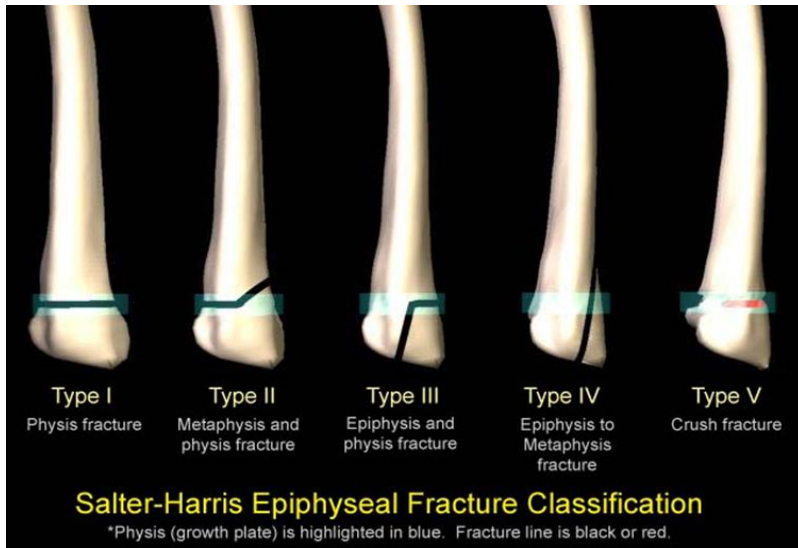
Type I – A transverse fracture through the growth plate 6%.

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.



Note(s):
Salter Harris Fractures can be remembered as *SALTER*

I - S = Slip (separated or straight across). Fracture of the cartilage of the (physis (growth plate)
II - A = Above. The fracture lies above the physis, or Away from the joint
III - L = Lower. The fracture is below the physis in the epiphysis
IV - TE = Through Everything. The fracture is through the metaphysis, physis, and epiphysis
V - R = Rammed (crushed). The physis has been crushed.

INDICATION FOR FIXATION NON-ARTICULAR

- Angulation
- Rotation
- Shortening



Transverse fracture of proximal phalanx



Gun shots and bone loss



Spiral fracture

Fractures of metacarpal bone:

Head

Shaft

Base

Ask pt where the area of maximum tenderness is, then look at this area on Xray

TECHNIQUE OF FIXATION

1st do x-ray; if it's reduced, you don't need to fix it > Close reduction splint

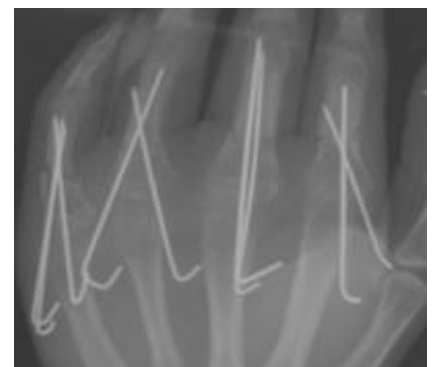
If it doesn't stay in place > **Close reduction K-Wire fixation** (To return it in its place)

ORIF (Open Reduction Internal Fixation)

Lag Screw (in most rigid place)

Plate

Circulage wire



Two are put to prevent rotation

Metacarpal & phalanges fractures fixed with KWire fixation (to prevent rotation)



Circulage wire & K-wire





Lag Screw , usually used in spiral



CARPAL TUNNEL SYNDROME

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(all structures are fixed in place ,can't move)

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

AETIOLOGY

Due to increase in 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

SYMPTOMS

Pain

Numbness(in the morning >edema happens during sleeping)

Paraesthesia in the median nerve distribution

Radial 3.5 digits

Night pain: When the patient sleeps on his hand, everything swells so he wakes up with more numbness in the morning

Pain radiates proximally to the shoulder

Weakness

Clumsiness(if he hold anything, it falls)

CLINICAL FEATURES

Weakness & wasting of the hand thenar muscles(it's a chronic problem,if acute > fracture and dislocation). When they hold something, it falls.

Altered sensation in the median nerve distribution

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 Phalanx test

This position should be held for about 1 minute>numbness or tingling along the median nerve distribution(Flexion makes symptoms faster)

Reverse Phalanx test(has to be straight)

The more severe the compression the faster the numbness

INVESTIGATIONS

X-Ray

CT scan

MRI

Nerve conduction studies: Most common test used for documentation

TREATMENT

Non-Operative (Mild)

Splints

Rests the hands but once stopped > symptoms will return

NSAID's

Steroid Injections(Not preferred)

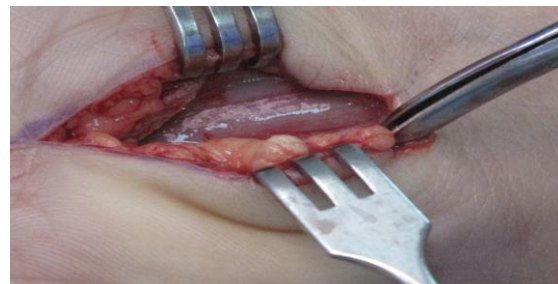
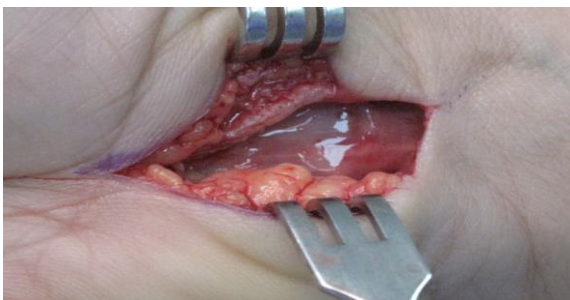
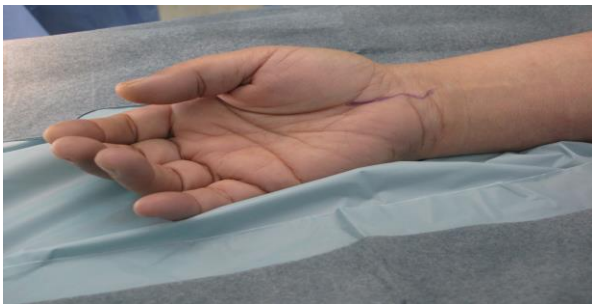
Operative (Persistent)(palmar cutaneous branch, it improves the sensory not the motor part)

All Open technique

The best approach

Limited incision Technique

Endoscopic Techniques: Lots of reports of injuries to the median nerve



SUMMARY

1. Hand Infections:
 - a. Paronychia Infections: most common hand infection.
 - i. Infection of Nail bed or nail plate
 - ii. Treatment: conservative(antibiotics and saline soaking) if no response I&D(Incision and Drainage)
 - b. Felon: a common surgical infection
 - i. Infection of the finger pulp
 - ii. Treatment: similar approach to a paronychia infection BUT incisions are made from the side (to decrease the pain since the pulp of the finger is richly innervated)
 - c. Herpetic whitlow: painful ,contagious and common in dentists.
 - d. Flexor tenosynovitis: a surgical emergency and has 4 signs which can be remembered as **STEP**
 - i. Symmetrical swelling of finger
 - ii. Tenderness over flexor tendon sheath.
 - iii. Extension (passive) of digit is painful
 - iv. Posture of digit at rest is flexed.
 - v. Treatment: Involves a Catheter irrigation(to prevent spread of the infection)
 - e. Hand Bites: Cats have the worst bites ever, never close a wound caused by a bite, antibiotics are always indicated.
 - f. Necrotizing Fasciitis: characterized by Skip lesions, Unstable patients, mostly occurs in Diabetics, and Group A Beta Hemolytic strep is usually involved.
2. Flexor tendon Injury: can be classified as Closed or Open
 - a. Hand is divided into 5 Zones for Prognostic purposes
 - b. On clinical examination a flexor tendon injury is indicated by loss of flexion cascade.
 - c. To repair a tendon skin is opened in a zigzag fashion
3. Replantation: several indications and contraindications have been described
 - a. There is a sequence followed when reattaching a finger, shorten the two ends of bone> ossify the two ends>repair the tendons> reattach artery vein and nerve(AVN)> close the skin+/-graft
4. Hand fractures: Unstable and stable fractures
 - a. Salter harris fracture is a specialized classification for the pediatric group always remember **(SALTER)**
5. Carpal Tunnel syndrome: Night pain is a common symptom of CTS
 - a. Several tests have been described in the text to confirm the diagnosis of CTS including Phalen's (and Reverse Phalen's test) , and Tinels sign.
 - b. Treatment: can be managed non operatively in mild cases

Deep palmar space infection

This is rare and may arise as a result of penetrating trauma, infection of a callosity, or as a complication of suppurative tenosynovitis. The infection occurs in the space deep to the flexor tendons but superficial to the interossei. The deep palmar space is divided into two by a septum attached to the third metacarpal. The space medial to the septum is the midpalmar space, the space lateral is the thenar space.

Symptoms and signs

Oedema of the dorsum of the hand. The skin is looser here and the swelling initially forms on the dorsum of the hand, although the infection is on the palm. Ballooning of the palm or thenar eminence. Acute throbbing pain. Fingers held flexed. Attempts at extension painful. Pain on pressure over affected space. Fever. Malaise.

Treatment

Incision and drainage. The midpalmar space is drained by an incision in the web space between the 4th and 5th or 3rd and 4th metacarpal heads. The thenar space is opened by an incision posteriorly in the web space between the thumb and index finger. Rest. Elevation. Antistaphylococcal antibiotics.

Questions

- 1 In carpal tunnel syndrome which is false?
- A. There is a 25% incidence in males.
 - B. Carpal tunnel decompression was first performed in 1896.
 - C. It is commonly bilateral.
 - D. The motor branch is vulnerable as it passes through the transverse carpal ligament in up to 25% of cases.
 - E. The age of presentation rises towards a peak in the late fifties.

2/ Most of the hand infections are caused by

- A. Streptococci
- B. Staphylococci
- C. Anaerobes
- E. coli

Q1: B

Q2: B