Flexor tendons

Anatomy and injuries

Dr Priyanka Sharma

Reconstructive & Plastic surgeon

ANATOMY

4 FDS, 4 FDP and 1 FPL

FDS	**FDP**
I, M, R, L	I,M,R,L
Median nerve	I,M - AIN R,L - ulnar
PIP flexion	DIP flexion
seperate bellies	common belly

Pulleys and sheaths

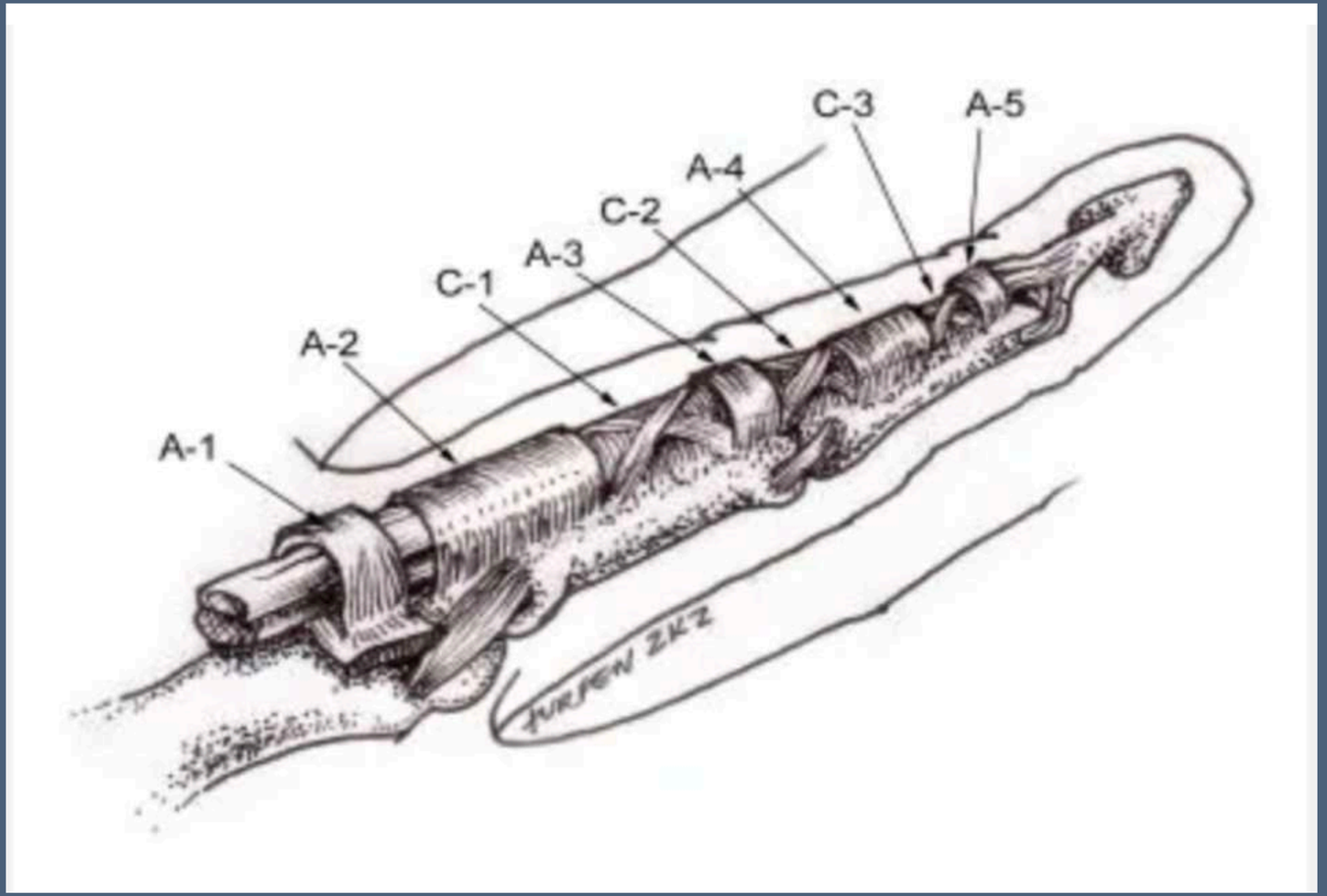
5 ANNULAR pulleys:

A1 to A5 rigid

A2 and A4 prevent bowstringing

3 CRUCIATE pulleys:

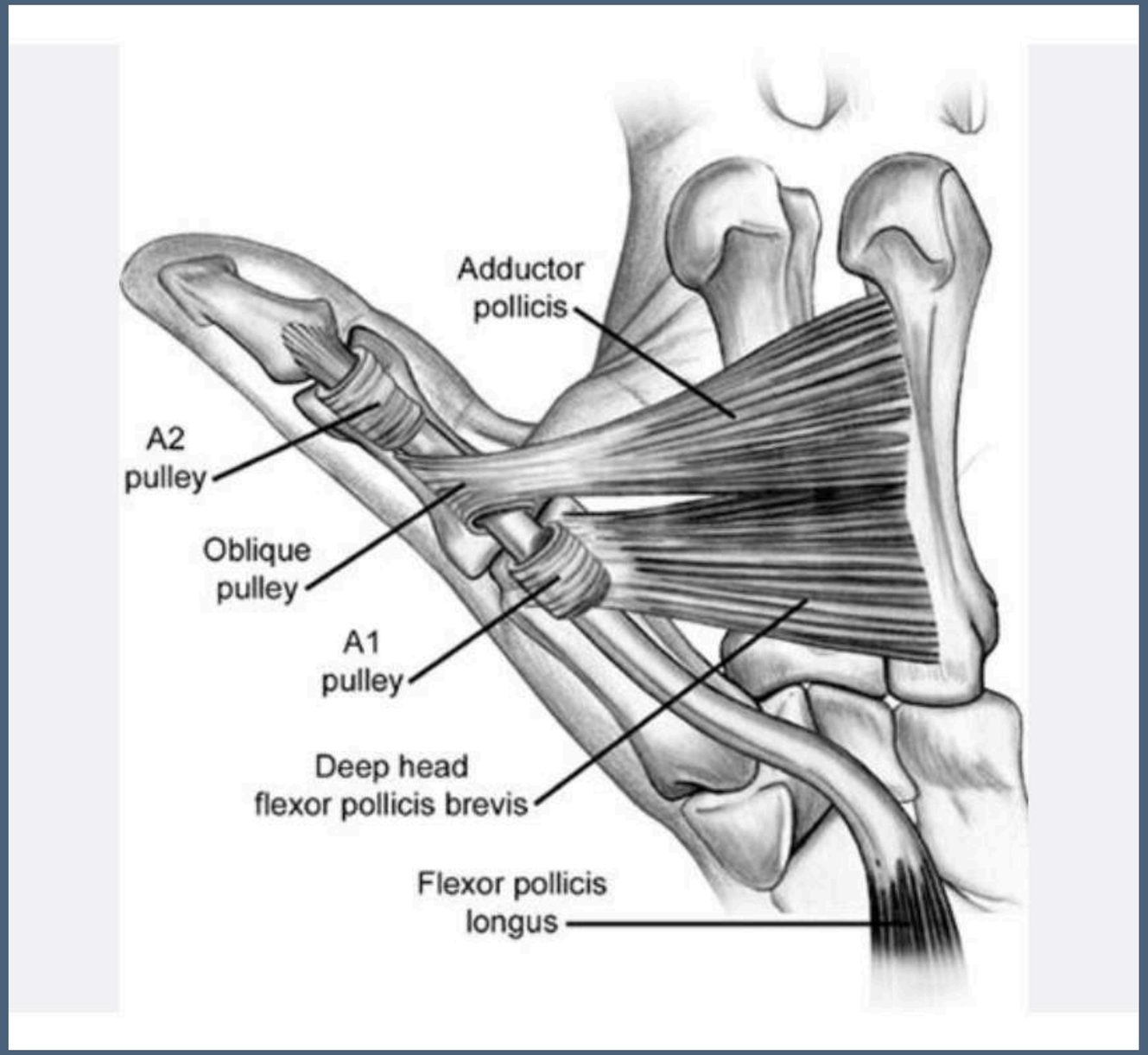
C1 - C3 Collapsible & flexible



FPL

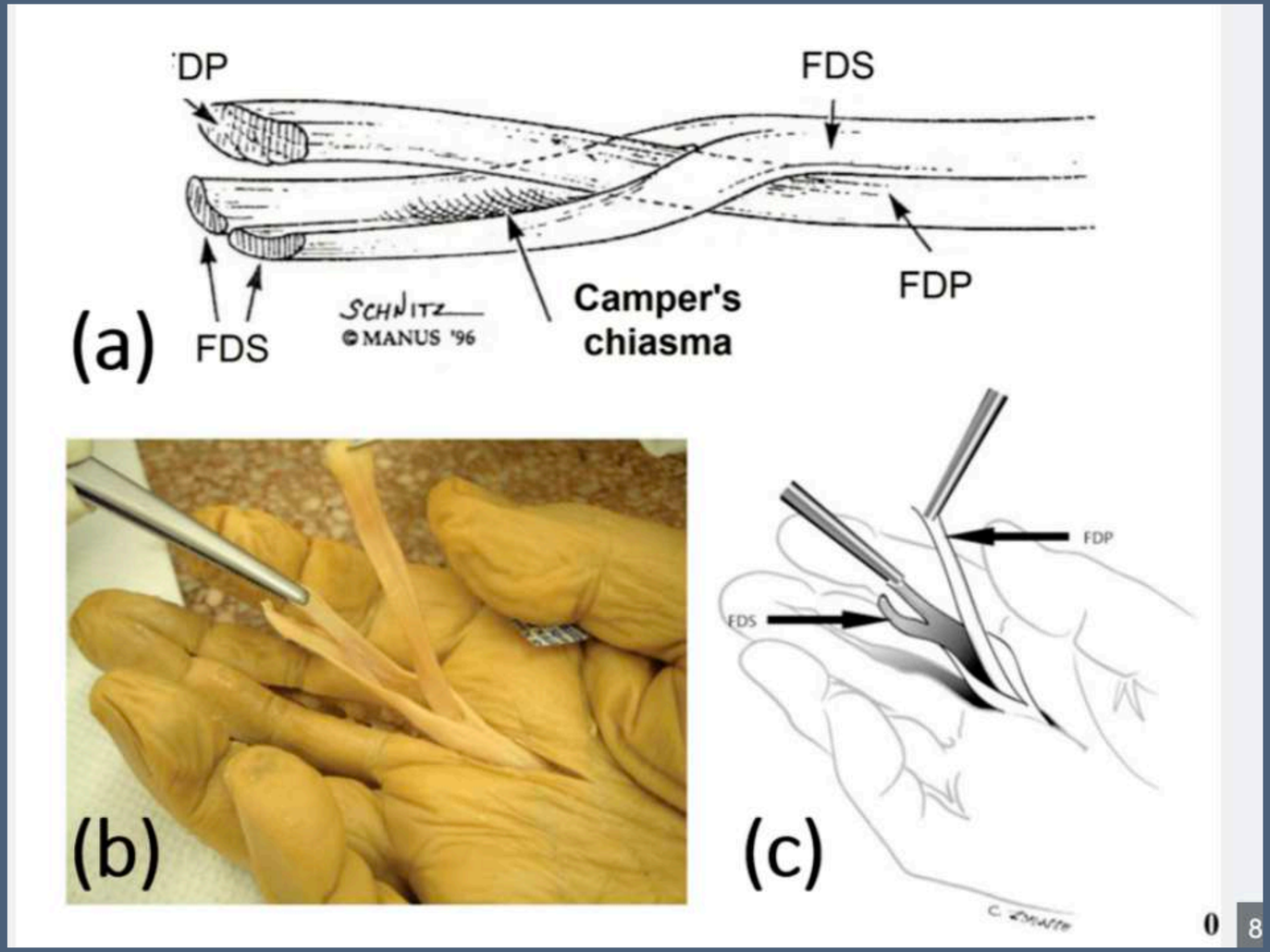
OBLIQUE pulley

prevents bowstring

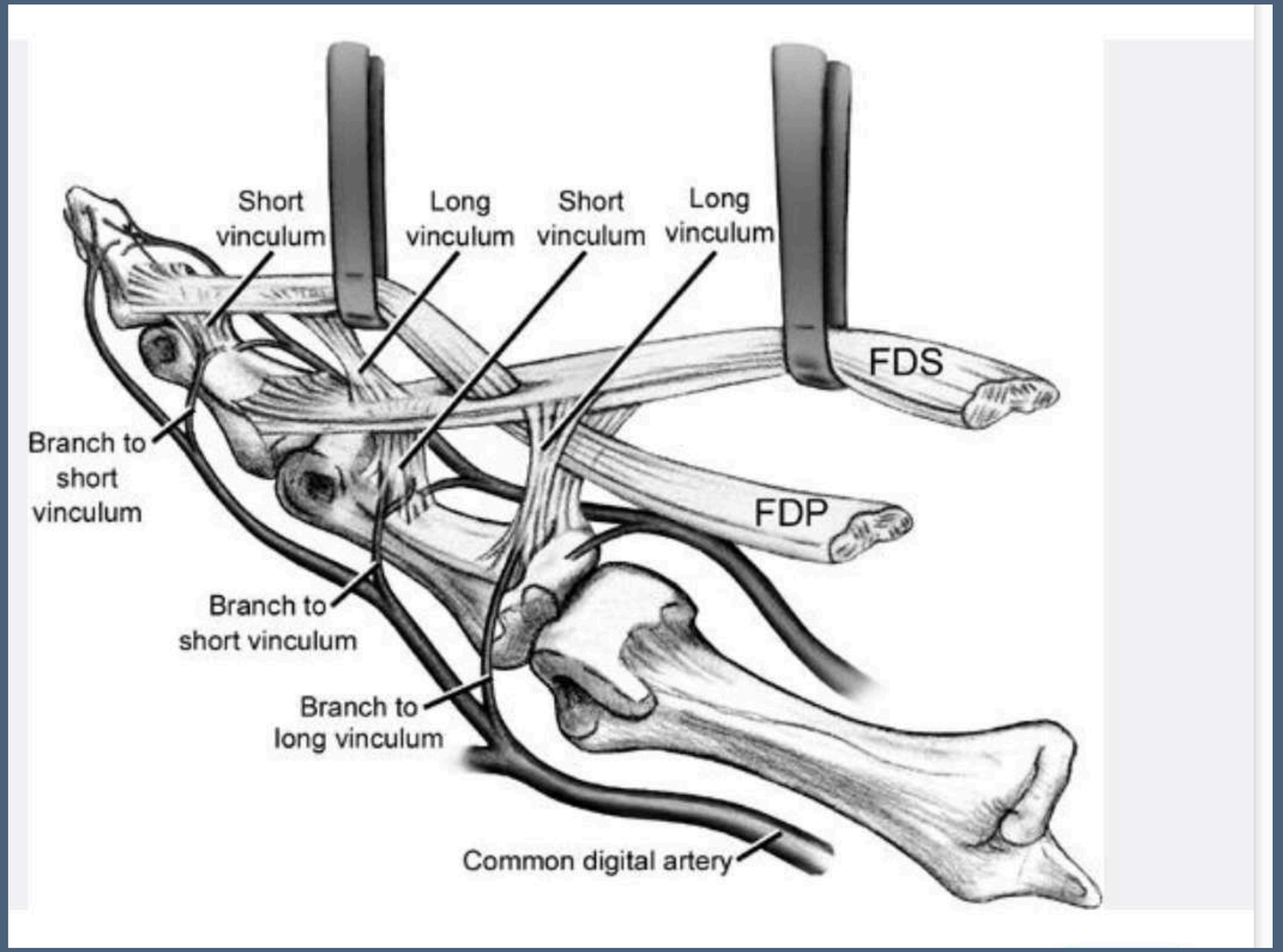


Campers Chiasma

The Camper's chiasm (CC) originates from the decussation of tendon fibers of the FDS at the level of the proximal phalanx.



VINCULA - Blood supply of tendons



Flexor tendon healing and nutrition

INTRINSIC	EXTRINSIC
Tenocytes healing	Inflammatory cells
Within tendon sheath	Via vincula and synovial fluid
Helps tendon gliding	More prone to adhesions

Zone classification of injuries to the flexor tendons

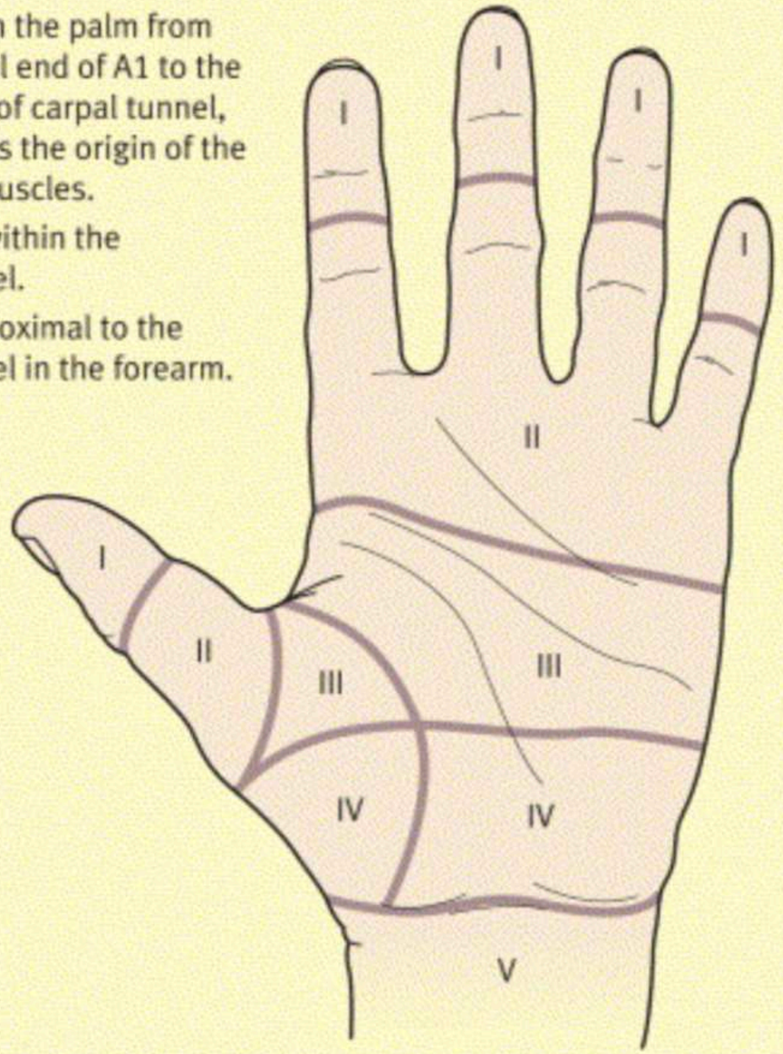
Zone I contains flexor digitorum profundus only, and is from its insertion to the insertion of flexor digitorum superficialis.

Zone II (once known as 'no-man's land') is from the insertion of flexor digitorum superficialis to the proximal edge of the A1 pulley.

Zone III is in the palm from the proximal end of A1 to the distal edge of carpal tunnel, and contains the origin of the lumbrical muscles.

Zone IV is within the carpal tunnel.

Zone V is proximal to the carpal tunnel in the forearm.



Zone 2 - NO MANS LAND ?

- Sterling Bunnel
- FDS & FDP both lie within same tendon sheath
- Risk of adhesions
- Most difficult recovery

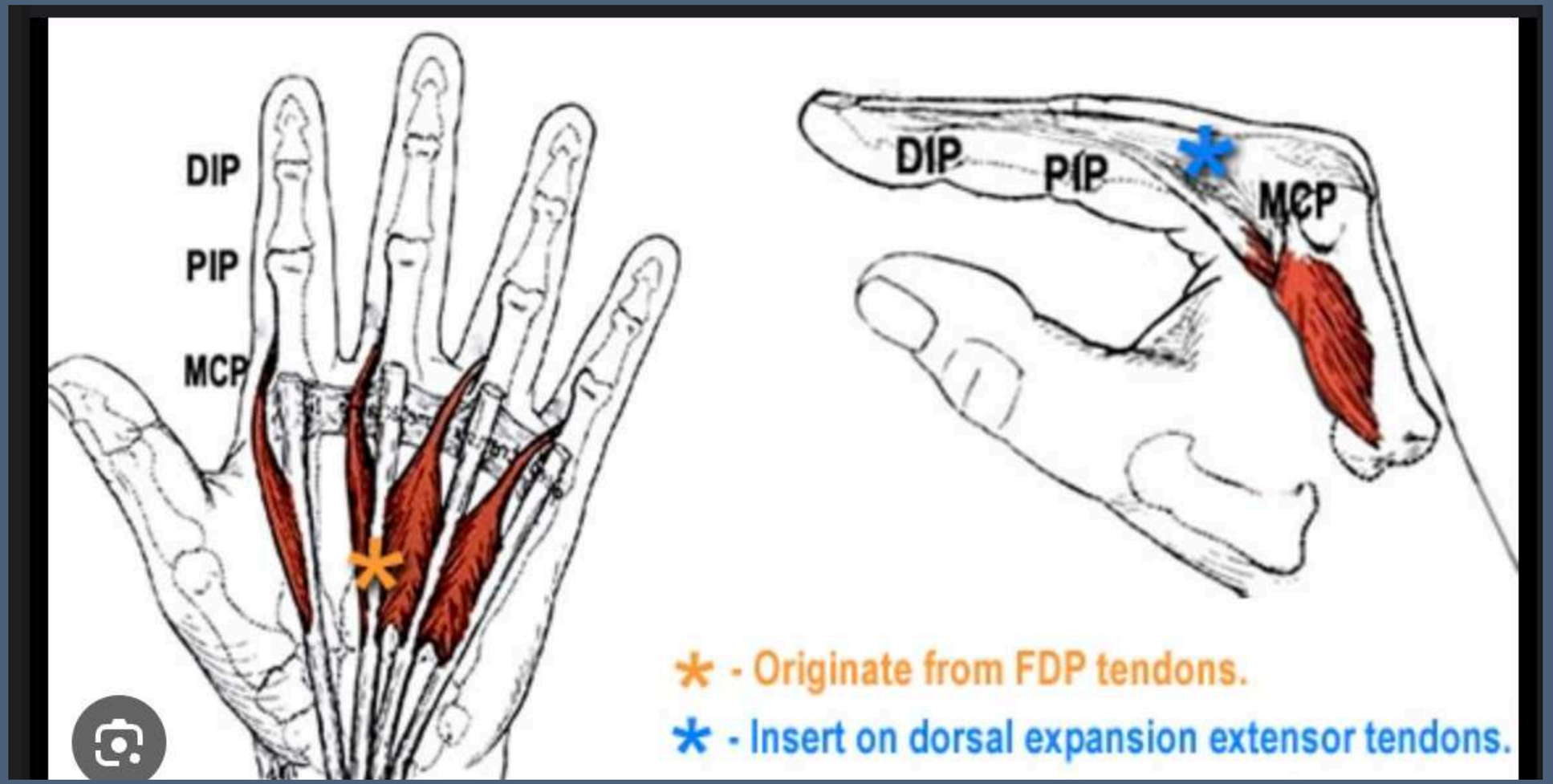
Q. Repair only FDP or repair both?? BOTH!

FUNCTION OF FINGER FLEXORS

FDS - Flexion at PIP

FDP - flexion at DIP

Flexion at MP joint?? - Action of intrinsics : Lumbricals, which originate from radial side of each FDP , insert on to the extensor expansion and aid in MP flexion and IP extension.



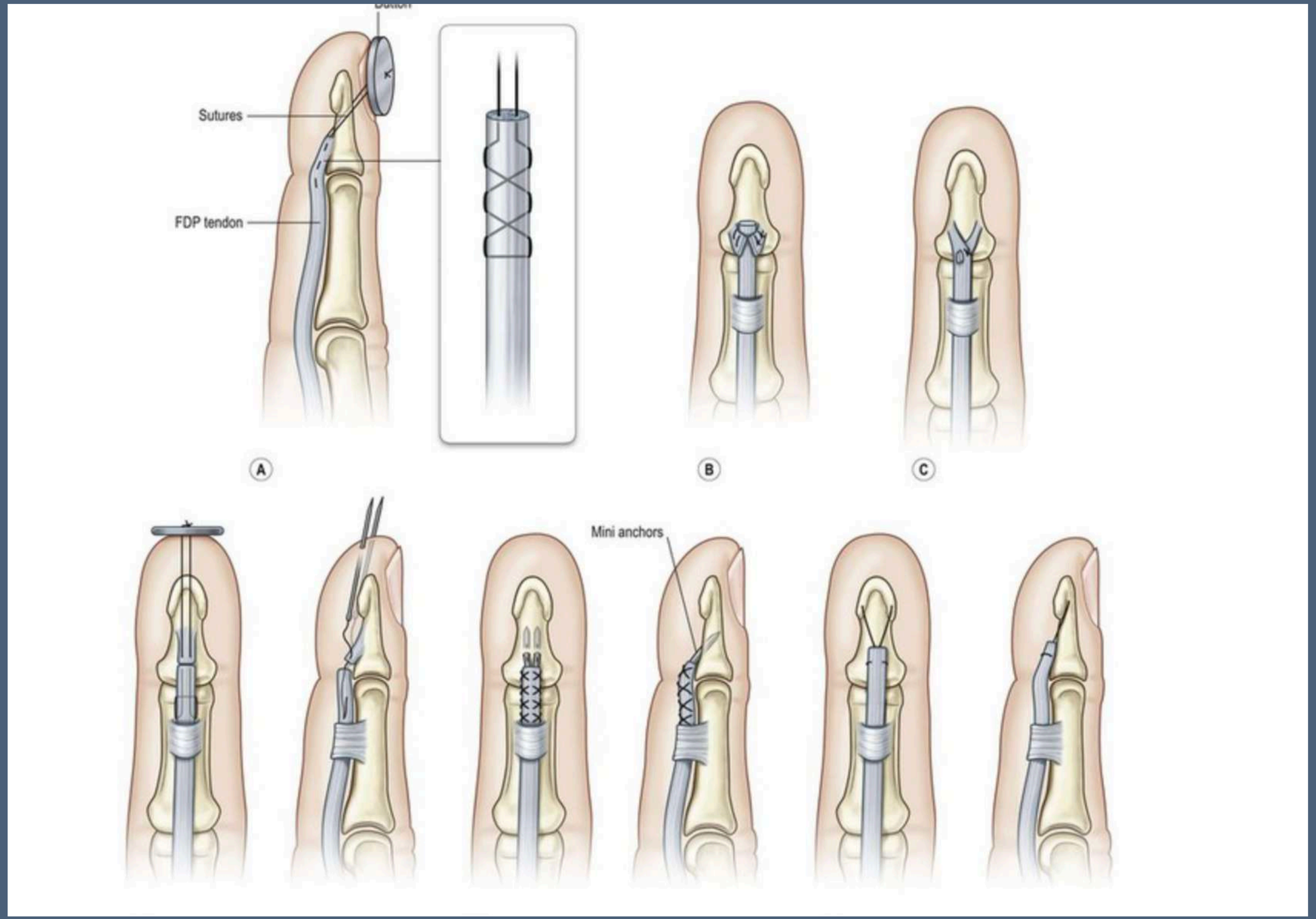
Flexor tendon injuries

- Cut injury

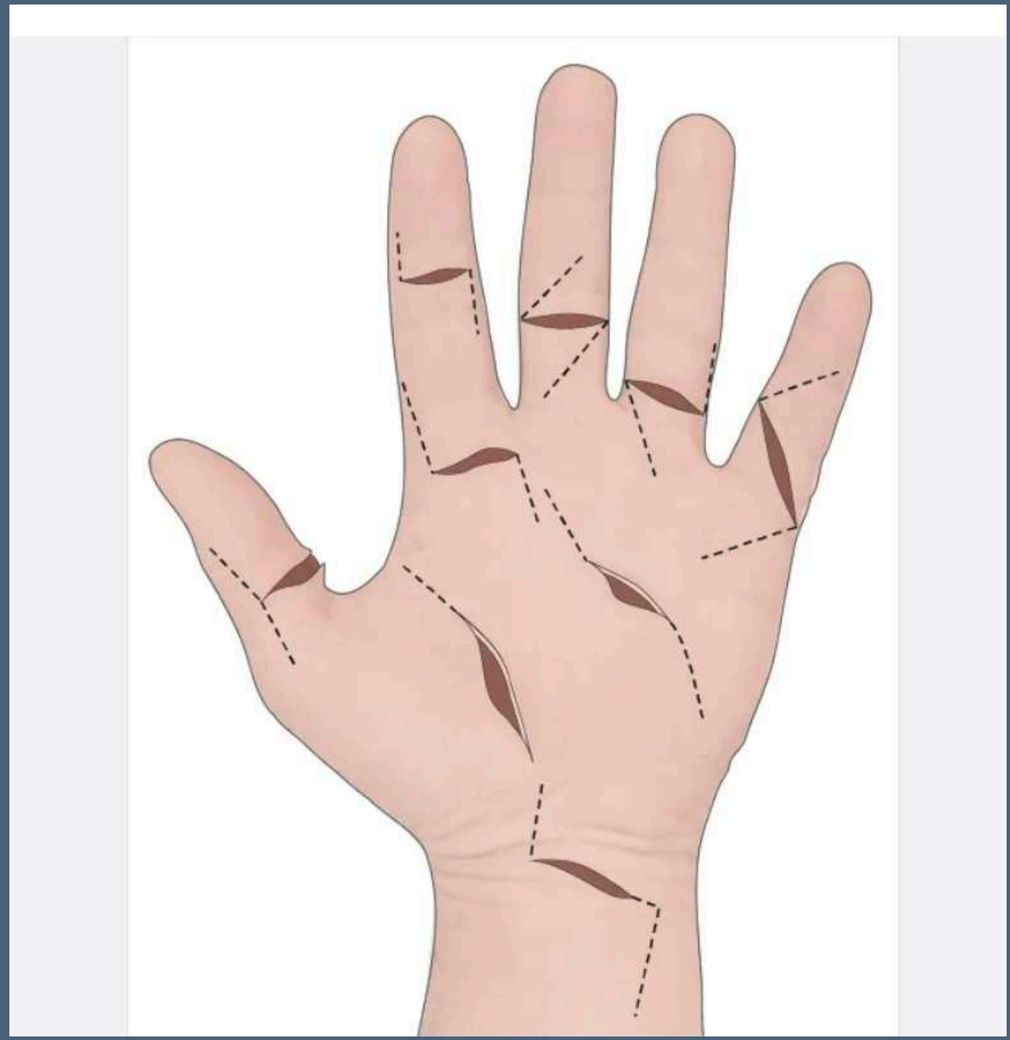
- Trauma

Jersey finger?

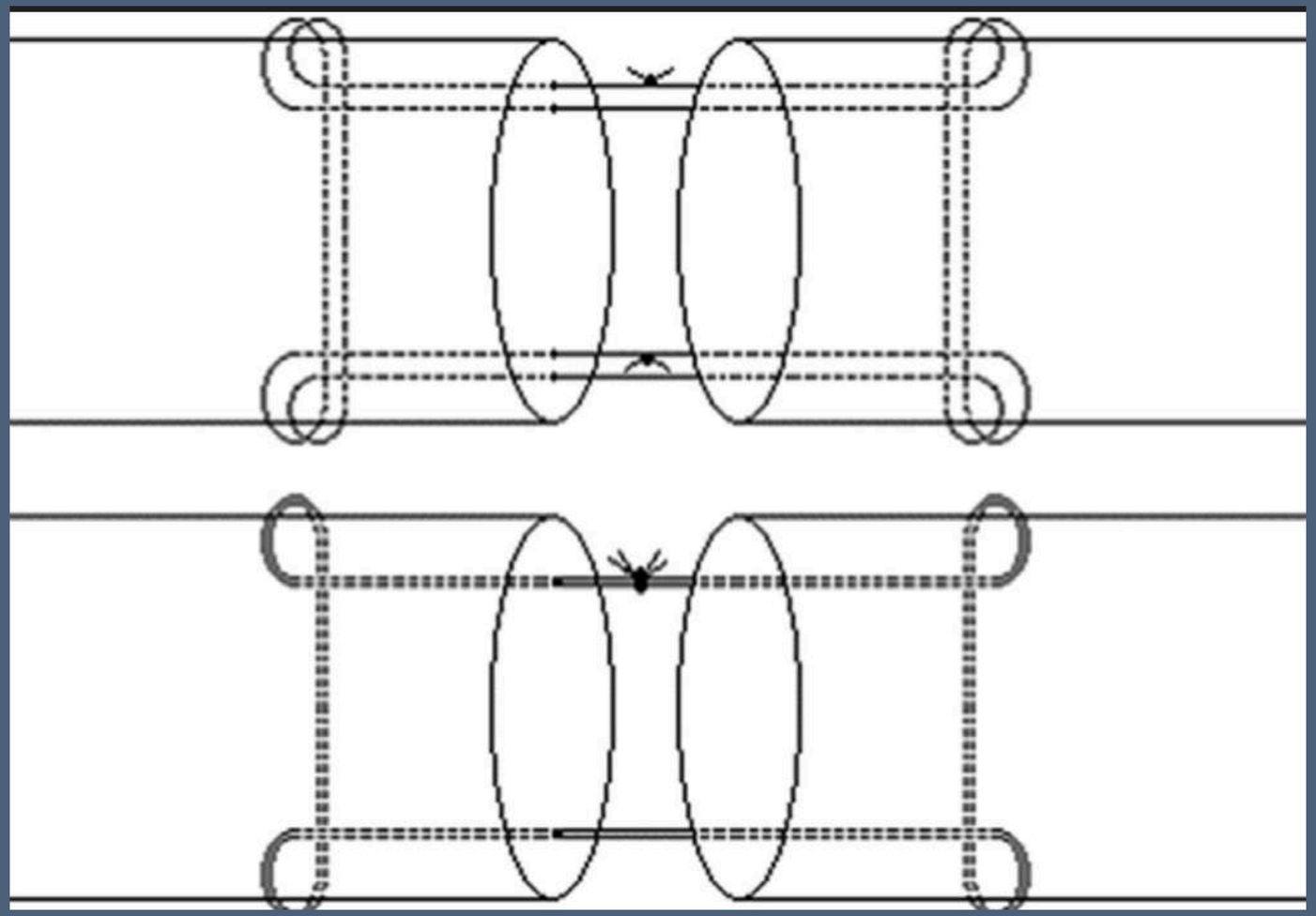
- Closed avulsion of FDP
- Loss of flexion at DIP
- Reinsertion of avulsed tendon
- Opposite of Mallet finger



Exploratory incisions



Types of tendon repair



Modified Kessler Mason

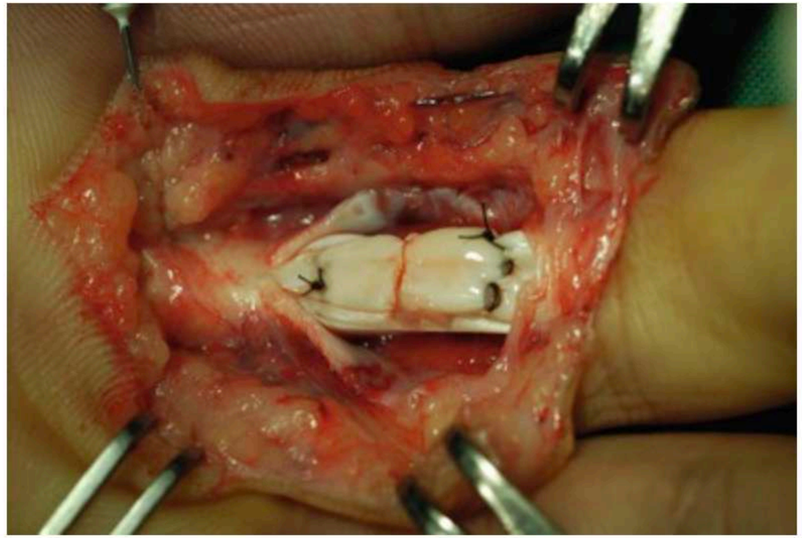
Core sutures

4 strand

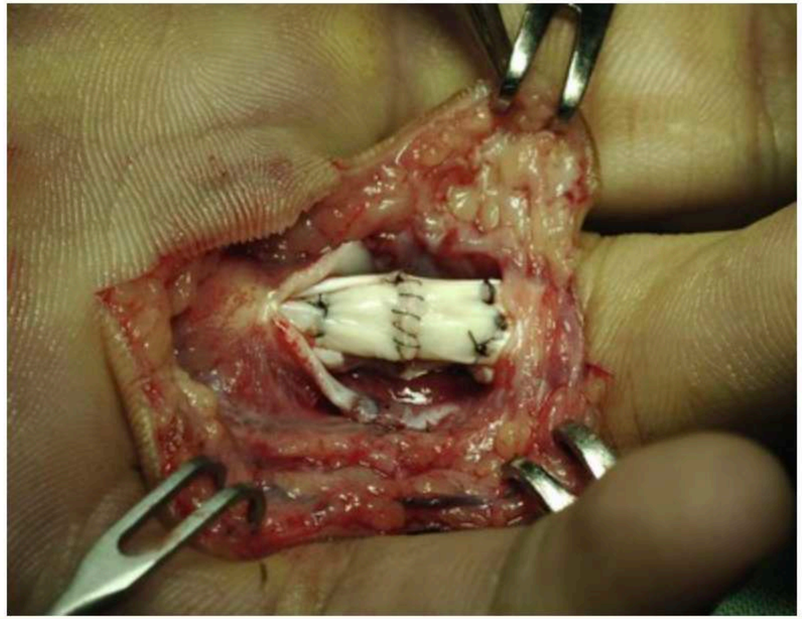
purchase 5-7mm

3-0 core stitch

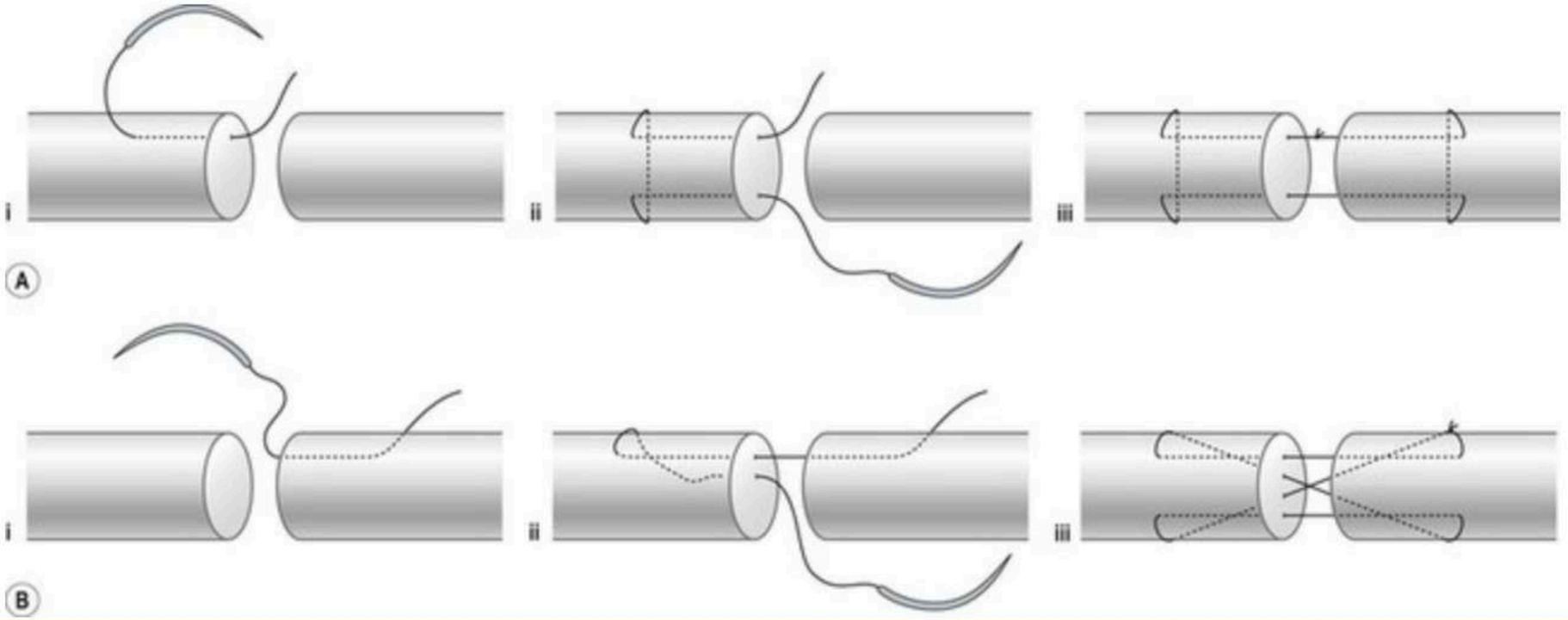
5-0 coaptation stitch



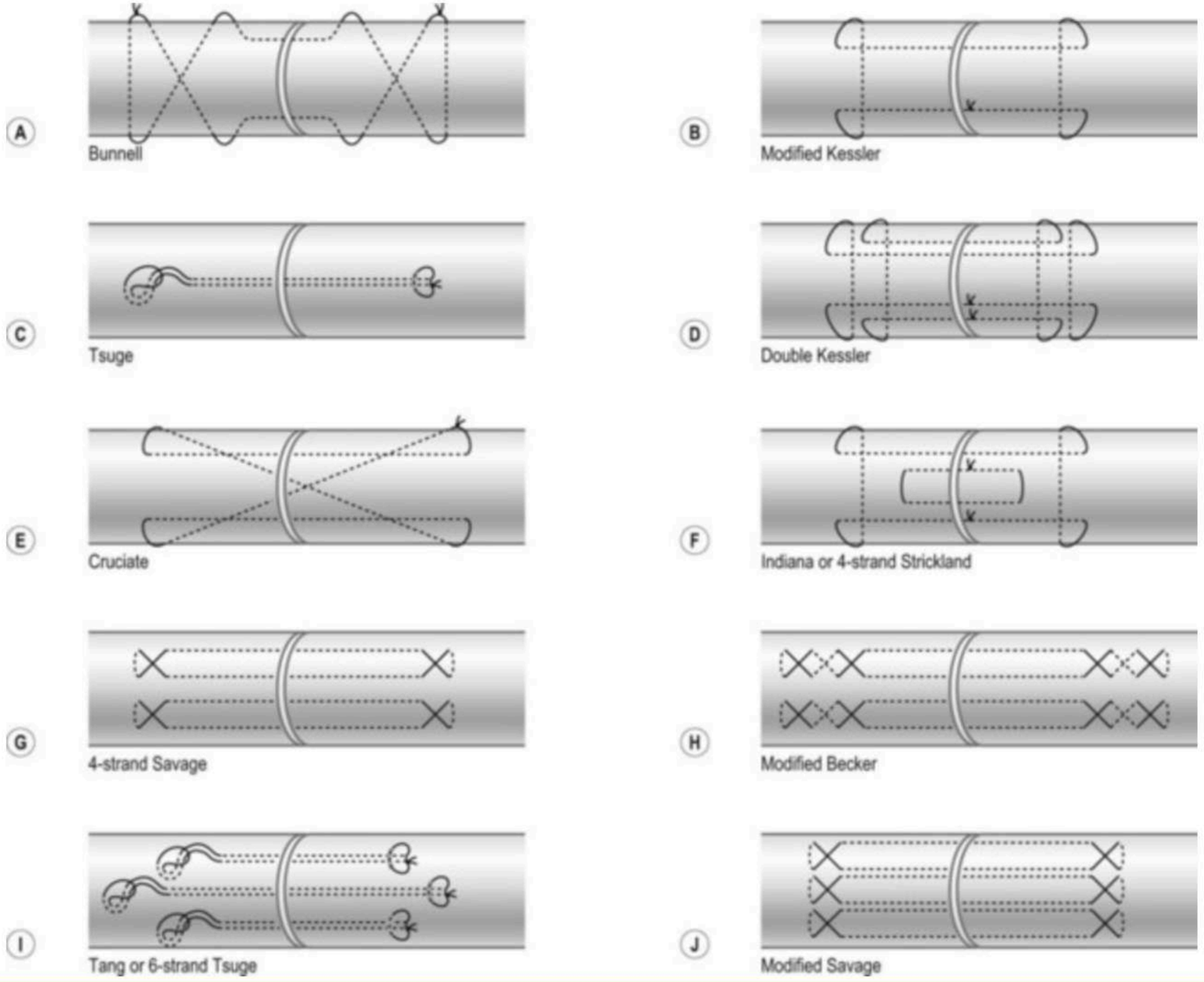
M-Tang repair.



peripheral repair.



Two common techniques in flexor tendon repairs: **(A)** modified Kessler method; and **(B)** cruciate method.



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

2 stage tendon repair

Indication :

- Delayed repair
- Loss of tendon
- Repeated adhesions

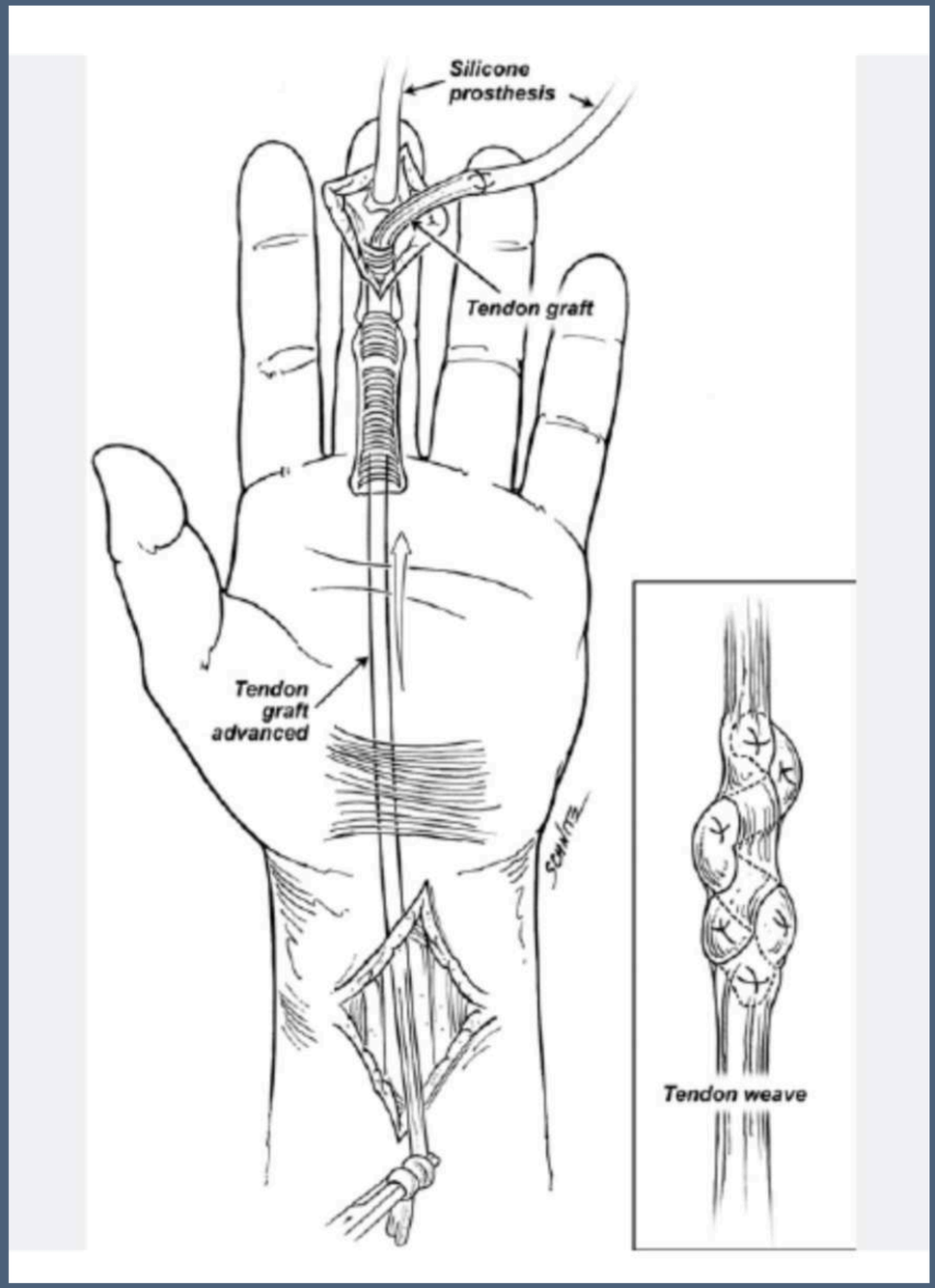
Prerequisite :

- supple skin
- sensate digit
- adequate vascularity
- full passive range of motion of adjacent joints

Hunter-Salisbury

- Stage I - SR is placed to create a favorable tendon bed (SILICONE ROD)

- Stage II (3-4 months) - SR is retrieved and a tendon graft is placed
- through the mesothelium-lined pseudosheath



WIDE AWAKE TENDON REPAIR

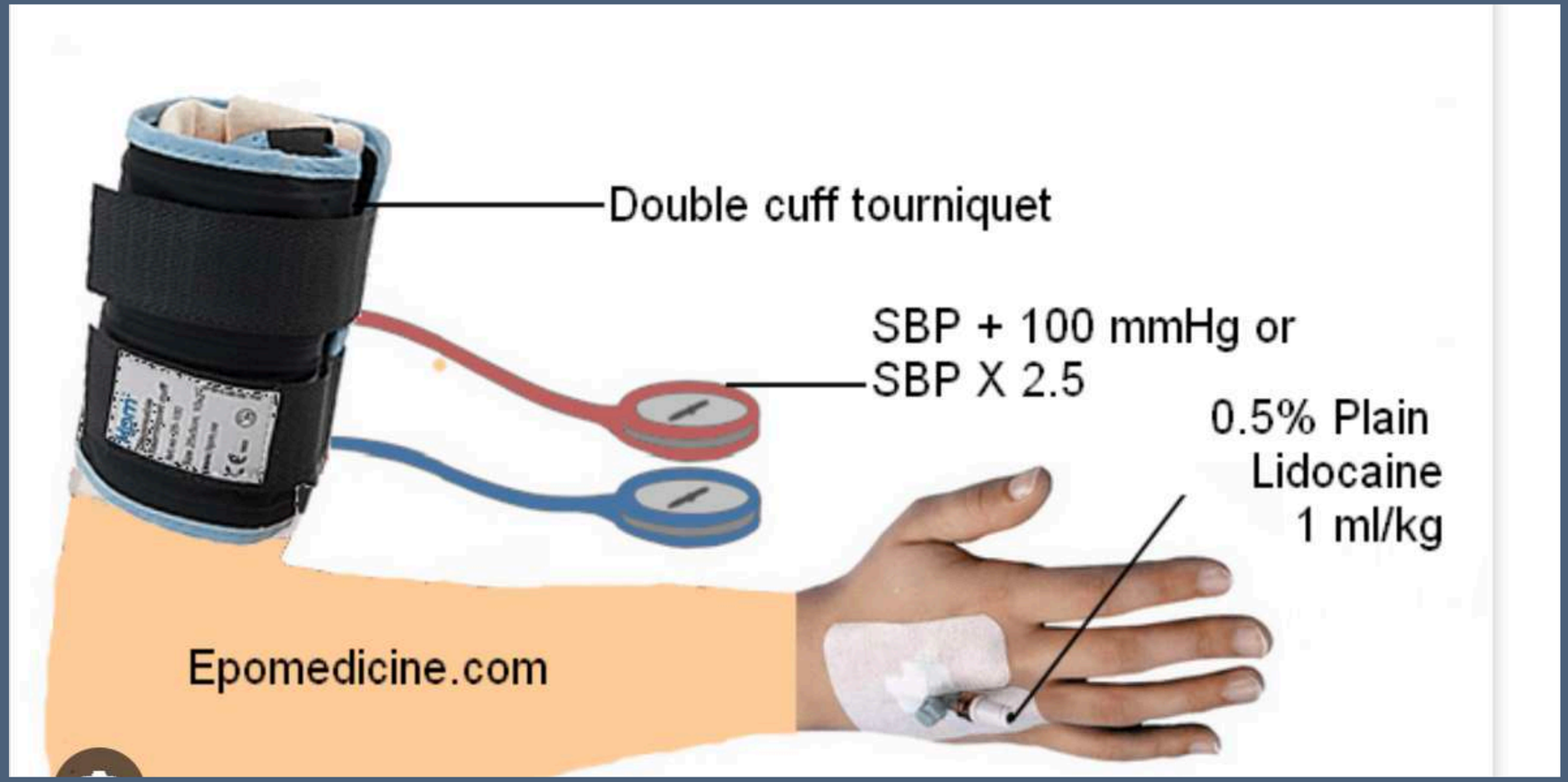
Wide-awake Local Anesthesia No Tourniquet (WALANT)

relies on local anesthetic and hemostatic agents to provide conditions

suitable for hand surgery without sedation and tourniquet.

- Epinephrine + 2% lignocaine + NaHCO3 most commonly used
- Bupivacine may added for longer surgeries

Biers block/ Intravenous regional anaesthesia IVRA



A vast majority of practitioners begin by exsanguinating the limb as Bier did with an elastic bandage (Esmarch bandage), squeezing blood proximally toward the heart, then pneumatic tourniquets are applied to the limb and inflated 30mmHg above arterial pressure to occlude all blood vessels and then the elastic bandage is removed.

A high dose of local anesthetic, typically lidocaine or prilocaine without adrenaline,[6] is slowly injected as distally as possible into the exsanguinated limb. The veins are filled with the anesthetic, with the anesthetic setting into local tissue after approximately 6–8 minutes, after which the surgery, reduction, or manipulation of the region may begin.

It is important that the region is isolated from active blood flow at this time. Analgesic effect typically remains for up to two hours depending on the dosage and type of anesthetic agent being used. The wait time and isolation of blood flow from the region is important for avoiding an overdose of the anesthetic agent in the blood which can lead to hypotension, convulsions, arrhythmia and death.
Cardiotoxic local anesthetic agents like bupivacaine and etidocaine are strictly contraindicated.

Complications of flexor repair

1. ADHESIONS - commonest complication

   - most common in Zone 2

   - Tenolysis if physiotherapy fails

2. RUPTURE

3. Joint contracture

4. Triggering - tight pulley repair, node formation

5. Swan neck deformity - Flexion at DIP and hyperextension at PIP, intrinsic imbalance

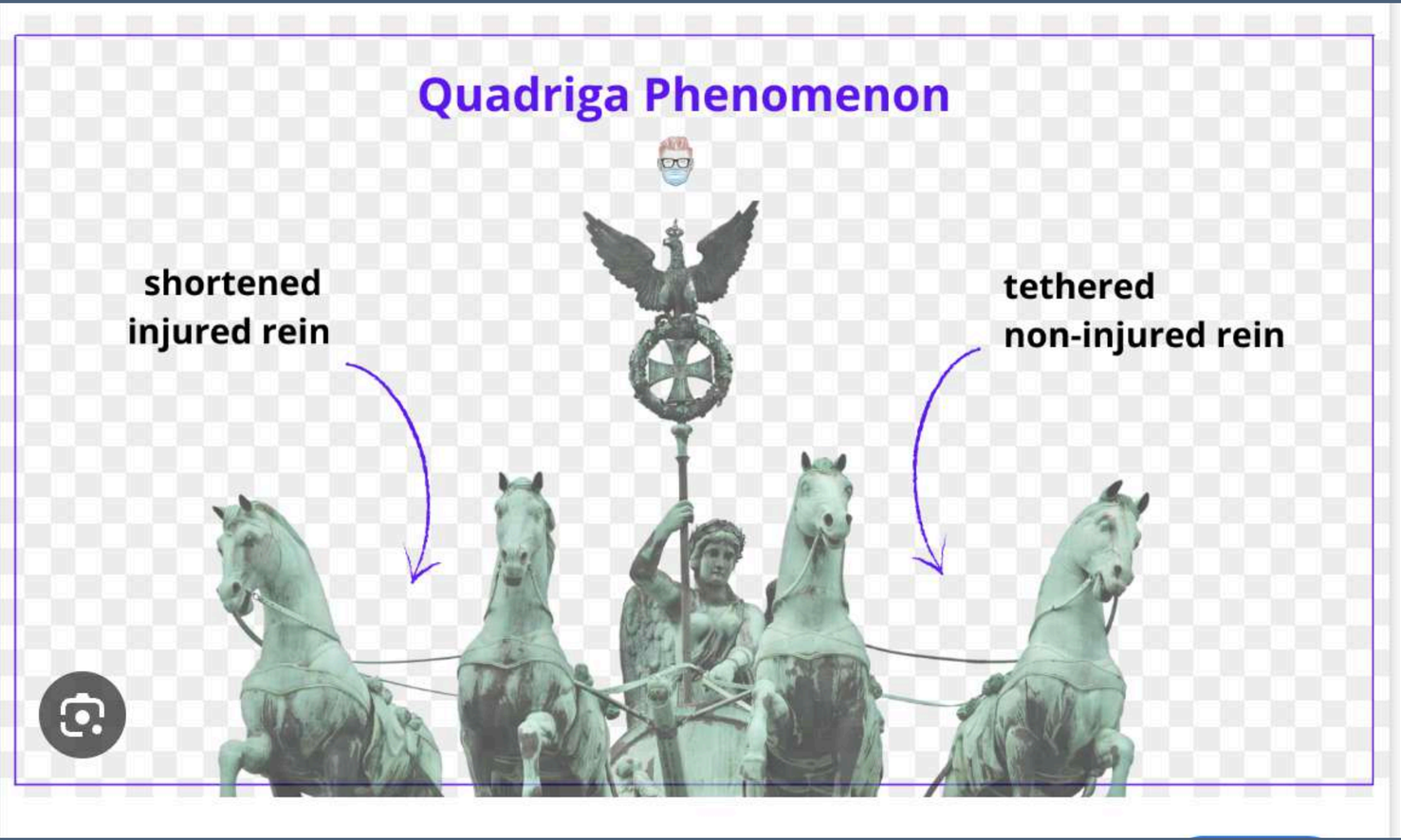
6. Lumbrical plus deformity - lumbricals originate from FDP

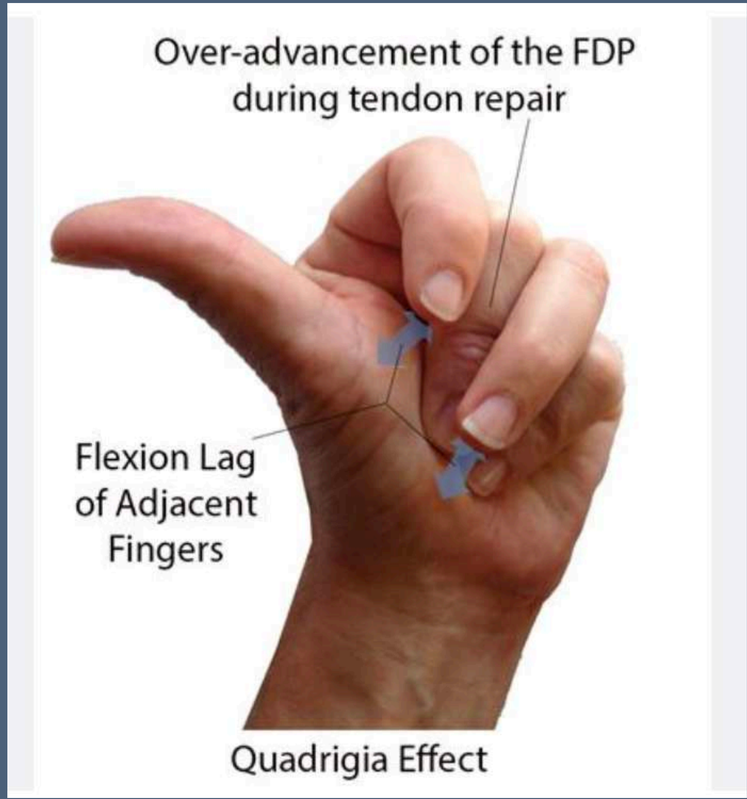
with FDP laceration, FDP contraction leads to pull on lumbricals

lumbricals pull on lateral bands leading to PIP and DIP extension of involved digit

- Paradoxical extension of IP joints on attempted flexion

QUADRIGA sign:





Rehabilitation protocol

- Immobilisation for 4 - 6 weeks with dorsal splint
- MP in 80 - 90 flexion and IP straight
- Supervised early active assisted mobilisation within splint for zone 2
- Mobilisation : Active assisted/ active/ passive/ resistance

- Duran protocol
  - low force and low excursion
  - active finger extension with patient-assisted passive finger flexion and static splint

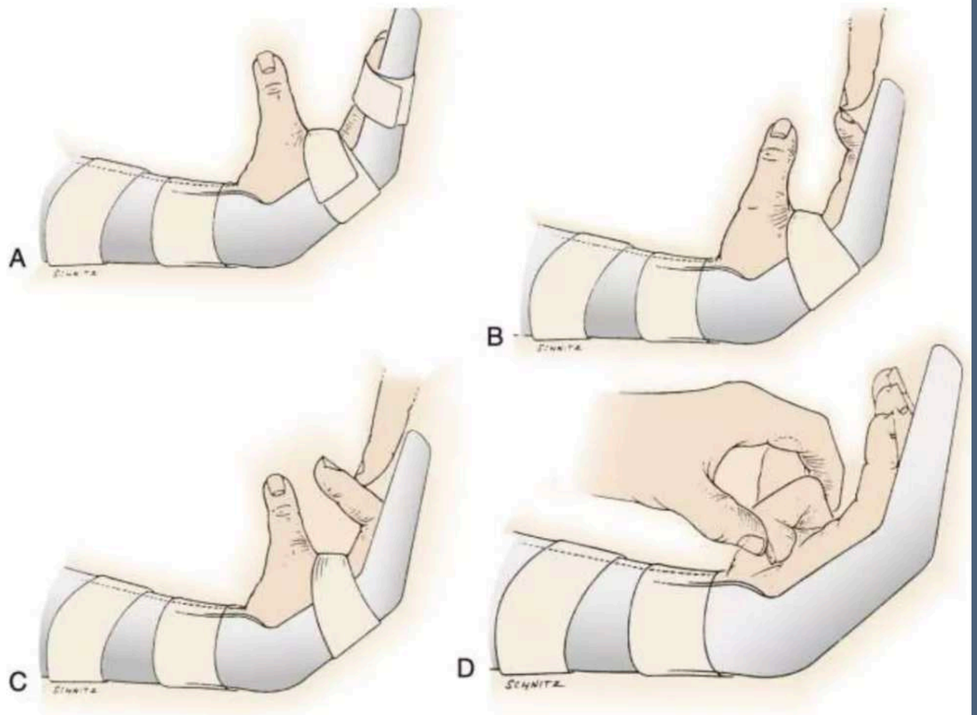
- Kleinert protocol
  - low force and low excursion
  - active finger extension with dynamic splint-assisted passive finger flexion

- Mayo synergistic splint
  - low force and high tendon excursion
  - adds active wrist motion which increases flexor tendon excursion the most

- Early active motion
  - moderate force and potentially high excursion
  - dorsal blocking splint limiting wrist extension
  - perform “place and hold” exercises with digits

DURAN protocol

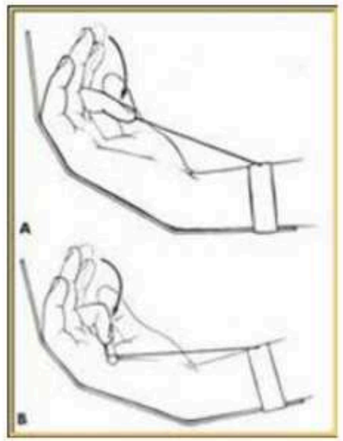
- Controlled passive motion method.
- **A,** Dorsal blocking splint is used to hold wrist in mild flexion, MP joints in about 45 degrees of flexion, and PIP and DIP joints in nearly full extension.
- **B,** Full isolated passive flexion of DIP joint.
- **C,** Full isolated passive flexion of PIP joint.
- **D,** Full passive flexion of MP, PIP, and DIP joints.



Kleinert program

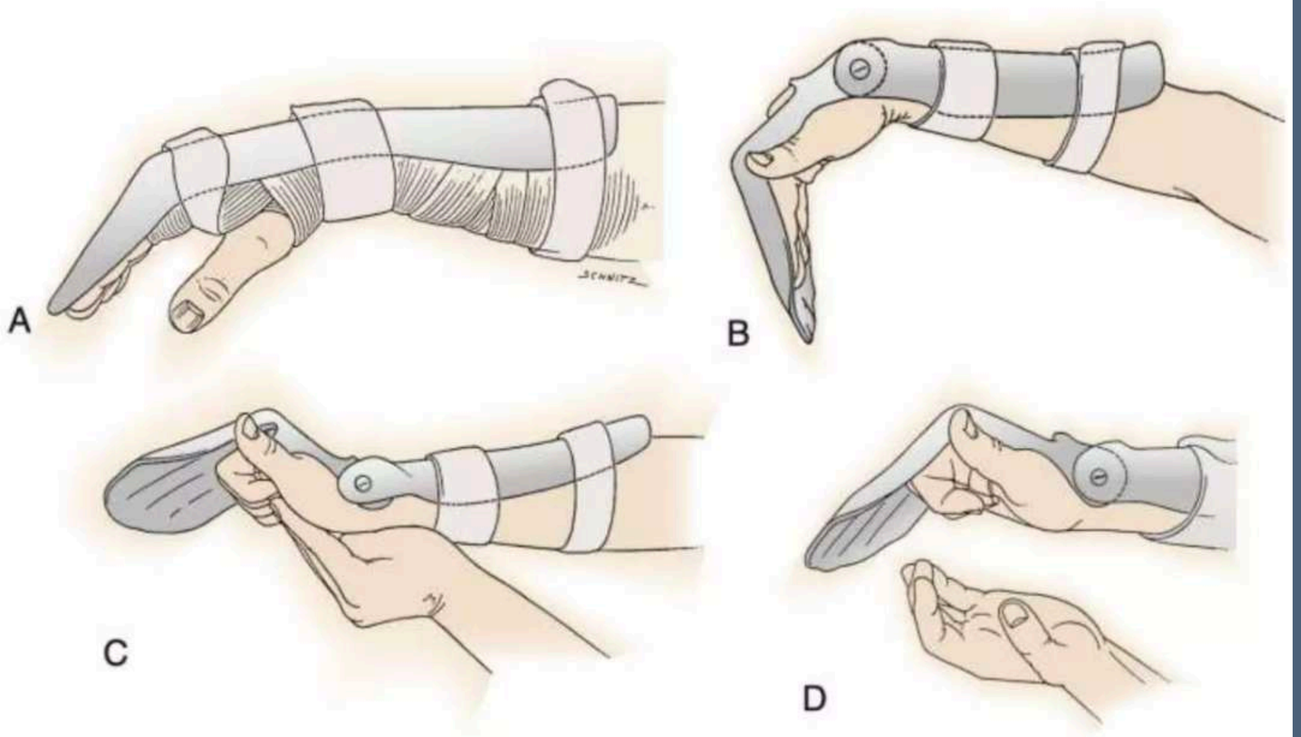
In the 1960s, Kleinert and others introduced an early controlled passive motion protocol using a dorsal protective splint (wrist, 30 flexion and MCP, 30–40(flexion) with elastic traction from the fingernail to the volar forearm

two modifications became standard: a palmar pulley was added to improve DIP flexion, and at night the elastic traction is detached and the fingers strapped into extension within the splint to prevent PIP joint flexion contractures.



Strickland protocol

- Controlled place-and-hold motion.
- A, Dorsal blocking splint that positions the wrist in 20 degrees of palmar flexion, MP joints in 50 degrees of flexion, and IP joints in extension.
- B, Splint with a wrist hinge is fabricated to allow for full wrist flexion, wrist extension of 30 degrees, and maintenance of MP joint flexion of at least 60 degrees.
- C, After passive digital flexion, the wrist extends and passive flexion is maintained.
- D, The patient maintains digital flexion and holds for about 5 seconds. Patients are instructed to use the lightest muscle power necessary to maintain digital flexion.



THANK YOU

- Instagram: dr.ps_plastics
- Youtube: Dr.PS