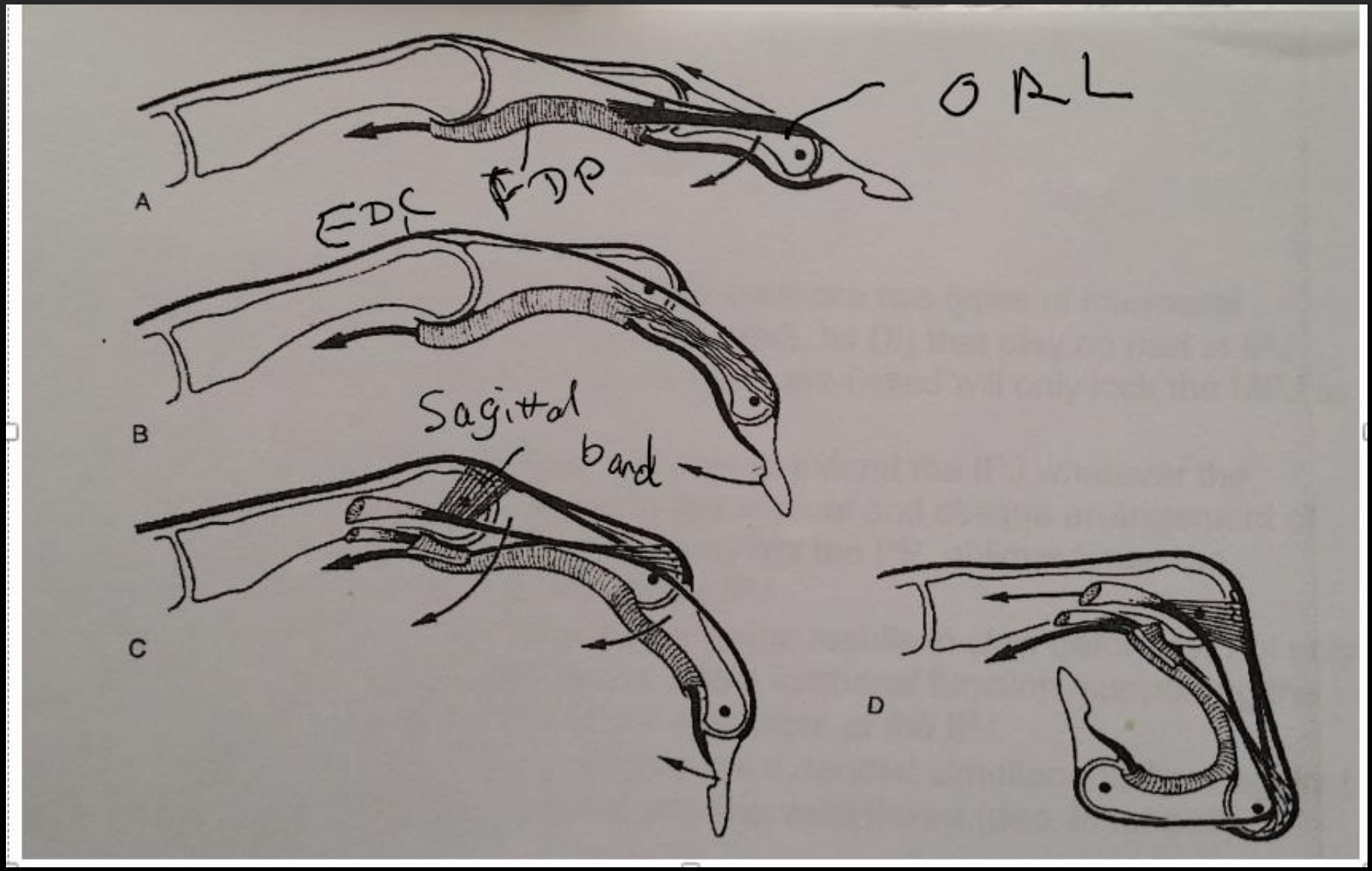
FLEXOR TENDONS REHABILITATIONS

Hand Therapy Training Program 2015

Yanshan LU

PHYSIOLOGY OF FLEXION OF THE FINGERS

- The flexor FDP and extensor EDC contract simultaneously at the beginning of flexion.
- Start with PIPJ flexion, then the MCPJ flexion,
- As PIPJ progressively flexes, the ORL is relaxed then DIPJ flexion is allowed.

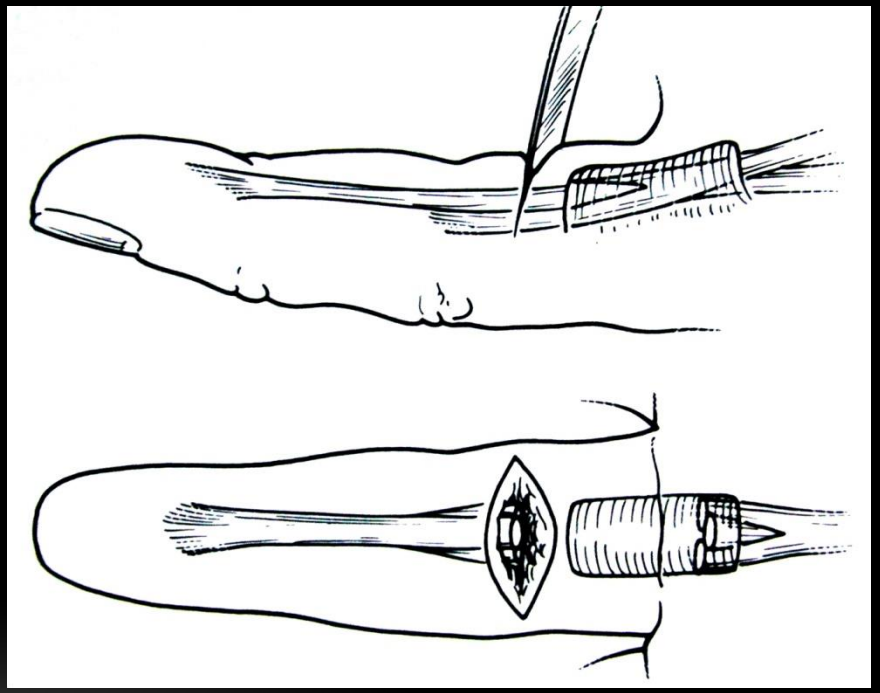

ORL
A
EDC
FDP
B
Sagittal
band
C
D

SEQUENCES OF FLEXION AND EXTENSION (TUBIANA)

Figure 1.118. The order of flexion of the phalanges is controlled by a complex mechanism. (A) The flexor profundus and extensor digitorum contract simultaneously at the beginning of flexion; the extensor acts as a braking mechanism. The oblique retinacular ligament, which is put under tension by flexion of the distal phalanx, acts as an active tenodesis to initiate flexion of the proximal interphalangeal joint. (B) As the proximal interphalangeal joint flexes, the tension in the oblique retinacular ligament decreases, thereby allowing for more flexion at the distal joint. (C) Flexion of the proximal interphalangeal joint puts the lumbrical and interosseous tendons, which cross obliquely in front of the axis of the metacarpophalangeal joint, under tension, and this initiates flexion of the metacarpophalangeal joint. (D) Flexion of the metacarpophalangeal joint displaces the interosseous hood distally; once distal to the joint, it can act as a flexor of the proximal phalanx. Thus, two structures that cross the joint obliquely at two successive levels have a similar tenodesis effect on the digital kinetic chain. Both are palmar to the axis of flexion proximally and dorsal to the axis distally. An increase in tension in these structures caused by the action of the extrinsic muscles will initiate flexion of the phalanx they cross. This tension can be brought about by two different mechanisms, i.e. flexion of the distal joint or flexion of the proximal joint.

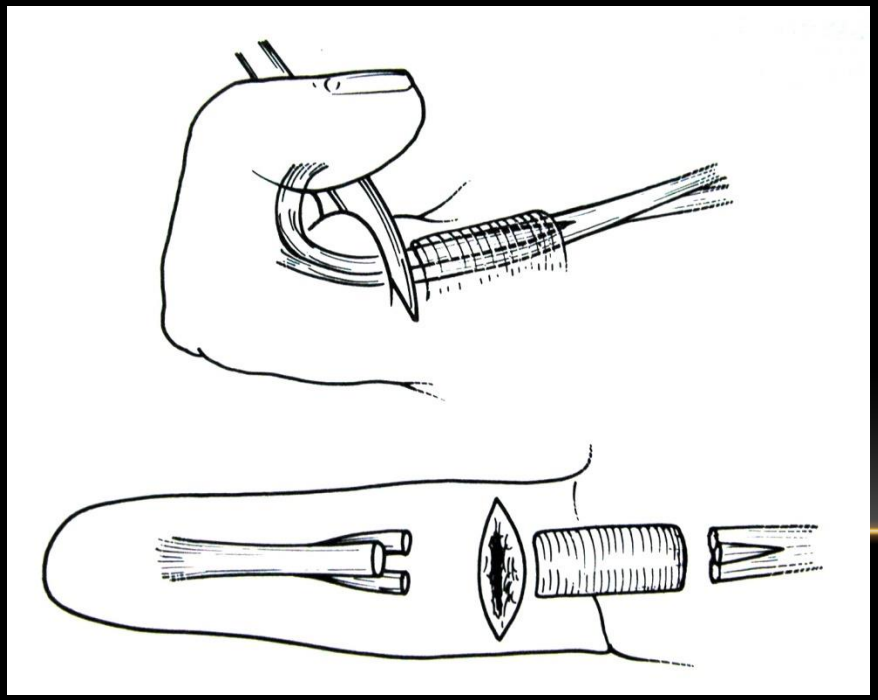
MECHANISM OF INJURY

- Out-stretched hand



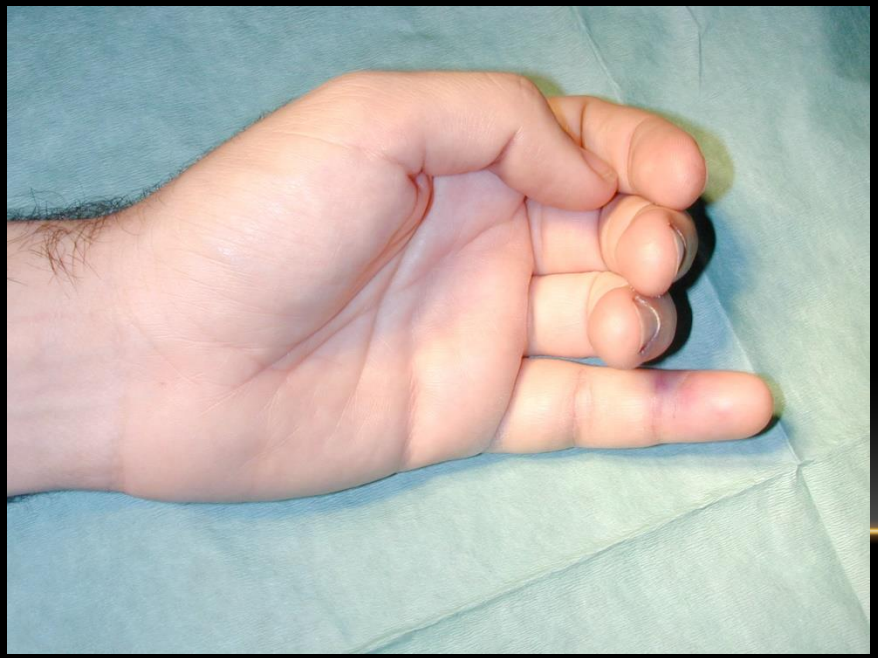
MECHANISM OF INJURY

- Out-stretched hand
- Clenched fingers



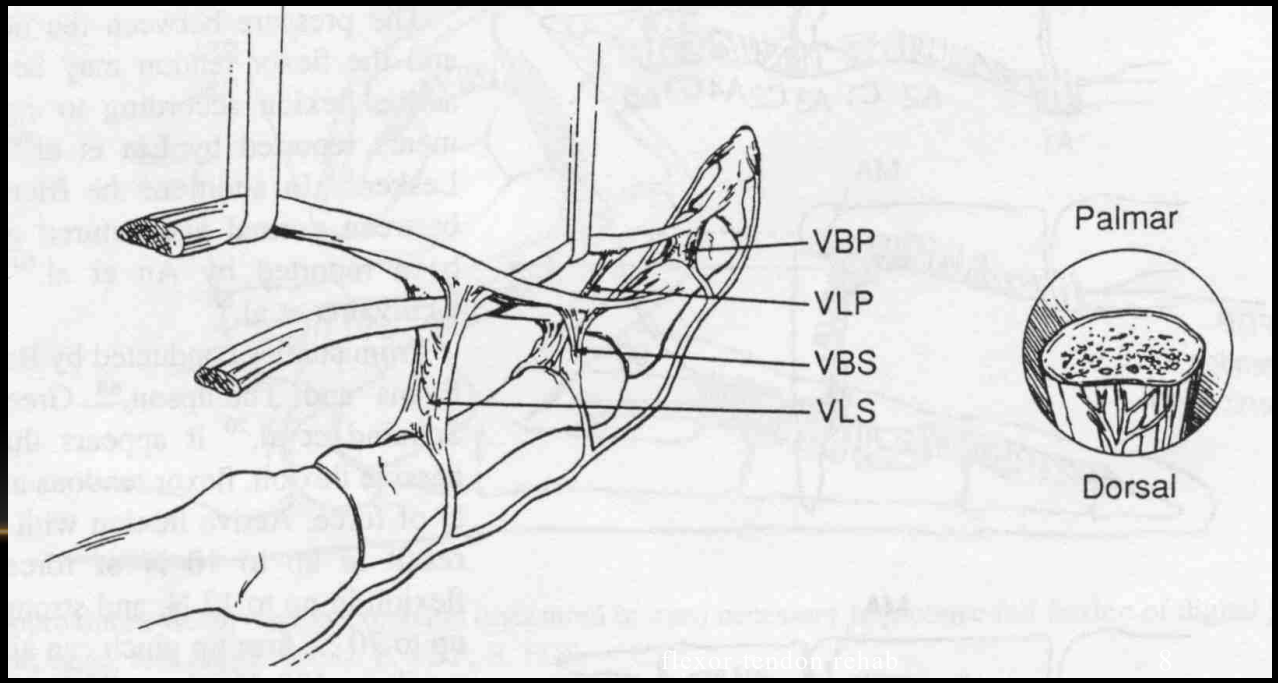
MECHANISM OF INJURY

- Out-stretched hand
- Clenched fingers
- Closed avulsion



MECHANISM OF INJURY

- Out-stretched hand
- Clenched fingers
- Closed avulsion
- Force

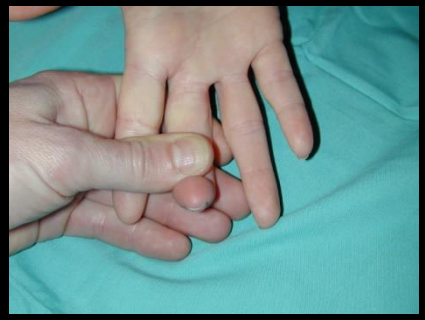


ASSESSMENT

- FDS

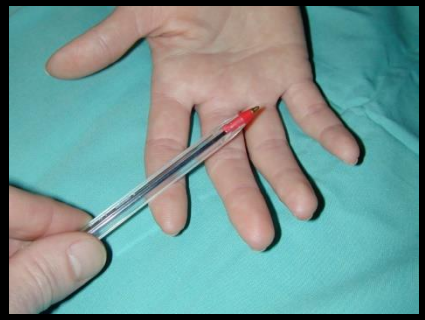
ASSESSMENT

- FDS
- FDP



ASSESSMENT

- FDS
- FDP
- Sensation

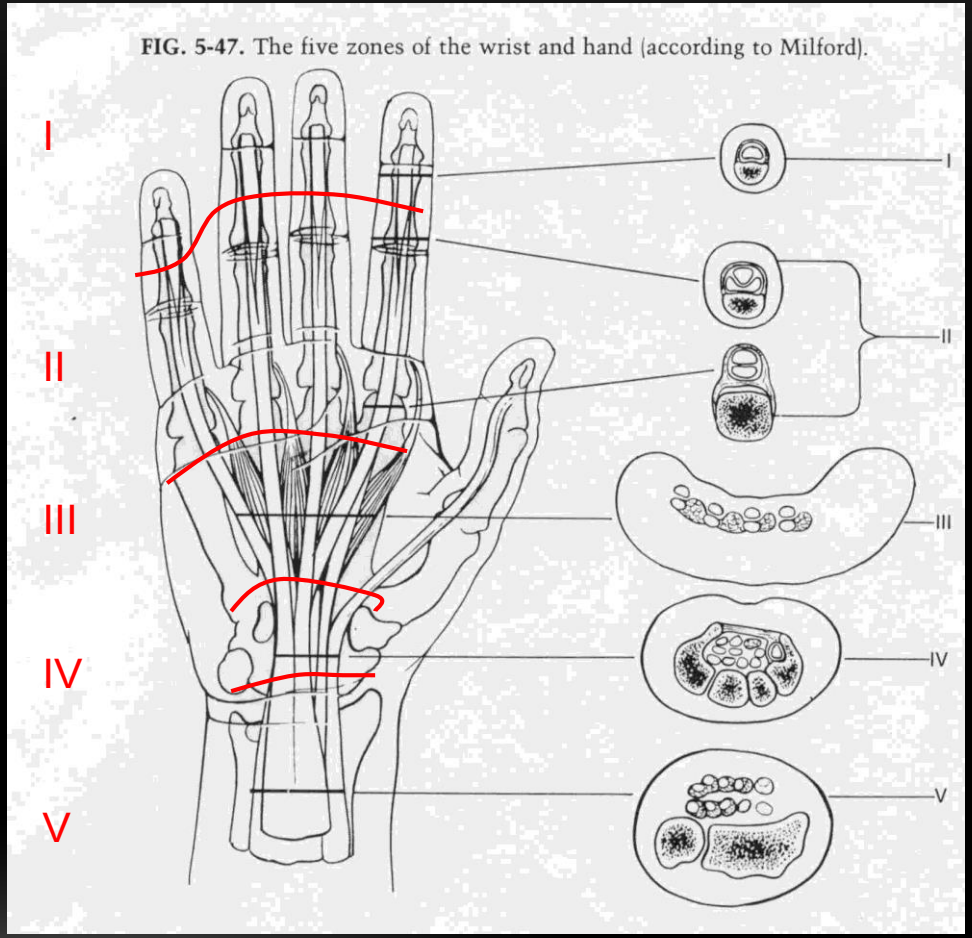


ASSESSMENT

- FDS
- FDP
- Sensation
- Perfusion

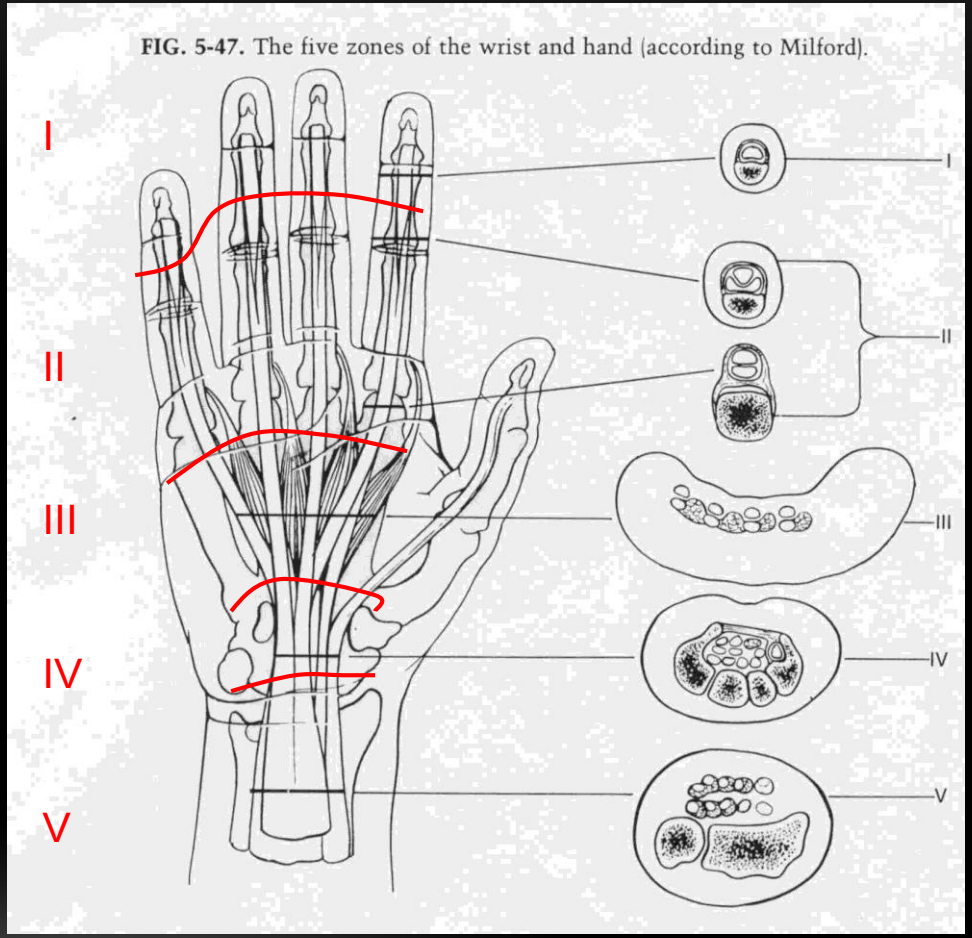
ASSESSMENT

- FDS
- FDP
- Sensation
- Perfusion
- Zone of injury



ASSESSMENT

- FDS
- FDP
- Sensation
- Perfusion
- Zone of injury



PROCEDURE

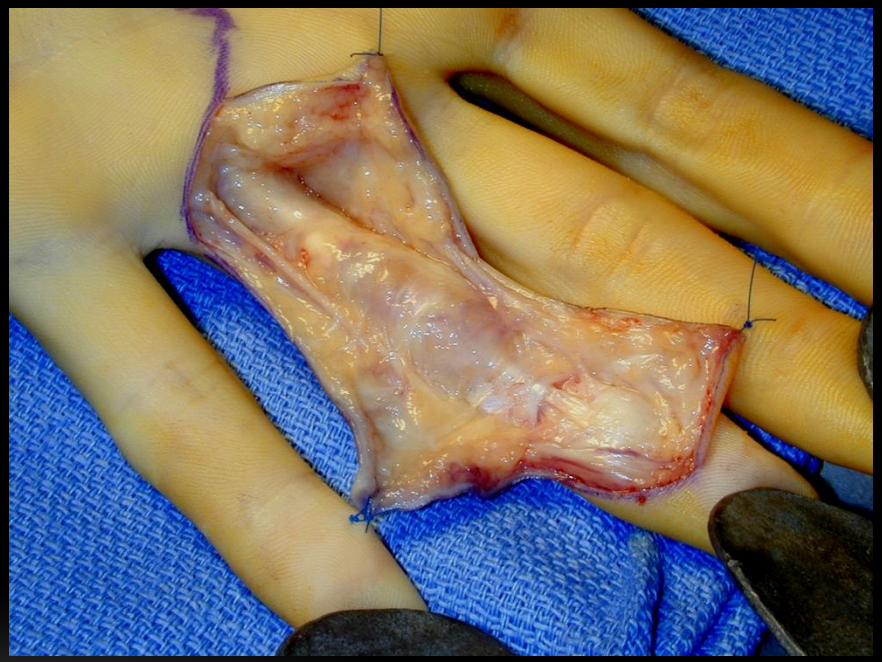
- Extend wound

PROCEDURE

- Extend wound

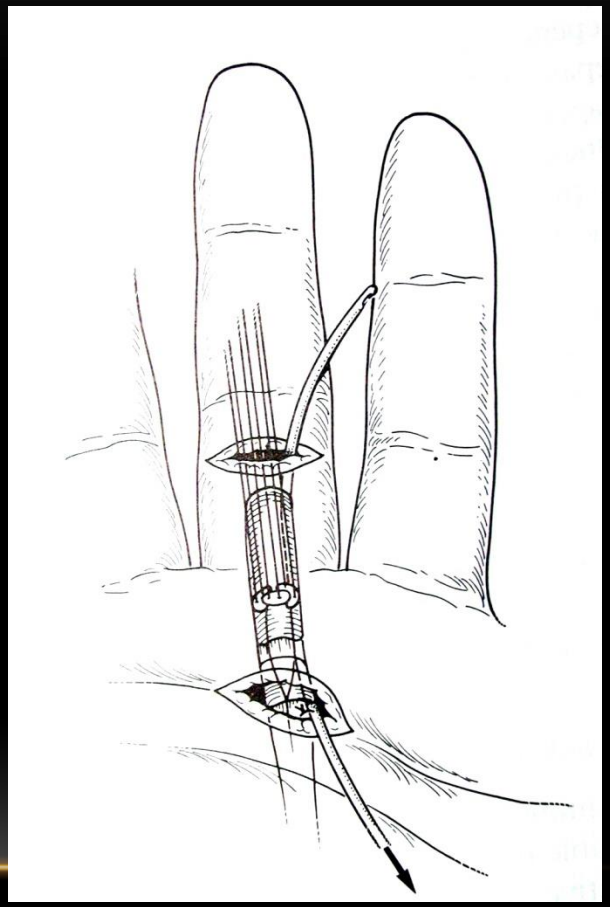
PROCEDURE

- Extend wound
- Expose flexor sheath



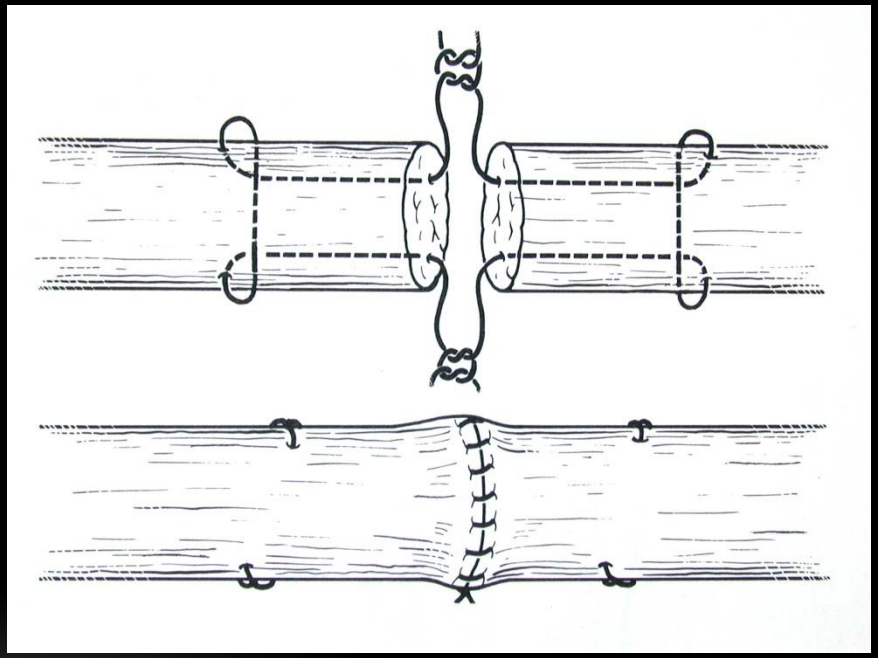
PROCEDURE

- Extend wound
- Expose flexor sheath
- Retrieve tendon ends



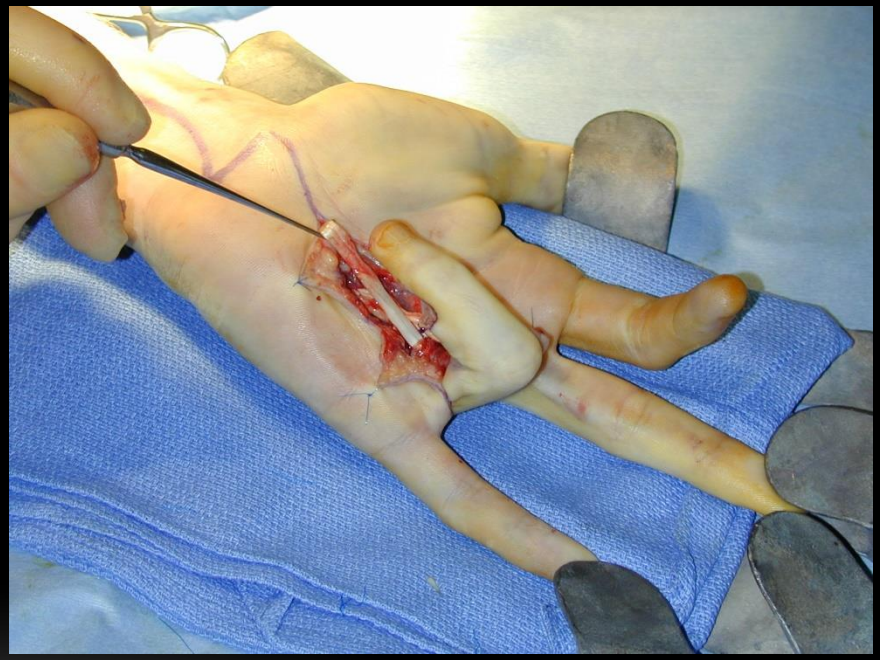
PROCEDURE

- Extend wound
- Expose flexor sheath
- Retrieve tendon ends
- Core suture
- Peripheral suture



PROCEDURE

- Extend wound
- Expose flexor sheath
- Retrieve tendon ends
- Core suture
- Peripheral suture
- Test repair
  - Tendon hook in palm
  - Squeeze forearm



PROCEDURE

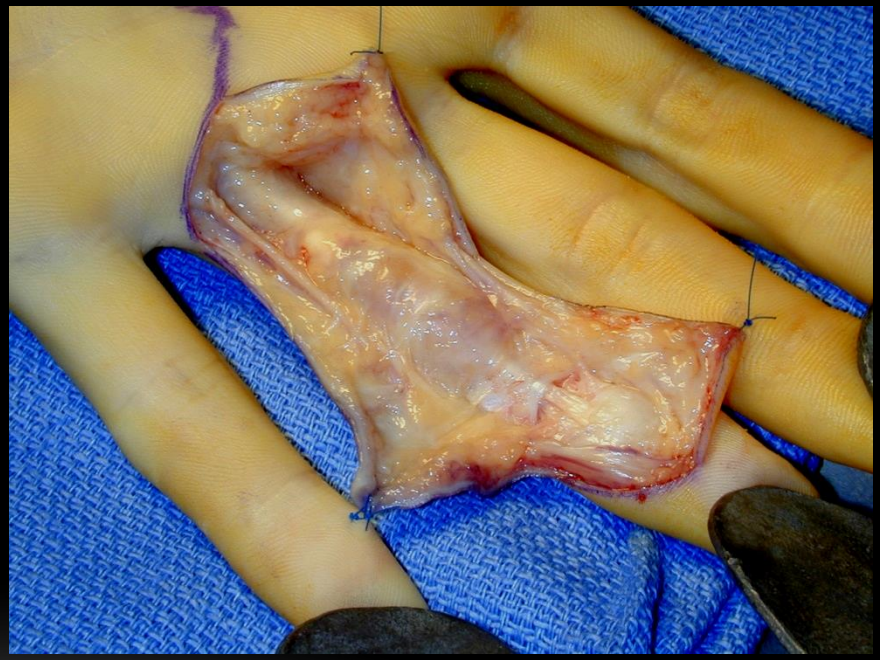
- Extend wound
- Expose flexor sheath
- Retrieve tendon ends
- Core suture
- Peripheral suture
- Test repair
- ? Close sheath
- Haemostasis
- Skin suture

PROCEDURE

- Extend wound
- Expose flexor sheath
- Retrieve tendon ends
- Core suture
- Peripheral suture
- Test repair
- ? Close sheath
- Haemostasis
- Skin suture
- Splint

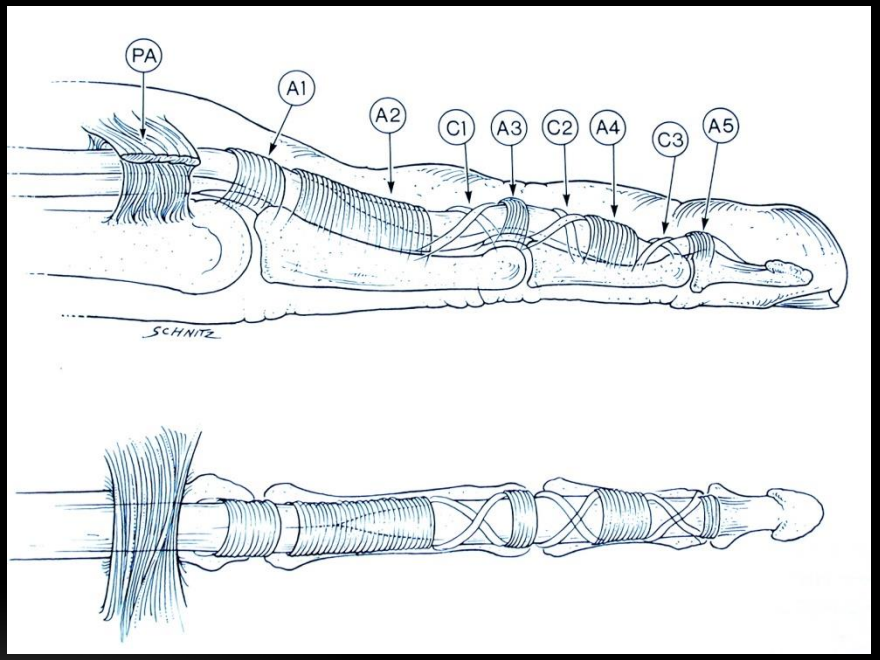
PRINCIPLES

- Good exposure



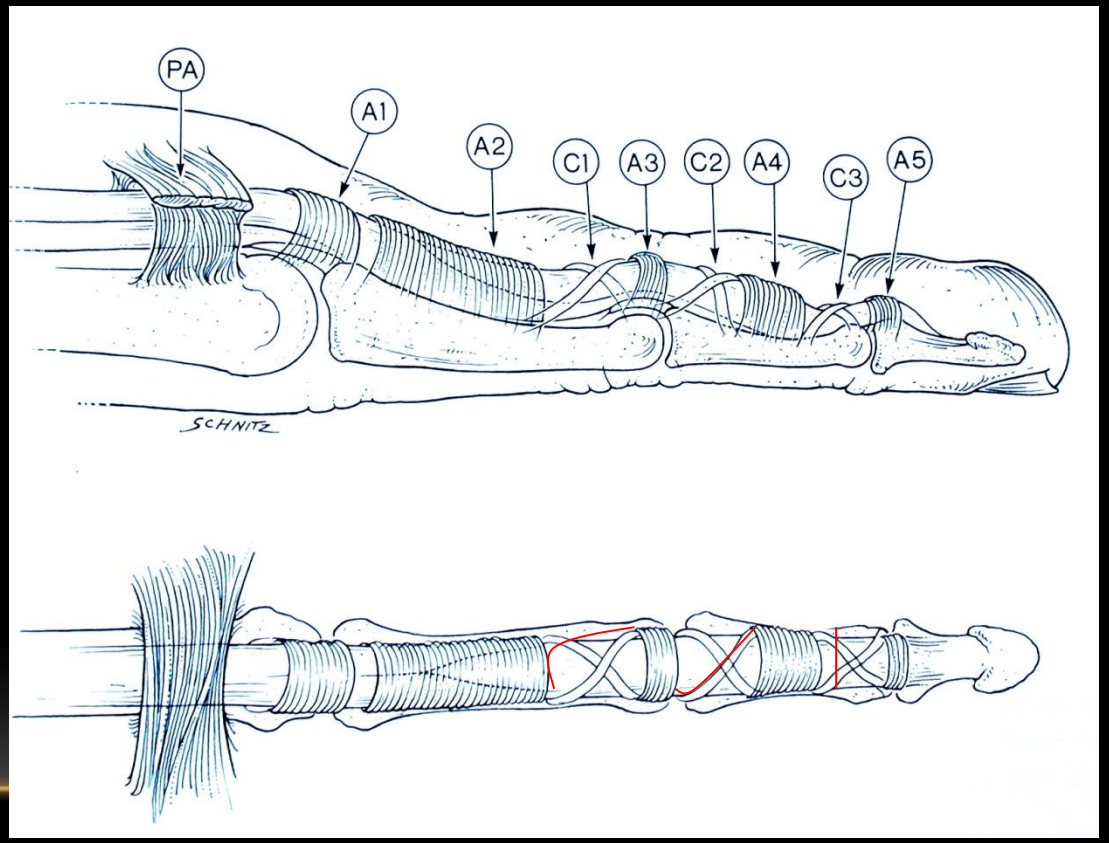
PRINCIPLES

- Good exposure
- Open cruciate windows



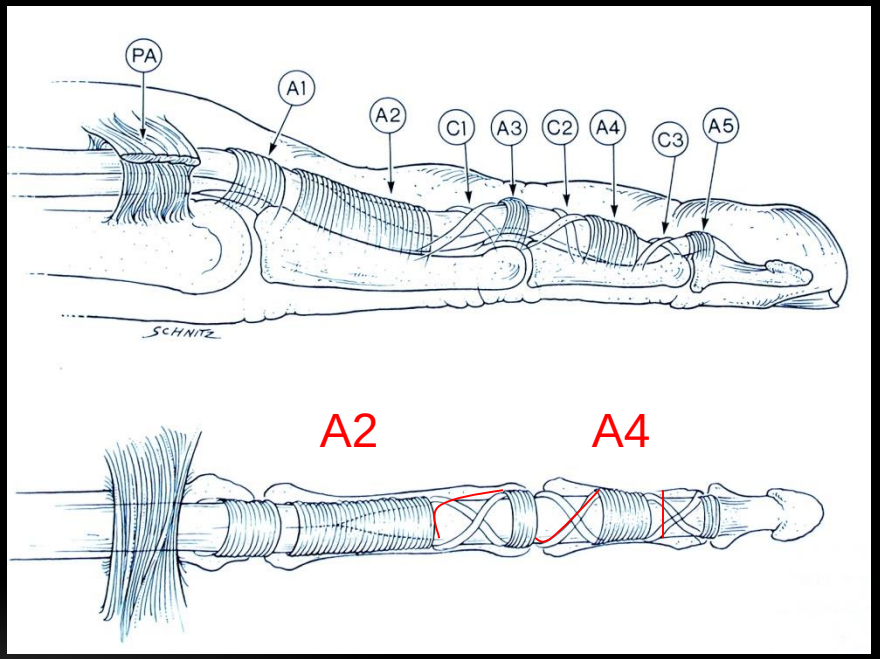
PRINCIPLES

- Good exposure
- Open cruciate windows



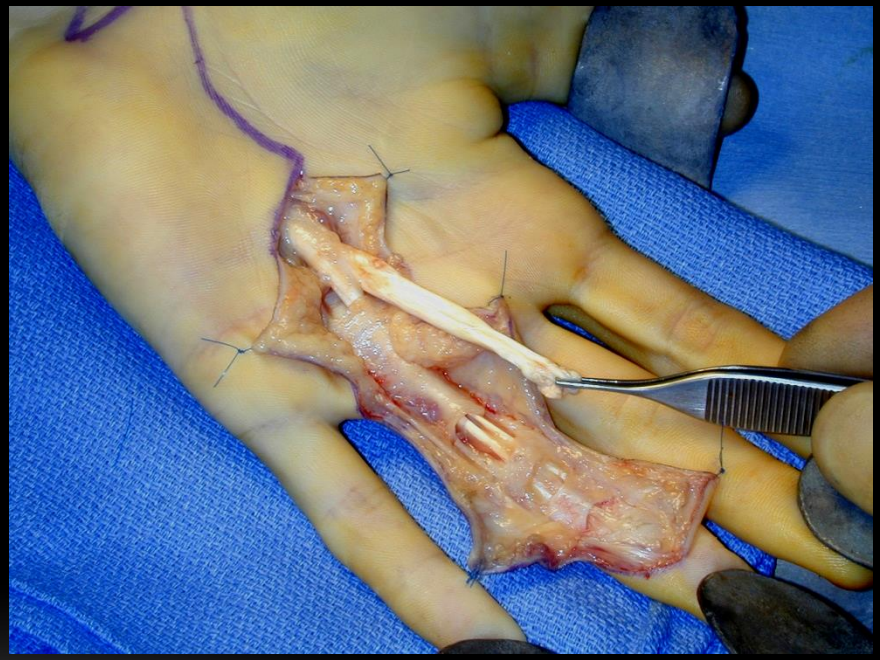
PRINCIPLES

- Good exposure
- Open cruciate windows
- Preserve annular pulleys



PRINCIPLES

- Good exposure
- Open cruciate windows
- Preserve annular pulleys
- Minimal handling of tendon ends

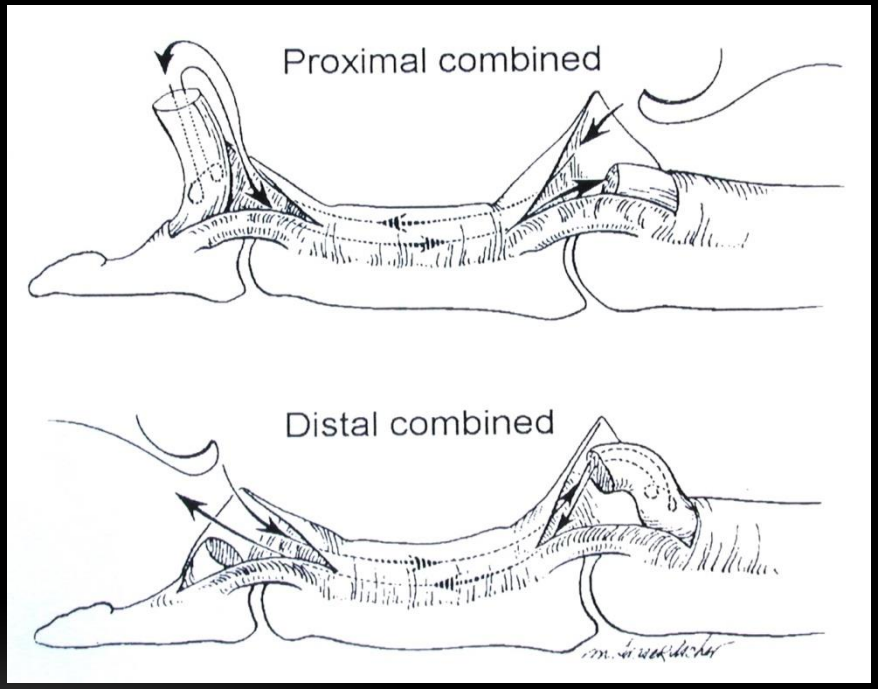


PRINCIPLES

- Good exposure
- Open cruciate windows
- Preserve annular pulleys
- Minimal handling of tendon ends

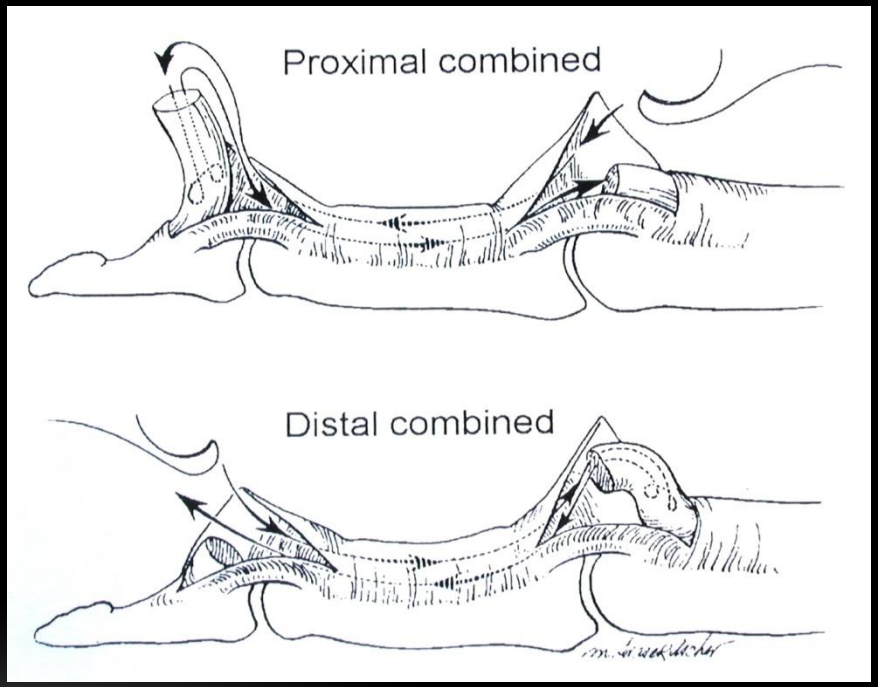
PRINCIPLES

- Good exposure
- Open cruciate windows
- Preserve annular pulleys
- Minimal handling of tendon ends
- Avoid withdrawal from sheath



PRINCIPLES

- Good exposure
- Open cruciate windows
- Preserve annular pulleys
- Minimal handling of tendon ends
- Avoid withdrawal from sheath
- Fix tendons with blue needle

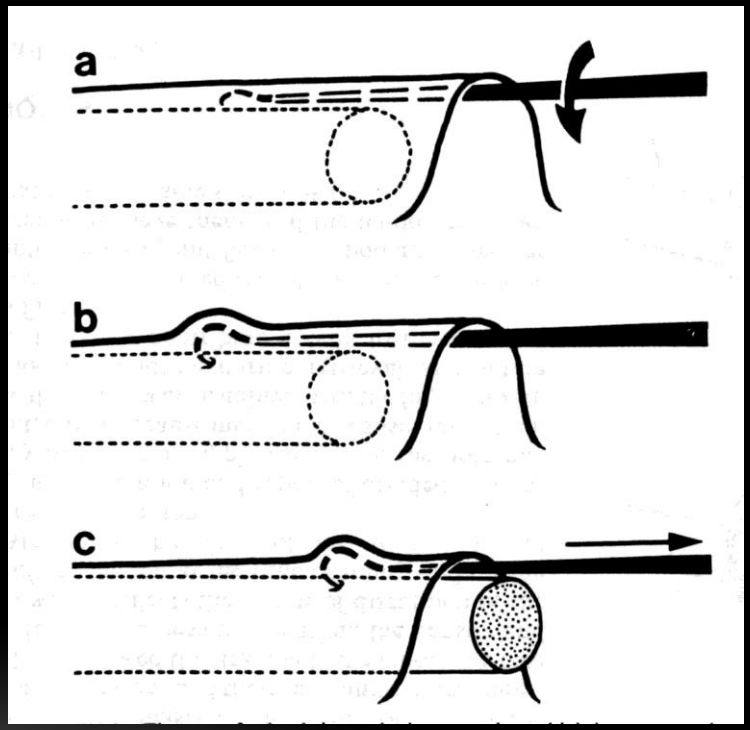


RETRIEVAL

- Milk tendon from palm

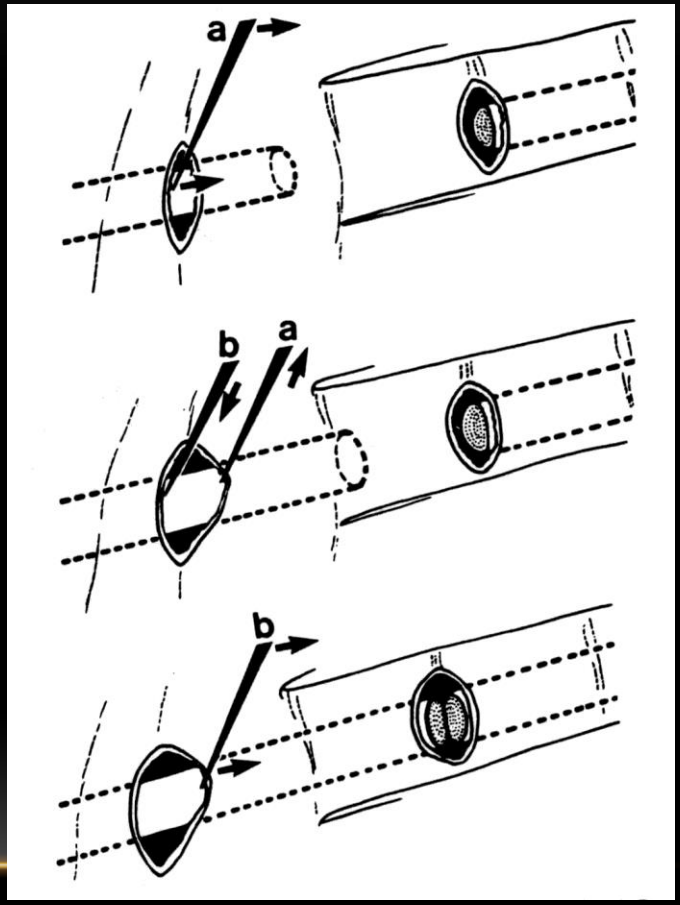
RETRIEVAL

- Milk tendon from palm
- Tendon grabber (once)



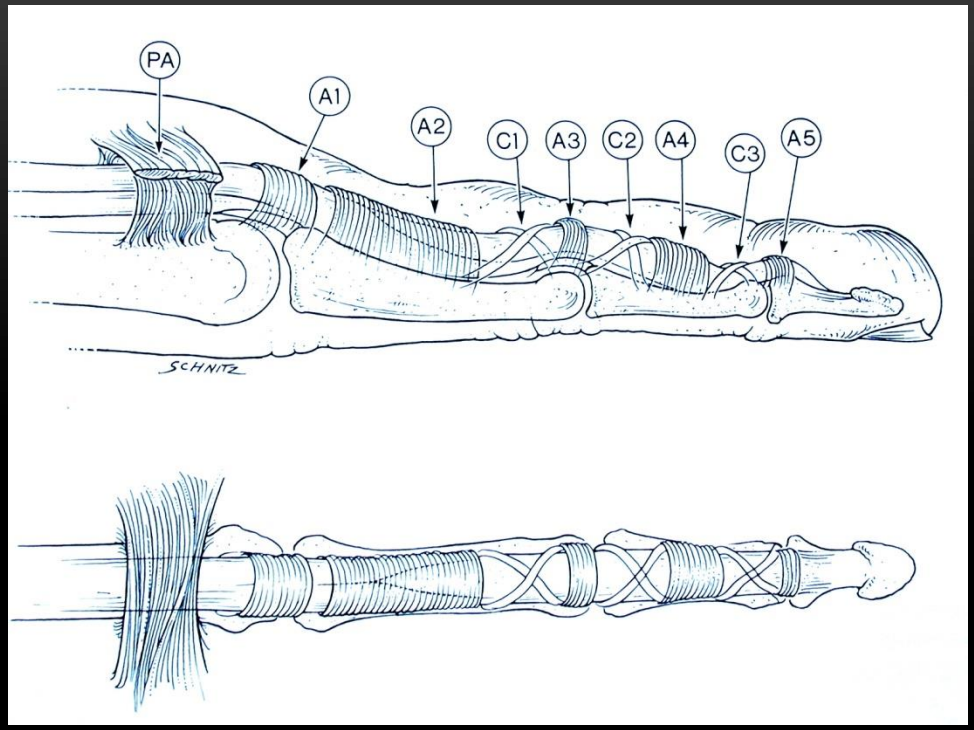
RETRIEVAL

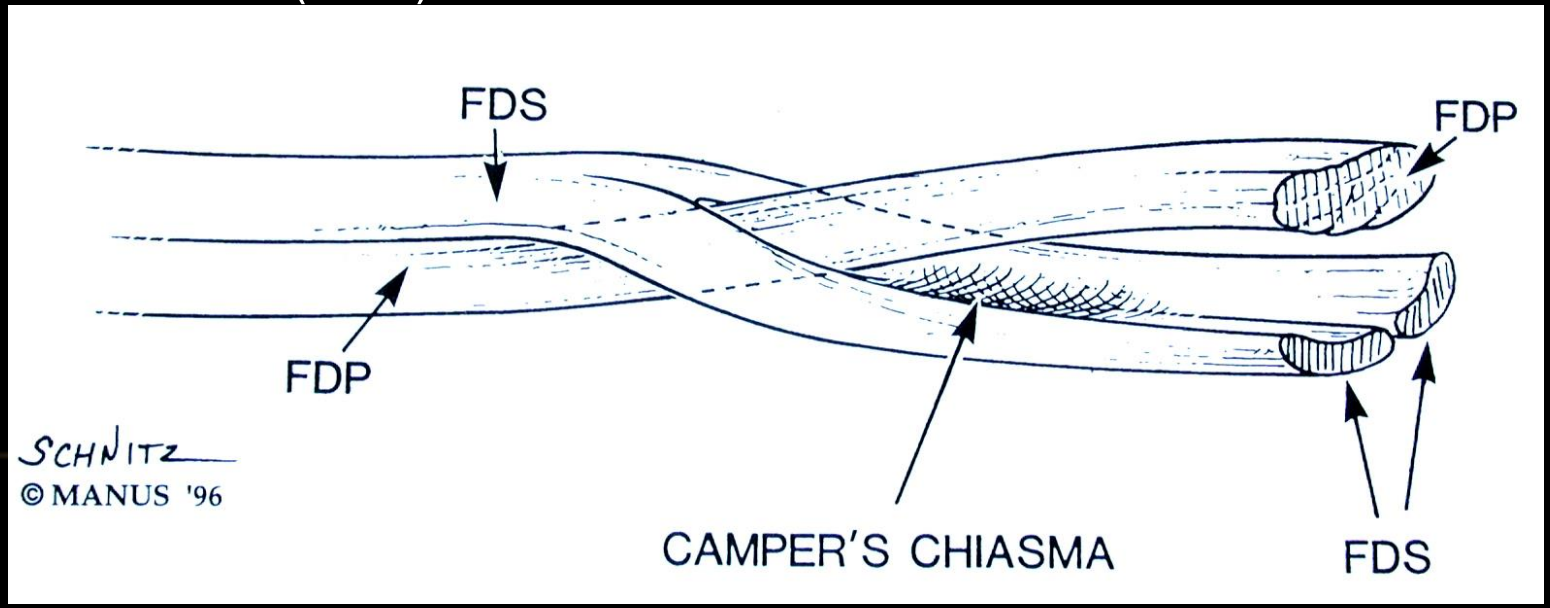
- Milk tendon from palm
- Tendon grabber (once)
- Walk with blue needles



RETRIEVAL

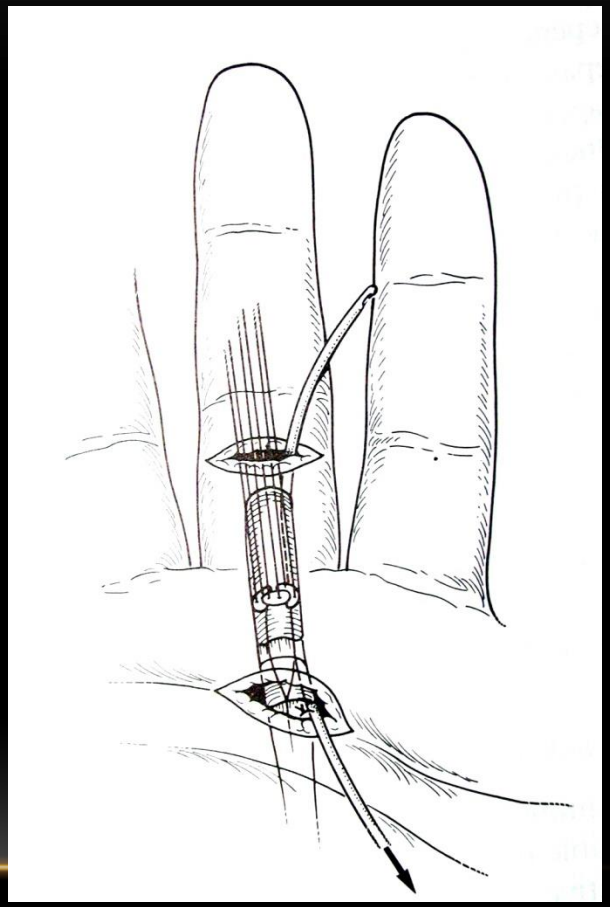
- Milk tendon from palm
- Tendon grabber (once)
- Walk with blue needles
- Camper's Chiasm (FDS)





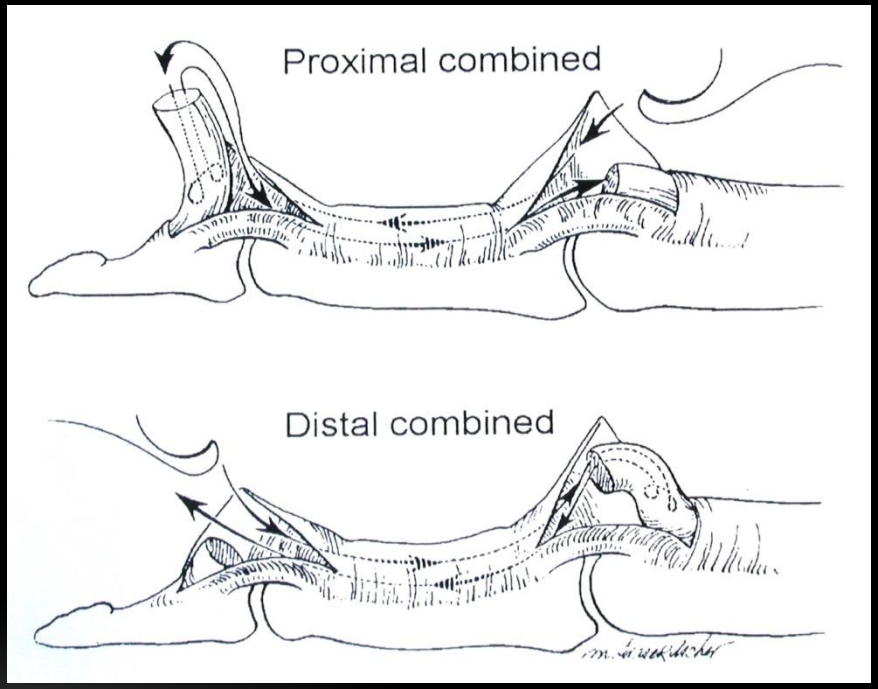
RETRIEVAL

- Milk tendon from palm
- Tendon grabber (once)
- Walk with blue needles
- Camper's Chiasm (FDS)
- Feeding tube

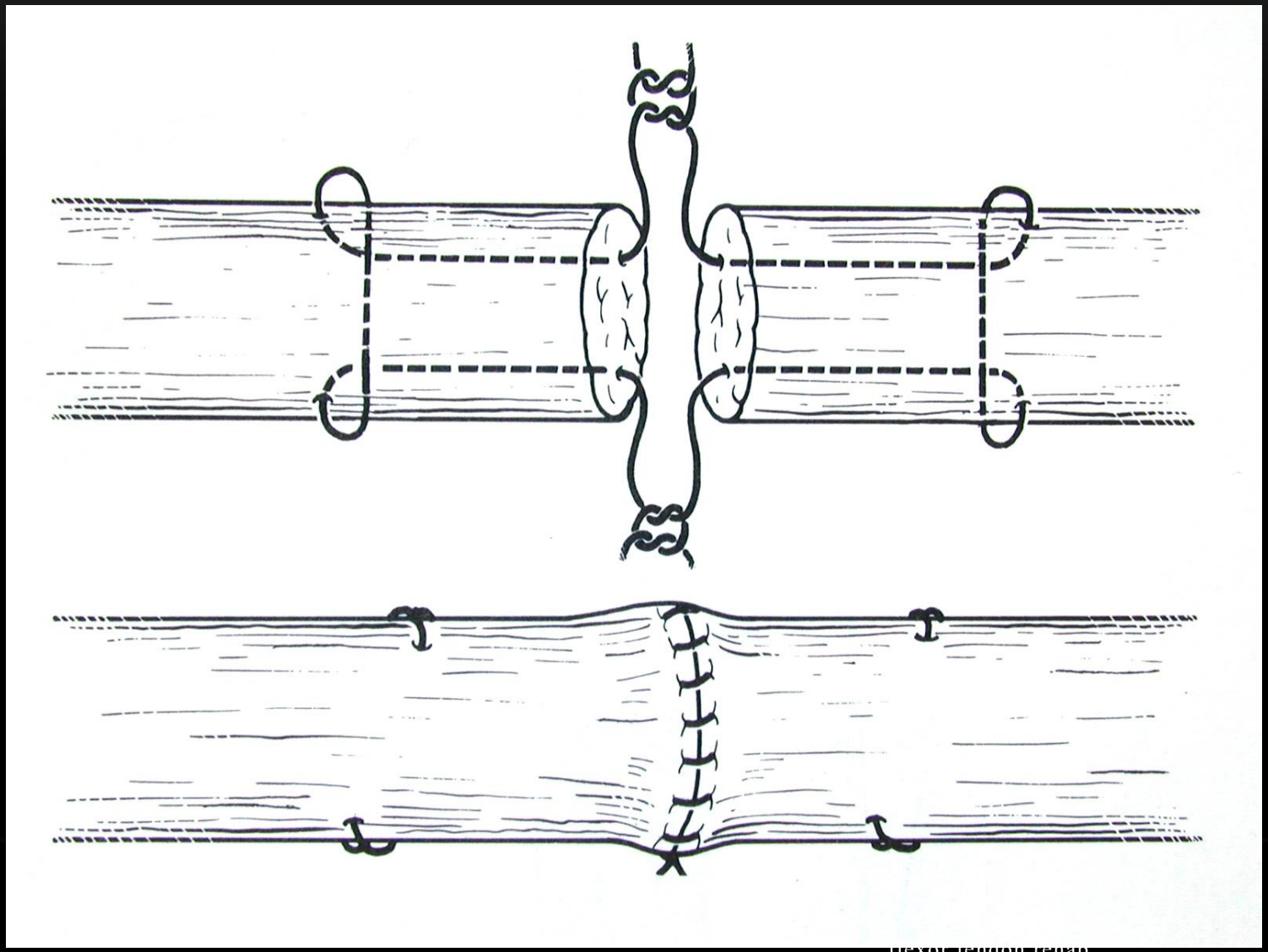


RETRIEVAL

- Milk tendon from palm
- Tendon grabber (once)
- Walk with blue needles
- Camper's Chiasm (FDS)
- Feeding tube
- Draw with core suture

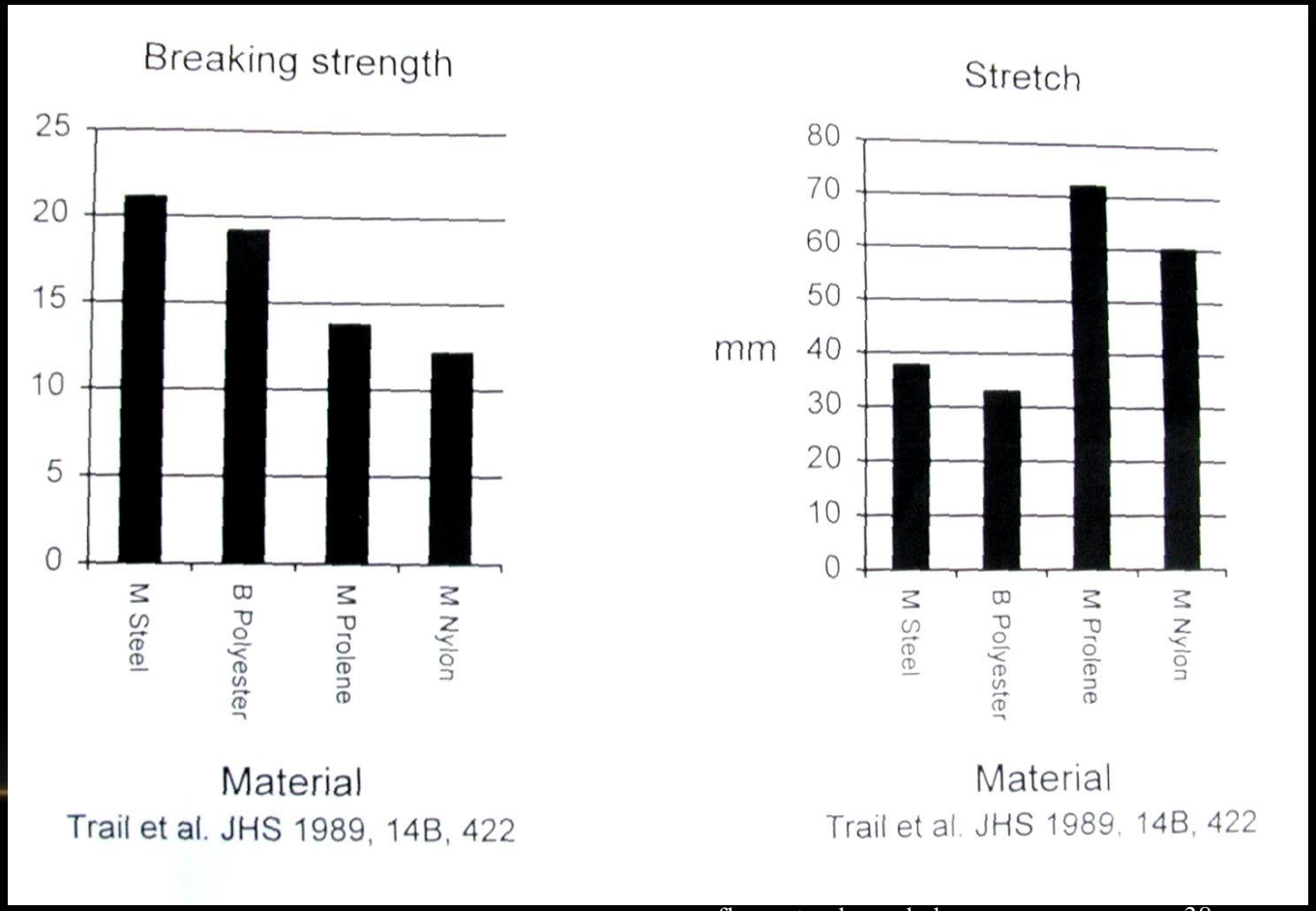


REPAIR



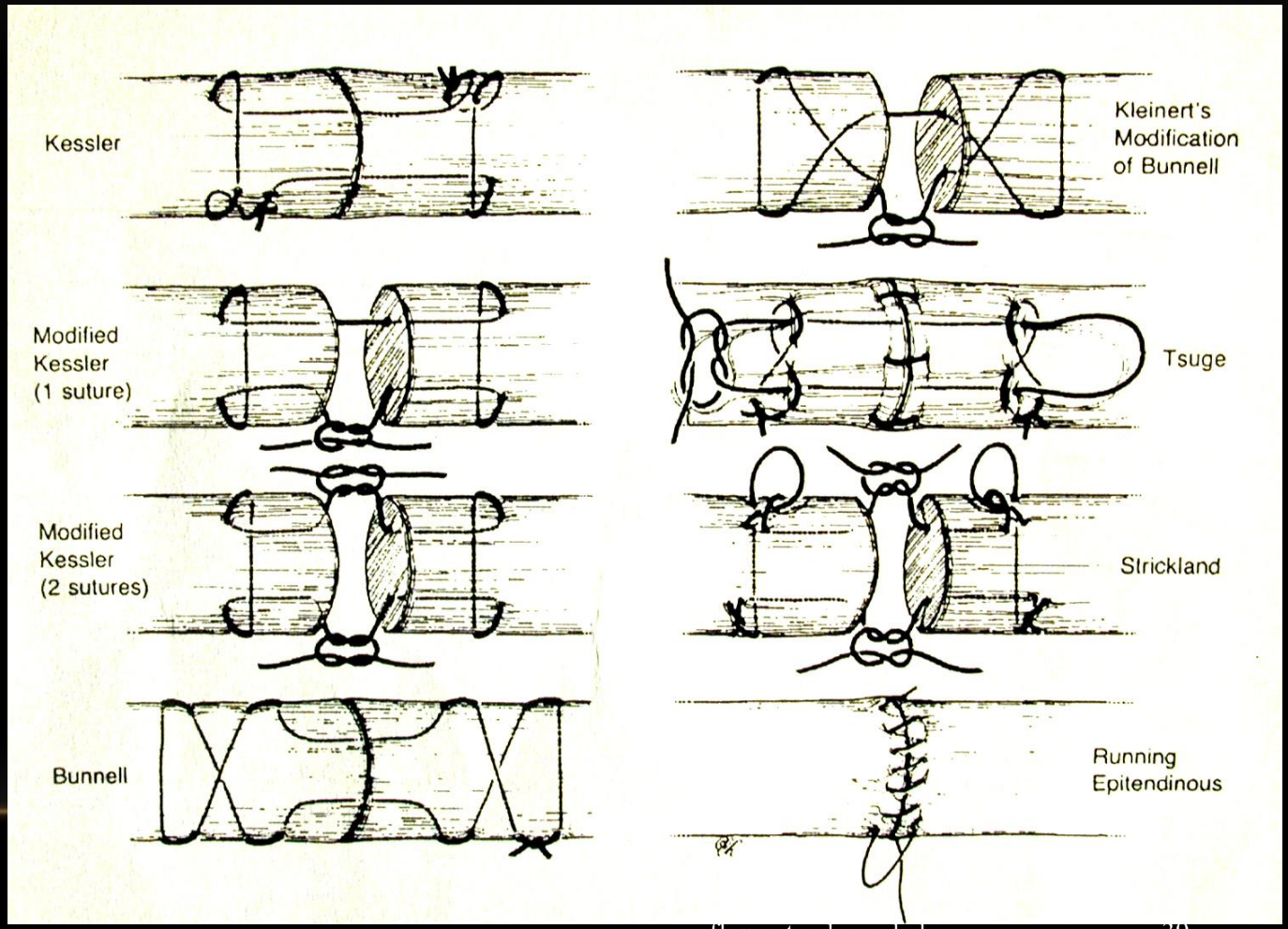
REPAIR - CORE SUTURE

- Material



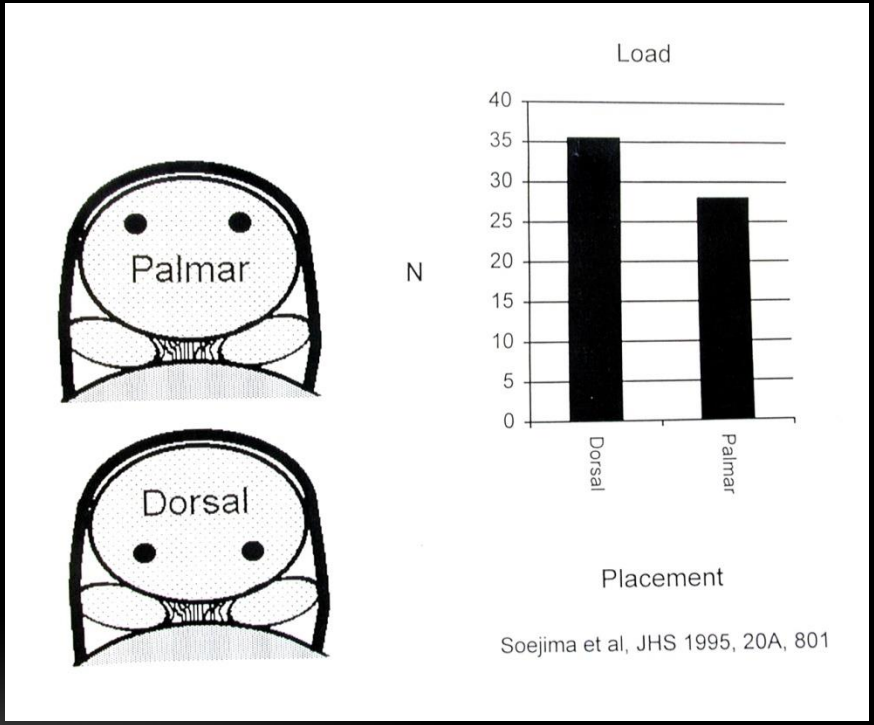
REPAIR - CORE SUTURE

- Material
- Technique



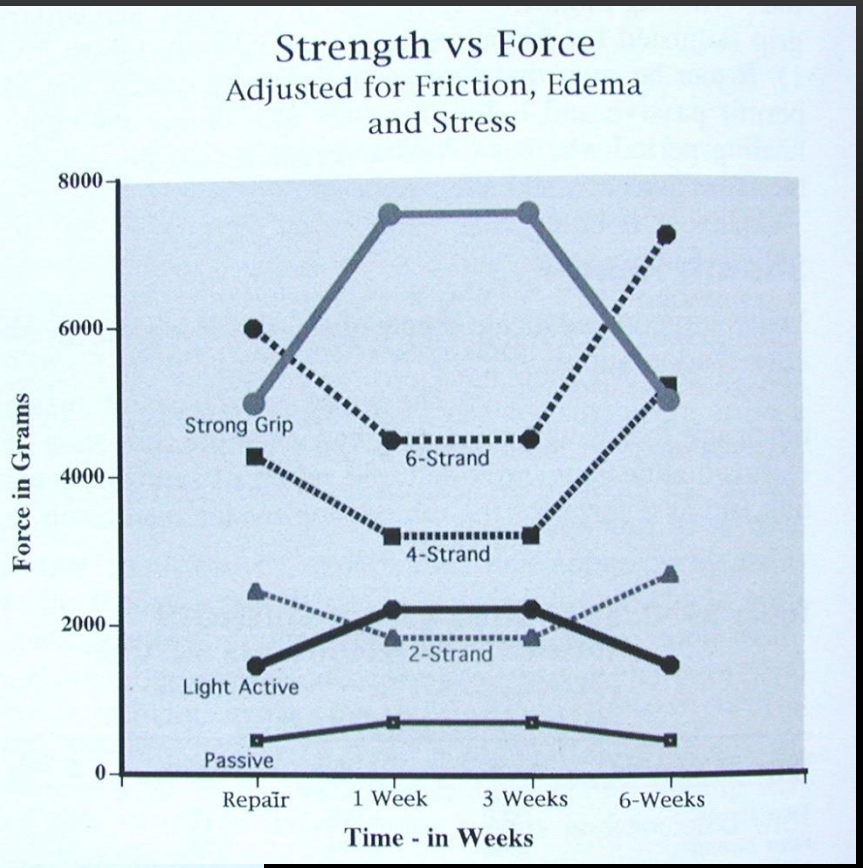
REPAIR - CORE SUTURE

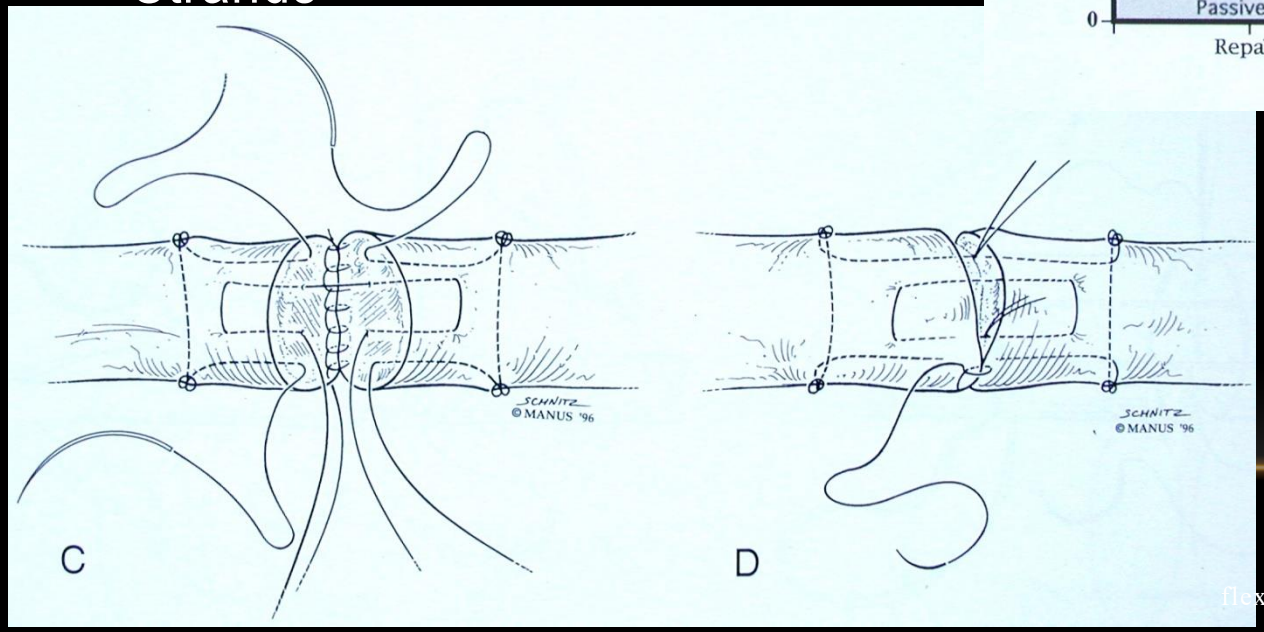
- Material
- Technique
- Placement



REPAIR - CORE SUTURE

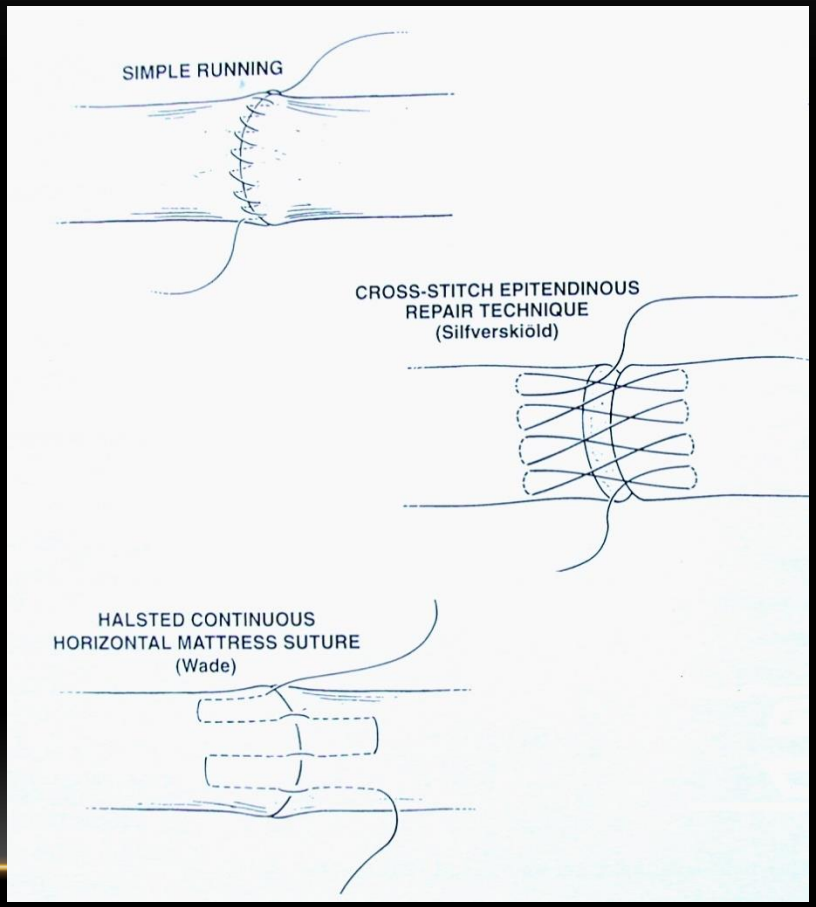
- Material
- Technique
- Placement
- Strands





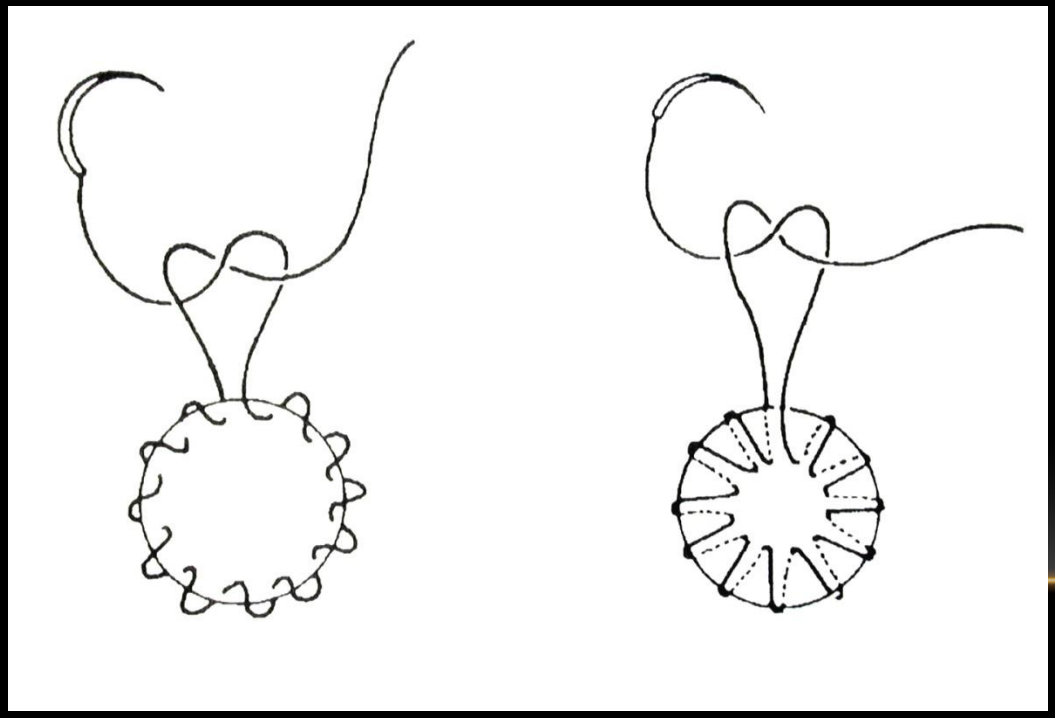
REPAIR - PERIPHERAL SUTURE

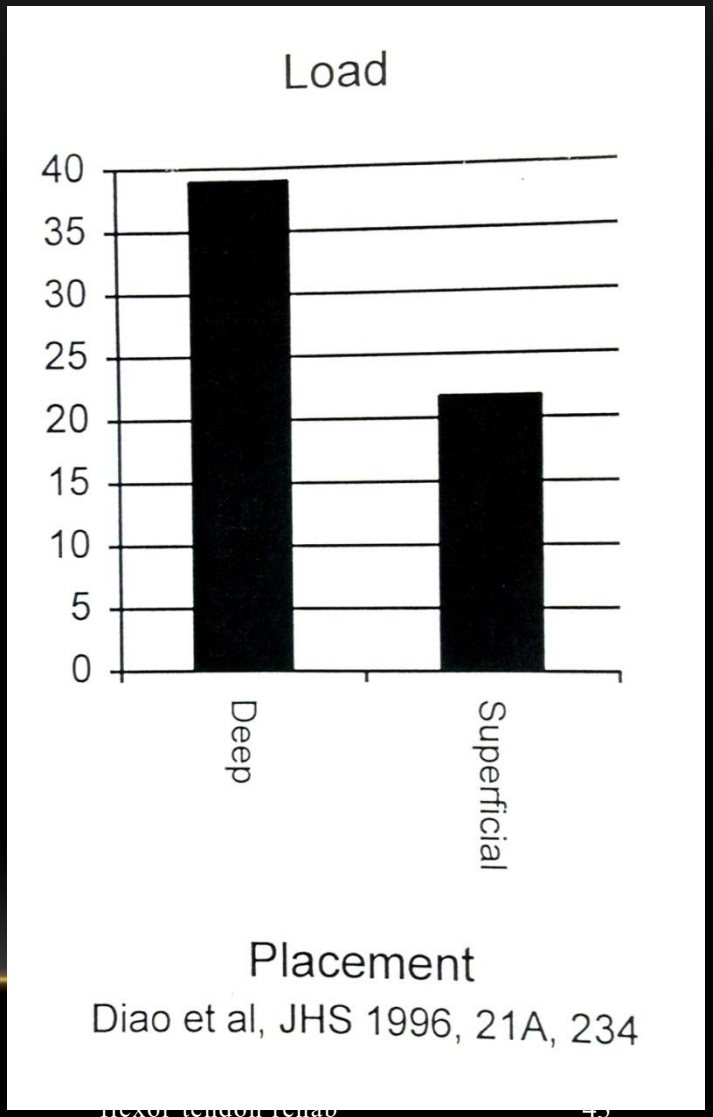
- Technique



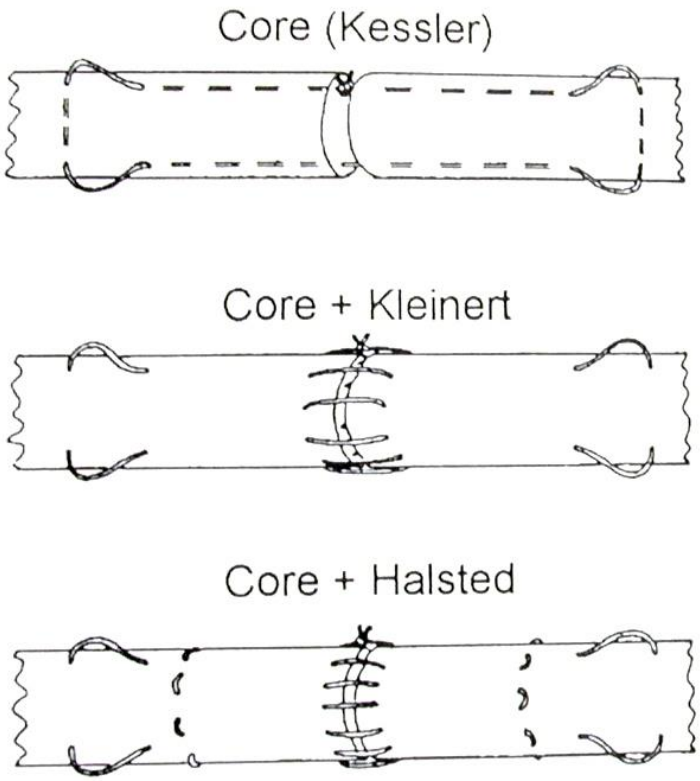
REPAIR - PERIPHERAL SUTURE

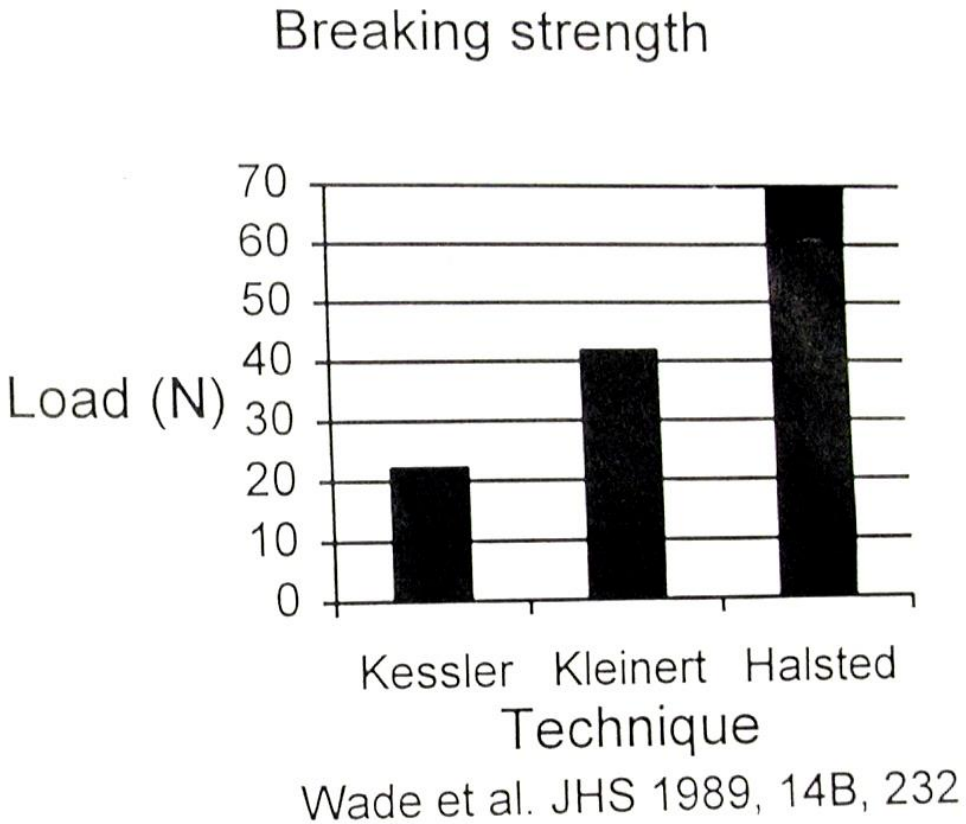
- Technique
- Placement





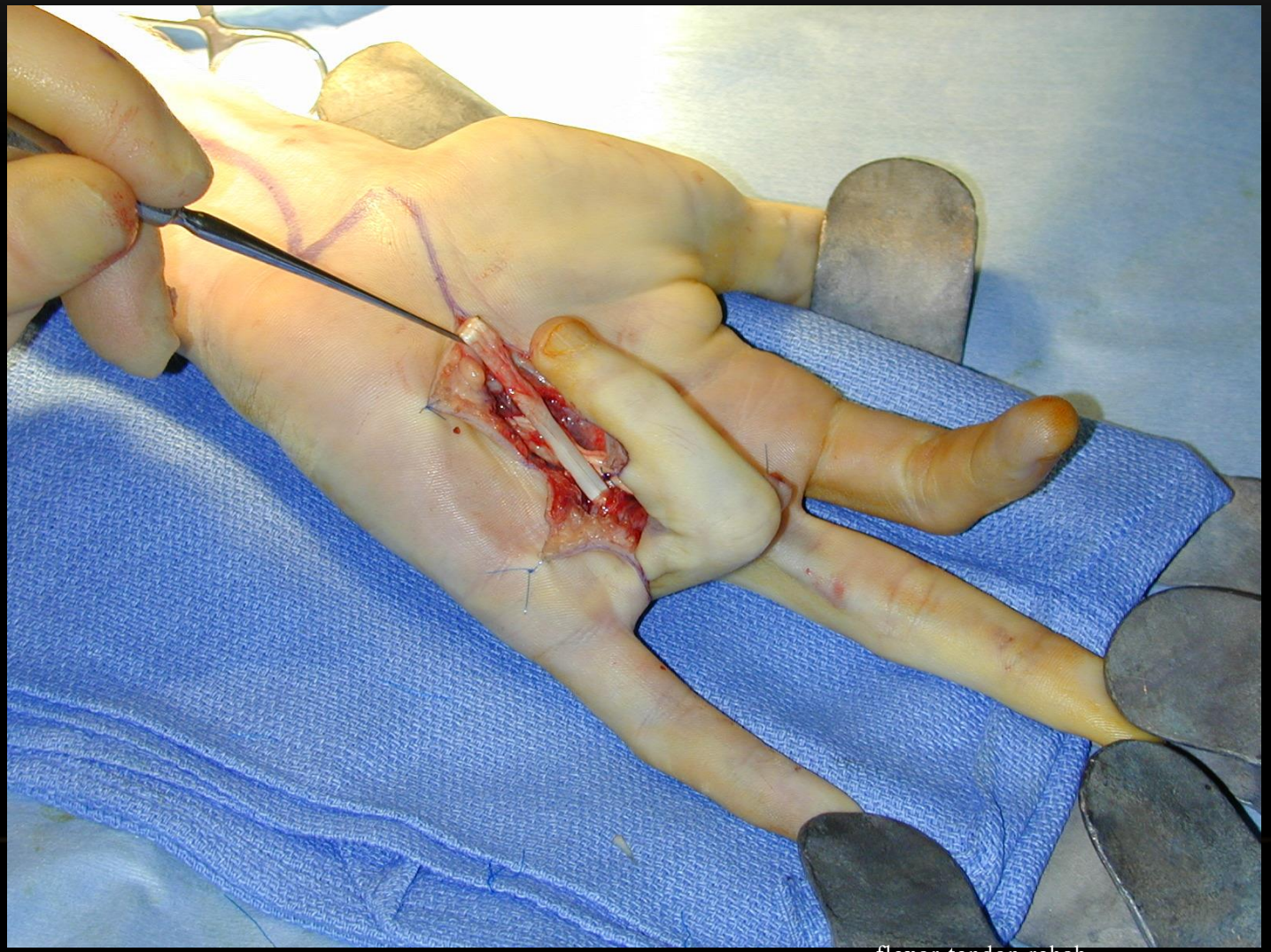
REPAIR





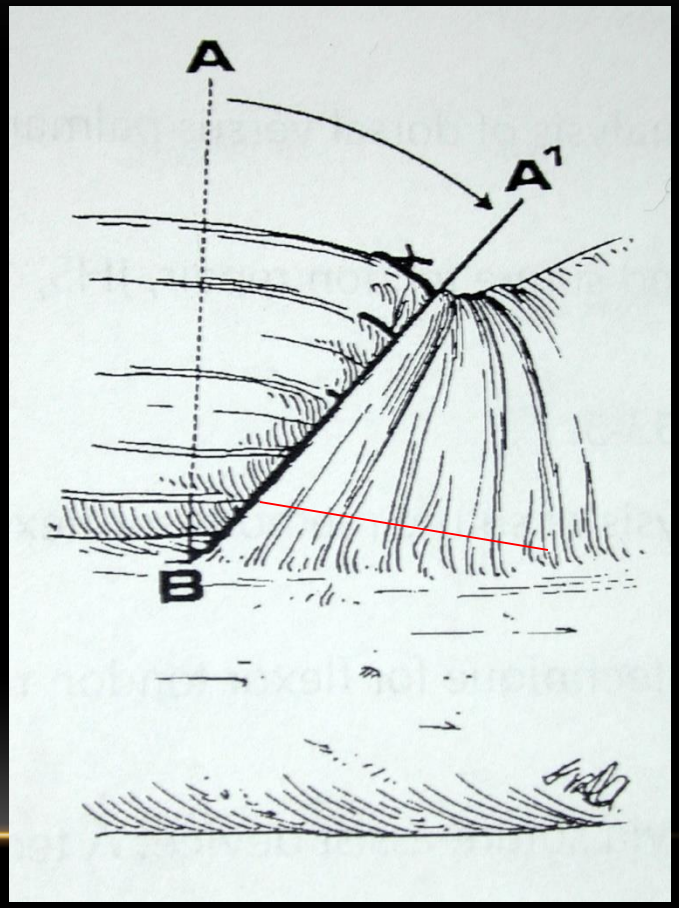
Wade et al. JHS 1989, 14B, 232

TEST REPAIR FOR GLIDE



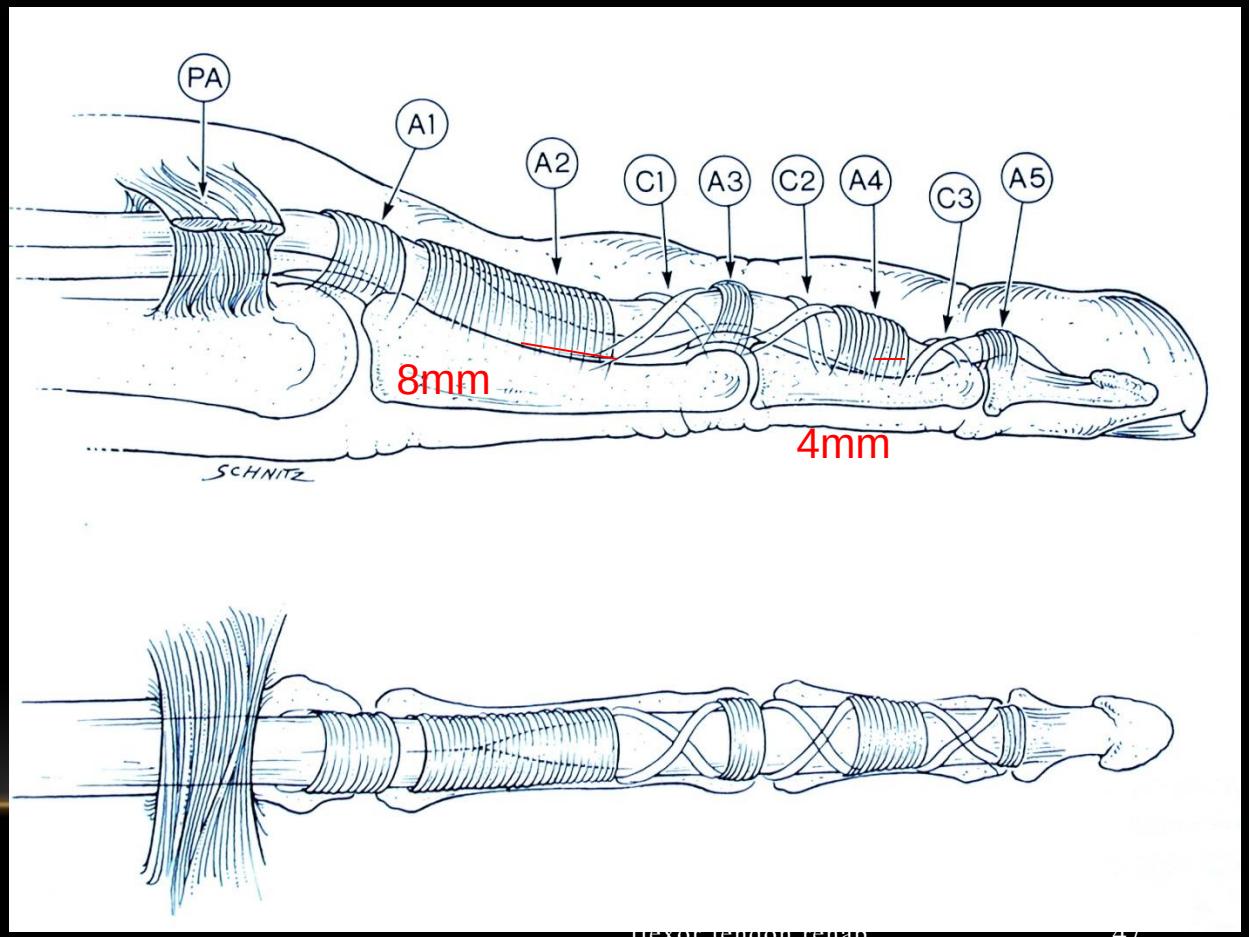
TEST REPAIR FOR GLIDE

- Vent pulleys



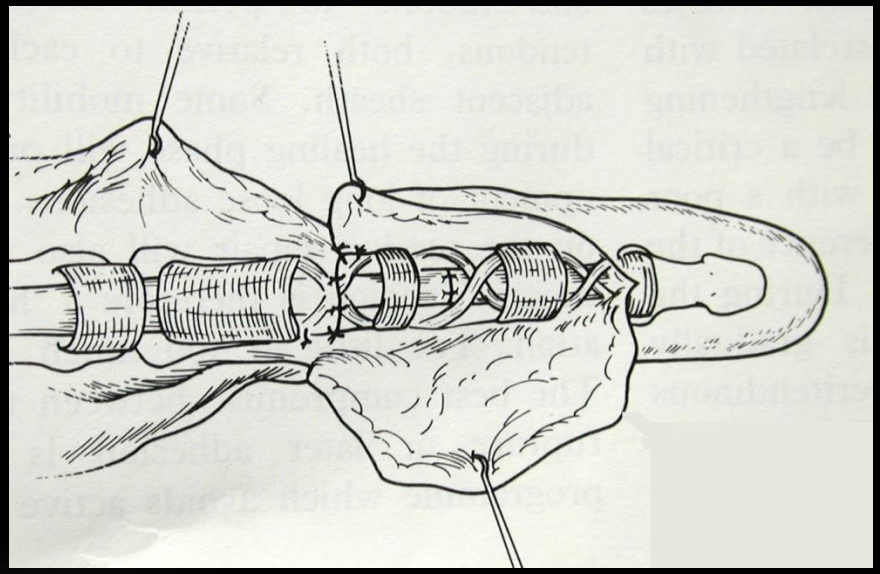
TEST REPAIR FOR GLIDE

- Vent pulleys

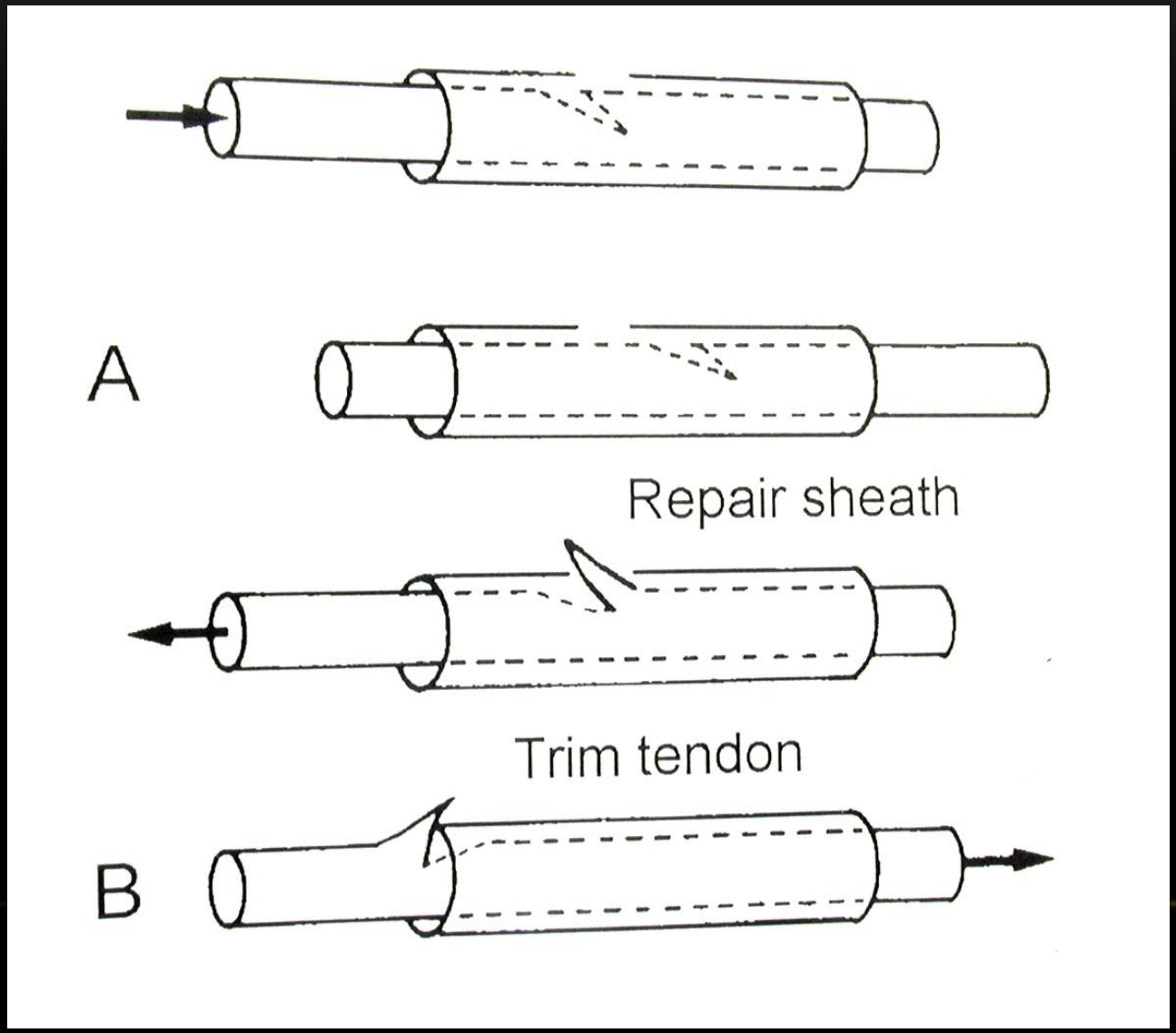


TEST REPAIR FOR GLIDE

- Vent pulleys
- Close sheath
  - Controversial
  - Better glide
  - Tendon nutrition



PARTIAL DIVISION

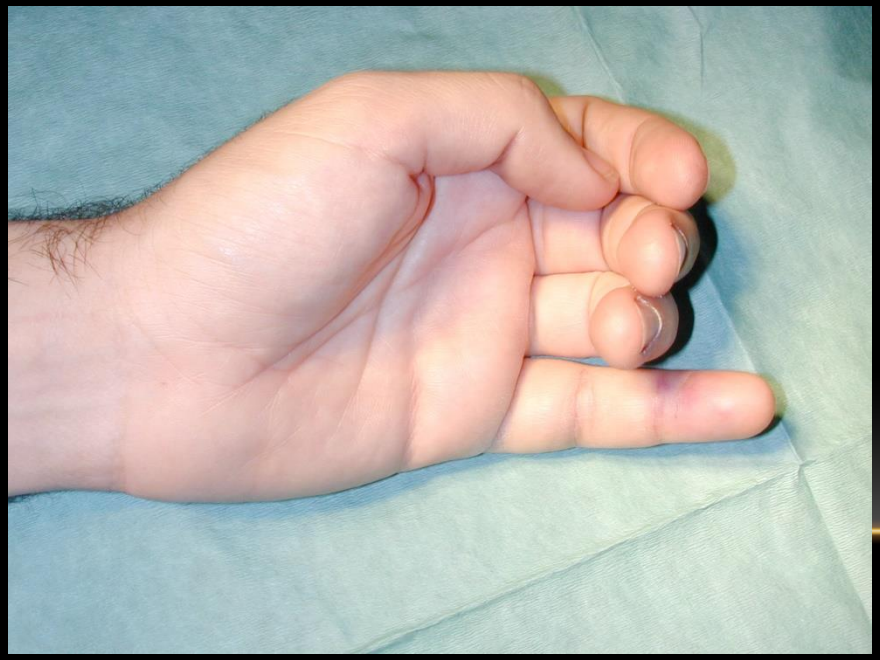


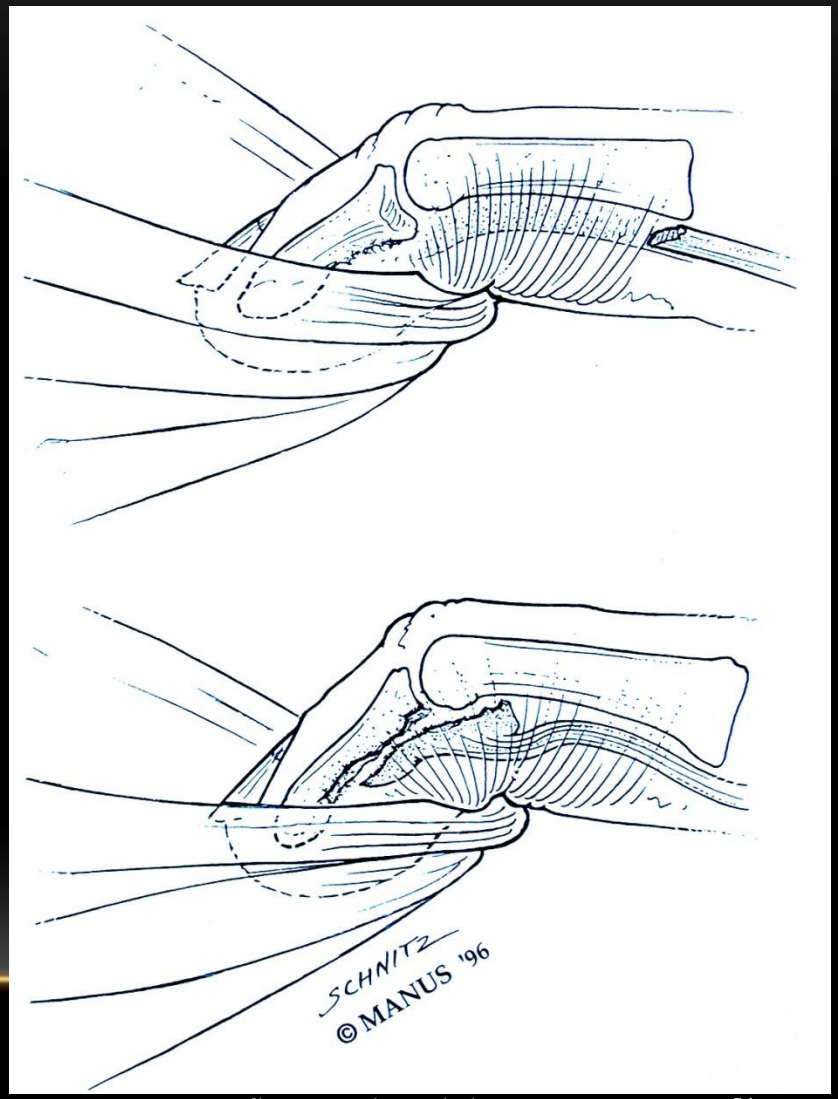
PARTIAL DIVISION

- < 50% epitenon suture only or trim tendon
- > 50% core suture + e/s
- Core suture weekens tendon by upto 50%

FDP AVULSION

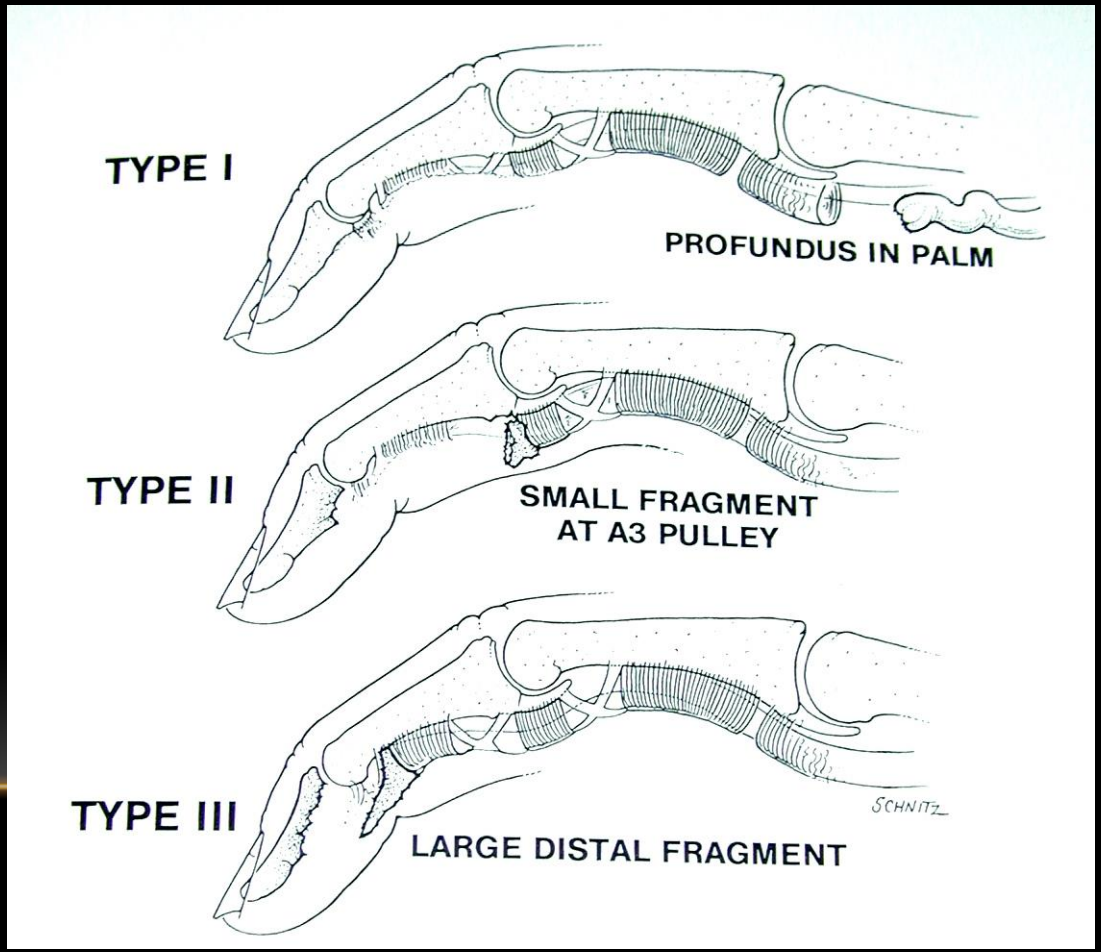
- Rugby shirt injury
- Forced extension whilst active flexion





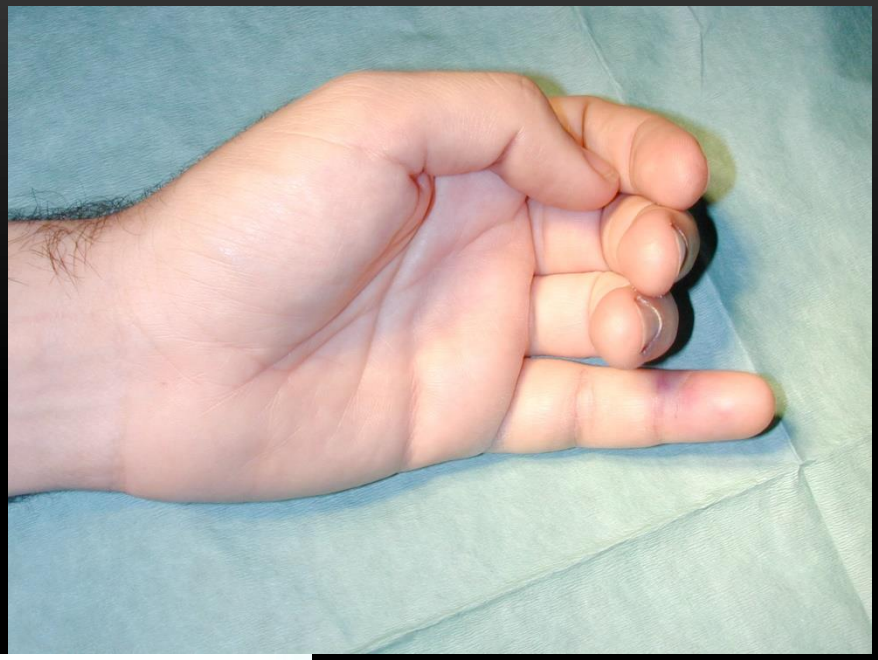
FDP AVULSION

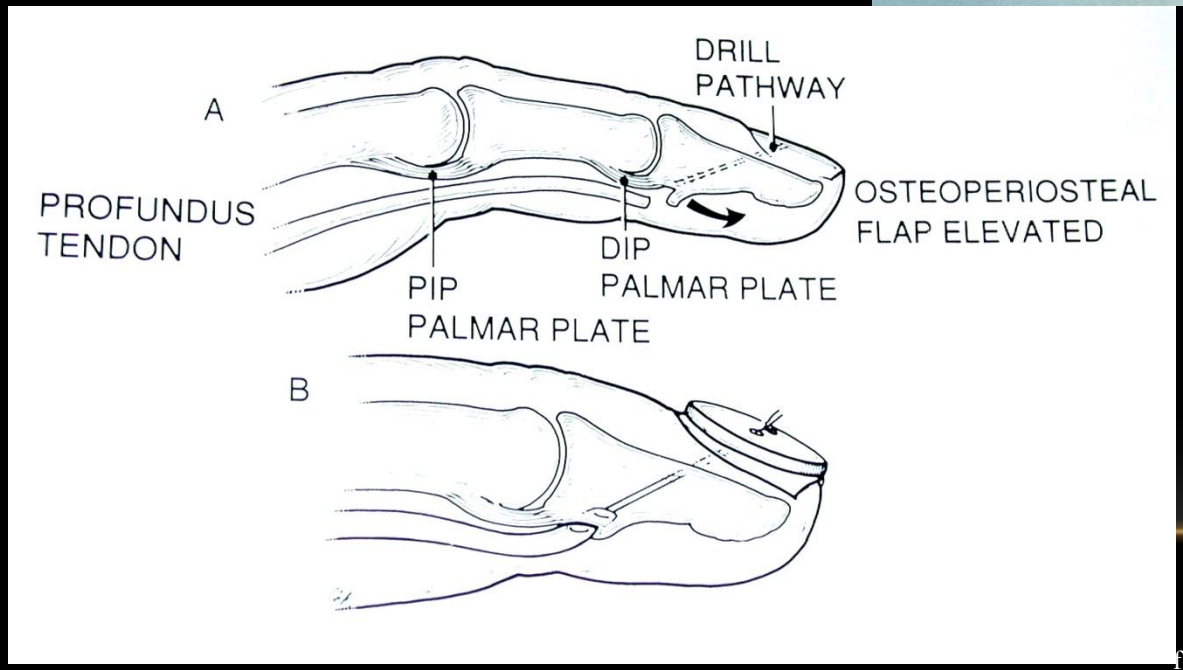
- With bony fragment
- Can avulse vinculae



FDP AVULSION

- Treat as tendon laceration
- Within 2 weeks
- Re-insert tendon





PHYSIOLOGICAL RESPONSE OF TENDON TO CONTROLLED STRESS

- Improved tensile strength
- Improved tendon excursion
- Increased DNA at repair site
- Increased peritendon vessel proliferation
- Increased synovial diffusion
- Increased fibronectin concentration
- Reorganisation of extrinsic scar

CONSIDERATIONS FOR USING EARLY CONTROLLED MOTION (ECM)

- Type of injury
- Age
- Level of injury
- Repair techniques/skill of surgeon
- Timing of repair
- Drag—resistance to motion
- Patient compliance

THERAPIST MANAGEMENT

- Education the patient*****
- Wound care
- Oedema control
- Protect the repair
- Initiate some tendon gliding
- Prevent joint stiffness
- Restore strength and function

DORSAL BLOCKING SPLINTS FOR FLEXOR TENDON REPAIR

TENDON EXCURSIONS

- Studies by Duran $ Houser(1975) demonstrated that excursion of :
- 3-5mm was sufficient to prevent adhesion of the healing tendon.
- Studies by Gelberman et al (1980's) demonstrated 3-4mm glide required to stimulate the repair process
- Some current opinions : only 1.7mm glide is required to prevent adhesons (Amadio et al)

TIME FRAMES

- 0-4 weeks splintage, ECM
- 4-6 weeks increased ROM, no use
- 6-8 weeks light resistance
- 8-12 weeks increased resistance, passive stretch the flexor, return to work.

TENSILE STRESS ON FLEXORS (URBANIAK, SCHIUND,POWELL, STRICKLAND)

- Normal FDP tensile strength

  passive motion: 500g

  light grip: 1500g

  strong grip: 5000g

  tip pinch: 9000g

REPAIR FDP TENSILE STRENGTH

- Passive motion: 750g
- Light grip: 2250
- Strong grip: 7500g
- Tip pinch: 13,500g

Clinically all these loads are increased by resistance created by a stiff swollen finger and the drag that a repaired tendon may have within its sheath.

EDUCATE

1) Anatomy
2) Wound care/dressing
3) Glide
4) Exercises frequency
5) Splint 24/24
6) Time frames

WHEN TO PROGRESS

- Stage of healing
- Amount of adherence
- Degree of tendon gliding
- Scarrers vs early mover
- Client compliance
- Surgeons request
- Use clinical reasoning

EARLY MOVERS V SCARRERS

- Early Movers

Good ROM early

Good tendon glide

Minimal adhererence

Potentially weaker repair

PROTECT and SLOW PORGRESSION

- Scarrers

Limited range of early motion

Indicative of adherence

Limited tendon glide

Protentially stronger repair

FASTER(with cautions) PROGRESSION TO ENCOURAGE TENDON GLIDE

CAM PROTOCOL

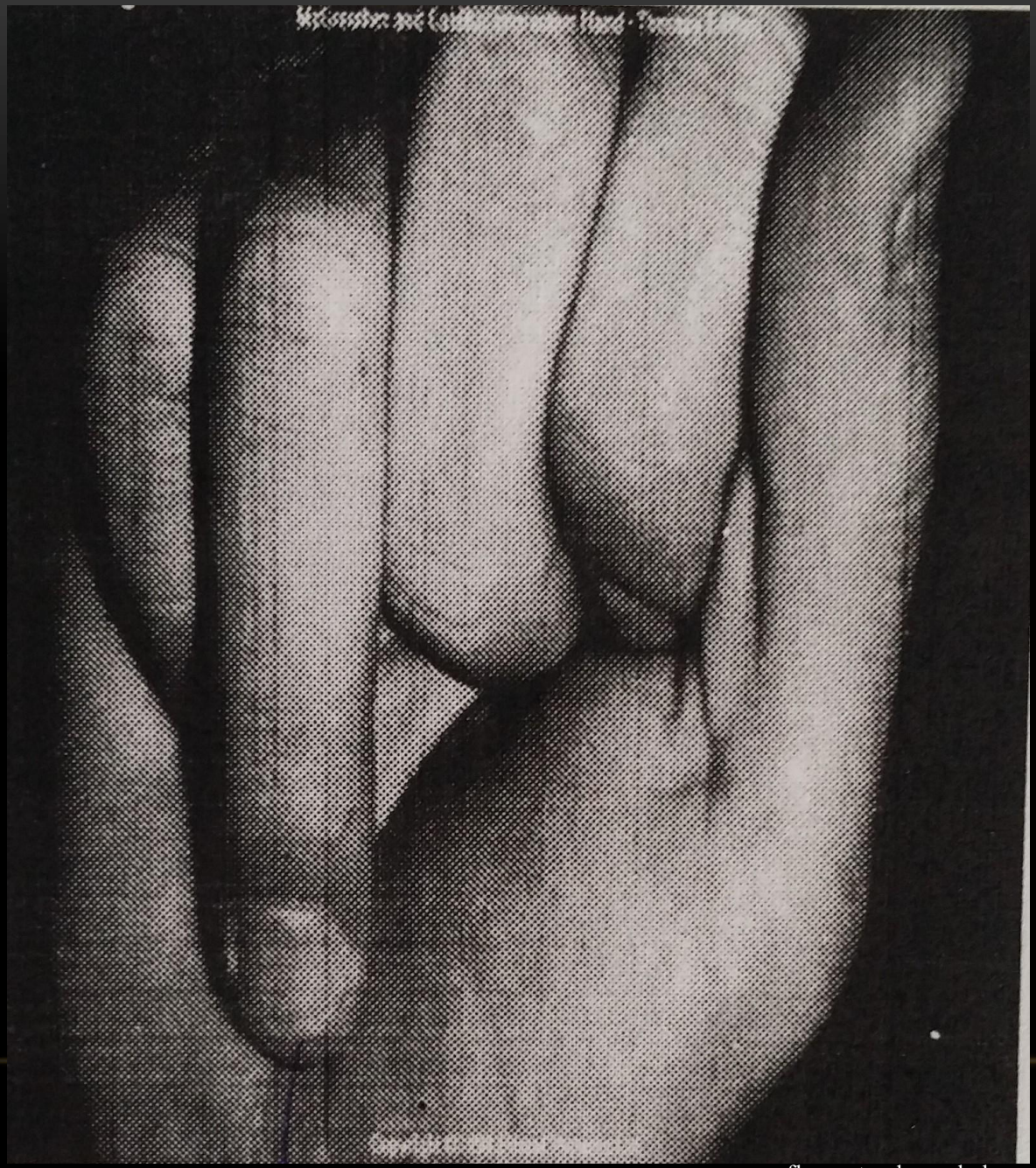
- Stage 1 post op to 4/52
- Stage 2 post op to 6/52
- Stage 3 6/52 onward

TGES

- Full fist –max excursion of the FDP
- Flat fist—max excursion of FDS
- Hook fist—max differential between FDS and FDP

COMPLICATION OF TENDON REPAIR

- Rupture
- Infection
- Adhesions and loss of glide
- Soft tissue and /or joint contracture
- Gapping, lag
- CRPS



TENOLYSIS

- Motivated pt, significant function comppromised
- Good sensory status
- Plateaued ROM---good PROM
- Min joint contracture
- Min 3/12 ideal 6/12 post surgery
- Strong motor unit
- Consider adhesion formation post release
- Priorty to mobilise early providing no compromise to tendon
- Wound care

TWO STAGES TENDON REPAIR

- First stage: restore ROM, oedma control, wound care, scar management.

- Second stage: tendon graft, follow a flexor tendon repair protocol

THERAPY CONSIDERATION FOLLOWING 2ND STAGE RECONSTRUCTURE

- Repair itself
- Length of time between primary repair and reconstruction
- Cortical retraining
- Initiation of glide/balance protection of new tendon

ACKNOWLEDGEMENT

Murry Beagley

Plastic and Hand Surgeon