Tendon Transfers

Yanshan LU

Tendon Transfers are REBALANCING Procedures

- All the muscles of the hand are needed for operational BALANCE
- **One cannot be transferred without having a direct biomechanical effect on others**

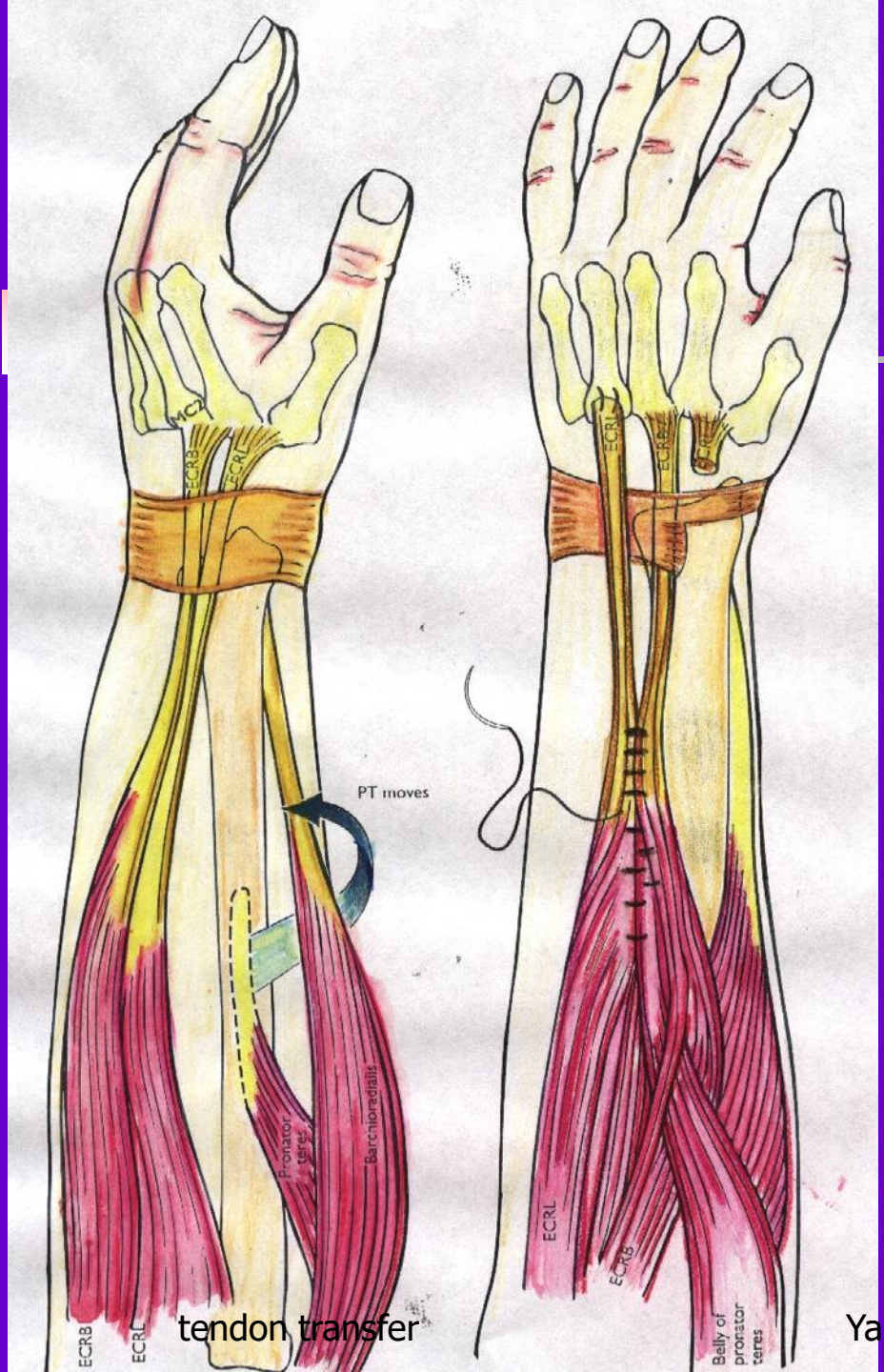
THUS

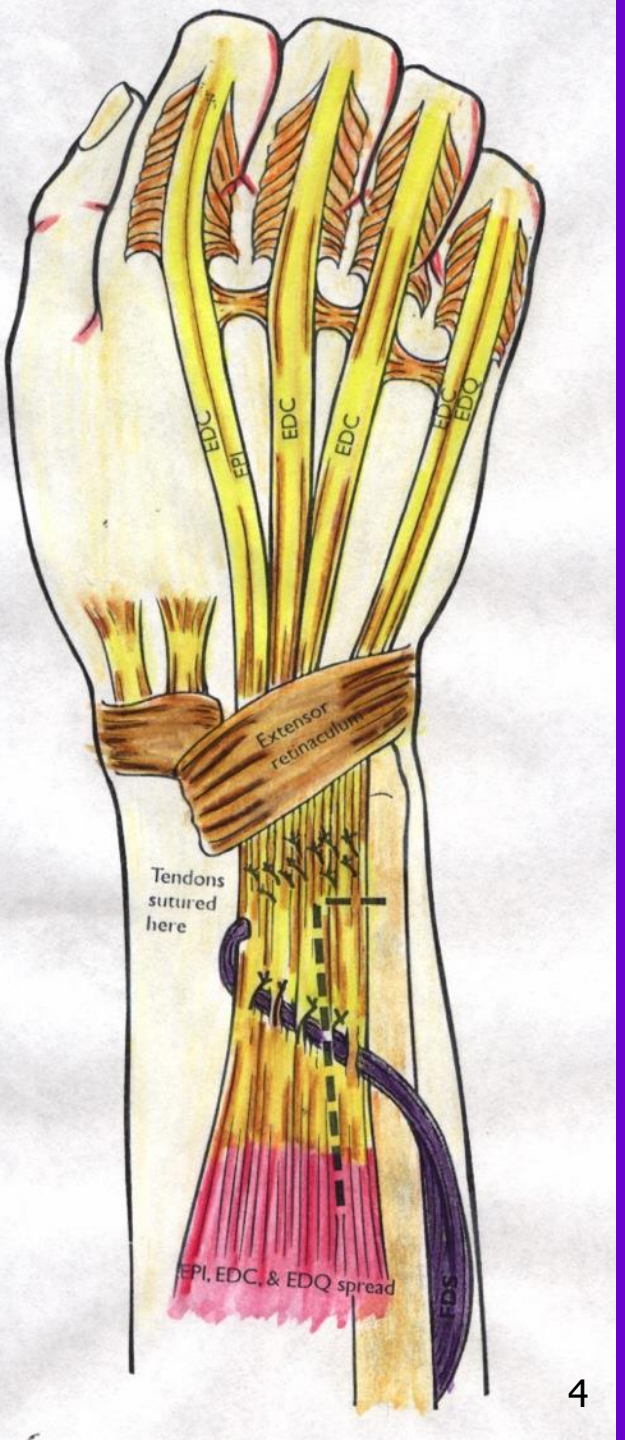
- Tendon transfer surgery is the **attempt to rebalance internally what has become imbalanced as a result of disease or injury** that causes loss of certain muscles in the system

Bunnell .

Commonly used tendon transfers for radial nerve palsy

Muscle	***Action***
PT	Wrist extension (ECRL, ECRB)
FCU or FDS	Finger extension (EDC)
PL or FDS	Thumb extension (EPL)

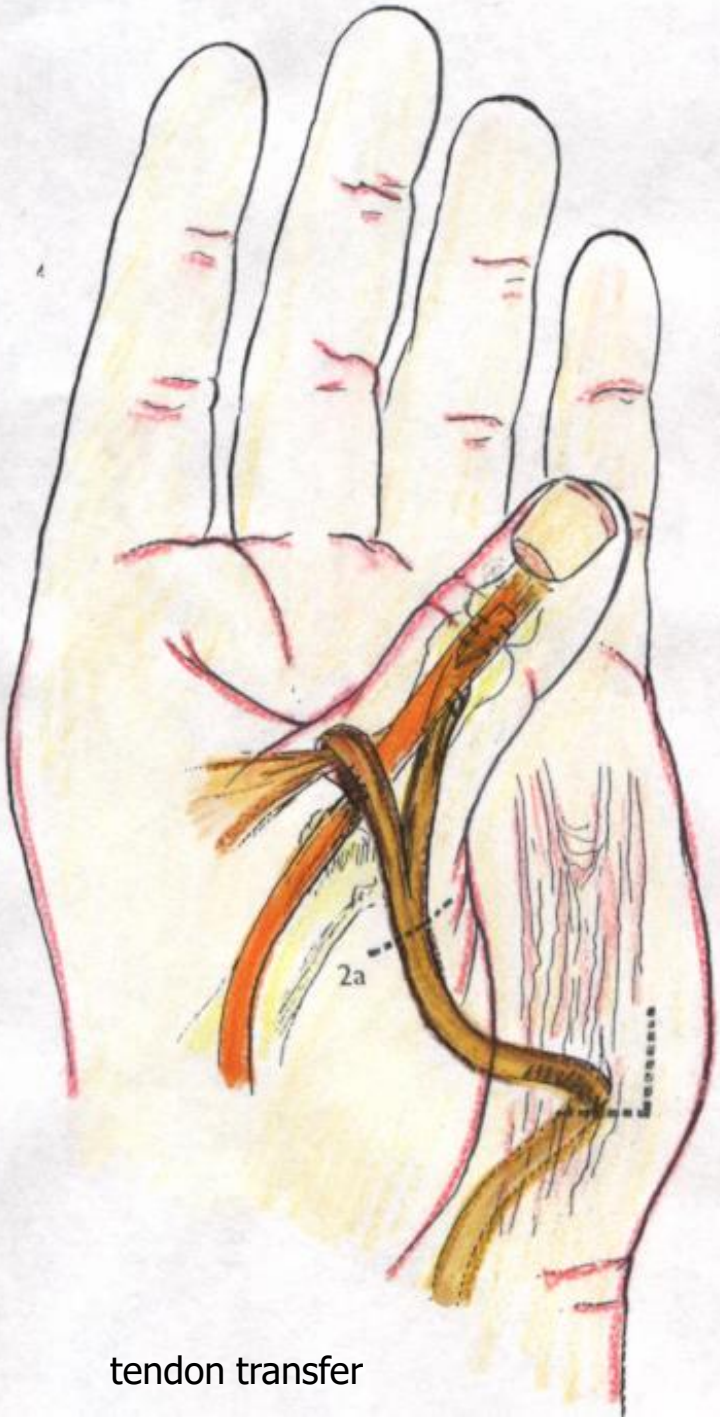

MCP
ECRB
ECRL
PT moves
Pronator teres
Brachioradialis
ECRB
ECRL
ECRL
ECRB
ECRL
ECRB
Belly of pronator teres


EDC
EPI
EDC
EDC
EDC
EDQ
Extensor retinaculum
Tendons sutured here
EPI, EDC, & EDQ spread
FDS

Possible motors for median tendon transfers

Needed function	*Possible motor*
Flexion of IF & MFs	FDP tenodesis
	BR
	ECU
	ECRL
Thumb flexion	BR
	ECRB
	ECRL
	ECU
	PT

Needed function	*Possible motor*
Thumb opposition	EI
	FDS
	ECRL
	ADM
	EDM
	ECU
	PL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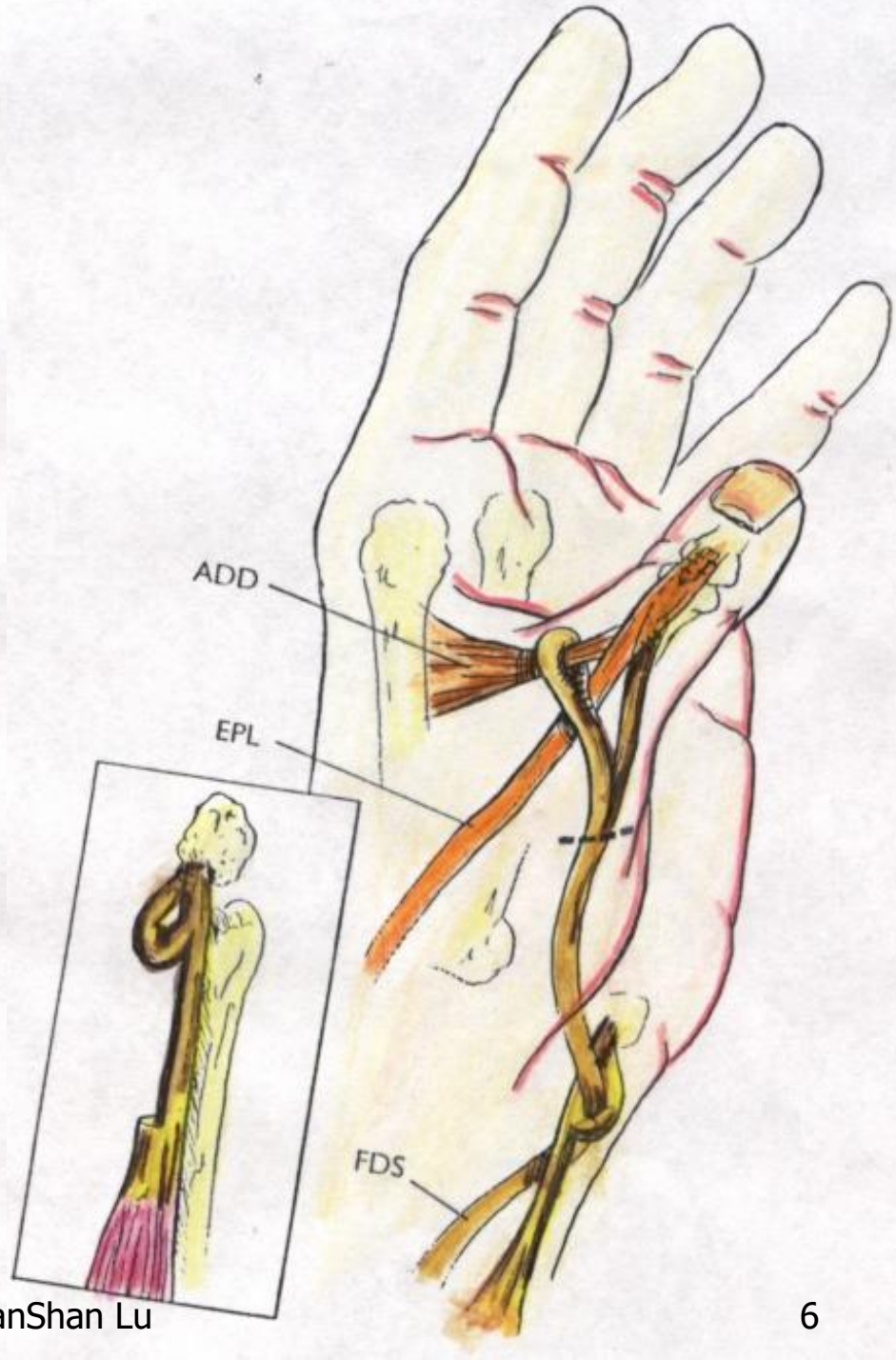

ADD
EPL
FDS

PREOPERATIVE THERAPY

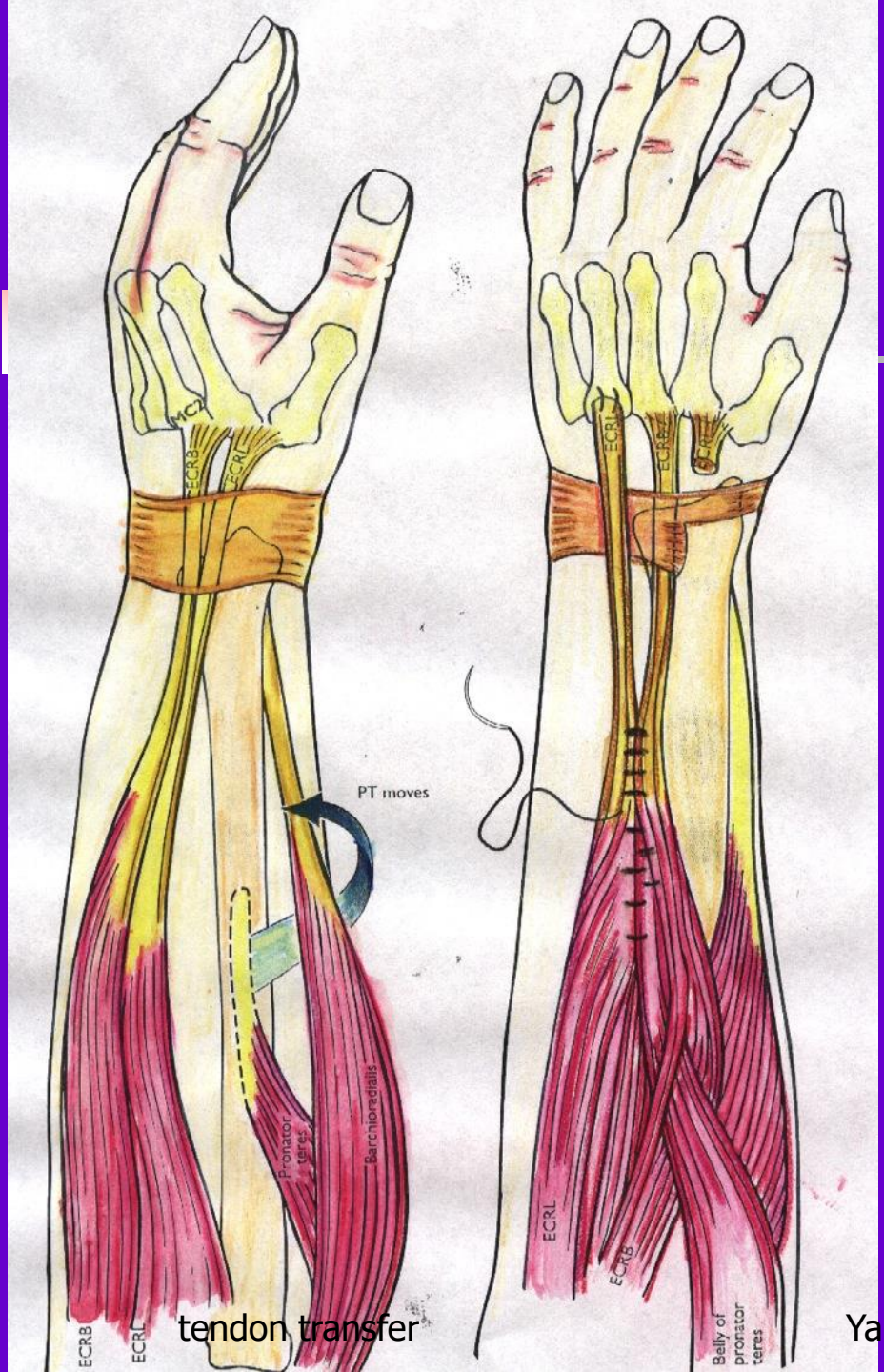
- Baseline motor evaluation
- Check sensibility
- Maintain function
  - Splintage
  - Avoid bad habits
- Improve skin/scar condition
- Prevent / correct contractures
- Isolate potential transfer and maximise strength
- Patients attitudes and expectations

POSTOPERATIVE EVALUATION

Must
understand
the
surgical procedure

POSTOPERATIVE EVALUATION

- Origin and insertion of specific ms-tendon units transferred
  - Normal and transferred insertions
- Through what route?
- To what surface?
- Through what pulley (or other structure)?
- Into what structure attached?
- Site or level of tendon suture?
- If tendon grafts used
  - Donor tendon?
  - Type of graft?
  - Site or level of attachment?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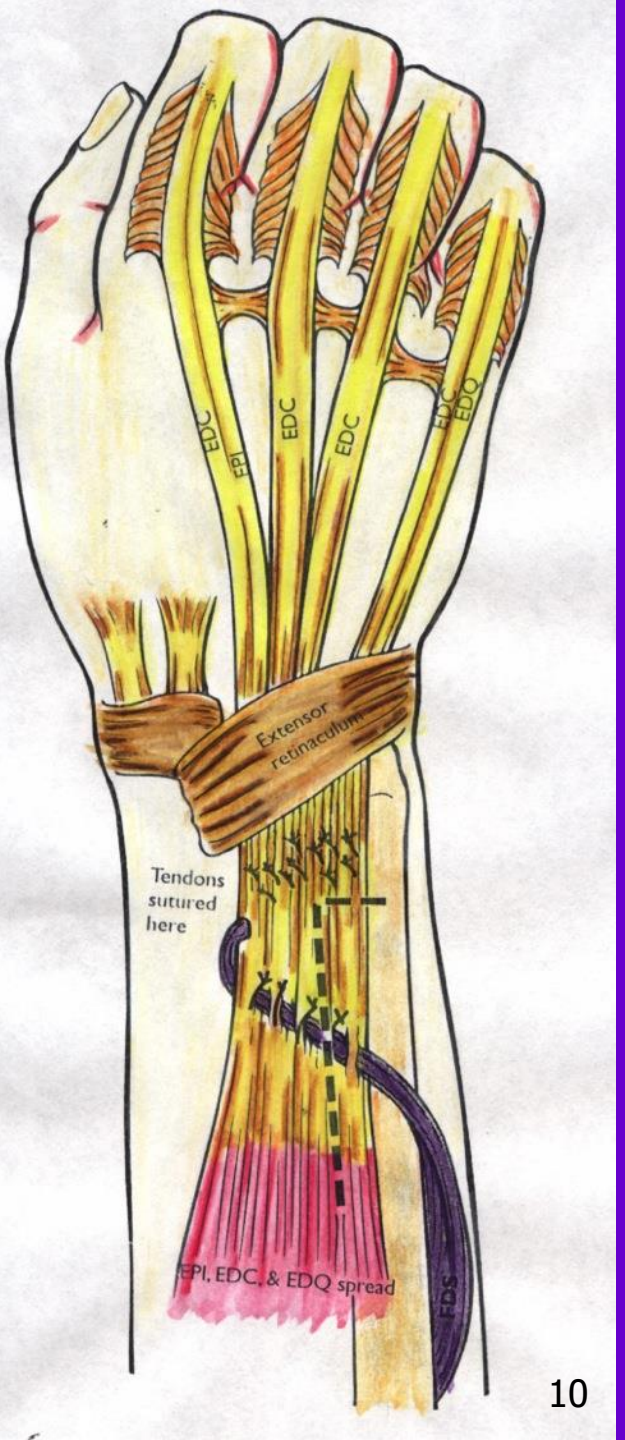
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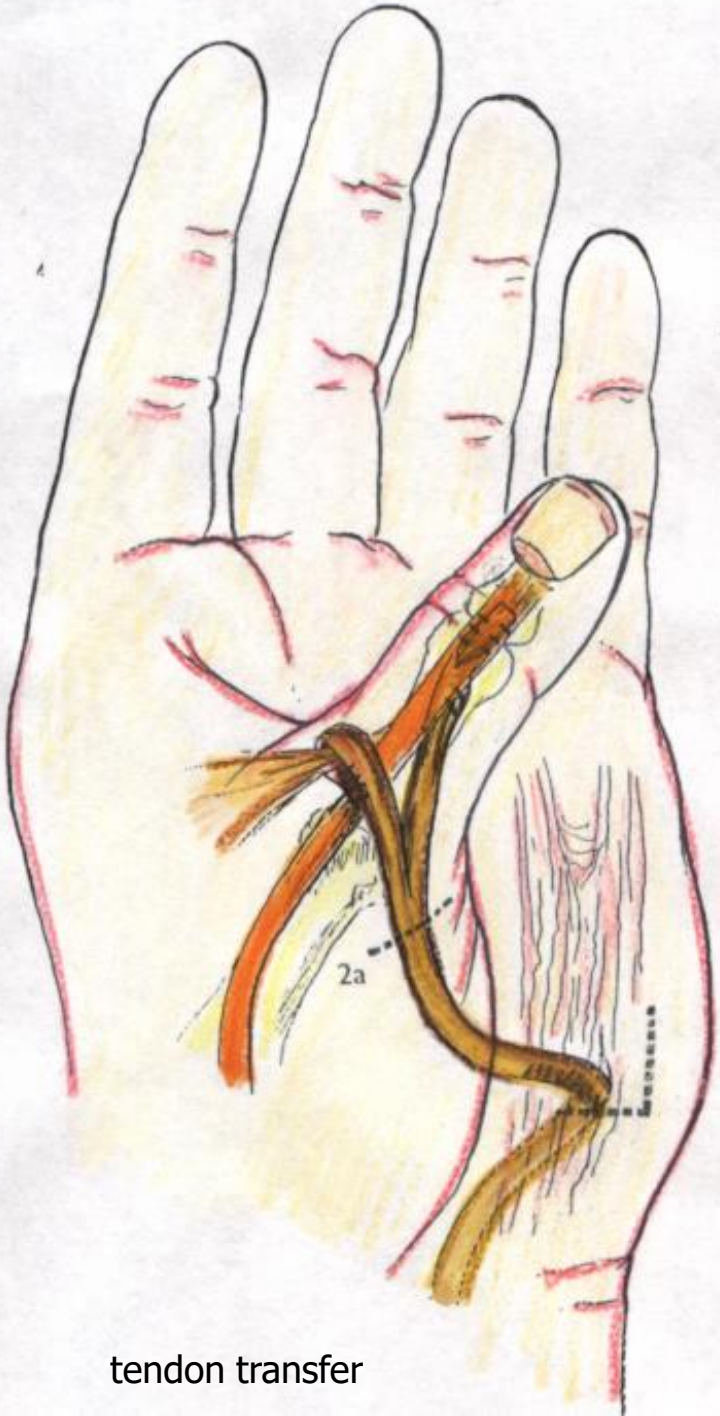
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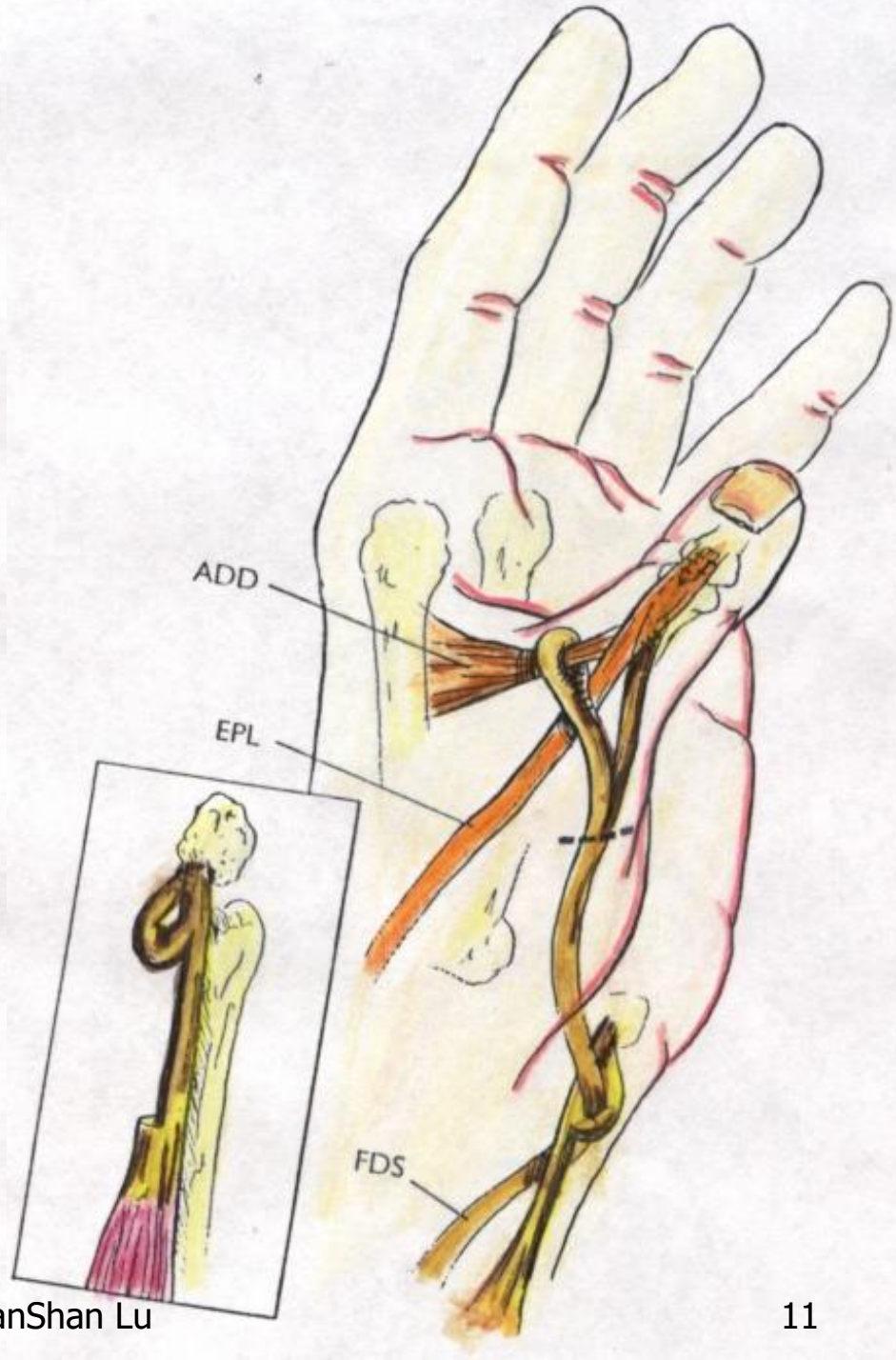

ADD
EPL
FDS

POSTOPERATIVE EVALUATION

- Ideal to attend operation
- Timing of the surgery or stage of surgery important to the projection of results

POSTOPERATIVE THERAPY

Historically: Immobilisation (3-4/52)

- Shortened position
- BUT WHY???

FOOD FOR THOUGHT

- In tendon repair surgery with end to end suturing, it is routine to practice early active motion
- Why not, early active motion with secure interwoven tendons as used in tendon transfer. Brandsma 2011
- Poor amount of research on this as small populations

POSTOPERATIVE THERAPY

PHASE TWO: Active exercise / Transfer retraining (splint shortened position between exercises)

- Commence AROM / AAROM
  - Isolated not composite joint ROM
  - Once able to isolate transfer then go for range – **AIM = CORRECT PATTERN**
  - Perform with uninjured hand first / together
  - Rapid muscle fatigue common
  - Biofeedback?

POSTOPERATIVE THERAPY

PHASE TWO: Active exercise / Transfer retraining

- Commence AROM / AAROM
- Functional activity – do not provide resistance

POSTOPERATIVE THERAPY

PHASE TWO: Active exercise / Transfer retraining (4-6/52)

- Commence AROM / AAROM
- Functional activity – do not provide resistance
- Training / exercise splints?

POSTOPERATIVE THERAPY

PHASE TWO: Active exercise / Transfer retraining (4-6/52)

- Commence AROM / AAROM
- Functional activity – do not provide resistance
- Training / exercise splints?
- Scar management

POSTOPERATIVE THERAPY

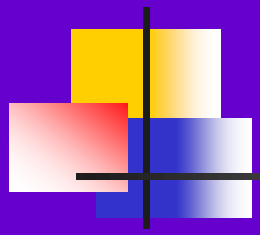
PHASE TWO: Active exercise / Transfer retraining (4-6/52)

- Commence AROM / AAROM
- Functional activity – do not provide resistance
- Training / exercise splints?
- Scar management
- Gentle passive → into non-tension range

POSTOPERATIVE THERAPY

PHASE THREE: Increase strength / Improve dexterity

- Protective splinting 7-8/52
- Commence strengthening ≈ 6-8/52
- PROM ≈ 7-8/52
  - Watch for decreased range of transfer – DON'T OVERSTRETCH



- ?8-12/52
- Increase length of transferred tendon
- Moderate → maximum contraction in lengthened position

Schreuders et al 1996.

Ref: Sultana, MacDermid, Grewal, Rath, 2013

- Early active mobilisation – quicker recovery of hand function, shorter total rehab time, cost effective. Better results at 4/52, but by 8/52 similar hand function to immobilisation group
- No clear long term benefits of early mobilisation but reduced total costs.
- Small sample sizes and therefore poor ability to draw strong conclusions.

Ref: Sultana, MacDermid, Grewal, Rath, 2013

- Treatment choices are best to consider expert opinion and patient preferences/environment.
- Eg geography, resources and patient individual circumstances / compliance to therapy in early postop period all tip the balance of scales as to immob or early mob

Case Presentation

- 41 year old female, 3 year old injury – extensive flap laceration at the level of elbow.
- Partial laceration ulna nerve, complete laceration of radial and median nerve.
- Poor acute care resulting in severe tissue damage.
- Sural nerve grafts for median and radial nerves 6 weeks post injury.

Pre-op Assessment

- Excellent ulna nerve recovery
- Moderate thenar function – grade 3 opposition, grade 3 abduction, grade 4 flexion (FPB).
- Poor IF and MF flexion and sensation.
- Thumb pulp – diminished light touch sensation.
- FPL no function
- Radial nerve good recovery – EDC grade 4, EPL grade 3

Surgery

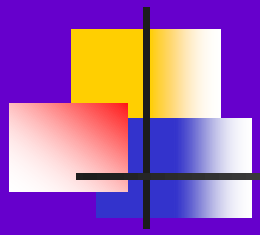
- Tendon Transfer - **FDS RF to FPL**.
- Scar modification
- Tenolysis

Pre-op Therapy

- Education / Expectations
- Strengthening of FDS/FDP RF
- Thumb ROM therapy
- Thumb thenar strengthening

Post-op Therapy

- Ideally splinted into shortened position – bulky post op dressings initially.
- Active and Active Assisted ROM ex's. No passive joint mob required.
- Functional retraining without resistance
- At 6/52 introduced resistance.



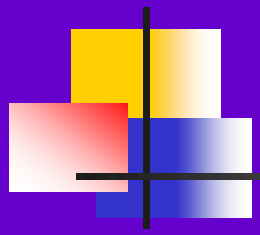
- At 10/52 post surgery began passive stretching of tendon transfer and trying to work tendon in all ranges.

- Function to date: patient now able to write well, functional gains in fine finger to thumb manipulation (RF to thumb).
- No perceived loss in strength of the RF.
- Patient delighted with improved function.

Case study 2

- HPC: 56 yr old male major and life threatening staphlococcus aureus bacterium infection with multi-organ failure and multiple tissue necrosis.

- Hospitalised 12.4.09-19.6.09 with 1/12 in ICU.



- Myonecrosis of R muscle bellies of EDC and EPL.
- RHD
- ++ functional deficit.

- 7.10.09 FCR to EDC transfer and PL to EPL. (Tensor fascia lata back up).

Surgeon's directive

- Pulvertaft weaves – very strong. Surgeon requested splint with
- Wrist 45 ext, fingers no more than 20 at MCP, and thumb fully extended.
- For early mobilisation.
- First seen on 14.10.09 1/52 post op

Hand Therapy

- Splint as requested + night finger extension component.
- 20-0 active ext MCP.
- IP jnt flexion in splint.
- Tenodesis exercises commenced immediately. (checked with surgeon)

Cont.

- By Christmas 09 – good EDC function with tenodesis function. Finger extension with wrist only 20 deg flexion.
- Thumb some EPL function but weak and lost in function.
- Surgical review of thumb –PL too weak as the motor for EPL – needs a more powerful muscle.

Cont.

- 27.7.10 MF FDS to EPB transfer with pulvertaft weave. Transfer through the 1st DC thus transfer is tight with wrist flexion and loose with wrist extension.
- Splinted with wrist and thumb extended
- Active mobilisation of transfer begun using a flexion pattern and attempting thumb extension. 4-6/52 started resistance.

Of Interest!!

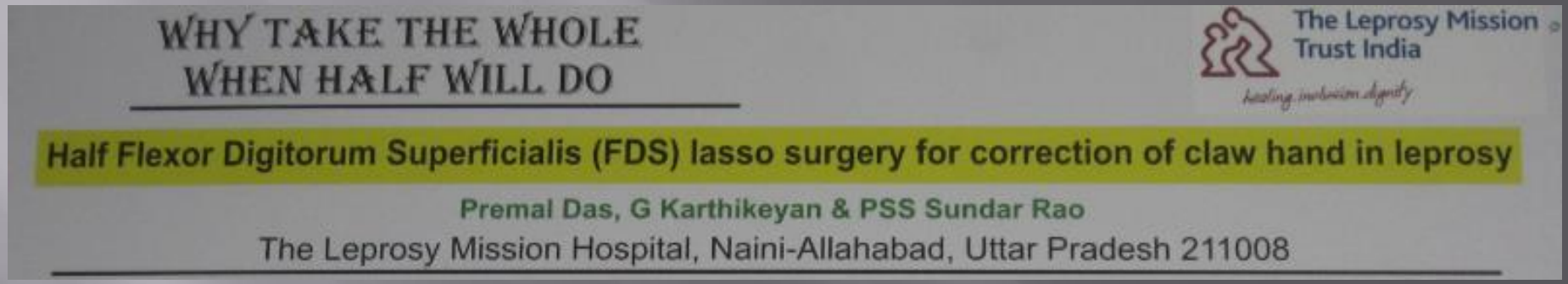
Toe to Thumb Transfer

Toe to thumb transfer

Preferred surgery by Dr Premal Das for Claw Hand

½ FDS Lasso– ulna slip only used

- Research presented in poster at Delhi 2013



Results of study- comparing ½ FDS Lasso to Full FDS Lasso using either RF or MF

- Comparable outcomes.
- All groups achieved pre-op grip strength by 1year.
- ROM achieved same in all groups
- They suggest the risk of adhesions is less for ½ FDS as thinner slip in tight pulley.
- The complication of Swan Neck deformity lessened

  -5% in ½ FDS

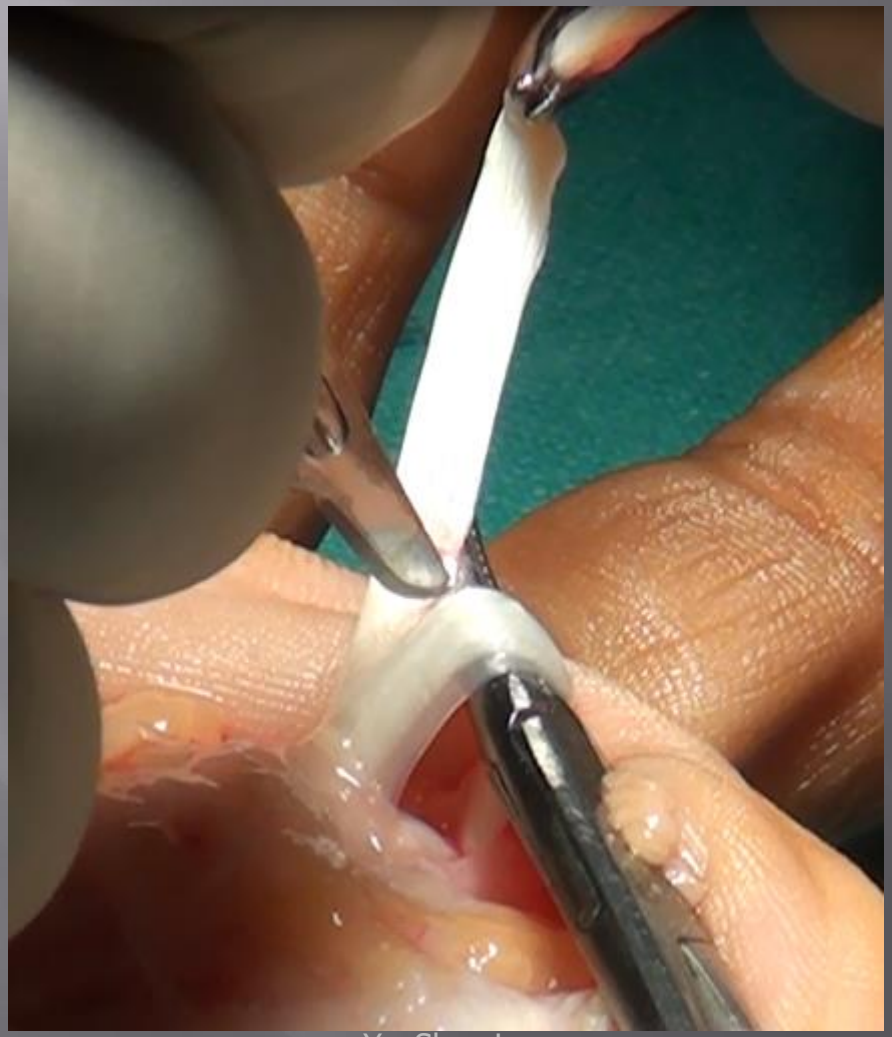
  -14% in full FDS Lasso

(still significantly less than with the insertion into the lateral bands)

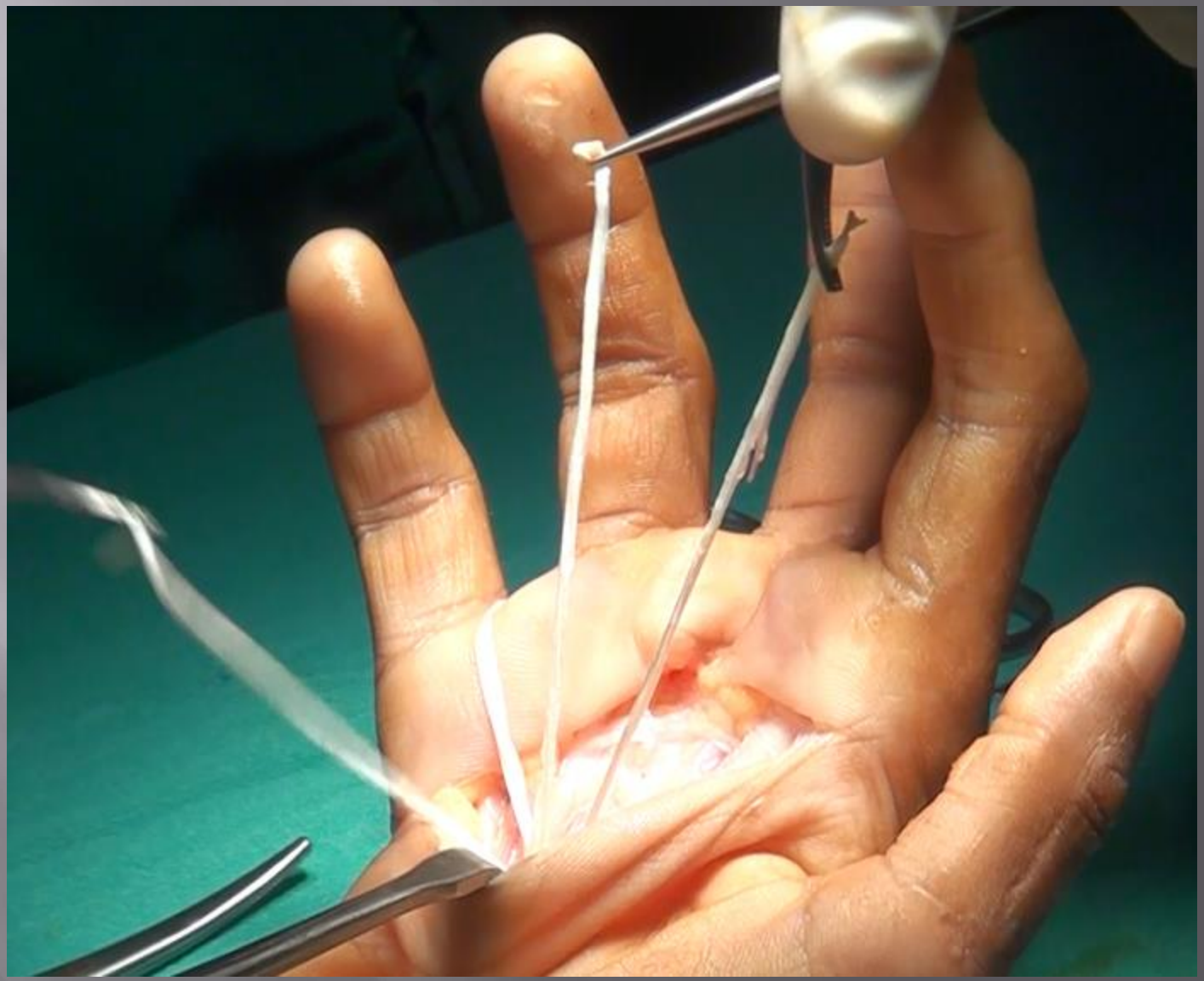
R hand Middle finger – FDS harvest as already short due to old infection

No GA

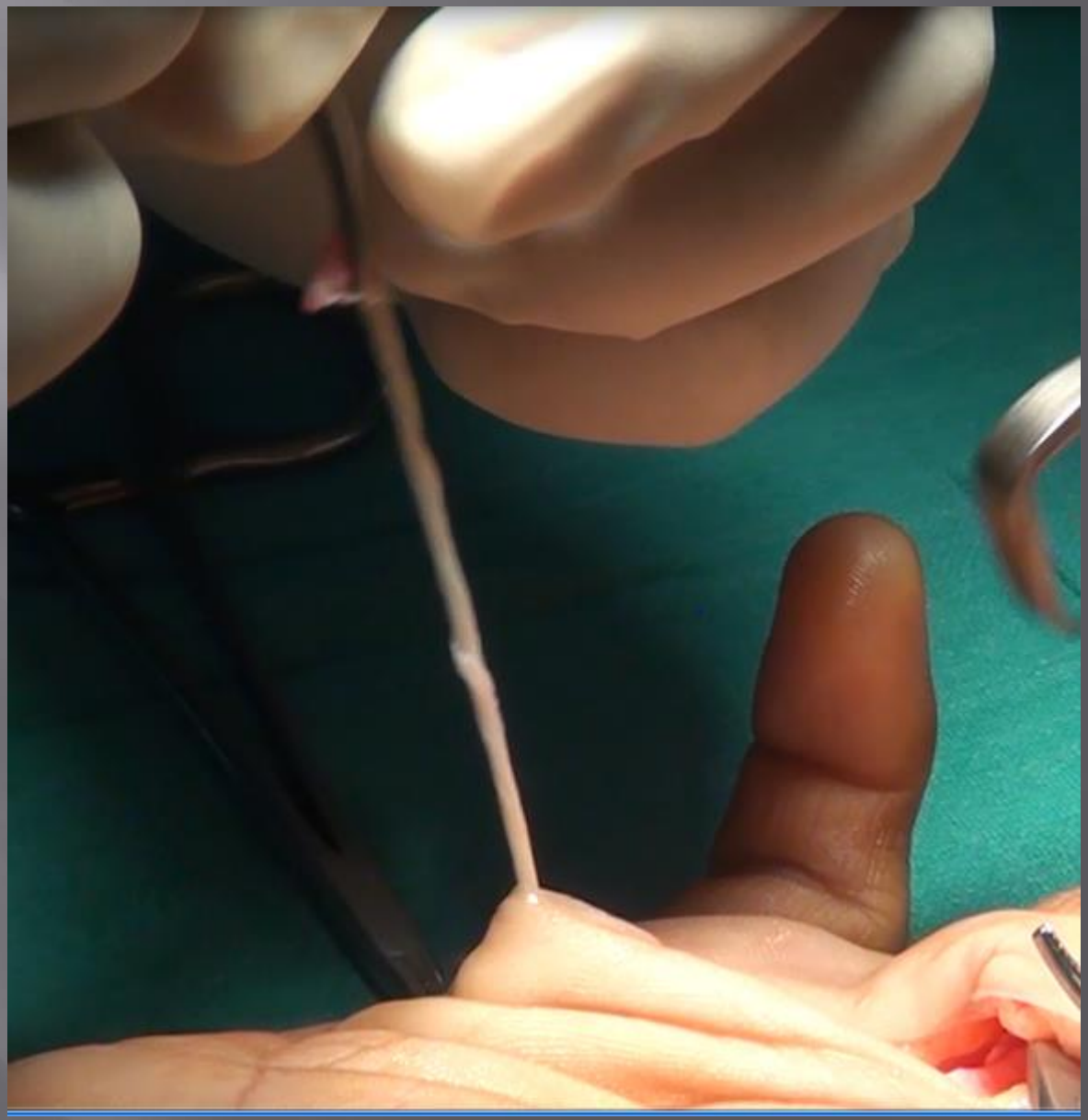
Harvesting Ulna slip of FDS MF



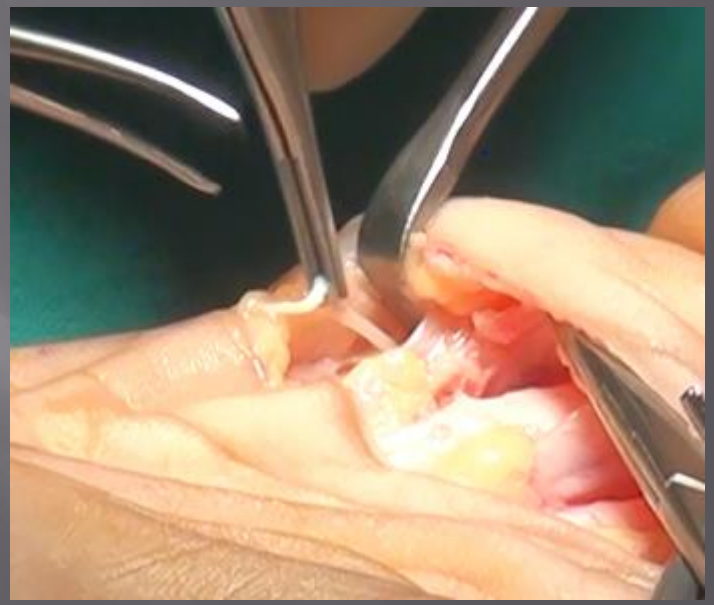
Splitting of ½ FDS into 4



Twisting of tendon to increase strength and smooth the edges ready for insertion.

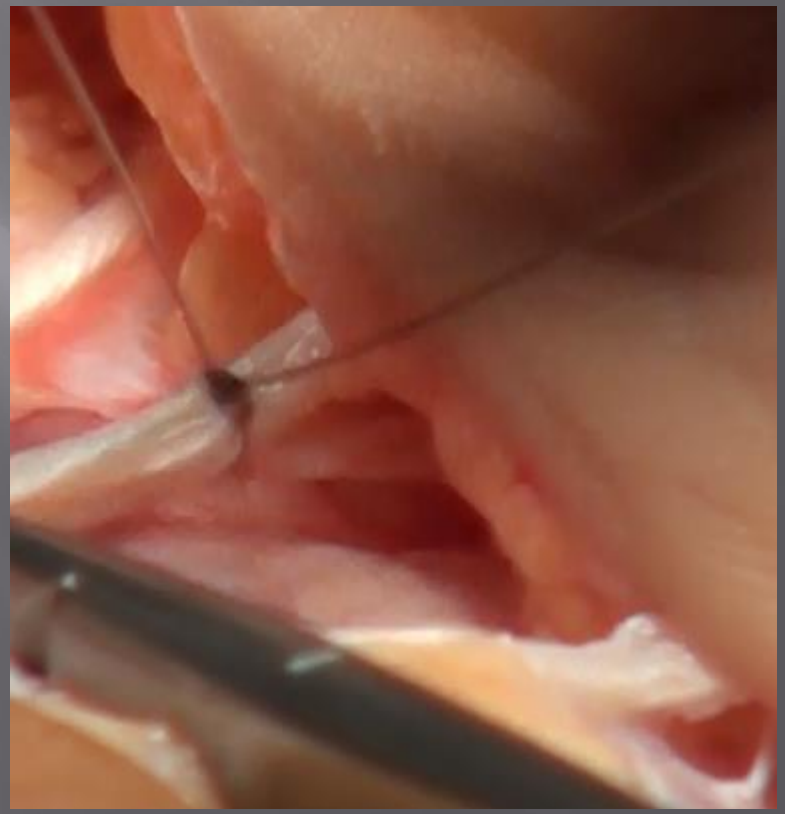


Tendon slip inserted into radial side of A1 and A2 pulleys in longitudinal direction to allow MCP joint flexion



Sutured back onto self.

Tension adjusted then further sutures woven to provide a strong hold. Cotton sutures.



Greatest tension on IF and LF to encourage power and maintain the transverse Metacarpal arch of the hand

Inert finest gauge fishing nilon suturing – not removed for 3/52

Cast 3/52. Then commence physiotherapy and occupational therapy as inpatient.

Activate the transfer, encouraging tenodesis, using splints and assists as required.

Work on tendon glide and isolated exercises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Early Mobilisation Post Tendon Transfers

- Secure interwoven tendons after tendon transfer not delicate end to end tendon repairs.

JHT 2013, Sultana et al

- A Systematic Review of effectiveness of early mobilisation after tendon transfers in the hand.
- Reports reduced total cost, rehab time and safe.
- In first 4 weeks – ROM, GS, pinch, TAM, deformity correction, and tendon transfer integration were significantly superior in early mobilisation.
- However by 2/12 to 1yr equivalent results.

Sultana et al, 2013

"It is important for therapists to note that positive outcomes following tendon transfer surgery can be achieved in a range of circumstances and this provides considerable latitude in customising the therapy protocol to the patient's individual needs."

THUMB SURGERY OPPONENS PLASTY

The options for Donor :

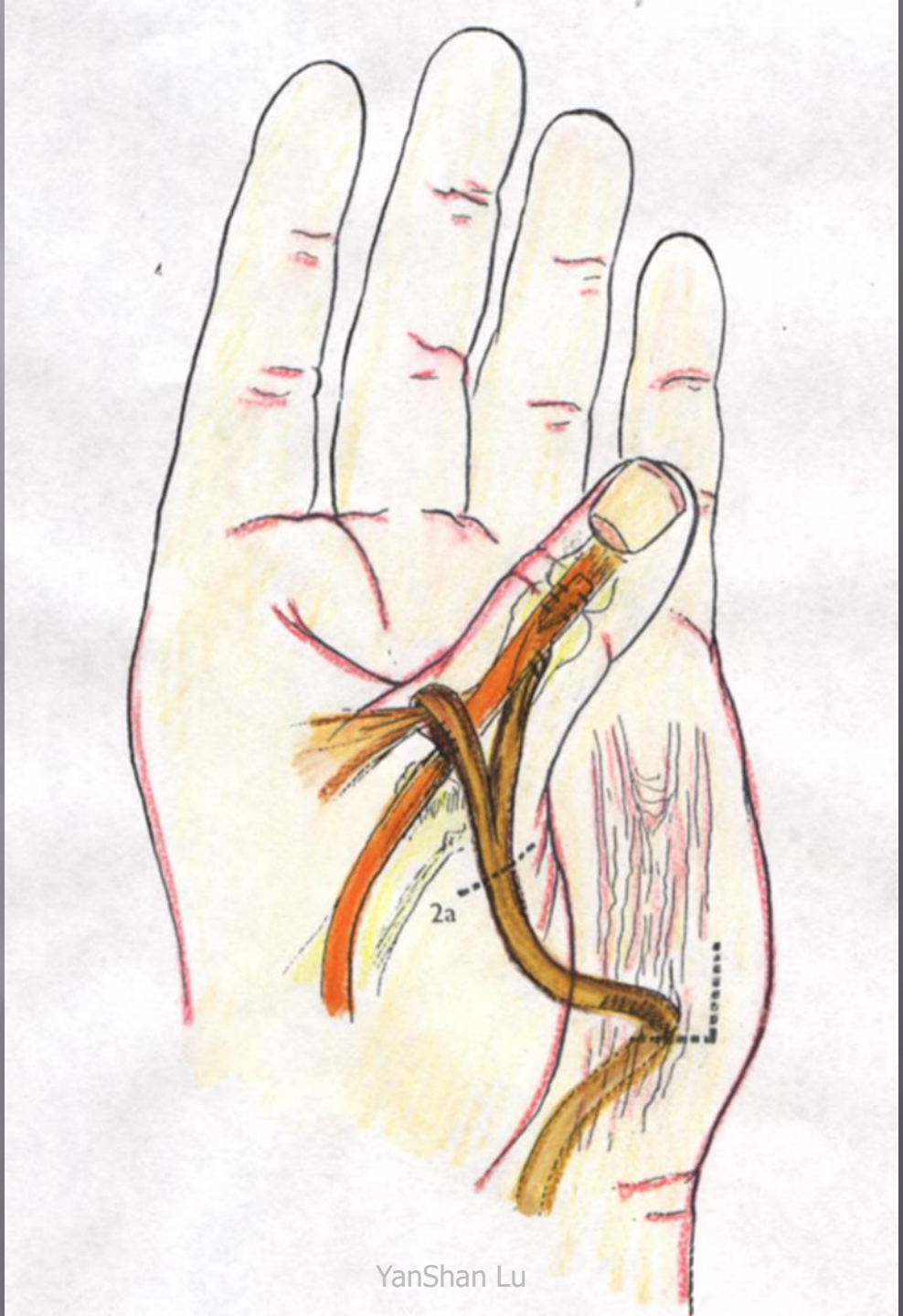
-Extensor Indicis – generally for isolated high median nerve palsy

-FDS - most common in median and ulna nerve palsy

Selection criteria for reconstructive surgery of the hand in Leprosy

FDS Ring finger to thumb Adductor and EPL

- Combination median and ulna nerve palsy
- Thumb MCP joint stabilisation is desirable as well as regaining opposition.
- Achieved with Brand double insertion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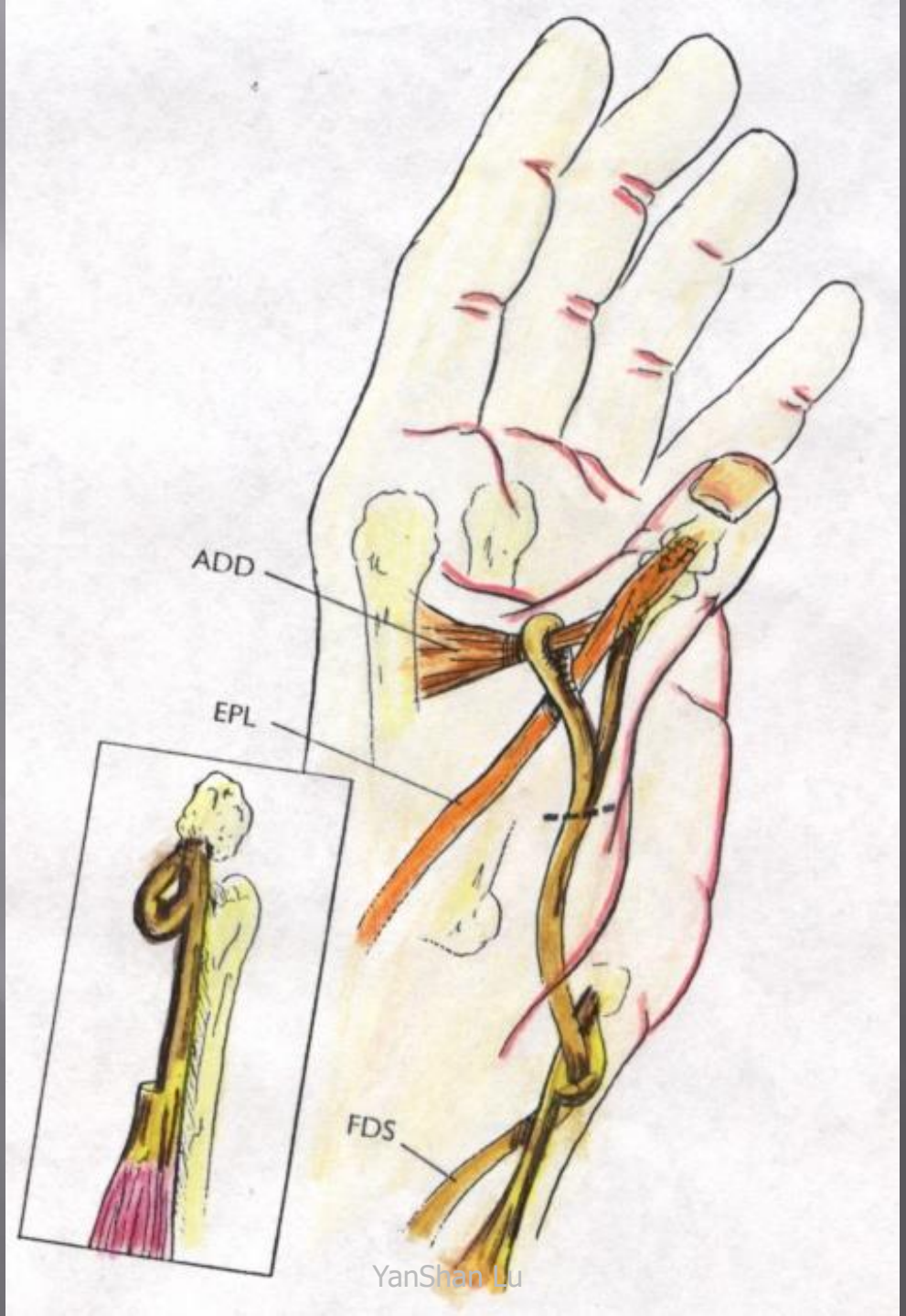

ADD
EPL
FDS

FDS harvested from Ring Finger

Incisions made:

1. over Transverse Carpal Ligament – window made to act as Pulley

2. Forearm incision

3. MCP incision - just radial to the hypothenar eminence

4. Dorsal IP joint incision

5. Incision over Ulna side of MCP joint to access Adductor

Locating and harvesting FDS at forearm incision

FDS tunnelled up forearm to the window made in the Transverse Carpal ligament and uses the ligament between pisiform and hamate

Tunnelled across to MCP joint incision

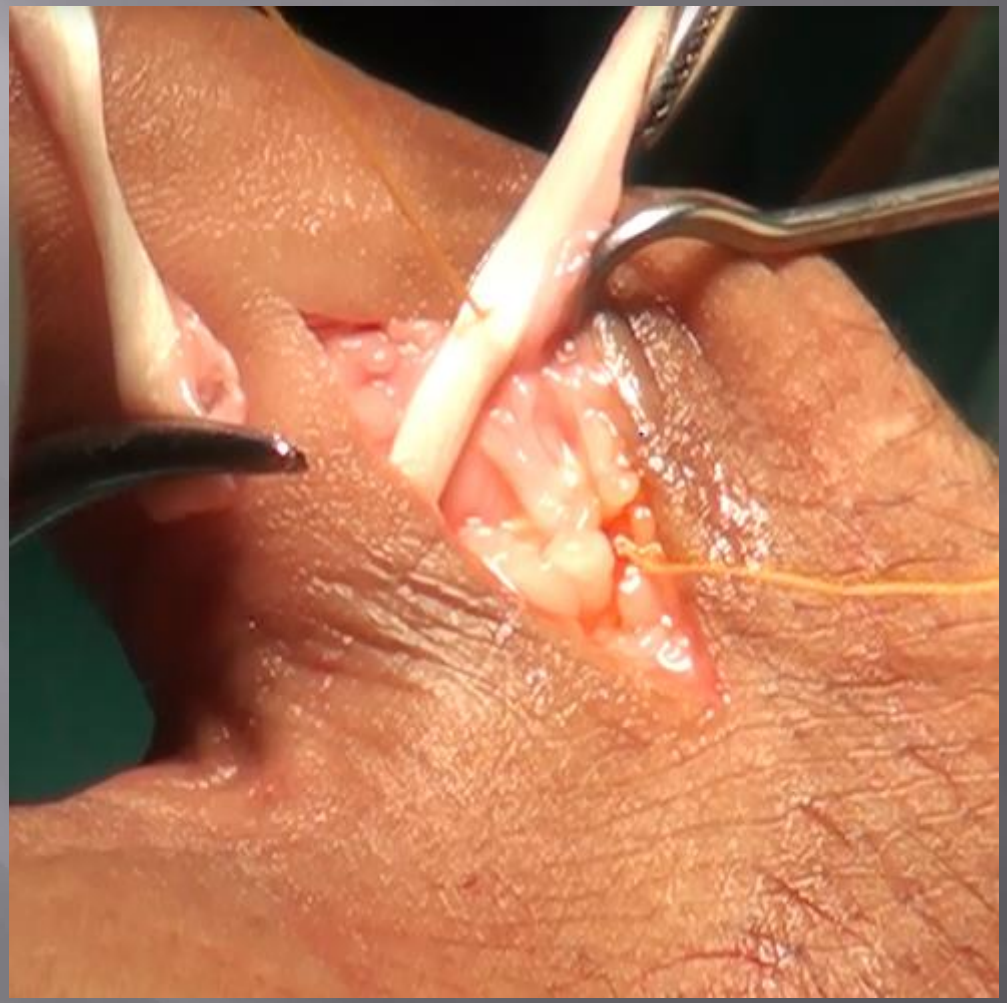
FDS split

One slip is routed palmar to the MCP joint to insert into EPL dorsally.

This slip acts as MCP flexor as well as IP joint extensor to correct the deformity arising from FPB paralysis.

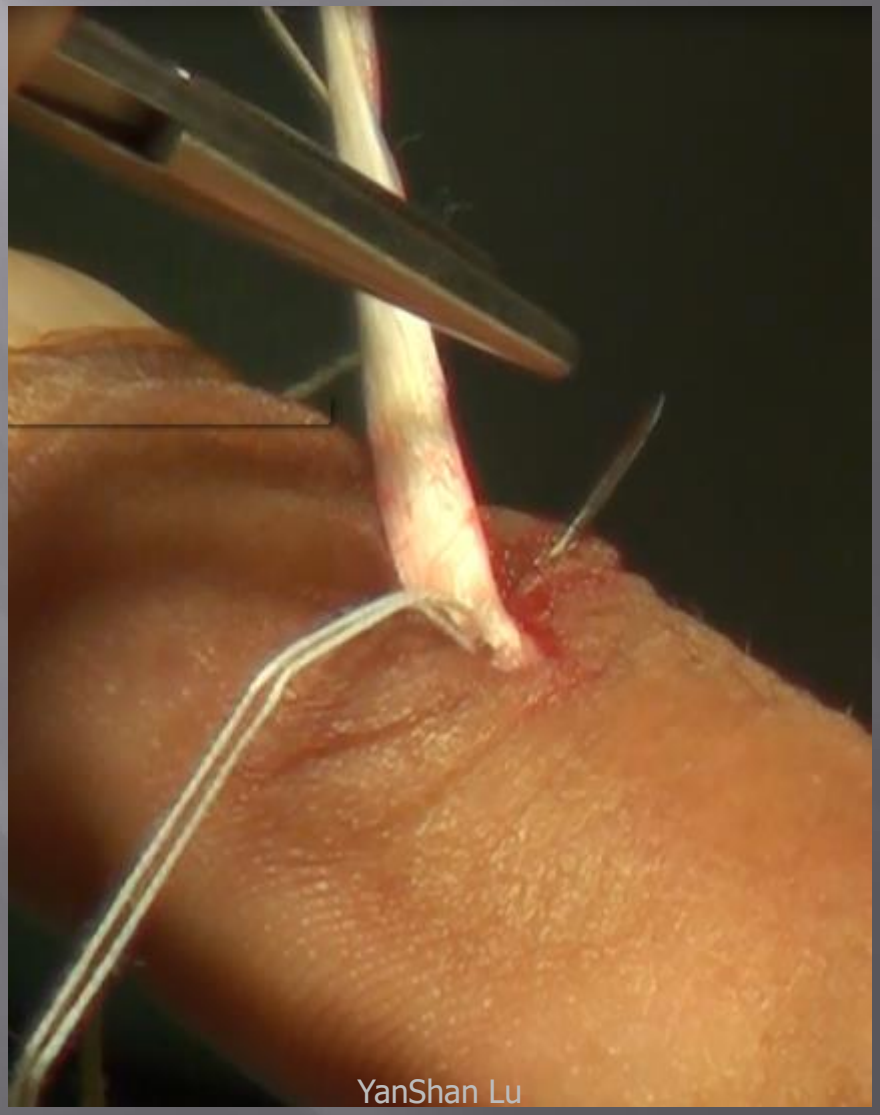
The second slip is passed just distal to MCP joint over the dorsal aspect and then looped around the Adductor insertion

Tendon insertion around Adductor insertion close to the bone



Tensioning – Dual insertion means only the insertion with the shortest moment arm ie under the greatest tension will be activated.
Care needs to be taken to get balance with adductor insertion and EPL insertion.

The EPL insertion is more to prevent any Z-deformity of the thumb rather than work to actively extend the IP joint of the thumb.



TLM Naini
Post op Management

- 3/52 immobilisation in cast and can go home.
- then start rehabilitation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SURGERY:

- Bilateral anti-claw surgery
- R hand – 3/52 post Oppenons Plasty
- L hand awaiting CMC joint stabilisation and then Oppenons Plasty.

acknowledgement

- Big thanks to Sarah Waldin