Interventions for the Stiff Finger

Presented by
Gary Solomon, MBA, MS, OTR/L, CHT

ASHT International Committee
Virtual Education Series

American Society of Hand Therapists™

Financial Disclosures

- None related to this presentation

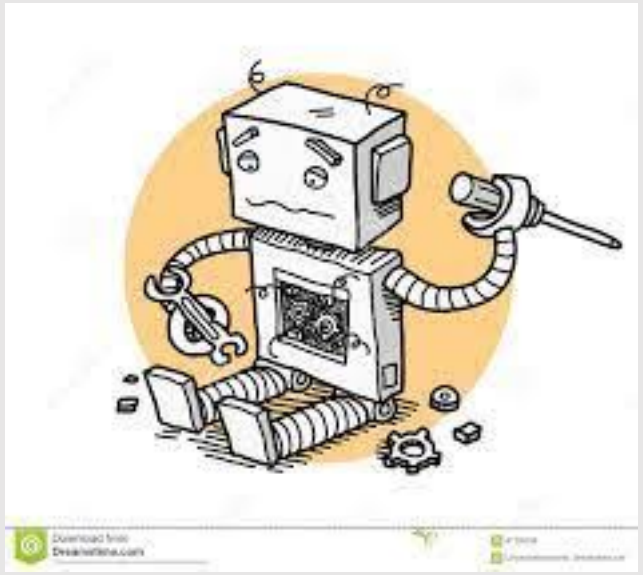
Goals

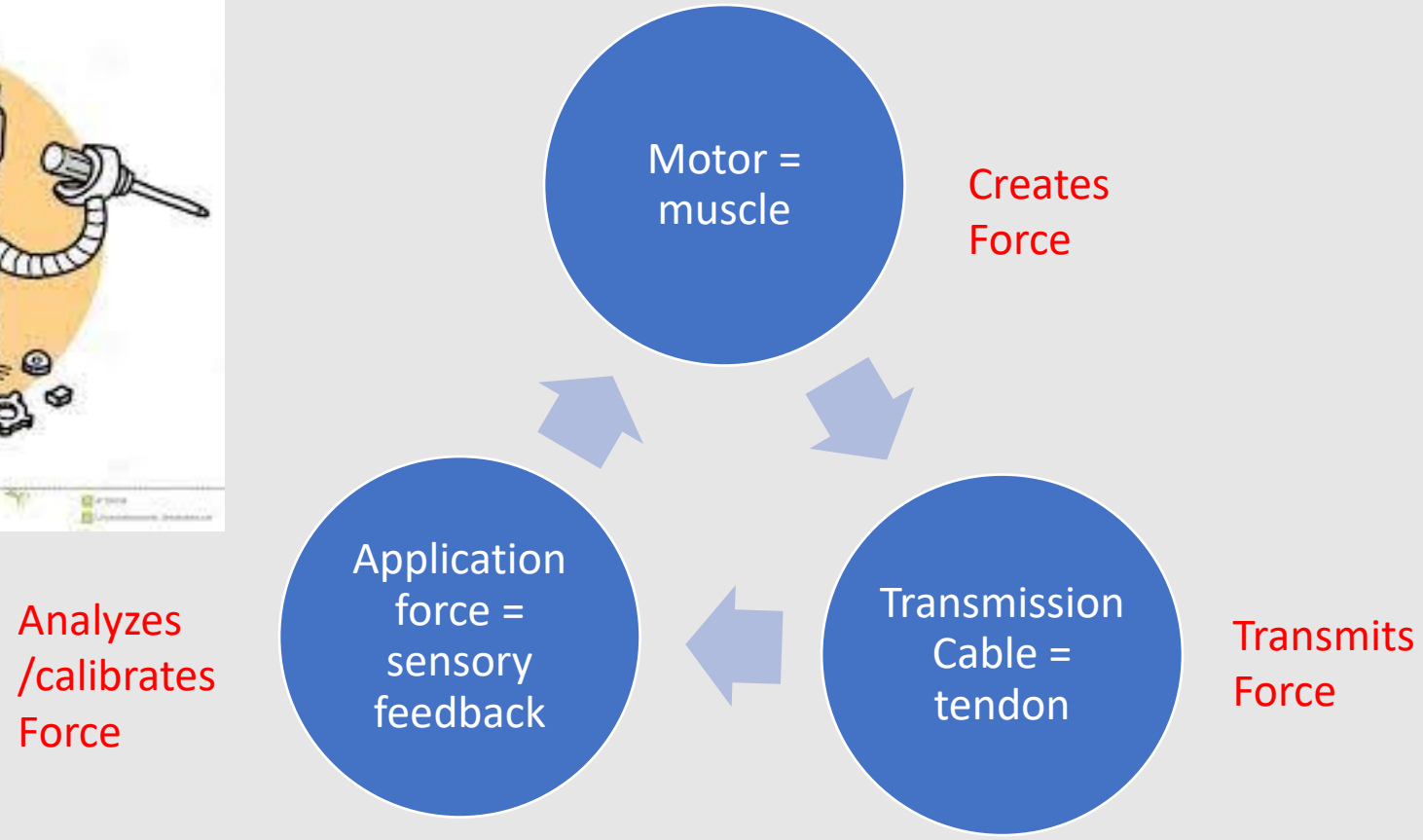
- Address potential interventions for various types of “stiffness”
- Discuss differences in interventions based on healing phase
- Provide orthosis and activity selection ideas throughout healing phases

Part 1

- Why is my patient’s fingers so stiff?

Where's the Breakdown? (Brand)





Friction and Drag = Forces which must be overcome to achieve normal movement (Scar, edema, etc.)

What Kind of Stiffness?

Muscle / Tendon

- Intrinsic Tightness
- Extrinsic Tightness

Joint Stiffness

Sensory feedback

- Poor sensation
- Hypersensitive
- Proprioceptive

Drag Issues

- Edema
- Adhesions

Differentiate Cause of Motion Limitation (What's limiting flexion?)

	MP extended	MP flexed
Intrinsic tightness	PIP passive flexion decreased	PIP passive flexion increased
Extrinsic tightness (dorsal structure)	PIP passive flexion increased	PIP passive flexion decreased
Joint Stiffness	PIP motion unchanged	PIP motion unchanged

Intrinsic Tightness

- Passive PIP Flexion GREATER when MP is flexed than if MP is extended

Extrinsic Tightness

- Passive PIP flexion is GREATER when MP is extended than when MP is flexed

Joint Stiffness

- PIP passive flexion with MP extended is EQUAL to PIP passive flexion when MP flexed

Clues.....

Intrinsic tightness

- Intrinsic plus positioning during immobilization
- ”Intrinsic waving..”

Extrinsic Tightness

- Dorsal hand trauma, Dorsal hardware / incisions, extensor tendon involvement

Joint Stiffness

- Involvement of soft tissues around digital joints

Process of ”Joint Stiffness”

- Acute / Inflammatory Phase (0-3 days post injury)
  - Edema
  - Pain
  - Protection / immobilization

Inflammation

Tissue Damaged → Capillaries expand to increase blood flow to area → Capillaries more porous to allow fluid flow

Capillaries more porous to allow fluid flow → Increase fluid and protein flow into area between cells → PRESSURE BUILD UP AND INFLAMMATORY MOLECULES LEAD TO PAIN

Inflammation

- As a result of these changes, the tissue in the inflamed area may not be able to function as it should
- Motion loss (Stiffness)

Acute/ Inflammatory Phase Interventions

Rest / Protect (orthosis)

Edema Control /Compression (wrap)

Motion? Depends…..

Questions:

- Will moving the structure result in more of an inflammatory response?
- Diagnosis dependent
  - 0-3 days - Digital motion distal radius fracture? Likely fine
  - 0-3 days –Digital motion of digital injury or surgery? Risk higher for prolonged inflammatory response

Question for thought? Do you need to move your post op flexor tendon patients or tenolysis on POD #1 or is Day 3-4 a better time to start?

Acute Phase Take Home

- RICE – ESPECIALLY R and C
- CONTROL EDEMA
- Motion – gentle if not directly involved and low risk of prolonging inflammatory response

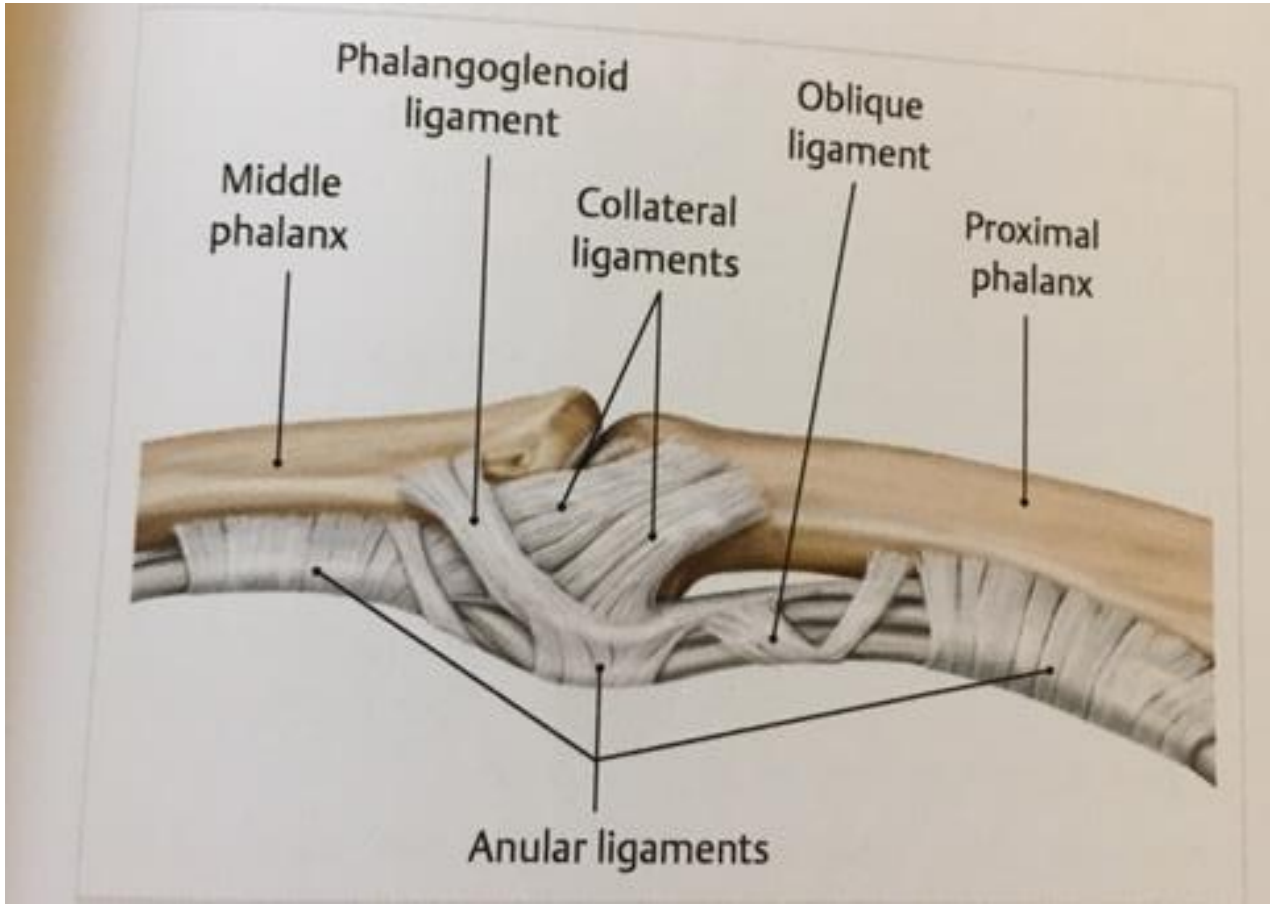
Fibroplasia Phase -3 days-3 weeks

- Period of collagen formation
- Randomly deposited
- If immobilized – leads to changes in joint structures
  - Components of ligaments and capsule
  - **Adhesions of folds of synovial lining**
  - **Formation of fibrofatty connective tissue within joint space**
  - Atrophy of cartilage and osteoporosis

Mobilizing the Stiff Hand: Combining Theory and Evidence to Improve Clinical Outcomes
Celeste Glasgow, Leigh R. Tooth, Jenny Fleming
Journal of Hand Therapy - October 2010 (Vol. 23, Issue 4, Pages 392-401, DOI: 10.1016/j.jht.2010.05.005)

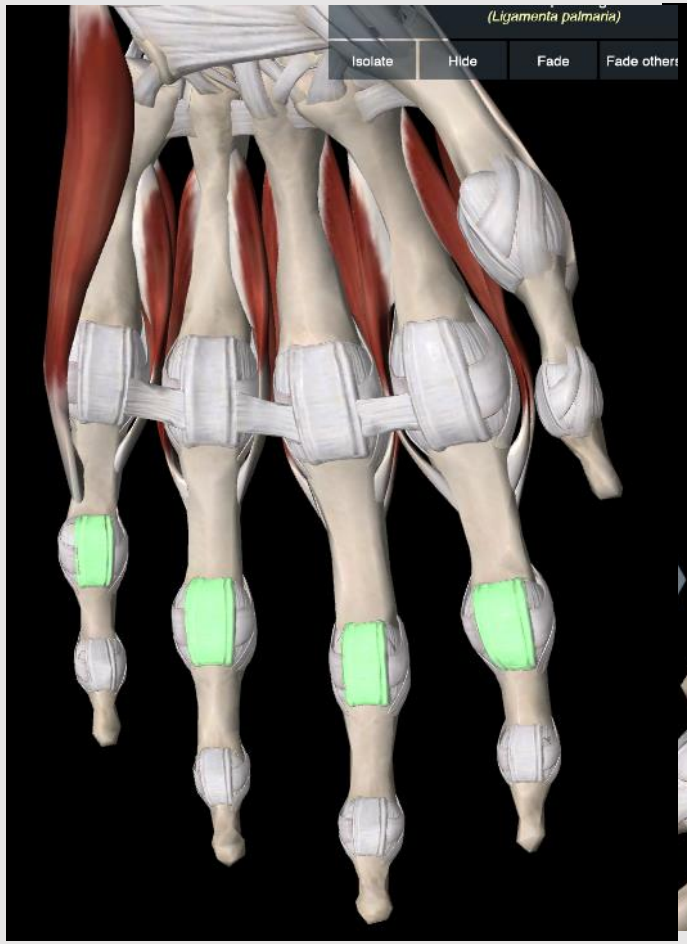
PIP Anatomy

- Small space – lots of structures



Ligaments

Pictures: Essential Anatomy 5

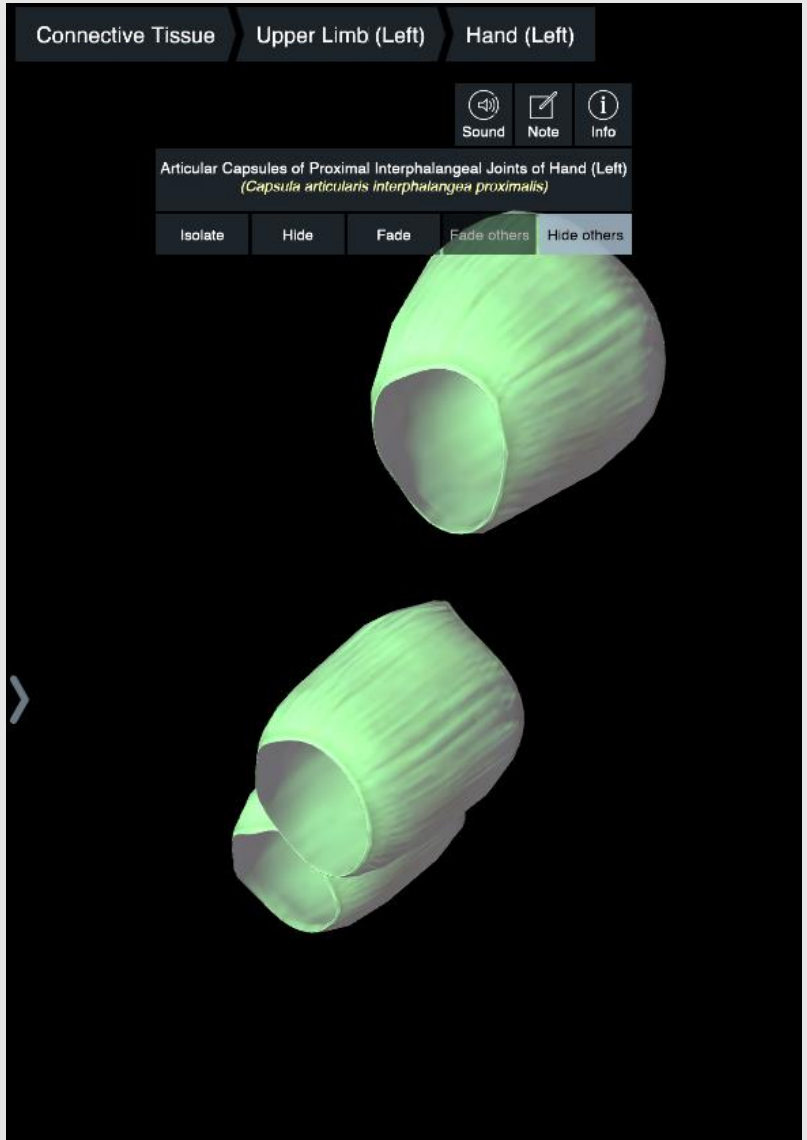


Volar Plate

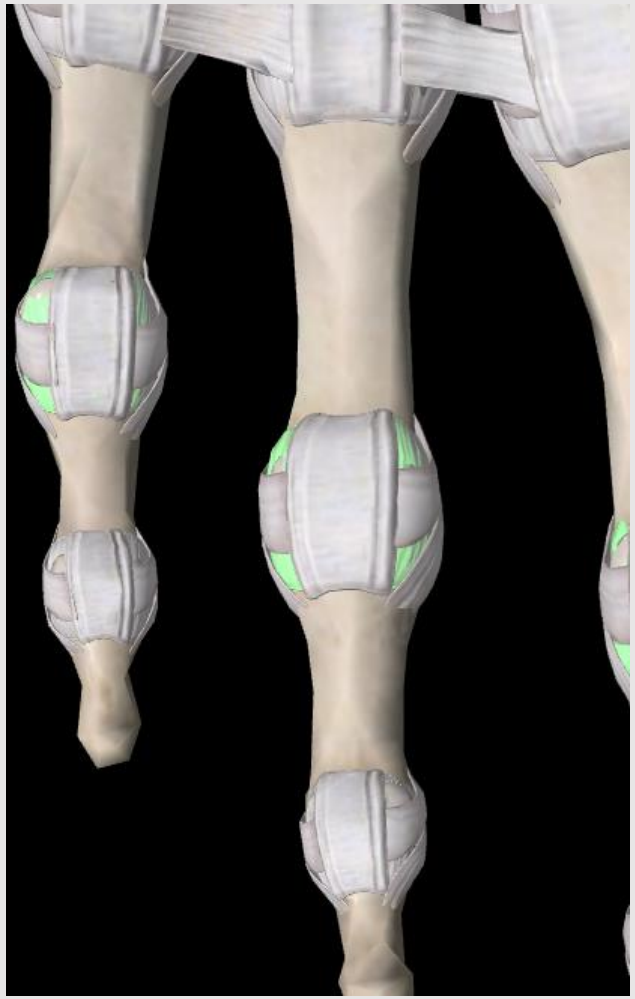
Accessory Collateral

Collateral

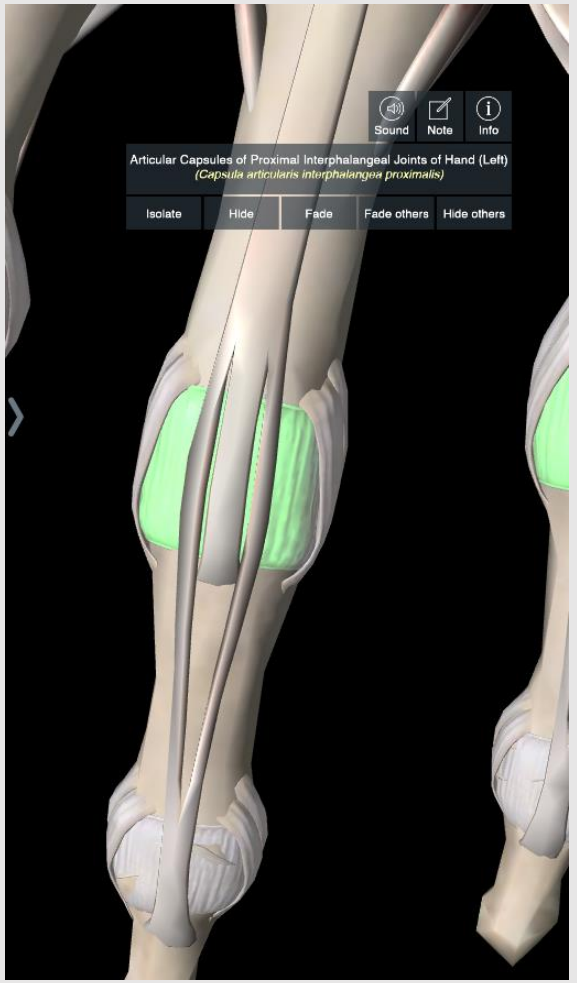
PIP joint Capsule



Joint Capsule



Volar



Dorsal

Oblique

Fibroplasia Phase

- This is the “key phase”
  - Decision time for “early motion”
  - Prevent stiffness…

Risk Benefit Analysis

- THIS PHASE IS WHERE MD's NEED YOUR INPUT!
- BASED ON PATIENT AND DIAGNOSIS
- Know your safe parameters
  - Literature- Therapy AND Surgery
  - Resources –ASHT (JHT), AAHS (HAND), and ASSH (JHS)
    - Importance of different perspectives
- Know your patient
  - High or low risk vs. high or low benefit for early motion?
  - An injury "category" or "diagnosis" does not define a particular patient status
  - Is my patient someone who would be "excluded" from a study?

Collaboration Questions

- Can digits safely move?
- How much can digits move?
  - Fractures
    - Stable?
    - Fixation type?
  - Dislocation
    - Joint stability?
    - Range of stability?
  - Tendon injury
    - Repair strength?
    - Tendon quality?

“Early” active motion opportunities

- Fracture - K-wire or non rigid fixation or STABLE with no fixation
    - Opportunity for “pain guided motion” (Lalonde and Higgins)
- Fracture – Rigid fixation

- Digital Dislocation
    - Dorsal -Flexion/ extension to limit of dorsal block
    - Lateral – Internal brace – Permits early motion

- Flexor Tendon –
    - PROM and gentle ½ fist

- Extensor tendon
    - Relative motion (ICAM) (Howell)
    - Short arc motion (Evans)

“Pain Guided Motion” – Digital Fractures

Don Lalonde, MD, Amanda Higgins BSc, OT

- Permits early limited motion of digits with fractures (without rigid fixation) to prevent stiffness
- Limited arc motion initiated when patient off pain medicine or analgesics – as soon as 3 days from injury or surgery
- Motion should not increase pain and pain is used as a guide for appropriate arc of motion

Pain Guided Hand Therapy for Hand Fractures: the Saint John Protocol

D. Lalonde MD, FRCSC
A. Higgins BSc. OT

Introduction

Early controlled mobilization of tissues surrounding a healing fracture has the potential to enhance the quality and rate of fracture healing and the functional range of motion of the hand[1]. Early mobilization has certainly been accepted for flexor tendon repair; it is one of the few things the Cochrane review on this subject has been able to support[2].

The risk of tendon rupture has not dampened the interest in early protected movement for flexor tendon repair because of the fact that a stiff finger is a useless finger[3],[4]. The loss of finger fracture reduction is a much easier thing to repair than a ruptured tendon.

The following protocol of early protected movement for finger fractures has been developed over many years in our unit with good success in terms of patient functional range of motion, patient satisfaction, and surgeon satisfaction. It has resulted in supple fingers and avoided stiffness. Very little loss of fracture reduction has occurred. It is based on two guiding principles:

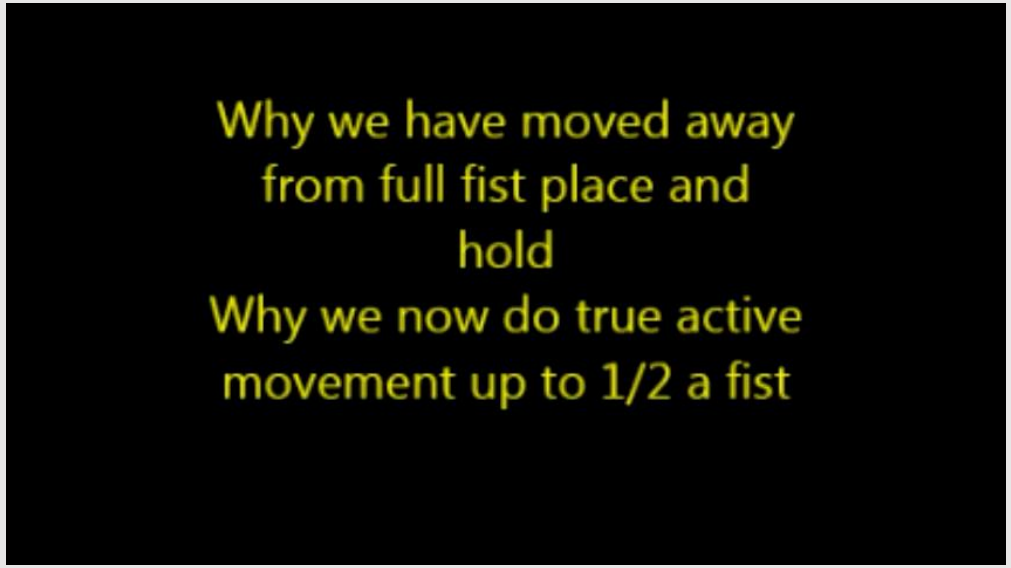
1. Early protected movement is just as important in finger and metacarpal fractures as it is in flexor tendon repair for the same reason; stiff fingers are not an acceptable good result. The risk of clinically significant loss of fracture reduction with this protocol has been lower than the risk of tendon rupture in early protected movement with flexor tendon repair in our experience.

Dorsal PIP Dislocation – “Early motion”

ROM within dorsal block

Flexor Tendon

Active motion up to ½ fist



Higgins A, Lalonde DH. Flexor Tendon Repair Postoperative Rehabilitation: The Saint John Protocol. *Plastic and Reconstructive Surgery Global Open*. 2016;4(11):e1134. doi:10.1097/GOX.0000000000001134.

Extensor Tendons

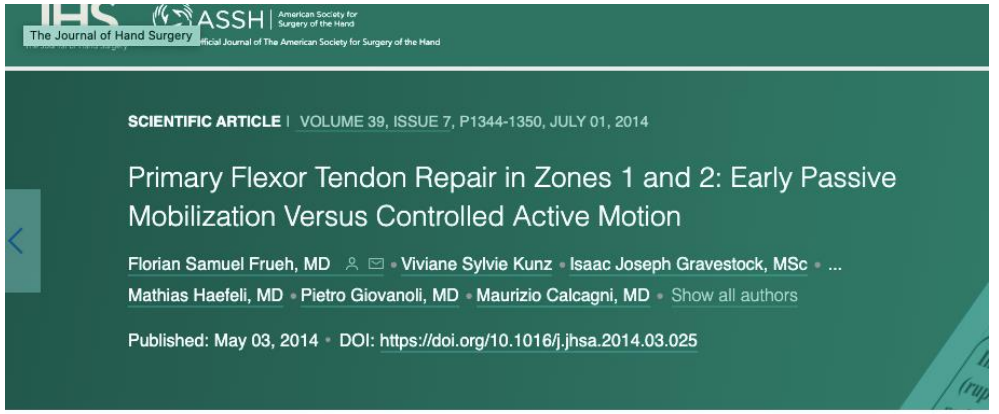
- Short Arc Motion (Zone 3)
- Immediate Controlled Active Motion (Zone 4-7)(RMO or “Yoke”)

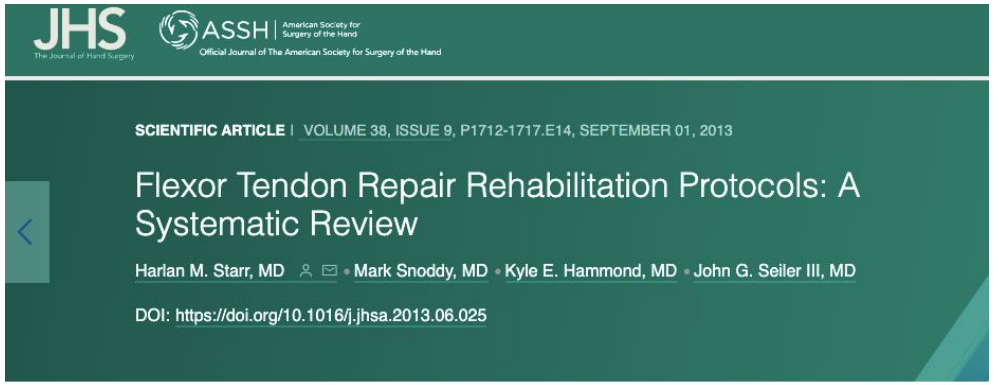
Remodeling Phase 3 Weeks +

- Collagen fibers replaced and reorganized depending on tensile load
- If immobilized – new collagen laid down in shortened position –
  - Contracture may become fixed

Remodeling Phase – 3 Weeks +

- Although it is 2021 – Rehab often starts here….
  - Fear / risk of losing reduction
  - Fear / risk of non-union
  - Fear / risk of rupture
  - Stiffness seen as a complication while adverse healing seen as “mistake”
  - Limited literature demonstrating safety of early motion
  - Long term outcomes significantly different??
  - Term “early motion” connotation of before the “norm”
  - Old “protocols”





Purpose

Hand Stiffness and Newton's Laws

- Resolving stiffness requires following "Laws"

Law #1: An object at rest will remain at rest unless acted on by an unbalanced force

Why is a joint remaining at rest?

How can you restore the correct force distribution?

Law #2

- Law #2: The greater the mass (of the object being accelerated) the greater the amount of force needed (to accelerate the object)
  - What factors influence “mass”?

Law #3

- Law #3 –Every Action has an Equal and Opposite Reaction
  - **Protect and improve tolerance for the “opposite reaction”**
  - Improve stress tolerance of healing tissue
  - Promote remodeling while protecting injured structures
  - Create the right stress at the right time…

Wolff's Law and Physical Stress Theory

- Muscle and other connective tissues will remodel according to stresses placed on them.

- Biologic tissues have five responses to physical stress available: decreased stress tolerance (i.e., atrophy), maintenance, increased stress tolerance (i.e., hypertrophy), injury, or death

- Effective Therapeutic Exercise Prescription: The Right Exercise at the Right Dose Brody, Lori Thein Journal of Hand Therapy , Volume 25 , Issue 2 , 220 - 232

Part 2: Interventions!

- Understand healing tissue tolerances
- Understand TERT
- Understand DOSE
- Understand mechanics
- Activity and orthosis selection

Activity and Exercise Selection

Dose = Applied level of stress X duration

Effective Therapeutic Exercise Prescription: The Right Exercise at the Right Dose Lori Thein Brody, PT, PhD, SCS, ATC

- What can tissues / healing structures tolerate AND for how long????

- High Stress Interventions
  - Joint Mobilization (higher grades)
  - Passive Stretching
  - Resistive Activity
  - Tendon Acceleration

- Moderate Stress Interventions
  - Low load prolonged stress
  - More rapid activity
  - Full range active movement

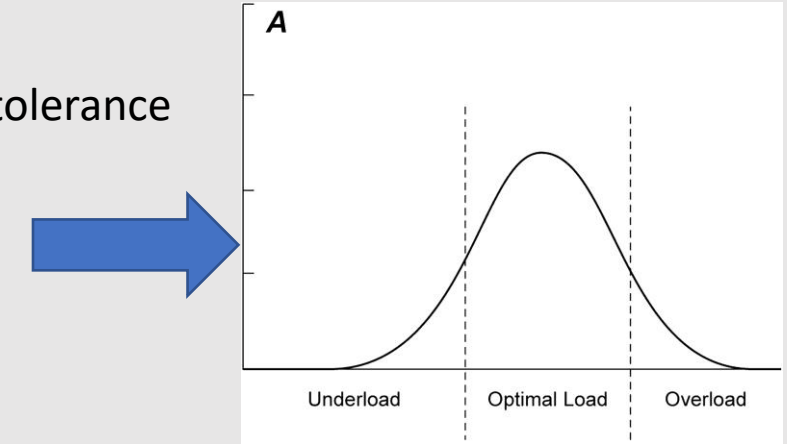
Activity and Exercise Selection

- Low Stress Interventions
  - Limited range
  - Limited effort
  - Does not increase pain
  - Gentle

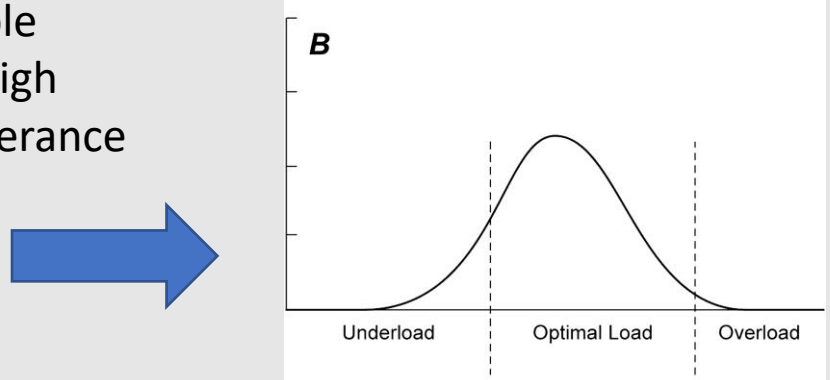
One More Point

- Tissue tolerance varies by human…
  - One person's "just right" is another person's "too much"

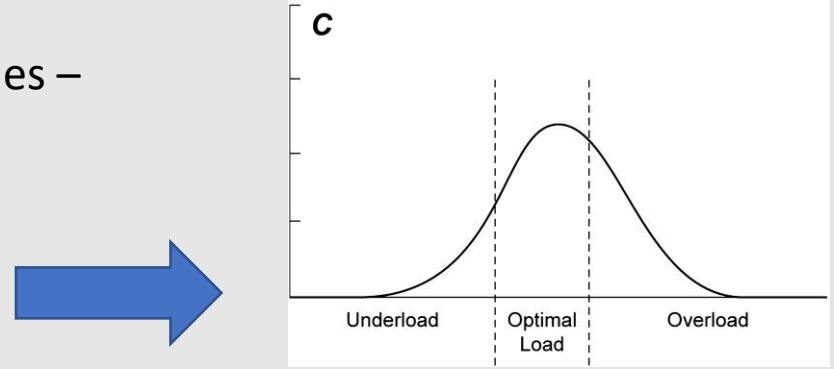
Typical load tolerance



Less irritable tissues – High activity tolerance

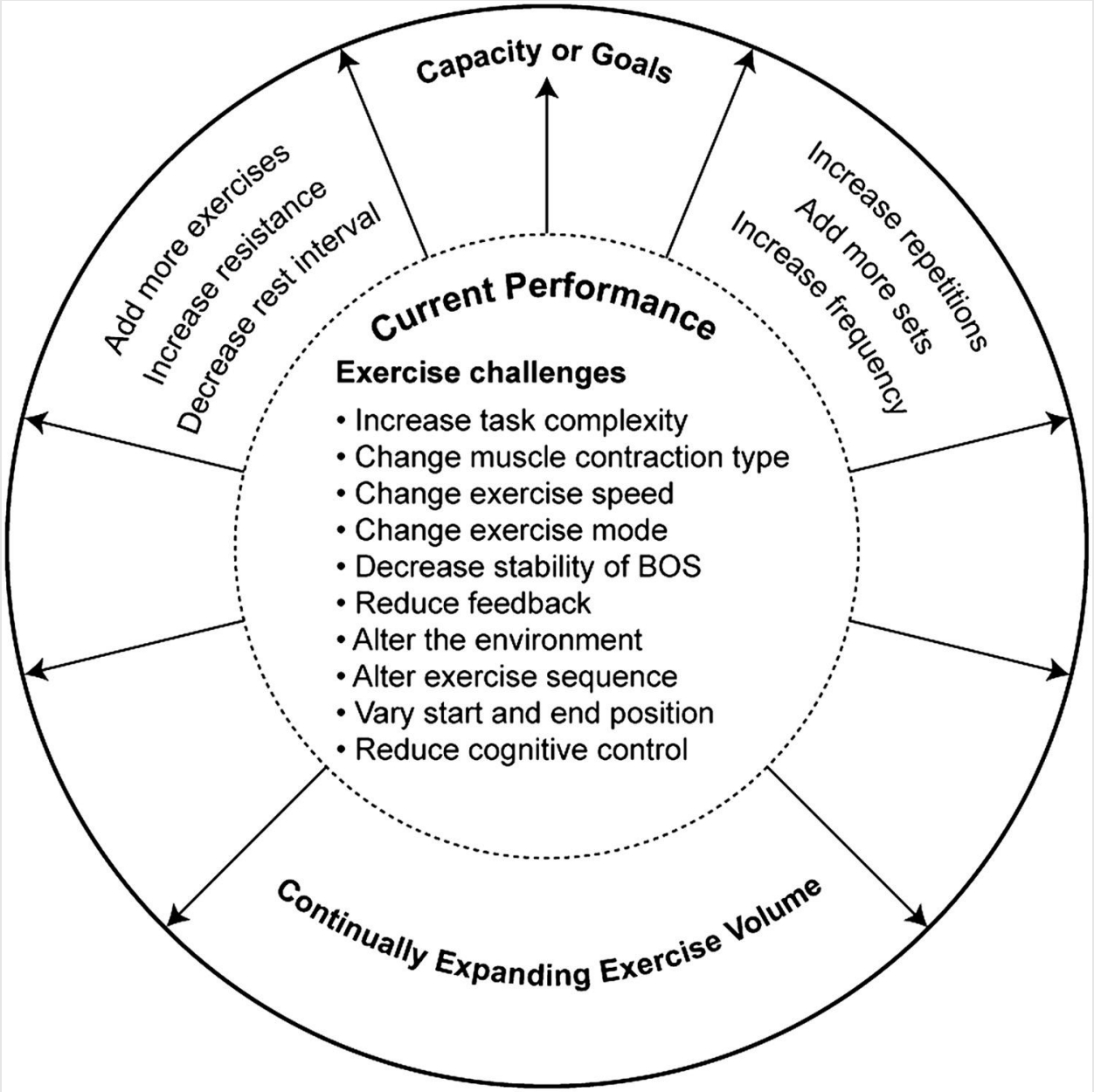


Irritable tissues – Low activity tolerance



Journal of Hand Therapy 2012 25, 220-232DOI: (10.1016/j.jht.2011.09.009)

Effective Therapeutic Exercise Prescription: The Right Exercise at the Right Dose *Lori Thein Brody, PT, PhD, SCS, ATC*



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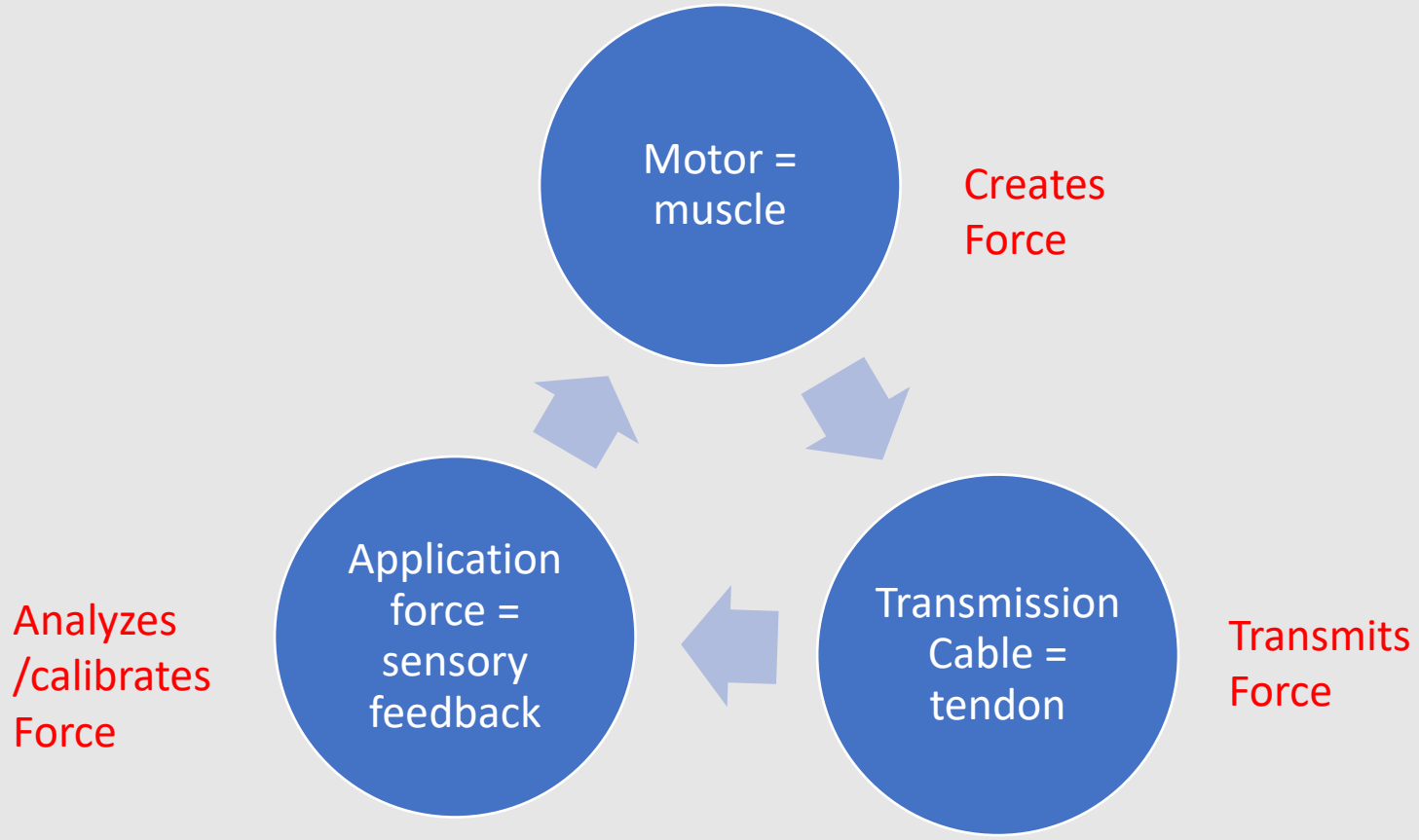
Fixing the System…



Friction and Drag = Forces which must be overcome to achieve normal movement

”Early Phase” of treatment

- For purposes across diagnoses – When clear to begin gentle motion
- Diagnosis specific precautions ALWAYS must be adhered to

Early Phase

Law #2: The greater the mass (of the object being accelerated) the greater the amount of force needed (to accelerate the object)

- Early phase - Minimize JOINT STIFFNESS
  - Decrease the MASS to allow less force to accomplish the work (Early coban wrapping)
  - Motion improves synovial diffusion to tendon AND joint
  - Understand your safe parameters
  - Dose = Low stress X duration

Adjust for Dose

Active Motion

- Active motion – greater tendon excursion than passive
  - Decrease adhesions
  - Improved intrinsic healing

KEYS TO SUCCESS

- Focus on activation of long flexors
  - Focus on mechanics of motion

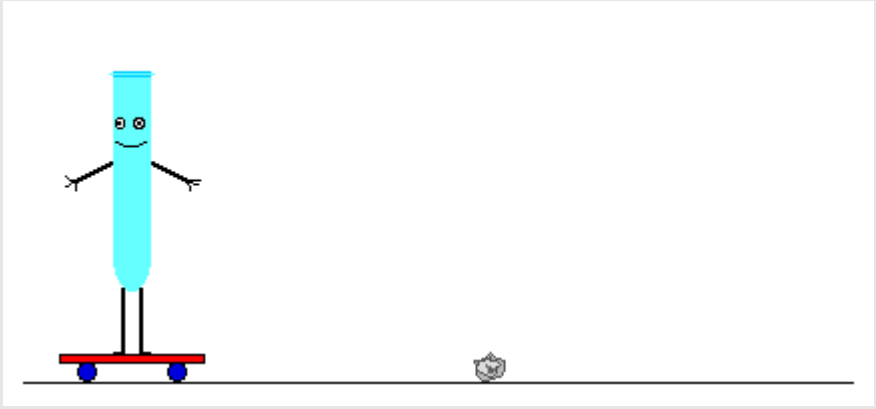
Initial Observations

- How is hook fist?
  - Problem maintaining MP extension? BLOCKING ORTHOSIS
- How is composite fist?
  - Is MP hyperflexing? RELATIVE MOTION ORTHOSIS

Early Phase - Redirect Forces to Stiff Joint

- Relative Motion Orthoses
- Blocking Orthoses

Law #1: An object at rest will remain at rest unless acted on by an unbalanced force



Blocking Orthoses – Direct force to stiff IP’s

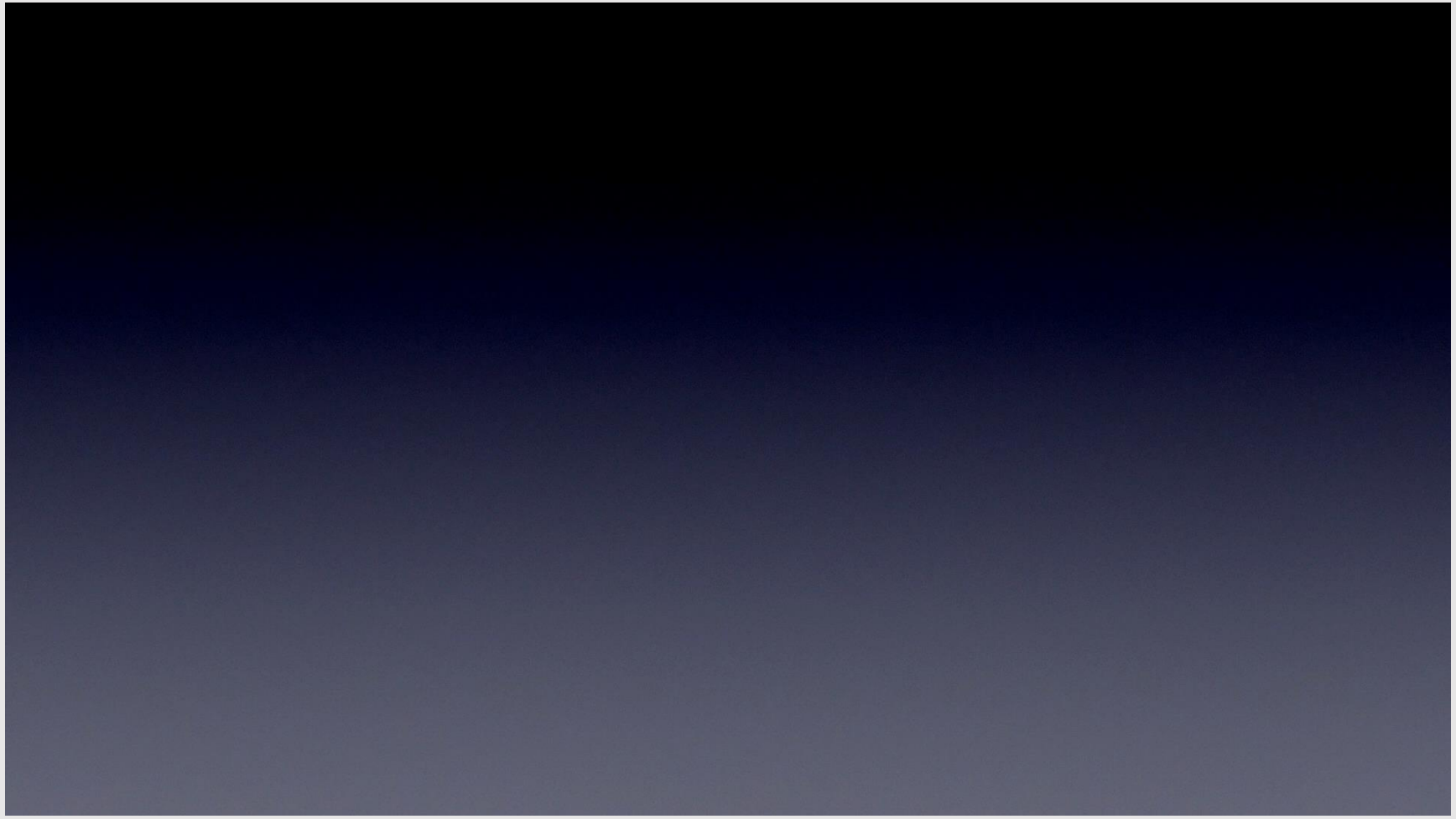
Blocking Orthosis

Blocking Cast



Blocking Cast

Blocking Cast



Blocking cast orthosis

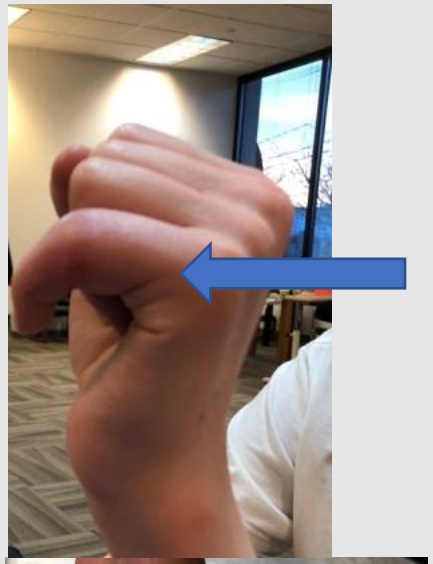
- First – Apply stockinette with enough length to extend from the wrist to the distal phalanx. Hang the radial part of the stockinette on the patients thumb
- Next, mark the level of the PIP crease for all of the digits
- Now apply 2-3 layers of cast padding from just distal to the PIP crease to the wrist on the ulnar side and the thumb web space on the radial side. Lave approximately ¾ of an inch of cast padding uncovered proximally and distally
- Next, dip your plaster into cool water and begin wrapping circumferentially from the PIP crease over the cast padding. Apply 2 layers of cast material and rub to blend the plaster
- Now, fold up the bottom end of the stockineete over the cast material,
- Next fold down the distal end making sure to just clear each of the PIP joints. Because of the height difference between the ring and small finger – support at the proximal phalanx of the ring finger and pull down on the material to find the small finger PIP crease.
- Now open a new cast material roll and add 1-2 layers of additional cast material making sure to secure stockinette onto the outside of the blocking cast. Rub the plaster to blend and smooth.
- Before fully hard, lift up to make sure the orthosis can be easily removed and replaced.

Relative Motion Orthoses

- Difficulty with PIP/DIP flexion
  - Observing MP hyperflexion
  - Place MP in relative ext.
  - Transfer force to IP joints

- Difficulty with PIP extension
  - Observing MP hyperextension
  - Place MP in relative flexion
  - Transfer force to PIP

- Pencil Test



Relative motion orthoses in the management of various

hand conditions: A scoping review

Hirth, Melissa J. et al.

Journal of Hand Therapy , Volume 29 , Issue 4 , 405 - 432

Relative Motion to Facilitate Flexion

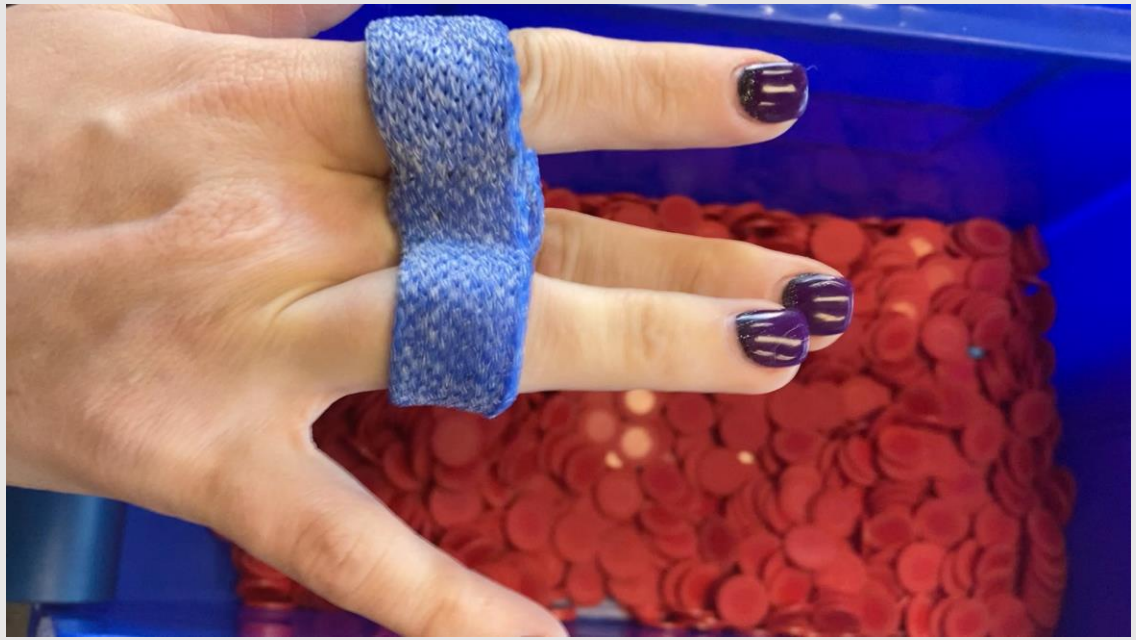
MF-RF Flexion Example

To fabricate a relative motion orthosis to facilitate PIP and DIP flexion, begin with the affected digit positioned with the MP joint in relative extension to the unaffected digits.
Take a ¼ inch wide strip of orthosis material and slip underneath the proximal phalanx of the affected digit and on rest on the dorsal surface of the proximal phalanges of the unaffected digits
Wrap around to the volar side of the unaffected proximal phalanges and connect the material together
Hold position of relative MP extension of the affected digit
Trim away excess material which may be blocking motion and smooth for comfort

Relative Motion Orthosis For Extension

Example: MF/RF extension

Relative Motion



Activities – Early phase

- Focus on gentle functional grasp
- Pain guided ranges
- Consider bilateral activities
- Consider “mirror” activities
- Consider “wedges”(Alison Taylor) between digits to relax interossei

Activity examples

- Bilateral towel gather
- Gentle grasping of soft textured items
- In hand manipulation of moderate sized objects

Early Activity Videos

More Activities – Early Phase

Treatment Principles – Intermediate Phase

- Middle / intermediate phase –
  - Add gentle passive interventions
  - Add more challenging end range active activities
  - Increase total end range TIME (Static progressive/ dynamic interventions)
  - Dose = Gradually increase stress X modified duration

Both factors variables

Understand Source of Stiffness

- Intrinsic Tightness
- Extrinsic Tightness
- Joint Stiffness

GOAL - Intermediate Phase: Increase Total End Range TIME

"...a daily TERT of greater than 6 hours per day facilitated contracture resolution at a faster rate than a daily TERT of less than 6 hours a day, over four weeks of splinting"

Optimal daily total end range time for contracture: Resolution in hand splinting
Celeste Glasgow, Judith Wilton, Leigh Tooth
Journal of Hand Therapy - July 2003 (Vol. 16, Issue 3, Pages 207-218, DOI: 10.1016/S0894-1130(03)00036-X)

Intrinsic Tightness Intervention Strategies

- Blocking – (early phase)
- Orthosis MP extension with IP flexion
- Reinforce correct movement patterns
  - Motion initiation with long flexors

Intrinsic stretch

Fabricate Dorsal Forearm based orthosis extended distally to PIP of involved digit

The MP should have enough room to fully extend

Width of material should extend 1/2 width of proximal phalanx of adjacent digits

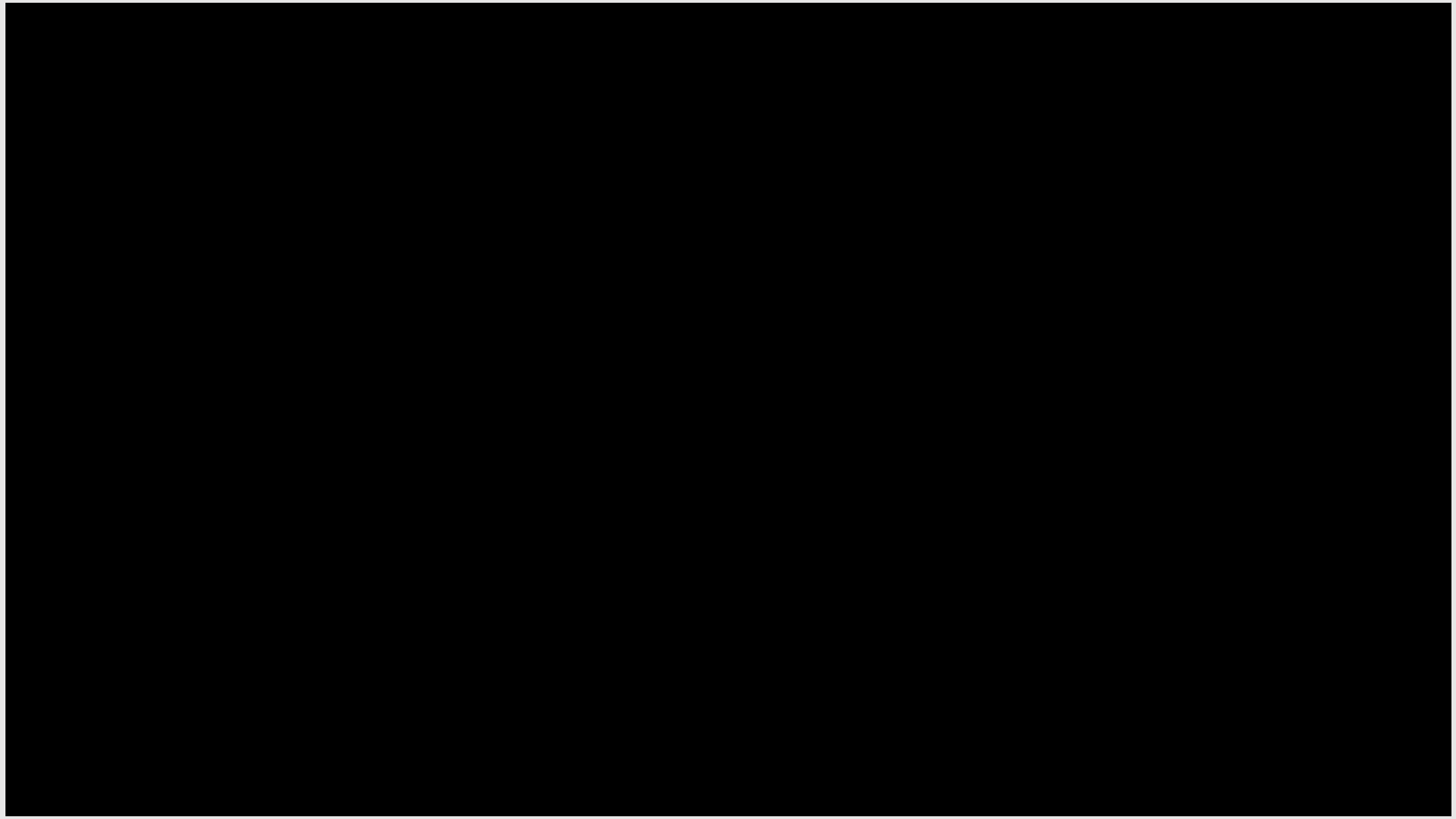
Intrinsic Stretch

Next, Fabricate a finger sling. I recommend using a mole skin sling -The sling should fit across distal end of middle phalanx when the PIP is in flexion with the length extending to the proximal phalanx
Attach line to both sides of sling

Thread both lines through perforations on dorsal side of web spaces to create intrinsic stretch pull of PIP flexion and MP extension

Attach Static progressive component to proximal base of orthosis
increase tension as appropriate to create light stretch

Intrinsic Tightness Orthosis Video



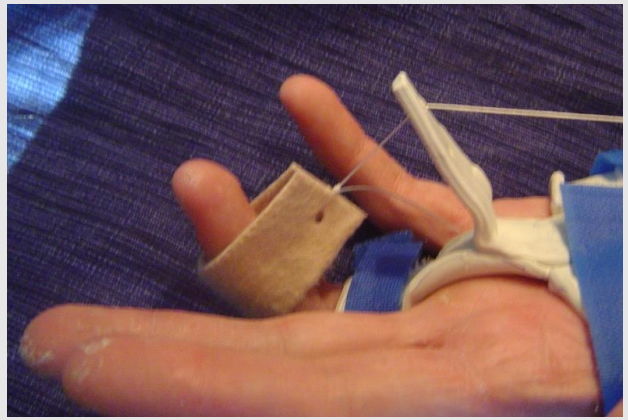
Stiff PIP joint

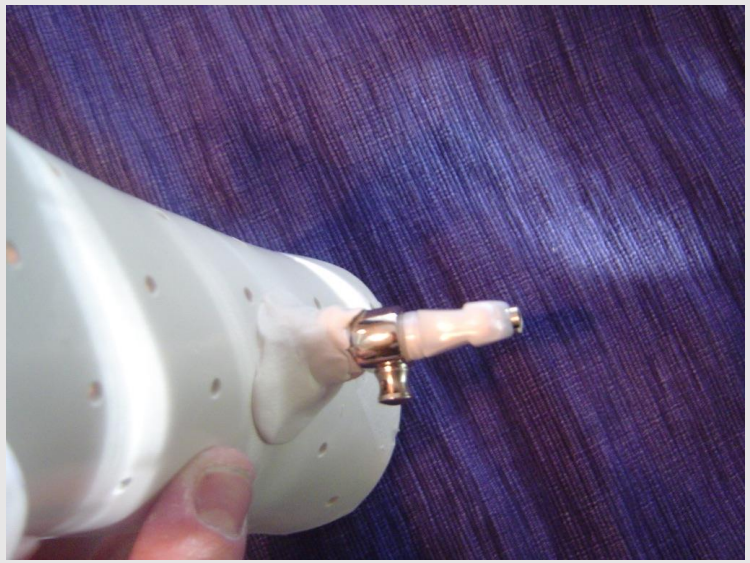
- Isolated joint interventions



Static Progressive PIP Flexion

- Begin with fabrication of a Forearm based orthosis – include Proximal phalanx of digit to be mobilized
  - Wrist 20 – 30 degrees extension
  - MP in full extension to slight hyperextension
  - Attach thermoplastic outrigger to volar surface at palm level

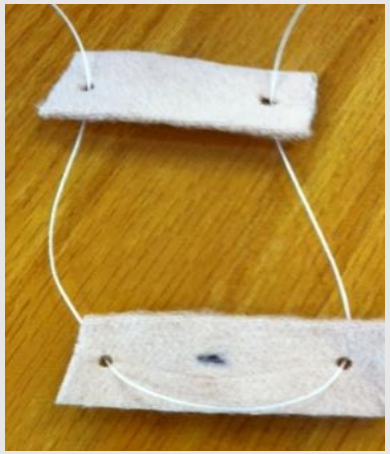




Next, Fabricate a finger loop - my preference is to use moleskin folded onto itself and wrap around the middle phalanx. The fingerloop should extend approximately ¼ inch past the volar surface of the middle phalanx. Then, tie on static the progressive line. Measure a 90 degree angle of pull, and then punch a whole in the outrigger and thread through the outrigger. Attach a static progressive component to the proximal base and turn to create gentle tension

Extrinsic Tightness

- Composite Digital Flexion
  - **Begin with Static Volar Wrist Orthosis Base wrist 25-30 degrees extended**




Fabricate Finger Loops

Fold strip of moleskin in half (unfolded width = twice length of proximal phalanx

Contour OPEN loop around proximal phalanx (end at volar P1 on both sides

Contour SECOND loop over DISTAL PHALANX – capture end of P2 and Proximal P3

Leave plenty of extra length in line (s) to reach from finger loop though outrigger and onto static progressive component

Combining cuffs

Weave line through distal phalanx cuff then up through each end of proximal cuff as shown

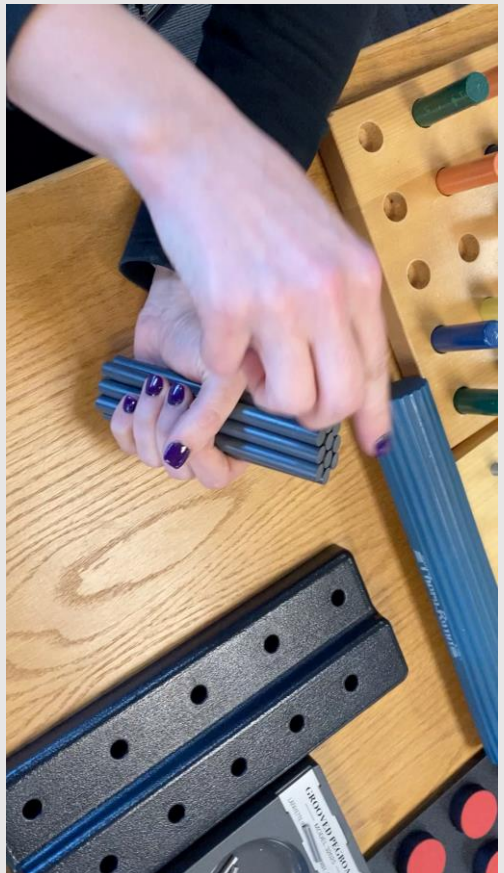
Thread through outrigger and attach to static progressive component

Composite Flexion

Activity examples - Intermediate Phase

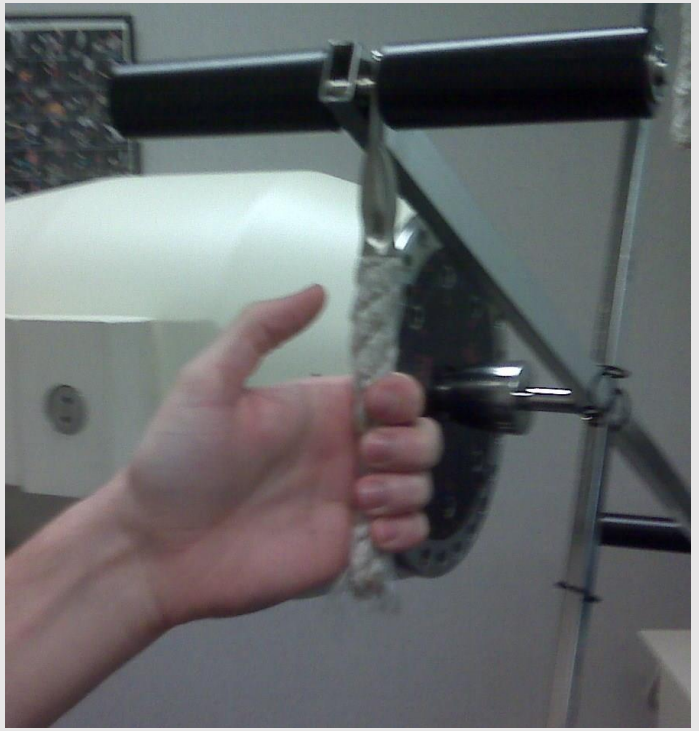
- Object (pen) removal
- Rapid object pick up

Intermediate activities



Intermediate Phase

- Increase end range time, speed, low force
  - Non resistive tool – BTE or biometrics
  - Dowel removal
  - Gentle putty stretch
  - Paper crunches off table
  - Moderate speed texture grasp



Treatment Principles

- Late Phase –
  - Dose = Higher stress X duration
    - Tendon acceleration
    - Rapid grasp or activity
    - Functional strengthening activities
    - Serial casting
    - DURATION!!!!

Serial Casting

1” strip plaster

Roll 1” plaster

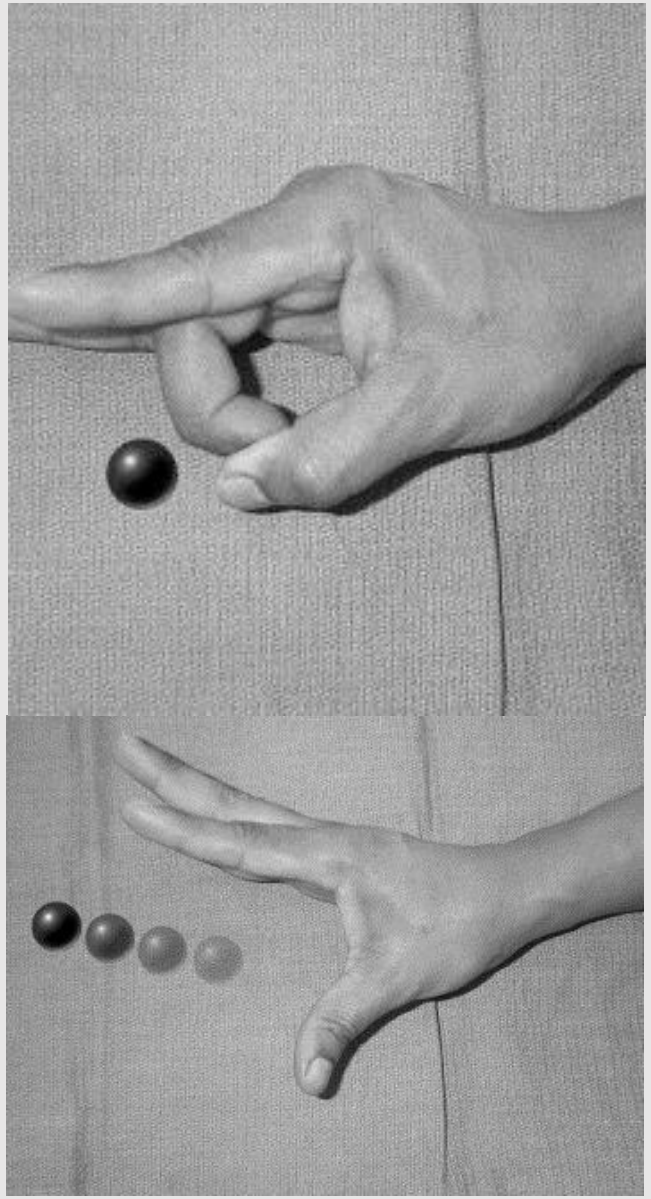
“Fluff” of cast padding over PIP

Apply 2 layers of plaster

Serial Casting

Lags and End ROM

- Tendon Acceleration - Preloading
  - Snapping
  - Flicking



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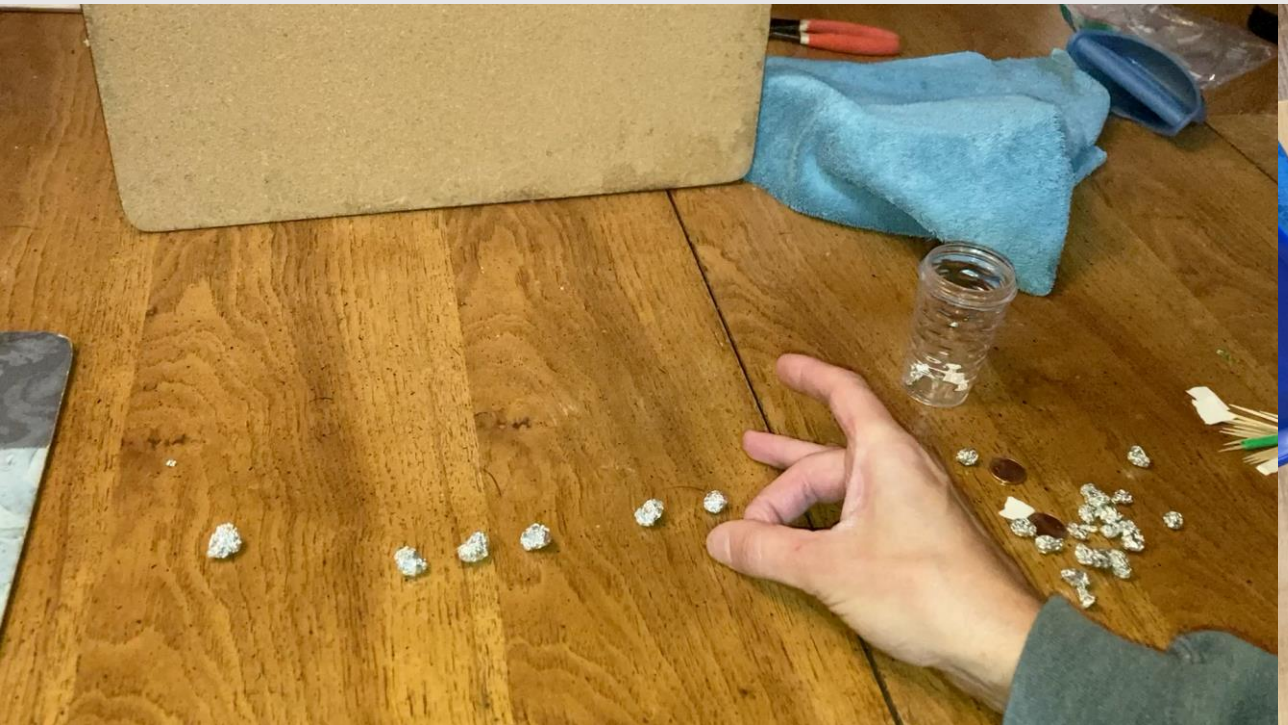
Late Phase: Activity Examples

- Rapid Grasp
- Rapid “Flick”
- Weighted ball



Late Phase: Higher “Dose Activities”

Functional Strengthening

Take Homes

- Address edema early
- Consider “early” motion but understand risk/ patient factors
- Know your safe parameters and have educated discussion with referring physician
- Progress treatment based on tissue healing and tissue tolerances by modifying treatment dose
- Use orthoses! Early – redirect forces, Middle – Total End Range Time
- Late – Vary SPEED as well as force

THANKS