

Introduction to Hand Therapy

Presented by Jennifer Macintire
OTR/L, CHT



Background and class intent

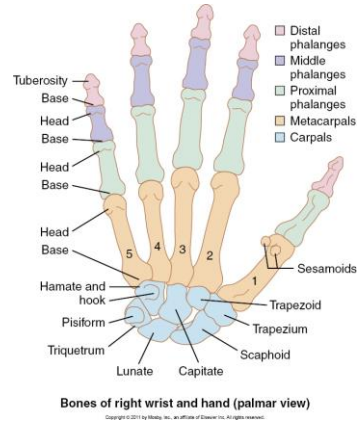
- Occupational Therapist (20+ years), Certified Hand Therapist (14 years). Graduated SJSU 1992 and completed CHT in 1999.
- Worked first five years in acute rehabilitation setting at County Hospital serving East Bay (Oakland etc.)
- Worked last 16 years at local community hospital working in out-patient setting treating primarily upper extremity patients.
- General understanding of evaluation of the hand (rom/strength/sensory evaluation)
- Basic hand, wrist and forearm anatomy
- Introduction to common hand injuries and their treatment (carpal tunnel/elbow tendonitis/distal radius fracture etc.)
- Develop a good general background of hand therapy to begin working as an entry level therapist in the specialty of hand therapy.

Hand Anatomy:

Finger flexors and intrinsic

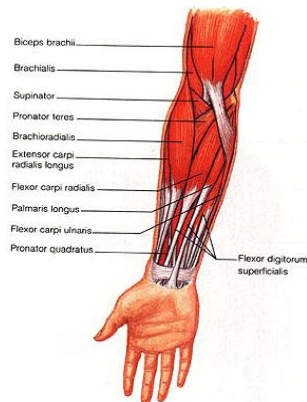


Carpals and phalanges

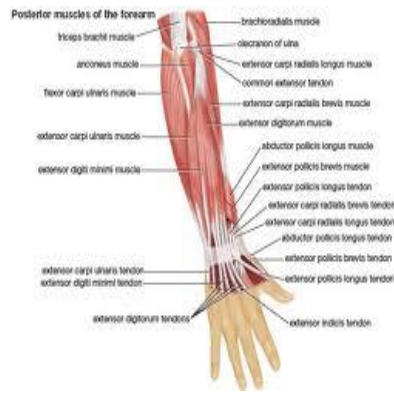


Forearm muscles

Extrinsic Flexors



Extrinsic Extensors



Finger anatomy

Finger flexion: FDS, FDP

Finger extension: EDC, EDQ, EI, and extensor mechanism.

Extensor Mechanism (simplified):

-EDC tendon attaches to proximal phalynx which extends MP joint

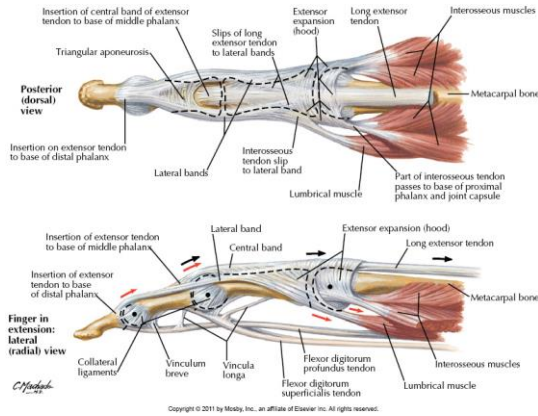
-Central tendon/slip attaches to base of middle phalynx where it can extend PIP joint

-Lateral bands proceed alongside PIP joint until attaching to distal phalynx and assists in extending DIP

-ORL (oblique retinacular ligament) fibers also assists in DIP extension.

-Finger abduction: dorsal interossi

-Finger Adduction: Palmar interossi



Thumb Anatomy

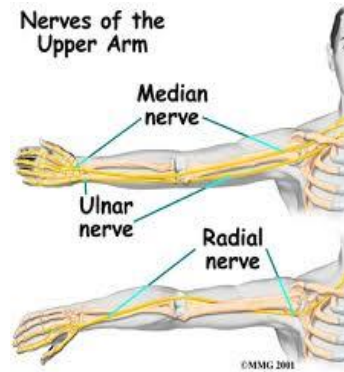
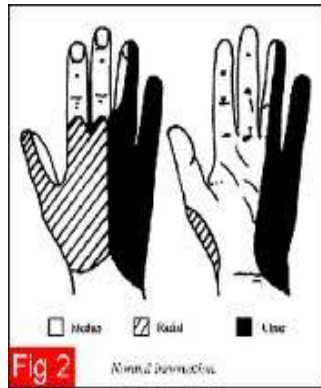
Thumb extensors



Thumb flexors and ab/adductors



Nerve distribution



Radial nerve

Innervation:

- Formed by axons from roots C5-T1
- Innervates all extrinsic wrist extensors except ECRL, finger and thumb extensors, extensor carpi ulnaris and abductor pollicis longus
- Clinical lesions: wrist drop

Wrist drop:



Median Nerve

Innervation

- C5-C7 roots from lateral cord or brachial plexus and C8-T1 roots from medial cord of brachial plexus
- Innervates: Abductor pollicis brevis, opponens pollicis, lumbricles 1 and 2, flexor pollicis brevis (also innervated by ulnar nerve)

“ape hand” : median nerve lesion results in thumb externally rotated and thenar wasting



Ulnar Nerve

Innervation

- C8 and T1 +- C7 roots
- Innervates: Flexor carpi ulnaris, flexor digitorum profundus (4th 5th), palmaris brevis, dorsal and palmar interossei, lumbricles 3 and 4, flexor pollicis brevis.

Ulnar nerve lesion: “clawing”
due to weakness lumbrical 3 and 4

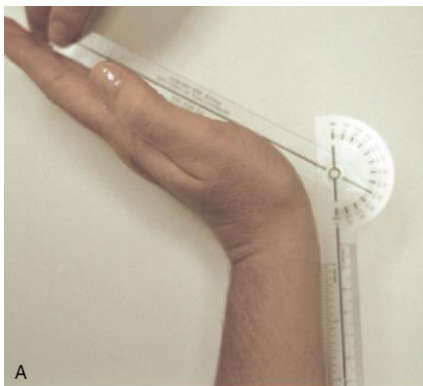


Evaluation of the hand

- Patient Interview:
- Patient history: mechanism of injury, important dates (injury, surgeries, etc.), medications, prior medical history etc.
- Subjective goals/roles: occupation, hobbies, patients own personal goals. Don't forget why the patient actually came to you!
- Evaluation will vary from diagnosis to diagnosis...(for example, you would not measure ROM on a person right after flexor tendon repair)...so this portion is a synopsis on "how" to complete the evaluative techniques of ROM, etc...not when.

ROM measurement of the wrist/hand:

Wrist extension



Wrist flexion



Wrist Active Range of Motion

- Normal maximum ROM of the wrist has been documented with the use of wrist goniometry.^[6] However, there is some variation in normal values. Therefore the uninvolved side should be measured for comparison. Functional ROM (i.e., the motion of the wrist required to perform most activities of daily living [ADLs]) has also been documented. Palmer and colleagues^[7] found that functional wrist motion is between 5 degrees of flexion and 30 degrees of extension, 10 degrees of radial deviation, and 15 degrees of ulnar deviation. Ryu and coworkers^[8] found that 40 degrees of wrist extension, 40 degrees of wrist flexion, and a total of 40 degrees of radial and ulnar deviation are needed to perform most ADLs.

ROM continued....

Ulnar and radial deviation:



Pronation and supination



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Digital and thumb AROM:

Thumb rom : palmar abduction (below)
(radial abduction, opposition, IP and MP)

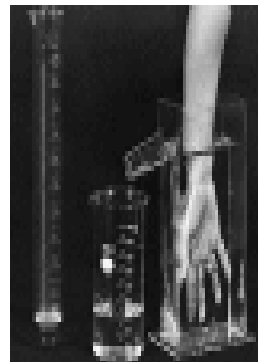


Finger flexion and extension



Edema Evaluation: volumetric

- Based on Archimedes' principle of water displacement, the *volumeter*, as designed by Brand,^[35] measures composite extremity mass (Fig. 16-1). Available in a range of sizes, volumeters monitor physiologic changes within the extremity as evidenced by changes in hand/extremity size, provided immersion of the extremity in water is not contraindicated. Although volumeter measurements are crucial for monitoring the inflammatory stage of wound healing, they also may be used to assess atrophy. Volumeter measurements are accurate to within 10 ml when used according to manufacturer specifications.



Edema Evaluation: circumferential

- When volumeter assessment is contraindicated, *circumferential* or *external diameter measurements*, using a flexible tape measure or external millimeter caliper, may be used to assess extremity size. Although less exact and accuracy of these tools is improved with consistent placement^l and tension of the tape or caliper on the extremity. Suspension of a 10- to 20-g weight from the end of the tape measure allows consistent tension from trial to trial, and caliper measurements are more appropriate for monitoring smaller diameters as with digital joints or segments.

Strength testing the hand

Grip with Jamar Dynamometer



How to:

- The grip dynamometer with adjustable handle spacings provides an accurate evaluation of the force of grip.^{34l} This dynamometer has five adjustable spacings at 1.0, 1.5, 2.0, 2.5, and 3.0 inches. The patient is shown how to grasp the dynamometer and is instructed to grasp it with his maximum force. The grip test position should be standardized. The forearm should be in neutral rotation and the elbow flexed 90 degrees. The shoulder should be adducted. The patient self-selects a wrist position with the gripping motion.
- Test procedure is important. In 1978 and 1983, the American Society for Surgery of the Hand recommended that the second handle position be used in determining grip strength and that the average of three trials be recorded.

Pinch testing

Pinch gauge



Three types of pinch are usually assessed: (1) prehension of the thumb pulp to the lateral aspect of the index middle phalanx (key, lateral, or pulp to side); (2) pulp of the thumb to pulps of the index and long fingers (three-jaw chuck, three-point chuck); and (3) thumb tip to the tip of the index finger (tip to tip). Lateral is the strongest of the three types of pinch, followed by three-jaw chuck. Tip to tip is a positioning pinch used in activities requiring fine coordination rather than power. As with grip measurements, the mean of three trials is recorded, and comparisons are made with the opposite hand.

Manual Muscle testing

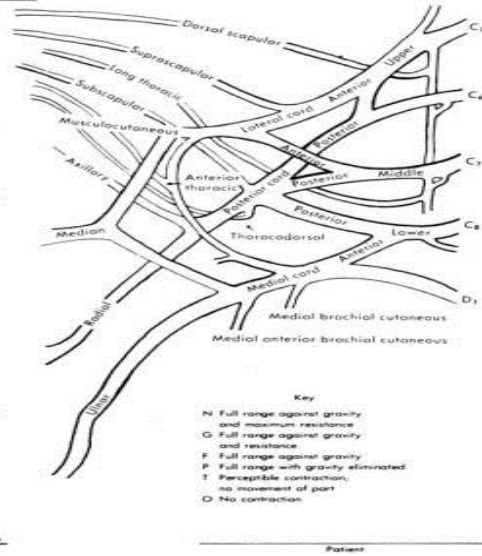
- **Key Muscles to Screen for Peripheral Nerve Function**
- Nerve Innervated Proximally ("High") or Distally ("Low") Muscle
- Radial nerve: High-Extensor carpi radialis longus and brevis Low-Extensor digitorum or extensor pollicis longus
- Median nerve: High -Flexor carpi radialis or flexor digitorum superficialis . Low Thenar muscles
- Ulnar nerve: High-Flexor carpi ulnaris or flexor digitorum profundus (ring, small) Low-Palmar or dorsal interossei



MANUAL MUSCLE TEST

Date _____ Nerve-muscle examination _____ Brachial plexus _____

					Upper
					Middle trapezius (Accessory C ₁ and C ₂)
					Lower
					Shoulder
					Suprascapular
					Infrascapular
					Serratus anterior
					Teres major
					Clavicle
					Serratus Fectoralis major
					Latissimus dorsi
					Biceps and brachialis
					Coracobrachialis
					Anterior
					Medial Deltoid
					Posterior
					Teres minor
					Proneur quadratus
					Proneur hexus
					Flexor carpi radialis
					Flexor digitorum profundus 1, 2
					Flexor digitorum superficialis
					Palmaris longus
					Flexor pollicis longus
					Flexor pollicis brevis
					Abductor pollicis brevis
					Opponens pollicis
					Lumbricals 1, 2
					Triceps
					Supinator
					Brachioradialis
					Extensor carpi radialis
					Extensor carpi ulnaris
					Extensor digitorum communis
					Extensor digiti quinti
					Extensor indicis proprius
					Extensor pollicis longus
					Extensor pollicis brevis
					Abductor pollicis longus
					Flexor carpi ulnaris
					Flexor digitorum profundus 3, 4
					Abductor digiti quinti
					Abductor pollicis
					Opponens digiti quinti
					1. Dorsal
					2. Interosse
					3. Interosse
					4. Volar
					1. Interosse
					2. Interosse
					3. Lumbricals 3, 4
					Flexor pollicis brevis (short head)



Sensory testing

Semmes Weinstein monofilaments



Filament Markings*Calculated Force

Green: Normal 1.65–2.830.0045–0.068

Blue: Diminished light touch 3.22–3.610.166–0.408

Purple: Diminished protective sensation 3.84–4.310.697–2.06

Red: Loss of protective sensation 4.56–6.653.63–447

Red-lined: Untestable >6.65 >447

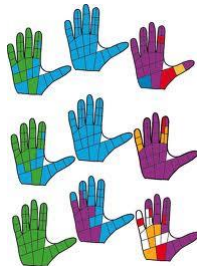


Semmes Weinstein testing technique

- Patient Testing Technique
- Testing with the monofilaments begins with filaments in the normal threshold level and progresses to filaments of increasing pressure until touch is identified by the patient. The filaments 1.65 to 4.08 are applied three times to the same spot, with one response out of three considered an affirmative response. This was found necessary in measurements of the filament forces.^[2] One touch may not reach the required threshold of these light filaments, but one out of three almost certainly reaches intended threshold. All the filaments are applied in a perpendicular fashion in 1 to 1.5 seconds, continued in pressure in 1 to 1.5 seconds, and lifted in 1 to 1.5 seconds. The filaments 1.65 to 6.45 should bend to exert the specific pressure. The 6.65 filament has been found most repeatable if applied just to bending. If we are careful to differentiate a false-positive response from a true detection, we may stimulate each site three to five times to ensure it is not felt. Filaments should be applied a minimum of three times, *with one response out of three taken as an affirmative response*

Sensory testing cont...

Semmes weinstein example

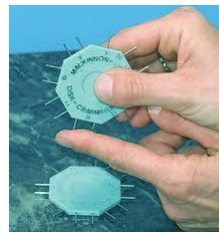


Other sensory testing options:

2pt discrimination

Static or moving 2pt discrimination

Moberg (1958) related certain 2pt discrimination with certain tasks like winding a watch



Carpal Tunnel Syndrome



Ergonomics:

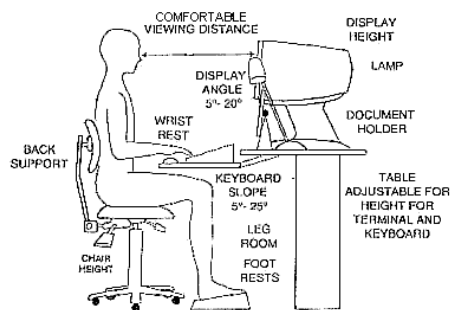


Diagram from "Ergonomics and VDT Use," flyer prepared by the Library of Congress Collections Services VDT Ergonomics Committee, 1991-92.

Common hand diagnosis: carpal tunnel

Carpal Tunnel Provocative tests:

Phalens-

Wrists in flexion for 60 seconds, paresthesia/sensory symptoms within that time frame is a positive test



Tinels: Tinel's nerve percussion test is more specific to axonal damage that may occur as a result of moderate to severe CTS.



Carpal tunnel continued...

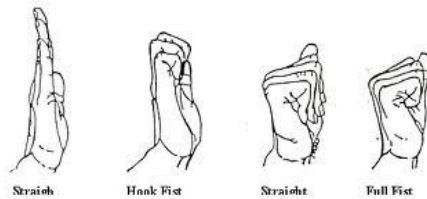
Indications:

- Night time paresthesia/pain
- Difficulty grasping objects/dropping objects
- Numbness median nerve distribution
- Positive phalen's/ possible tinels
- Positive NCS or EMG
- Often repetitive work tasks

Some common treatment:

- Wrist positioning: possible orthosis especially at night (wrist neutral not wrist extension), ergonomic/ adl education and postural education
- Pain and edema management techniques: ice, contrast baths, soft tissue mobilization, modalities such as ultrasound etc.
- Exercise as tolerated (not reproducing sensory symptoms): wrist rom/stretch, tendon gliding, nerve gliding etc.

Tendon gliding exercises



Cubital Tunnel Syndrome

- The ulnar nerve is subject to compression as it pierces the medial intermuscular septum (MIS); at the arcade of Struthers; within the cubital tunnel; and between the humeral and ulnar heads of the flexor carpi ulnaris (FCU).
 - Pressure can be imparted to the ulnar nerve about the elbow in three ways: compression, stretch, and friction.
 - The capacity of the cubital tunnel is greatest when the elbow is in extension.
 - Pressure within the cubital tunnel is increased with elbow flexion and is further increased with contraction of the FCU.
 - Patients with intermittent symptoms, no atrophy, and mild electrodiagnostic findings may respond well to nonoperative treatment.
 - Surgical management options include endoscopic release, in situ decompression, medial epicondylectomy, and anterior transpositions.
 - Postoperative therapy depends on the surgical procedure performed.



Cubital tunnel cont...

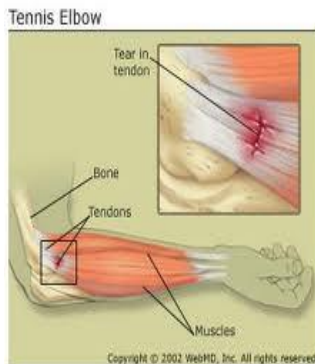
Conservative treatment

- Night time splinting: elbow flexed about 30 degrees, neutral forearm, wrist extension 0-20 degrees
- Activity modification: avoid leaning on elbow, avoid elbow flexion (phone, driving, etc.)

Evaluation and treatment:

- Evaluate pain, rom, strength, sensation (rule out guyon canal with tinels ulnar wrist)
- *Elbow flexion test*: bend elbow past 90 degrees, recreate pain symptoms or parasthesia in ulnar nerve distribution = positive
- Treatments: education, rom/strength if indicated, modalities (to reduce pain/inflammation)

Tennis and Golfer's Elbow



- Epicondylitis may occur at the lateral of medial epicondyle as a result of an acute or chronic injury.
- ECRB most common involved tendon.
- Medial epicondylitis may be associated with cubital tunnel or medial collateral ligament irritation.
- Often called tennis elbow (lateral) and golfer's elbow (medial)
- Provocative tests for lateral epicondylitis: resistive 3rd finger test

treatment



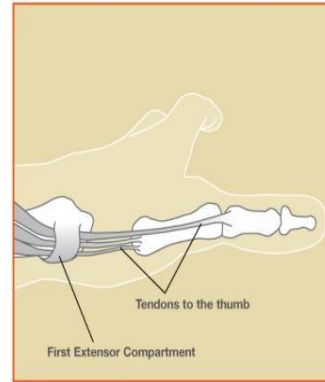
- Band it brand elbow cuff/counterforce strap and possible wrist cock-up splint (be careful not to create nerve compression!)
- Modalities for pain/inflammation (ice, ultrasound, rom, bodymechanics education)
- Restrict aggravating motions: grip, pinch, fine finger motions

Forearm Stretches



DeQuervain's tendonitis

- Definition: Stenosing tenosynovitis of the first dorsal compartment of the wrist involving the extensor pollicis brevis and abductor pollicis longus tendons as they pass through the osteoligamentous tunnel of the radial styloid and the transverse fibers of the dorsal carpal ligament



DeQuerain's cont...

PROCARE



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- Treatment goals: restoration of normal painless (or reduced pain) use of the involved hand, resolution of the chronic inflammatory process, prevention of reoccurrence
- Special Tests: Finklestein- Instruct patient to make a fist, tuck the thumb inside the digits and ulnarly deviate. Sharp pain is a positive test.
- Treatment: Thumb spica splint or neoprene wrist/thumb support, modalities for pain reduction and edema reduction (heat, ice, ultrasound etc.), rom (restoring normal), soft tissue mobilization, education

Wrist tendonitis/sprains

- Definition of wrist tendonitis:
inflammation of any of the wrist's tendon's and or synoial tissue surrounding it as it crosses the wrist.
- Definition of wrist sprain:
- Treatment goals the same: reduction of pain for functional use of the involved hand, reduce chronic inflammatory process, prevent re-occurrence or re-exacerbation.

Wrist tendonitis/sprains
cont.



- Treatment: modalities for pain/edema reduction (ice heat, ultrasound, etc), soft tissue mobilization, possible wrist cock-up splint and/or neoprene wrist support, education (ergonomics education, modifying adl's to avoid exacerbation etc).

Strengthening....where does that fit in???

Suggestions: 1. don't rush into strengthening the involved body part because often over use is what got them here to begin with!
2. Consider beginning with proximal strengthening exercises (if the larger muscles are stronger they will have reduced risk of overusing smaller muscle groups) ex. I,Y,T's, scapula stabilization exercises.

A note on hot/cold modalities:

- Heat modalities can be effective adjuncts to passive and active ROM, either in combination with or preceding mobilization. Superficial heat agents include paraffin, heat packs, and fluidotherapy. Deeper heat is provided by ultrasound. Cold can be provided through cold packs or ice. All heat and cold should be applied with caution in the hand with sensory or vascular compromise.
- Heat application produces vasodilation and increased blood flow, which improve nutrition and may aid healing. Cold decreases muscle spasm and can reduce edema. It can also control postexercise pain. Although the actual mechanism is not known, both heat and cold relieve pain, with some patients being more amenable to one than to the other.

Modalities Continued:

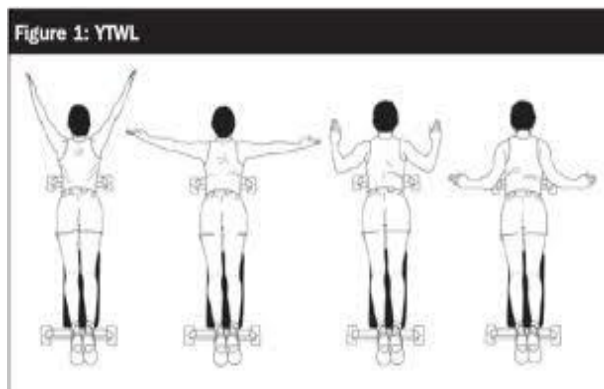
Contrast baths

- Method where you alternate between basin of warm water and very cold water to get benefits from both heat and cold modalities.
- Favorable for home program pain/edema management and ROM

Other modalities:

- Different types of current for pain/edema: TENS, Interferential current, direct current, etc.
- Iontophoresis: drug delivery system which delivers a NSAID medication

Prone Shoulder Exercises:



Contraindications???

For all of the above diagnosis make sure to be aware of...

1. Any prior medical history that may conflict with treatments (circulatory disorders, pacemaker, arthritis's, etc, etc, etc)
2. Make sure to get adequate information from MD and call their office if necessary for information (test results etc)....never be afraid to communicate with the doctor!

Fractures of the wrist and hand

- Fracture Healing
- - The *inflammation phase* is characterized by bleeding from the fracture site and hematoma formation.
 - The *repair phase* occurs when gentle range-of-motion exercises can generally be instituted. Radiographs depict callus formation at the fracture site.
 - The *remodeling phase* continues long after the fracture has clinically healed.
- Chung and colleagues,^[2] in a review of nearly 1.5 million fractures recorded by the National Hospital Ambulatory Medicare Care Survey, determined that 44% of fractures involved the distal radius; of these, 30% occurred from an injury at home and 47% were caused by accidental falls.
- Scaphoid fractures are the most common carpal fractures. They typically occur in young males aged 15 to 30, with an incidence of 35,000 to 50,000 annually.
- Distal phalynx fractures are reported as the most frequent of all hand fractures at a rate of 40-50%. (per Kasch, Taylor-Mullins Hand Therapy Reiew Course Study Guide. 1990)

Distal Radius Fracture Evaluation

- **Suggested Therapist Examination Components After Distal Radius Fracture Early Testing After DRF**
- Pain using VAS or PRWE
- Function with self-report outcomes questionnaires (PRWE or DASH)
- Light touch with monofilaments to screen for nerve compression (median, ulnar, dorsal radial nerve)
- Figure-of-eight measurement or volume displacement (if no external fixation device or cast)
- ROM (if wrist is still immobilized measure adjacent joints)
- **Later Testing After DRF (From 6 to 8 Weeks Onward and once indicated by MD)**
- ROM
- Grip strength
- Pinch strength
- Push-off test
- Function with outcomes questionnaires (PRWE or DASH)
- DASH, Disability Arm, Shoulder, and Hand questionnaire; DRF, distal radius fracture; PRWE, Patient-Related Wrist Evaluation; ROM, range of motion

Distal Radius Fracture Rehab



- Keypoints:
- Therapy strategies should focus on restoration of functional wrist and forearm motion.
- Digital motion can be markedly limited after high-impact injuries, after falls in the elderly, and in patients who have osteoarthritis . Therefore, careful monitoring of finger and thumb motion is important.
- Don't forget the shoulder and scapula!!

Distal radius fracture cont.

Early Protective Phase

- 1-6 weeks depending on fracture stability
- Goals: protect fracture, control swelling/pain
- Treatments: cast/orthosis/surgical fixation, edema control (elevation with overhead fisting, retrograde massage, compression wraps)

Cont.

- Tendon gliding exercises
- Digital rom should be attained in this phase along with uninvolved joint mobility
- Abnormal paresthesias should be recorded along with signs of Complex Regional Pain Syndrome (CRPS: edema/pain/red)

Distal radius fracture cont.

Motion/mobilization phase

- Starts immediately after immobilization
- AROM and PROM of digits, shoulder, AROM of wrist, forearm rotation (be cautious when beginning PROM at wrist/forearm and check with MD when fracture is stable....begin with AROM)
- Dynamic splinting when ok with MD

Cont.

- Pain, swelling due to excessively vigorous ROM exercises should be avoided
- Excessive ROM should be avoided if any indicators of delayed healing or instability
- Wrist extension with digital flexion = priority

Distal Radius Fracture cont.

Functional/Strength Phase

- Begun when proven healing/bone fixation
- Increase ROM to WFL
- Increase strength to WFL's: isometric to isotonic exercises; resisted exercises with putty or grippers

cont

- Precautions: excessive discomfort /irritated tissues after exercise or functional activities
- *Adapted from LaStayo PC, Michlovitz SM, Lee M. Wrist and hand. In: Kolt G, Snyder-Macker L, eds. Physical Therapies in Sport and Exercise. 2nd ed. 2007.*

1. [Hand and Upper Extremity Rehabilitation: A Practical Guide/Edition 3](#) by Susan L. Burke, James Higgins, Michael A. McClinton and Rebecca Saunders (good basic book with simple illustrations and pathophysiology with treatment for a multitude of upper extremity injuries/disorders).
2. Diagnosis and Treatment Manual, 4th Edition by the Indiana Hand to Shoulder Center (this is a protocol book describing nonsurgical and postsurgical rehabilitation for conditions of the upper extremity)

RECOMMENDED FURTHER READING

Case Study #1:

- 42 year old female complaining of right (dominant) elbow pain at medial epicondyle
- Pain occurs with all lifting around the house, work tasks (scanning groceries) and has been of progressive onset for 4-6 months
- Clinical Findings: limited wrist AROM, positive elbow flexion test
- Clinical findings cont: negative phalens test, nocturnal numbness nightly, limited grip strength right compared to left
- What would my plan be????

Possible plan for case study #1:

- pain/edema management with modalities
- Reducing inflammatory cycle by educating patient regarding aggravating activities, teaching activity modification, splinting etc.
- Nocturnal numbness may be due to elbow flexion/ splint to keep elbow at 0-30?
- Educate regarding avoiding weight bearing over ulnar nerve at elbow.
- Progressive reintroduction into adls while teaching biomechanics/ reinjury prevention.
- Stretching and strengthening as indicated : stretching wrist extensors/flexors without reproducing pain/neural symptoms, proximal strengthening



Questions???????

THANK YOU !!!!!!! And best of luck with your future in hand therapy!