- **Sensibility**
- Inspect the patient's hand for dryness, moistness, and calluses. Blisters may be an alert to injurious hand use because of sensory loss. "Wear marks" illustrate where and how the hand is used and which parts of the hand avoid use, indicating sensory impairment.
- The Semmes-Weinstein Monofilament Test and the Two-Point Discrimination (2PD) test are most commonly used in hand therapy. The Semmes-Weinstein Monofilament Test assesses pressure threshold, and the 2PD assesses density of receptors. The Moberg Pickup Test is a functional test appropriate for use on patients with median or median and ulnar nerve lesions.

- **Sensory Examination**

Exam in this order

  - Superficial (Exteroceptive) sensation
  - Proprioceptive(deep) sensation
  - Combined cortical sensations.

- If the superficial sensation is impaired then some impairment is also seen in deep and combined sensations.
- Sensory tests are done from the distal to the proximal direction.

Superficial Sensation	Deep Sensation	Combined Cortical Sensation
1. Pain Perception 2. Temperature Awareness 3. Touch Awareness 4. Pressure Perception	1. Kinesthesia Awareness 2. Vibration Perception	1. Stereognosis Perception 2. Tactile Localization 3. Two-Point Discrimination 4. Double Simultaneous Stimulation 5. Graphesthesia 6. Recognition of Texture 7. Barognosis

- Pain Perception

- It is also known as sharp/dull discrimination. To test this sensation, the sharp and dull end of any objects like a safety pin, a reshaped paperclip, or neurological pin is used. The sharp and dull end is randomly applied perpendicular to the skin, should not be applied too close to each other or in a too rapid manner to avoid the summation of impulses. The patient is asked verbally to indicate sharp/dull when a stimulus is felt. All areas of the body should be tested. After testing the instrument should be sterilized or disposed.

- Temperature Awareness

- Two test tubes with stoppers are required for this examination; one should be filled with the cold water (between 5°C to 10°C) and warm water(40°C to 45°C). It should be taken care that the temperature should remain within this range for accuracy. The test tubes are randomly placed in contact with the skin area to be tested. All skin surfaces should be tested. The patient is asked to respond hot and cold after each stimulus application.

- Touch Awareness

- A piece of cotton, camel-hair brush, or tissue is used to perceive the tactile touch input. Light touch or stroke is applied in the area to be tested. The patient is asked to indicate where he/she recognizes that a stimulus has been applied.

- Pressure Perception

- The therapist's fingertip or a double-tipped cotton swab is used to apply a firm pressure on the skin surface. The patient is asked to indicate when an applied stimulus is recognized.

- Kinesthesia Awareness

- Awareness of movement is known as kinesthesia. The Therapist passively moves a joint through a relatively small range of motion and the patient is asked to describe the direction of movement. The patient can also respond by simultaneously duplicating the movement with the opposite extremity.

- Proprioception Awareness

- Proprioception includes position sense and awareness of joint at rest. The joint is moved through a range of motion and held in static position by the therapist, the patient is asked to describe the position either verbally or by demonstrating on another limb.

- Vibration Perception

- The perception of a vibratory stimulus is tested by placing the base of the vibrating tuning fork on the bony prominence(sternum, elbow, ankle). Generally, the tuning fork should be of 128Hz. If there is impairment patient will be unable to distinguish between a vibrating and nonvibrating tuning fork. Therefore, there should be a random application of vibrating and nonvibrating stimuli.

- Stereognosis Perception

- Tactile object recognition is determined in this test. A familiar object of different shape and size are required like keys, coins, combs, safety pins, pencils). A single object is placed in a hand and the patient manipulates it to identify the object and say it verbally. For speech impairment patients sensory testing shield can be used.

- Tactile Localization

- The test checks the ability to localize touch sensation on the skin. This test is not performed in isolated manner rather it is done in combination with pressure perception or touch awareness.

- Two-Point Discrimination

- It determines the ability to perceive two points applied to the skin simultaneously. Aesthesiometer or the circular two-point discriminator are the devices to test. The two tips of the instrument are applied to the skin simultaneously with the tip spread apart. With each successive application, the two tips are gradually brought closer together until the stimuli are perceived as one. The smallest distance between the stimuli that is still perceived as two distinct points is measured.

- Double Simultaneous Stimulation(DSS)

- DSS examines the ability to perceive a simultaneous touch stimulus on opposite sides of the body; proximally and distally on a single extremity; or proximally and distally on one side of the body.

- Graphesthesia(Traced Figure Identification)

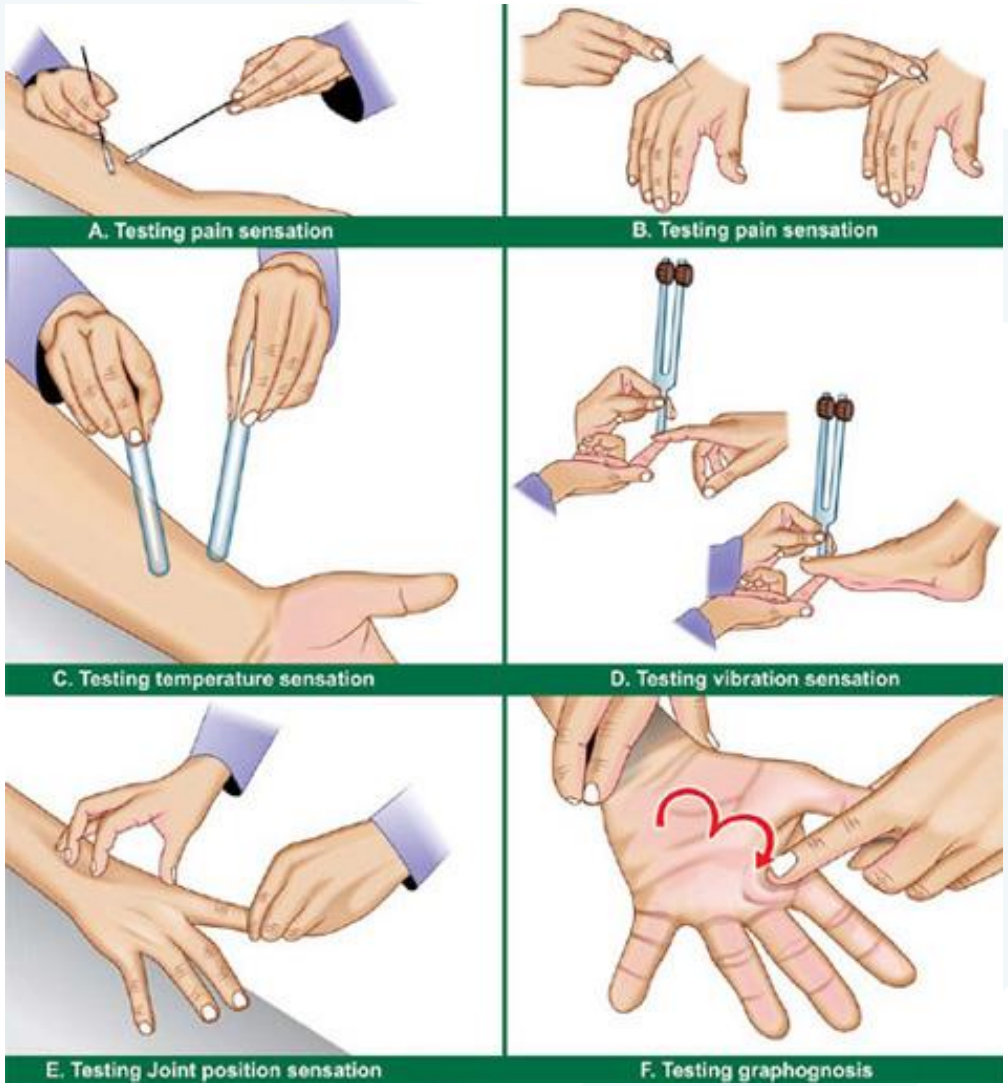
- The ability to recognize letters, numbers, or designs traced on the skin is examined using fingertip or the eraser end of the pencil. the patient is asked verbally the figures drawn on the skin.

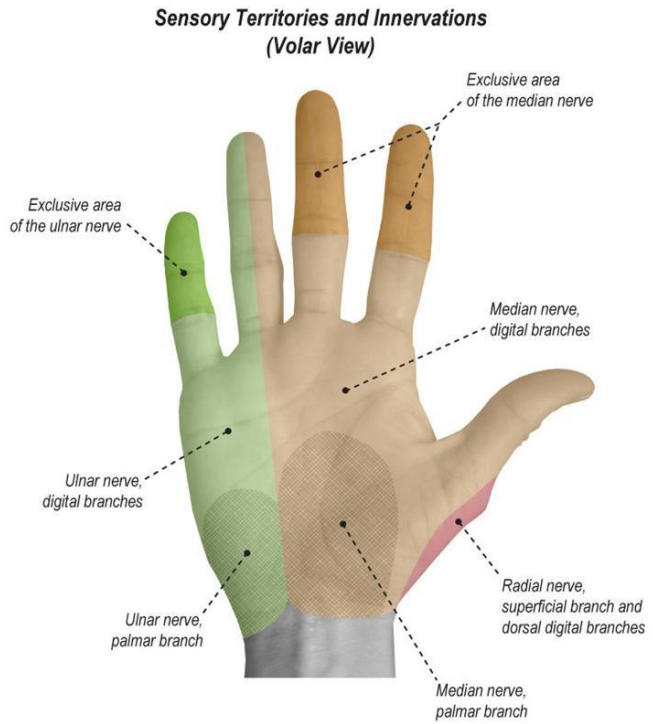
- Recognition of Texture

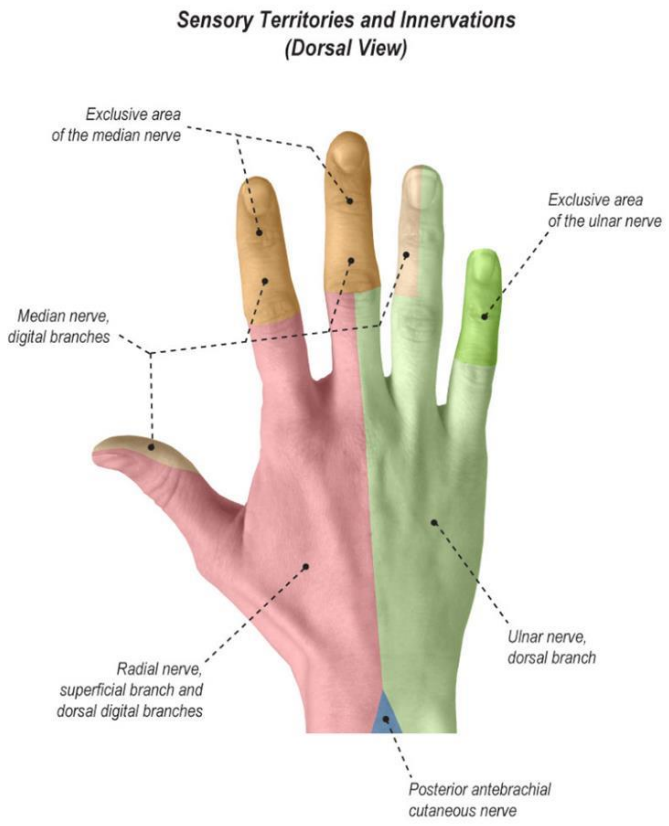
- The test examine the ability to differentiate among various textures like cotton, wool, or silk.

- Barognosis(Recognition of weight)

- For the test different weights are used. the therapist may choose to place a series of different weights in the same hand one at a time, place a different weight in each hand simultaneously.


A. Testing pain sensation
B. Testing pain sensation
C. Testing temperature sensation
D. Testing vibration sensation
E. Testing Joint position sensation
F. Testing graphognosis


Sensory Territories and Innervations
(Volar View)
Exclusive area of the median nerve
Exclusive area of the ulnar nerve
Median nerve, digital branches
Ulnar nerve, digital branches
Radial nerve, superficial branch and dorsal digital branches
Ulnar nerve, palmar branch
Median nerve, palmar branch

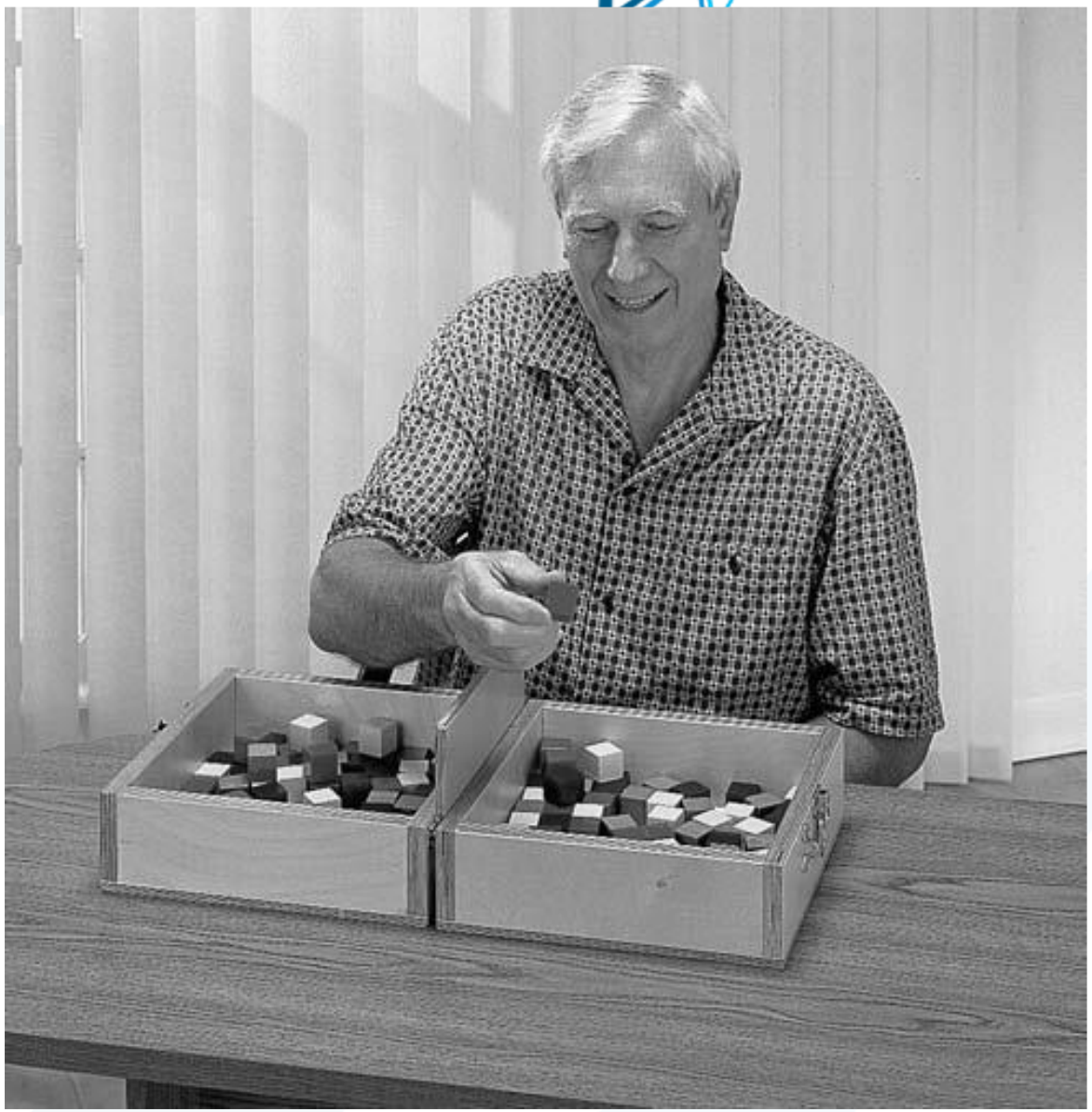

Sensory Territories and Innervations
(Dorsal View)
Exclusive area of the median nerve
Exclusive area of the ulnar nerve
Median nerve, digital branches
Ulnar nerve, dorsal branch
Radial nerve, superficial branch and dorsal digital branches
Posterior antebrachial cutaneous nerve

- **Dexterity and Hand Function**

No one evaluation covers all features of hand function

Box and Block Test

The Box and Block Test measures gross manual dexterity. It was developed to test people with severe problems affecting Coordination. The subject transfers 1-inch blocks from one side of the box to the other. The score is the number of blocks transferred in 1 minute for each hand.



Administration Procedures for the Box and Block Test (Mathiowetz et al., 1985)

- Place the test box lengthwise along the edge of a standard-height table (Fig. 37-2).
- The 150 cubes are in the compartment of the test box to the dominant side of the patient.
- Sit facing the patient to monitor the blocks being transported.
- Give these instructions: "*I want to see how quickly you can pick up one block at a time with your right [left] hand [the therapist points to the dominant hand]. Carry the block to the other side of the box and drop it. Make sure your fingertips cross the partition. Watch me while I show you how.*"
- Transport three cubes over the partition in the same direction the patient is to move them. After the demonstration, say, "*If you pick up two blocks at a time, they will count as one. If you drop one on the floor or table after you have carried it across, it will still be counted, so do not waste time picking it up. If you toss the blocks without your fingertips crossing the partition, they will not be counted. Before you start, you will have a chance to practice for 15 seconds. Do you have any questions? Place your hands on the sides of the box. When it is time to start, I will say 'Ready' and then 'Go.'*"
- Start the stopwatch at the word *go*. After 15 seconds, say "*Stop*."
- If the patient makes mistakes during the practice period, correct them before beginning the actual testing.
- On completion of the practice period, return the transported cubes to the compartment.
- Mix the cubes to ensure random distribution, and then say, "*This will be the actual test. The instructions are the same. Work as quickly as you can. Ready; go. [After 1 minute:] Stop.*"
- Count the blocks transported across the partition. This is the patient's score for the dominant hand.
- If the patient transports two or more blocks at the same time, subtract the number of extra blocks from the total.
- After counting, return the blocks to the original compartment and mix randomly.
- Turn the test around so that the blocks are on the nondominant side.
- Administer the test to the nondominant hand using the same procedures as for the dominant hand, including the 15-second practice.

From Mathiowetz, V., Volland, G., Kashman, N, & Weber, K. (1985). Adult norms for the box and block test of manual dexterity. *American Journal of Occupational Therapy, 39*, 386–391.

Table 37-1 Average Performance of 628 Normal Subjects on the Box and Block Test[a]

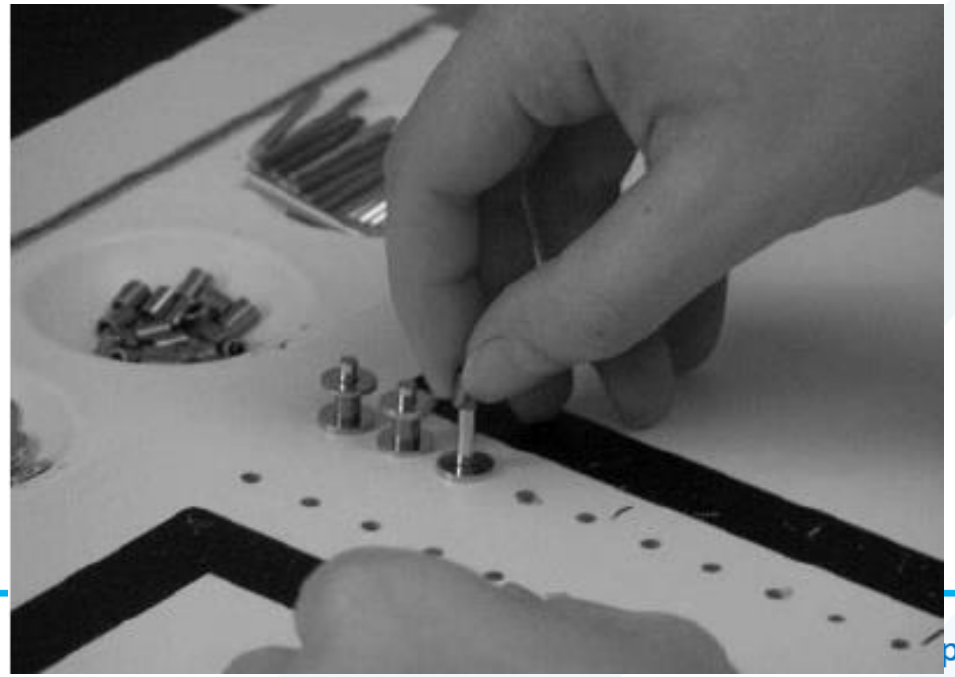
Age (Years)	Males		Females		Age (Years)	Males		Females	
	Mean	*SD*	*Mean*	*SD*		*Mean*	*SD*	*Mean*	*SD*
20–24					50–54				
Right hand	88.2	8.8	88.0	8.3	Right hand	79.0	9.7	77.7	10.7
Left hand	86.4	8.5	83.4	7.9	Left hand	77.0	9.2	74.3	9.9
25–29					55–59				
Right hand	85.0	7.5	86.0	7.4	Right hand	75.2	11.9	74.7	8.9
Left hand	84.1	7.1	80.9	6.4	Left hand	73.8	10.5	73.6	7.8
30–34					60–64				
Right hand	81.9	9.0	85.2	7.4	Right hand	71.3	8.8	76.1	6.9
Left hand	81.3	8.1	80.2	5.6	Left hand	70.5	8.1	73.6	6.4
35–39					65–69				
Right hand	81.9	9.5	84.8	6.1	Right hand	68.4	7.1	72.0	6.2
Left hand	79.8	9.7	83.5	6.1	Left hand	67.4	7.8	71.3	7.7
40–44					70–74				
Right hand	83.0	8.1	81.1	8.2	Right hand	66.3	9.2	68.6	7.0
Left hand	80.0	8.8	79.7	8.8	Left hand	64.3	9.8	68.3	7.0
45–49					75+				
Right hand	76.9	9.2	82.1	7.5	Right hand	63.0	7.1	65.0	7.1
Left hand	75.8	7.8	78.3	7.6	Left hand	61.3	8.4	63.6	7.4

- **Purdue Pegboard Test**

The Purdue Pegboard Test of finger dexterity assesses picking up, manipulating, and placing little pegs into holes with speed and accuracy. It tests finger or fine motor dexterity.

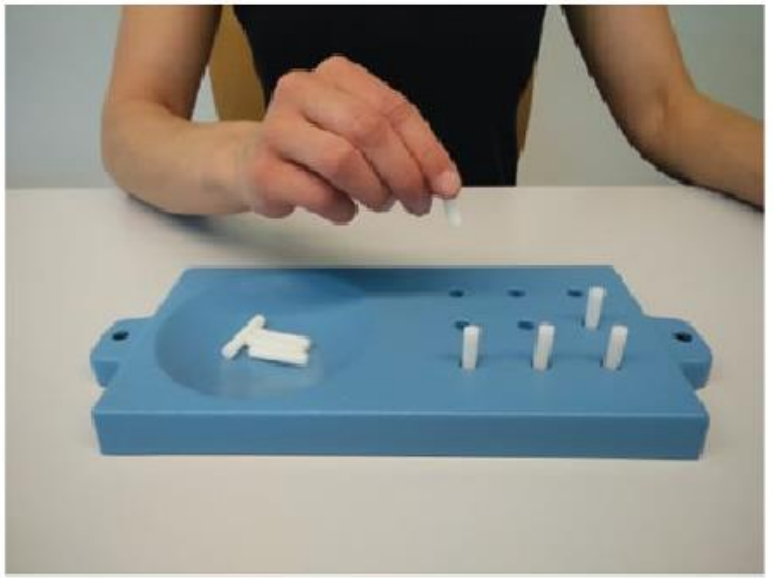
It has a wooden board with two rows of tiny holes plus reservoirs for holding pins, collars, and washers. The four subtests are performed with the subject seated. To begin, there is a brief practice. The subtests for preferred, nonpreferred, and both hands require the patient to place the pins in the holes as quickly as possible, with the score being the number of pins placed in 30 seconds.

- The subtests for preferred, nonpreferred, and both hands require the patient to place the pins in the holes as quickly as possible, with the score being the number of pins placed in 30 seconds. The subtest for assembly requires the patient to insert a pin and then put a washer, collar, and another washer on the pin, with the score being the number of pieces assembled in 1 minute. The Purdue Pegboard Test manual provides normative data using percentile tables for adults and different categories of jobs and for children 5–15 years of age by age and sex.



- **Nine-Hole Peg Test**

The Nine-Hole Peg Test measures finger dexterity among patients of all ages. Test administration is brief, involving the time it takes to place nine pegs (7 mm diameter, 32 mm length) in holes in a 5-inch square board and then remove them.



- Scoring:

- The number of seconds it takes for the patient to complete the test.
- Alternative scoring - the number of pegs placed in 50 or 100 seconds can be recorded. In this case, results are expressed as the number of pegs placed per second.

- **TEMPA**
- TEMPA is an acronym from the French for Upper Extremity Performance Test for the Elderly. It consists of nine tasks, five bilateral and four unilateral, reflecting daily activity. Each task is measured by the three sub scores of speed, functional rating, and task analysis.
- The nine tasks are 1.to pick up and move a jar, 2. open a jar and take a spoonful of coffee, 3. pour water from a pitcher into a glass, 4. unlock a lock, 5. take the top off a pillbox, 6. write on an envelope and affix a postage stamp, 7. put a scarf around one's neck, 8. shuffle and deal cards, use coins, and 9. pick up and move small objects.

- The test takes about 15–20 minutes for an unimpaired elderly subject and about 30–40 minutes for an impaired elderly subject. Advantages of the TEMPA are clinical use, especially with hand patients older than 60 years of age.

CLINICAL REASONING AND INTERVENTION

- **Questions to Ask**
- General categories of questions may include the physician's expectations for functional recovery; tendon status, such as fraying or vascular compromise; whether the patient is medically cleared for AROM only or AROM and/or PROM; and whether the patient is medically cleared for low-load, long-duration dynamic splinting.
- **Activities of Daily Living and Occupational Role Implications**
- The functional use of the upper extremity and the patient's ability to perform in the areas of occupation are what really matter.

- **Goal Setting:**
- Express hand therapy goals or projected outcomes in terms that reflect the patient's occupational functioning. Ultimately, the number of degrees achieved in ROM is less important than whether the patient can open a door, get dressed, or return to work. One way to integrate concrete and functional outcomes is to measure the movement needed to accomplish an appropriate patient-specific functional task and incorporate that measurement into the stated goal.
- For example, if a patient wants to be able to splash water on his or her face but lacks forearm supination to do so, have the patient perform the activity with the opposite upper extremity. Measure the supination needed to perform the task. In this instance, the goal could be stated as "sufficient forearm supination (60°) for ability to wash the face."

- **Quality of Movement**
- Poor quality of movement (called dys-coordinate co-contraction) may result from co-contraction of antagonist muscles. The cause may be habit, fear of pain, guarding, or excessive effort. Poor quality of movement looks awkward and unpleasant. It is important to identify dys-coordinate co-contraction early and to work on retraining a smooth, comfortable, effective quality of motion. Pain-free occupation is the best way to promote good quality of motion.
- Oscillations are rhythmic therapeutic movements that may be helpful, but they must be pain free. Imagery, such as pretending to move the extremity through water or gelatin, may also help (Cooper, 2007). Biofeedback may aid in muscle reeducation as well.

What Structures Are Restricted, and Does Passive Range of Motion Exceed Active Range of Motion?

- It is not adequate to identify a general problem, such as decreased ROM. Rather, it is important to understand and treat the specific structures causing the restriction. Limited PROM may be due to pericapsular structures, such as adhered or shortened ligaments, or actual joint limitations, such as mechanical block or adhesions.

- PROM that exceeds AROM may be due to disruption of the musculotendinous unit, adhesions restricting excursion of the tendon, or weakness.
- When PROM exceeds AROM, promote active movement and function of the restricted structures with differential tendon gliding exercises, blocking exercises, place-and-hold exercises, and functional orthoses.
- When PROM equals AROM, discern whether the restriction is joint or musculotendinous or both and promote both passive and active flexibility.

- **Joint versus Musculotendinous Tightness**
- With joint tightness, the PROM of the particular joint does not change with repositioning of the joints proximal and/or distal to it. With musculotendinous tightness, the PROM of the particular joint does vary with repositioning of joints crossed by that multiarticulate structure.
- Treat joint tightness with dynamic splinting, static progressive splinting, or serial casting, followed by AROM. Treat musculotendinous tightness the same as extrinsic tightness

- **Lag versus Contracture**
- A lag is a limitation of active motion in a joint that has passive motion available. A joint contracture is a passive limitation of the joint. A patient with a PIP extensor lag cannot actively extend the PIP joint even though passive extension is available. A patient with a PIP joint flexion contracture lacks passive extension of that joint.


Over-advancement of the FDP
during tendon repair
Flexion Lag
of Adjacent
Fingers
Quadrigia Effect
Normal

- Treat lags by facilitating motion of the restricted structure with scar management, blocking exercises in mechanically advantageous positions, place-and-hold exercises, static splinting to promote normal length of the involved structure, and functional splints. Treat contractures the same as for joint tightness.
- An advantageous position to test or treat extensor lag at the PIP level is to maintain MP flexion while trying to extend actively at the PIP. An advantageous position to test or treat extensor lag at the DIP level is to maintain MP and PIP flexion while trying to extend actively at the DIP. This is contraindicated if the diagnosis is acute mallet finger.

A

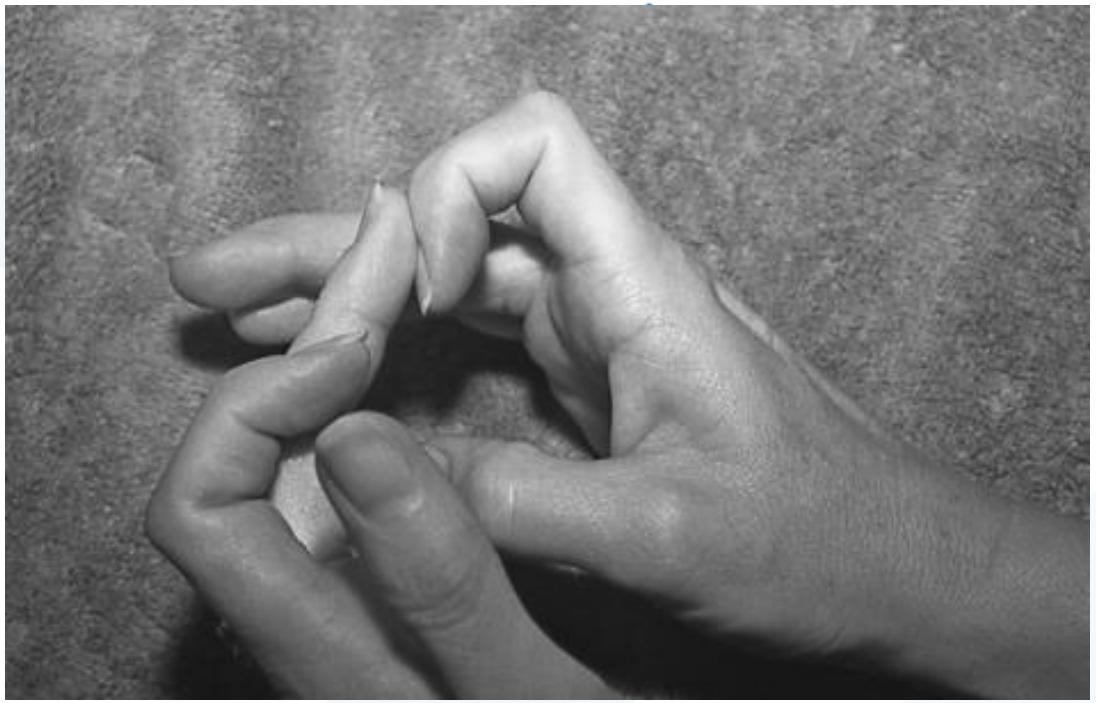
B

C

Intrinsic or Extrinsic Extensor Muscle Tightness

- Intrinsic muscles are the small muscles in the hand. Extrinsic muscles are longer musculotendinous units that originate proximal to the hand.
- Intrinsic tightness and extrinsic extensor tightness are tested by putting these muscles on stretch. This is accomplished by comparing the PROM of digital PIP and DIP flexion when the MP joint is passively extended and then passively flexed.
- With interosseous muscle tightness, passive PIP and DIP flexion is limited when the MP joint is passively extended or hyperextended. With extrinsic extensor tightness, PIP and DIP flexion is limited when the MP joint is passively flexed.

- To treat intrinsic tightness, perform PIP and DIP flexion with MP hyperextension. Functional orthotics are very helpful for isolating specific exercise to restore length to the intrinsics while performing daily activities. In other words, promote IP flexion with MPs hyperextended.
- To treat extrinsic extensor tightness, promote composite motions (that is, combined flexion motions of the wrist, MPs and IPs) with orthotics, gentle stretch, and exercise. Instruct the client that performing these exercises with the wrist in a variety of positions is helpful.



Interosseous muscle tightness.Proximal interphalangeal (PIP) and distal interphalangeal (DIP) flexion is passively limited when the metacarpophalangeal (MP) joint is passively extended or hyperextended.

Extrinsic extensor tightness.PIP and DIP flexion is passively limited when the MP joint is passively flexed.

Figure 6

A B

Clinical photographs of the intrinsic tightness test. **A,** The metacarpophalangeal (MCP) joint is held extended while the degree of proximal interphalangeal (PIP) joint motion is measured (arrow). **B,** The MCP joint is flexed, and the degree of PIP motion is again examined (arrow). With intrinsic contracture, PIP joint motion is restricted while the MCP joint is extended and is improved when the MCP joint is flexed.

- **Tightness of Extrinsic Extensors or Extrinsic Flexors**
- With extrinsic extensor tightness, there is less passive composite digital flexion available with the wrist in flexion than with the wrist in extension. In contrast, with extrinsic flexor tightness, there is less passive composite digital extension available with the wrist in extension than with the wrist in flexion. Treat extrinsic flexor or extensor tightness with place-and-hold exercises, static splinting comfortably at end range (especially useful at night), dynamic or static progressive splinting during the day, and functional splinting.