


Disorders of Voluntary Movement

Paralysis and Paresis



Cynthia Robinson, PT, PhD
Associate Teaching Professor and Director of Clinical Education
School of Medicine
University of Washington
Seattle, WA, USA

Objectives



- Participants will be able to explain the following related to voluntary muscle function
 - Clinical examination components
 - Clinical examination techniques
 - Clinical interventions
 - Standardized outcome measures

Overview of Patient Examination

- Subjective interview
 - Predisposing, precipitating, and perpetuating factors
- Objective measurements
 - Observation of posture and movement
 - Joint range of motion
 - Muscle performance
 - Reflex integrity
- Standardized outcome measures
 - Patient reported outcome measures
 - Functional outcome measures

Subjective Interview

- Primary complaint and/or problem
- History of current episode
 - Onset, symptoms, associations,
 - Diagnostic tests
 - Medical/surgical procedures
 - Medications
 - Previous treatment/ rehabilitation
- Social History
 - Living situation, social support, home environment
 - Work support, work environment

Subjective Interview

- Current function vs. function prior to onset
 - Activities of daily living (ADLs)
 - Ambulation, transfers/transitions, sitting/standing tolerance
 - Instrumental activities of daily living (IADLs)
 - Driving, meal preparation, self care and home management
 - Social roles
 - Parent, student, employee
- Lifestyle, health, and fitness
- Occupational/recreational/educational history
- Patient/caregiver goals

Overview of Objective Examination

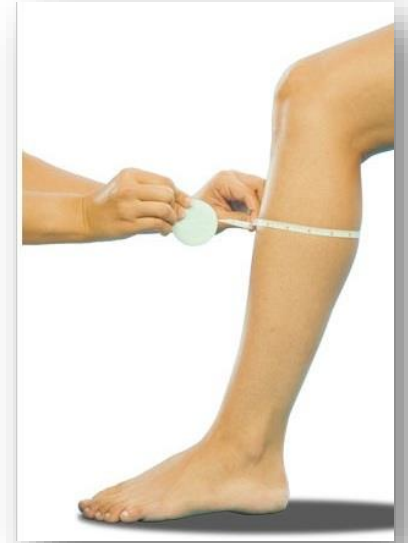
- Musculoskeletal
 - Posture
 - Gross range of motion
 - Gross strength
- Neuromuscular
 - Deep tendon reflexes
 - Pathologic reflexes
- Gross movement
 - Functional activities
- Standardized Outcome Measures



Figure 1 The bones and muscles work together to provide structure, support, protection, and movement.

General Observation – Symmetry & Alignment

- Asymmetrical muscle bulk
 - Atrophy
 - Hypotrophy



General Observation: Spontaneous

- Posture
- Movement

BAD POSTURE

VS

GOOD POSTURE



- Reduced Spine Motion



- Neck & Back Pain



- Chronic Fatigue



- Bad Blood Circulation



- Potential Disc Herniation



- More Energy



- Looking Good



- Prevents Backache



- Joint Protection



- Spine Protection



Posture Affects Function

Consider posture of extremities, not just trunk and neck

- Position of the eyes
- Produces abnormal strain on muscles and other soft tissue structures
- Can compress nerves and blood vessels
- Changes the position of the COM in relation to the BOS
 - COM- center of mass
 - BOS- base of support
- Impacts UE ROM
- Impacts respiratory function
- For every action, there is an equal and opposite reaction!!

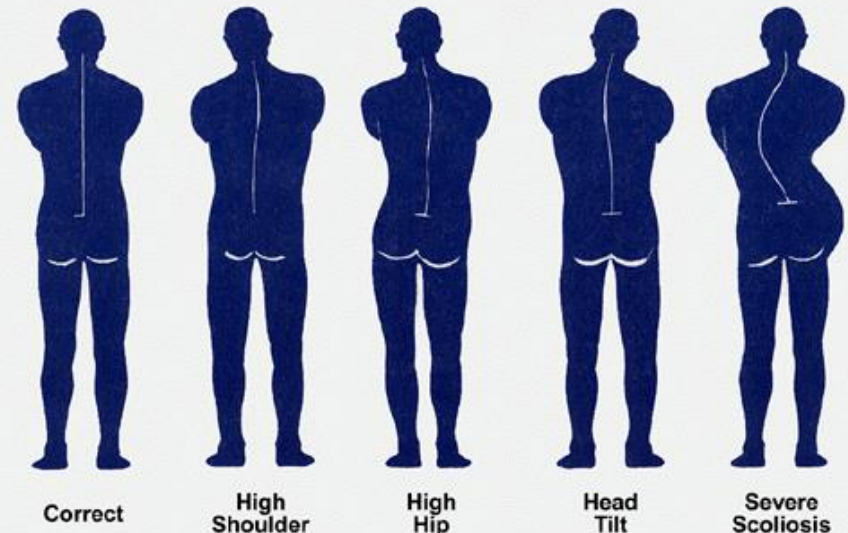
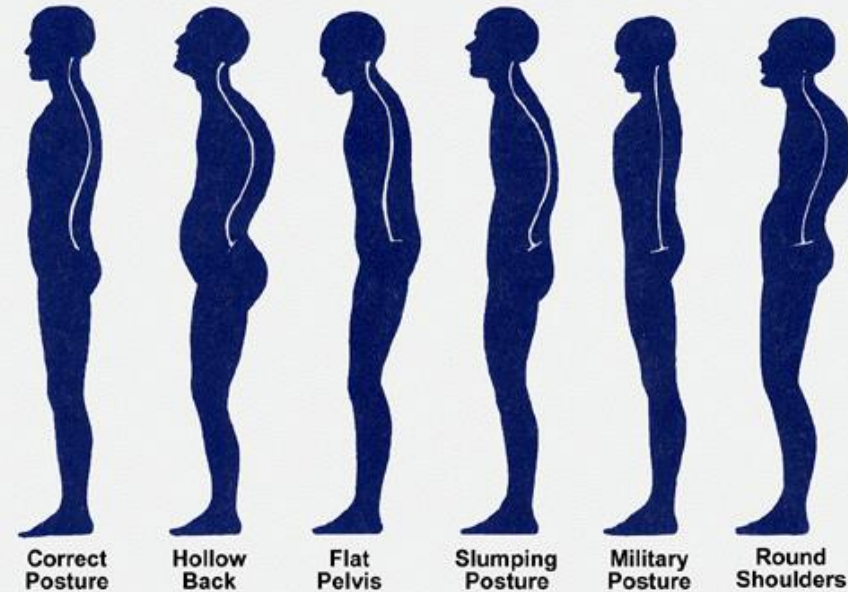


General Observation

Use your eyes and your hands

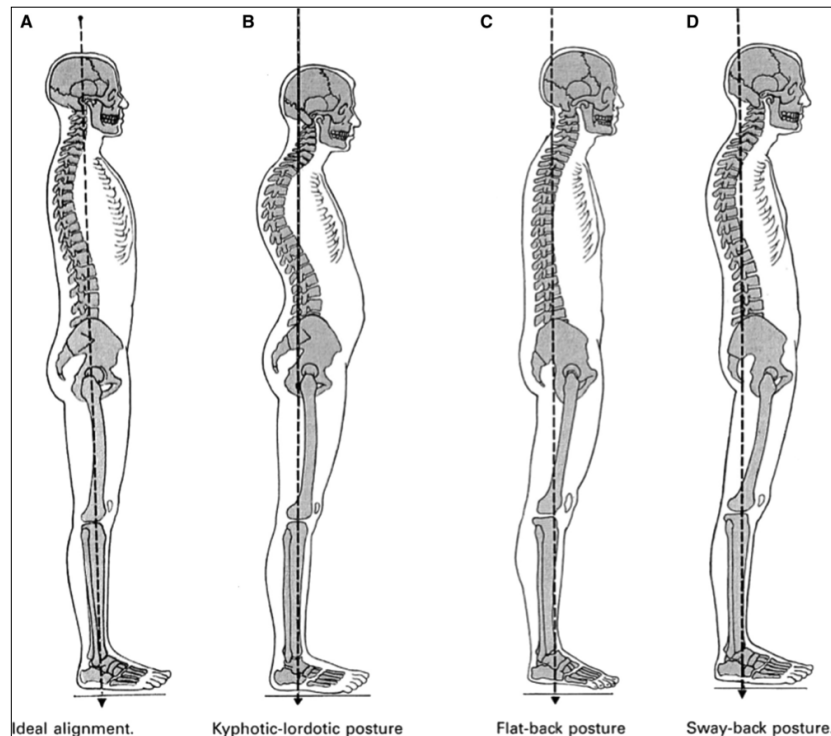
- Symmetry
- Alignment
- Muscle bulk

LOOK AT YOUR POSTURE... OTHERS DO



Objective Examination - Musculoskeletal

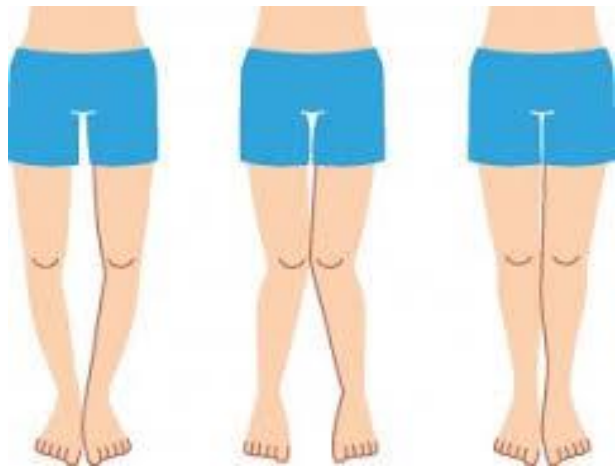
- Standing posture
 - Plumb line
 - Kendall's Classification



An imaginary plumb line falls:		Think of the body as a series of building blocks. In good body alignment these blocks balance one above the other
just behind the apex of the coronal suture		The centre of the head, usually the ear, sits above
through the centre of the external auditory meatus and the upper cervical vertebral bodies		the centre of the chest which in turn sits above
through the centre of the thorax		
and the lumbar vertebral bodies		
just behind the axis of the hip joint		the centre of the pelvis, which sits above
just in front of the axis of the knee joint		
just in front of the lateral malleolus		the centre of the feet

Objective Examination - Musculoskeletal

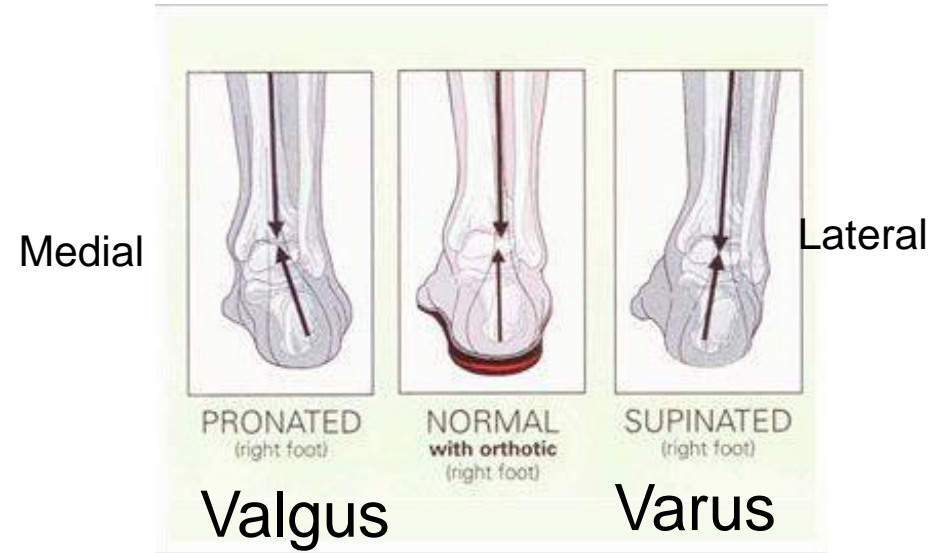
- Knee and Ankle



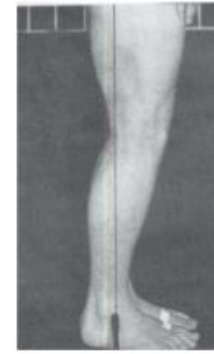
Genu
Varum

Genu
Valgum

Normal



Good Alignment



Flexion of Knees

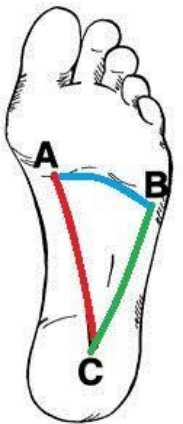


Hyperextension
of knees

Objective Examination - Musculoskeletal

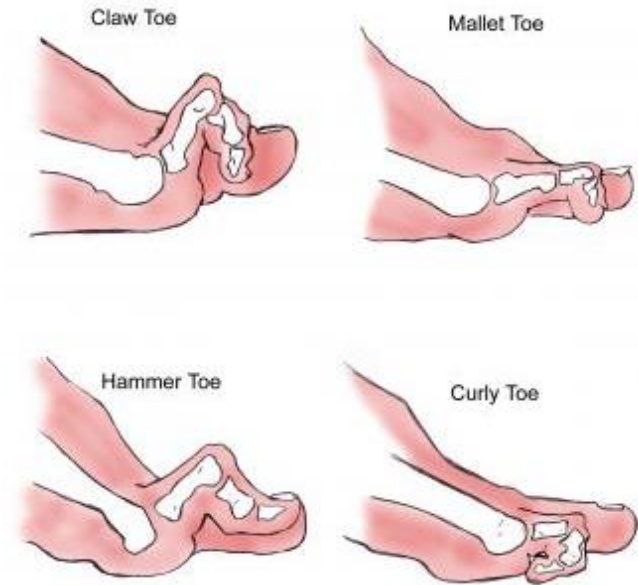
- Foot and Toes

Observe for calluses in unexpected locations



Horizontal Arch

Longitudinal Arch



Hallux Valgus



Calluses

Objective Examination - Musculoskeletal

- Sitting posture - Impact on function



Anterior Pelvic Tilt



Pelvic Obliquity



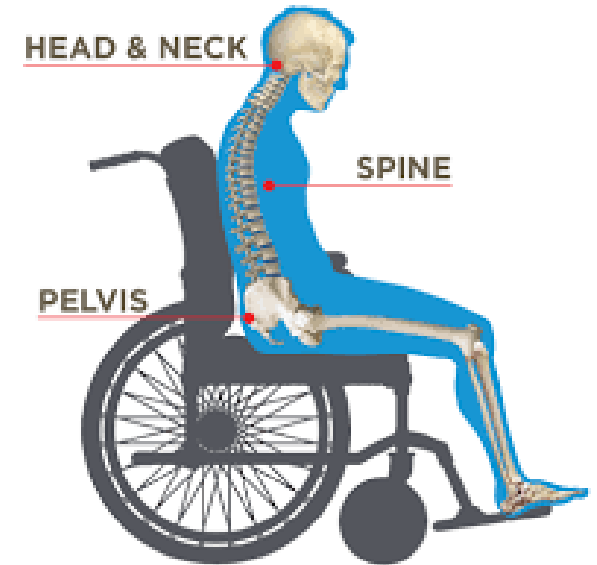
Pelvic Rotation



Posterior Pelvic Tilt



Windswept Deformity



Objective Examination - Musculoskeletal

- Supine posture



Low tone



High tone

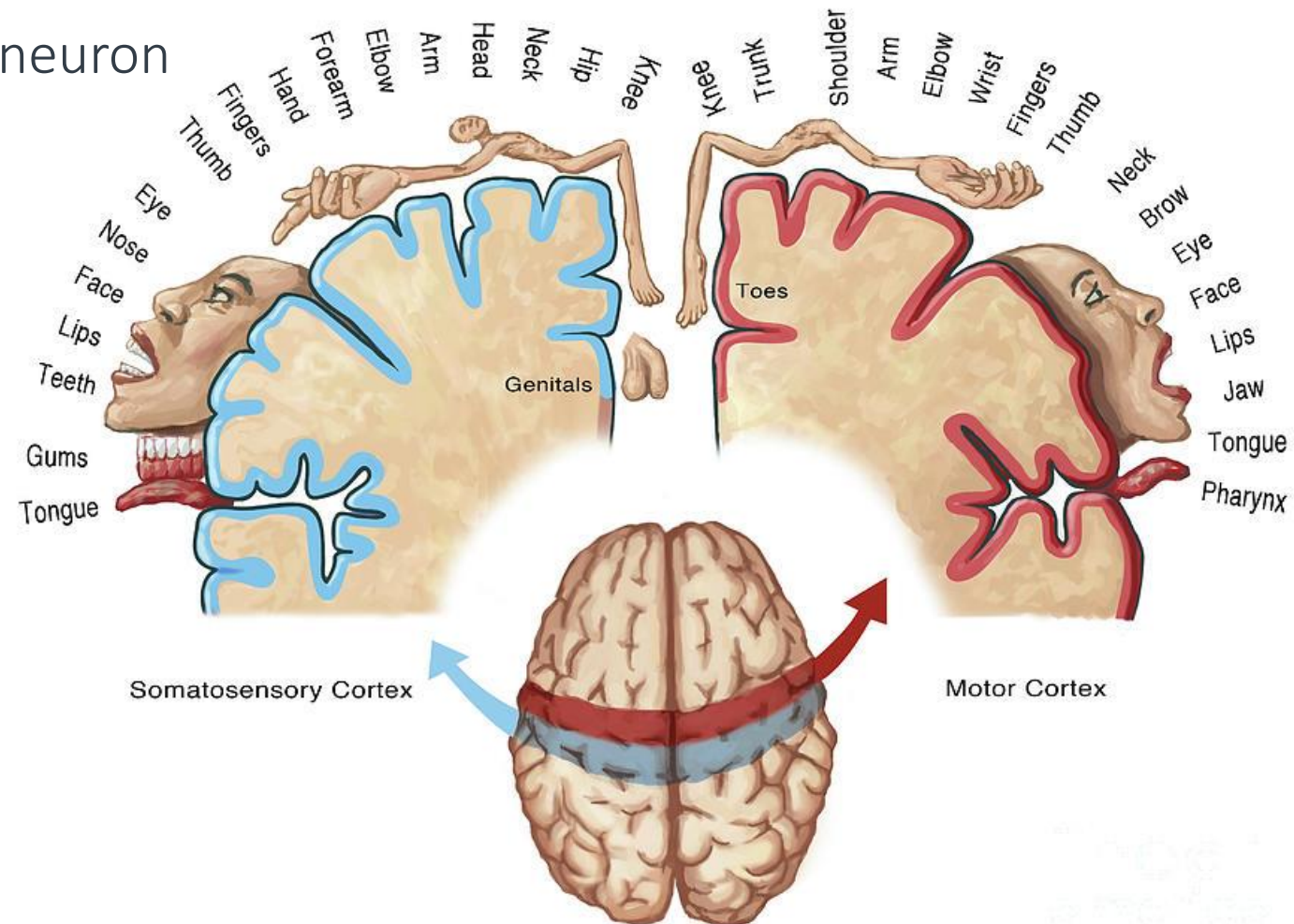
MANUAL MUSCLE TESTING



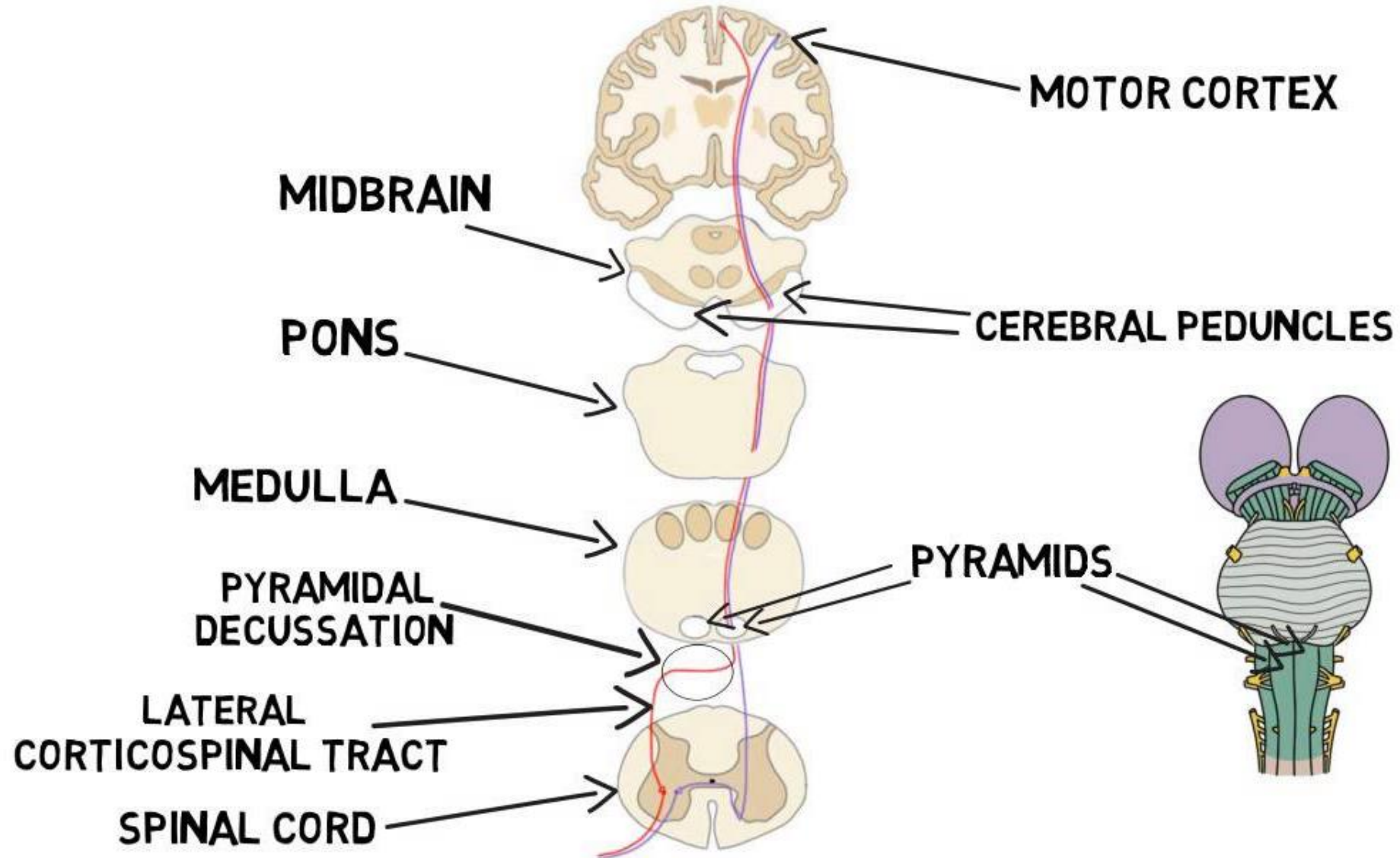
Cortex – Gyrus Precentralis

1st neuron

- Upper motor neuron



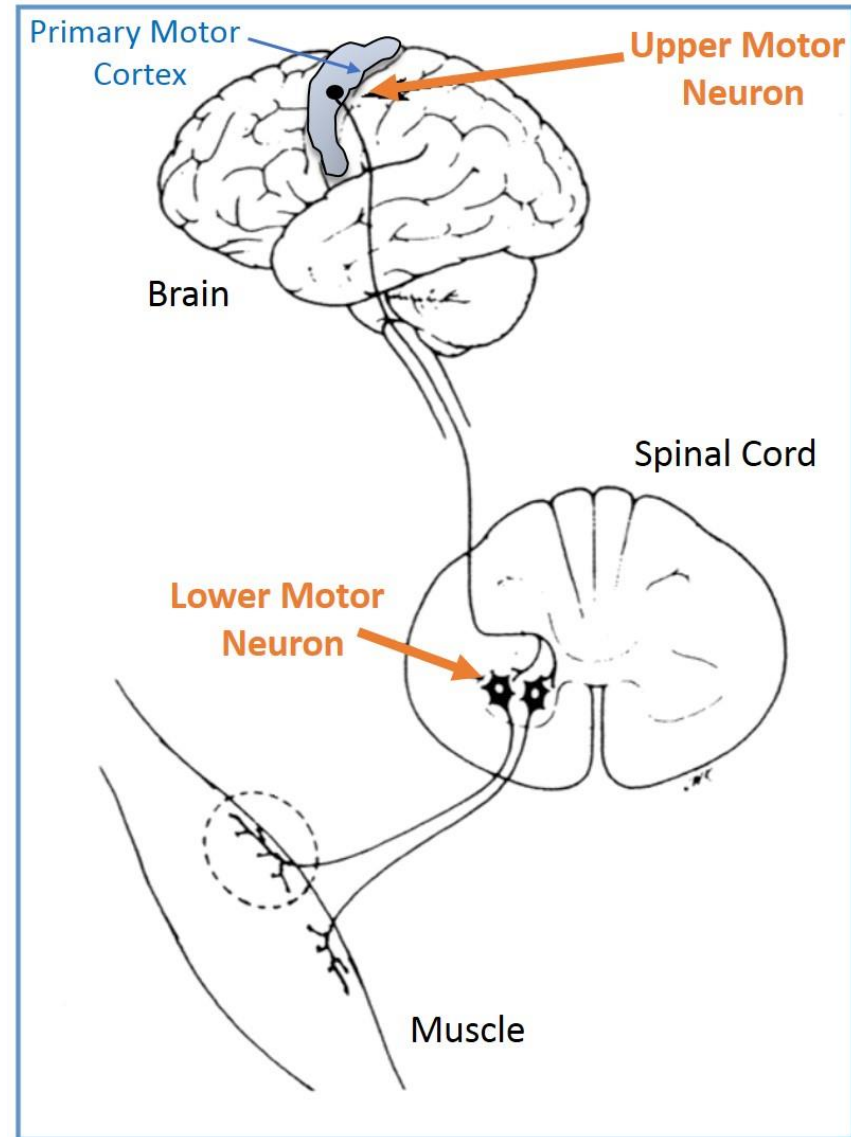
Pyramidal (Corticospinal) Tract



Spinal Cord – Anterior Horns

2nd neuron

- Lower motor neuron



Disruption at any location in the path



- Paresis
 - Muscle strength >0 , but <5
- Paralysis (-plegia)
 - No active movement
 - Muscle strength 0

Classification of Paresis and Paralysis



By neural segments involved

- Central
 - 1st neuron
- Peripheral
 - 2nd neuron

By body segments involved

- Mono – single limb
- Hemi – one half of body
- Para – lower extremities
- Tri – 3 extremities
- Tetra – 4 extremities
 - quadriplegia

Mapping the Spinal Cord

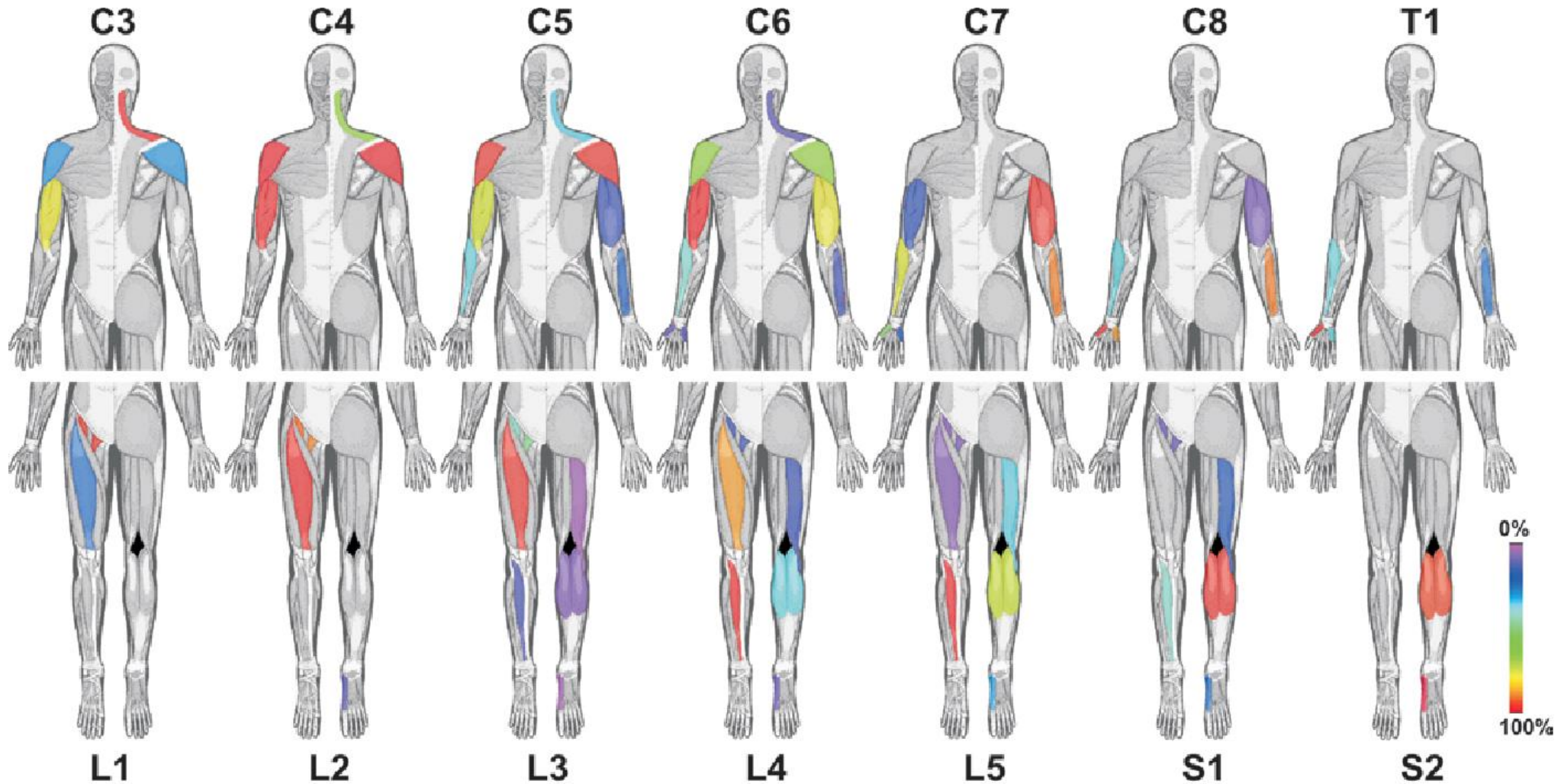


FIG. 1. Overview of the contributions of the individual nerve roots stimulated to individual muscle groups studied. The muscles are color coded to reflect the rate of response.

Manual Muscle Testing Principles

- Subject assumes standardized testing position
- Muscle is moved actively through full range of motion to confirm at 3/5 strength
- Resistance is applied at the furthest distance of the body segment
 - Do not cross more than one joint
- If 3/5 strength demonstrated
 - Patient actively moves to mid-range of muscle
 - Resistance applied in opposite direction of motion
 - Resistance applied at furthest point along body segment, without crossing a second joint
- If 3/5 strength not demonstrated
 - Repeat motion in gravity minimized position

Manual Muscle Testing Grading

Grade	Percentage	Description
5	90-100	Moves through full ROM against gravity and takes maximum resistance
4	50-90	Moves through full ROM against gravity and takes moderate resistance
3	20-50	Moves through full ROM against gravity and is unable to take any added resistance
2	5-20	Moves through full ROM in the gravity eliminated position with no added resistance
1	0-5	Tension is palpated in the muscle or tendon, but no motion occurs at the joint
0	0	No tension is palpated in the muscle or tendon

Manual Muscle Testing - Dynamometry

- More objective, reproducible test results
- Improved inter-rater reliability



MANUAL MUSCLE TESTING

Upper Extremity



Scapular Elevation

Upper Trapezius

- **Position-** short sit
- **Movement-** raise scapulae to bring shoulders toward ears
- **Resistance-** downward over acromial ends of clavicle and scapula
- **Stabilization-** none, monitor spinal posture



Scapular Adduction

Middle Trapezius

- **Position-** prone near edge of table, shoulder abducted 90°, elbow flexed 90° so forearm parallel to floor
- **Movement-** raise arm and shoulder from the table
- **Resistance-** downward through distal humerus
- **Stabilization-** contralateral scapula



Scapular Depression and Adduction

Lower Trapezius

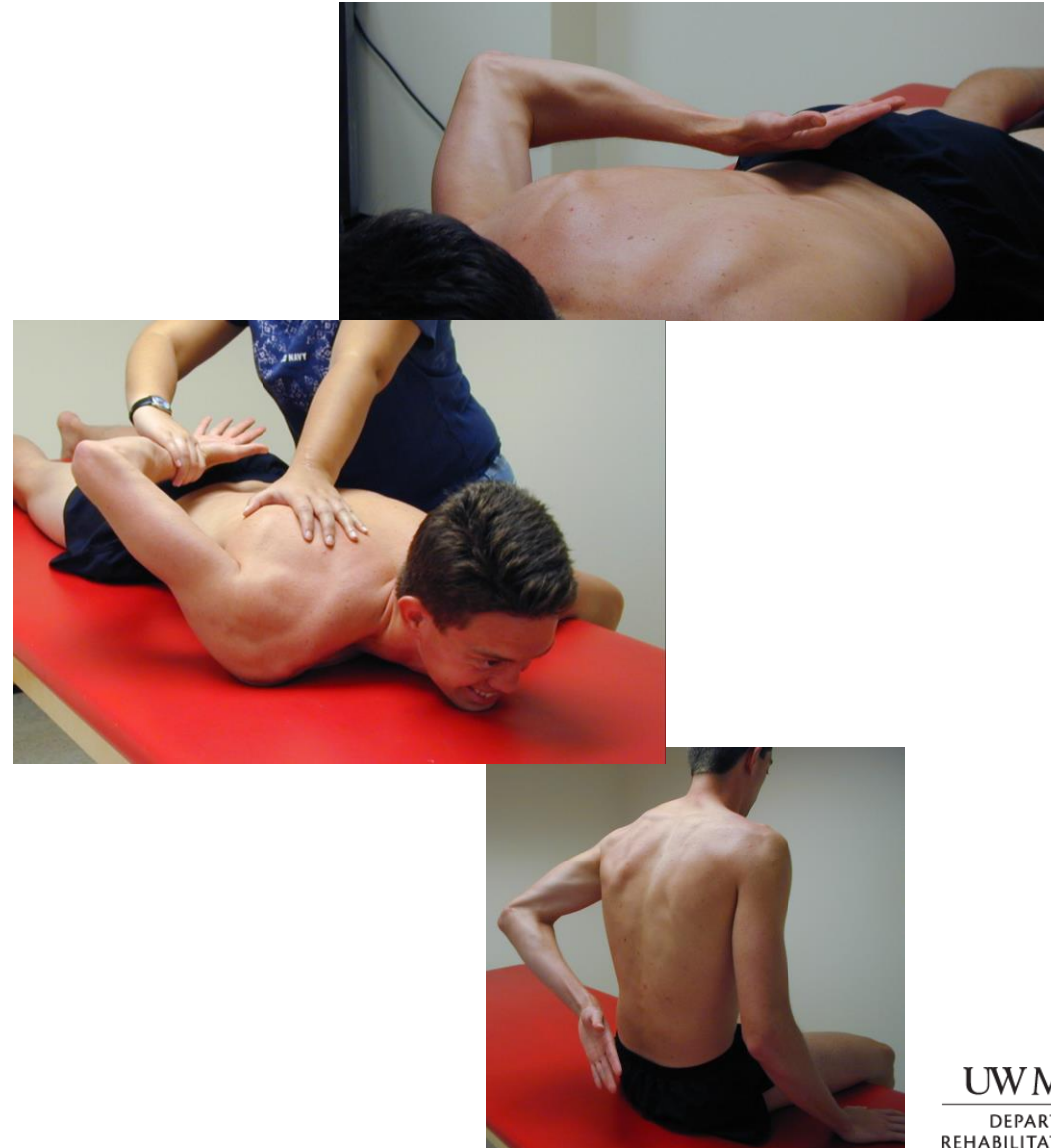
- **Position-** prone with shoulder abducted 145°
- **Movement-** raise arm from the table
- **Resistance-** downward through distal humerus
- **Stabilization-** opposite scapula



Scapular Adduction & Downward Rotation

Rhomboids

- **Position-** prone, shoulder extended and internally rotated, elbow flexed so hand on lumbar spine
- **Movement-** raise hand from back
- **Resistance-** down and away through distal humerus
- **Stabilization-** opposite scapula



Shoulder Flexion

Anterior Deltoid, Coracobrachialis, Supraspinatus

- **Position-** short sit, arm at side
- **Movement-** flex shoulder from 0° to 180°
- **Resistance-** shoulder at 90° , force downward through distal radius
- **Stabilization-** same or opposite shoulder



Shoulder Extension

Latissimus Dorsi, Teres Major, Posterior Deltoid

- **Position-** prone with arm at side
- **Movement-** raise arm
- **Resistance-** downward through distal humerus
- **Stabilization-** opposite scapula



Shoulder Abduction

Supraspinatus and Middle Deltoid

- **Position-** short sit
- **Movement-** abduct arm from 0° to 180°
- **Resistance-** shoulder abducted 90° with palm down, force downward through distal humerus
- **Stabilization-** same or opposite shoulder



Shoulder Horizontal Adduction

Pectoralis Major

- **Position-** supine, shoulder abducted 90°
- **Movement-** raise arm and bring across body
 - Sternal head- reach toward opposite hip
 - Clavicular fibers- reach toward opposite ear
- **Resistance-** distal humerus
 - Sternal head-up and out
 - Clavicular head- down and out
- **Stabilization-** anterior shoulder



Shoulder External Rotation

Infraspinatus and Teres Minor

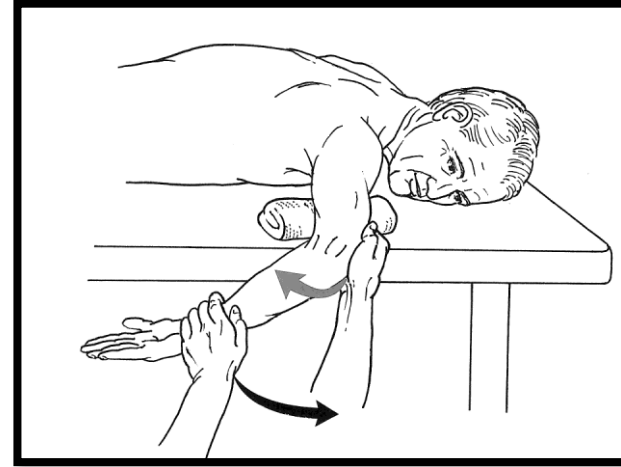
- **Position-** prone, 90° shoulder abduction and 90° elbow flexion, humerus horizontal
- **Movement-** maintain humerus on table, raise back of hand toward ceiling
- **Resistance-** proximal to wrist, downward
- **Stabilization-** humerus



Shoulder Internal Rotation

Subscapularis

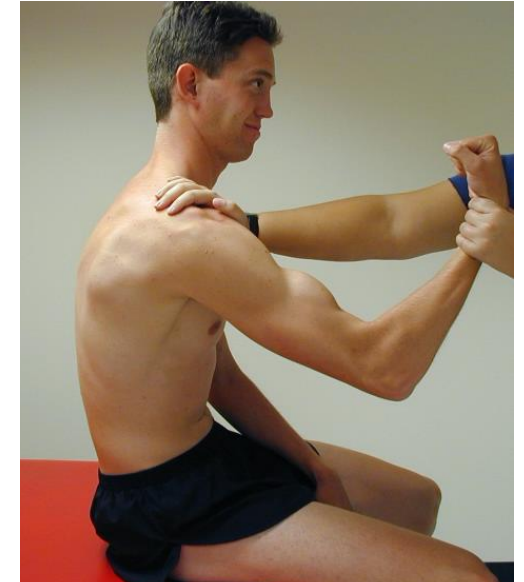
- **Position-** prone, 90° shoulder abduction and 90° elbow flexion, humerus horizontal
- **Movement-** maintain humerus on table, raise palm of hand toward ceiling
- **Resistance-** proximal to wrist, downward
- **Stabilization-** humerus



Elbow Flexion

Biceps Brachii, Brachialis, Brachioradialis

- **Position-** short sit, arm at side
- **Movement-** flex elbow to bring fingers to anterior shoulder
- **Resistance-** proximal to wrist, pull away from shoulder
- **Stabilization-** shoulder



Elbow Extension

Triceps Brachii

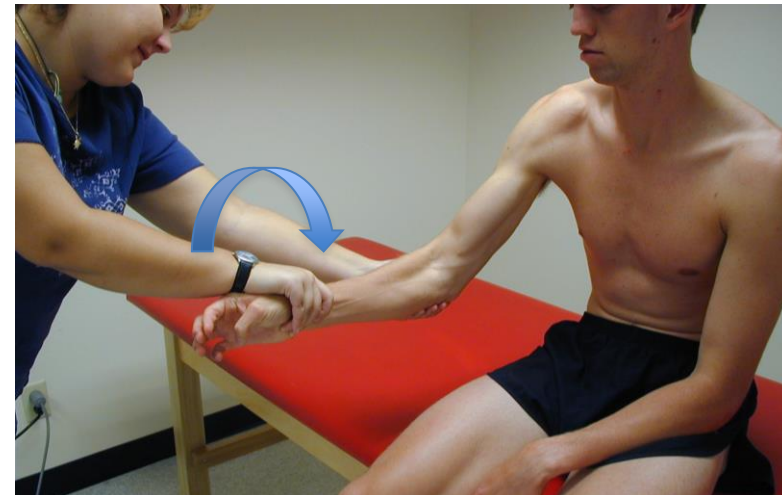
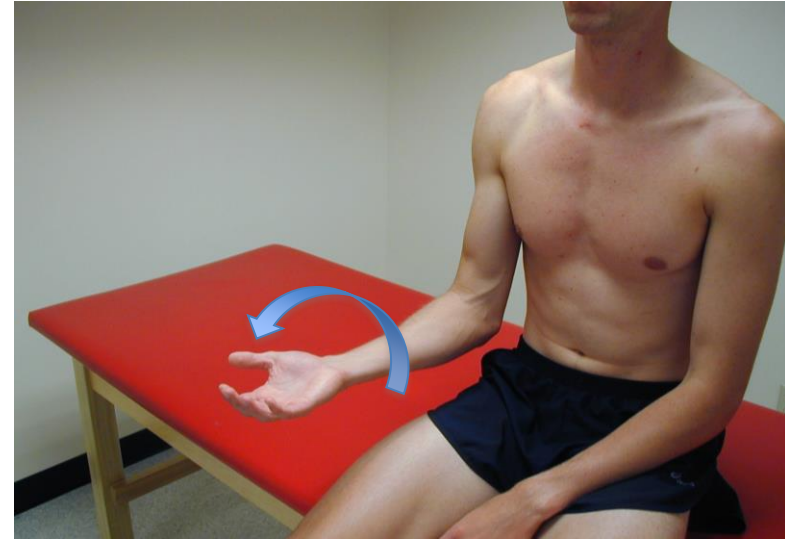
- **Position-** prone, shoulder abducted 90° with humerus horizontal, lower arm off table, elbow flexed 90°
- **Movement-** extend elbow
- **Resistance-** proximal to wrist, force downward
- **Stabilization-** humerus



Forearm Supination

Supinator and Biceps Brachii

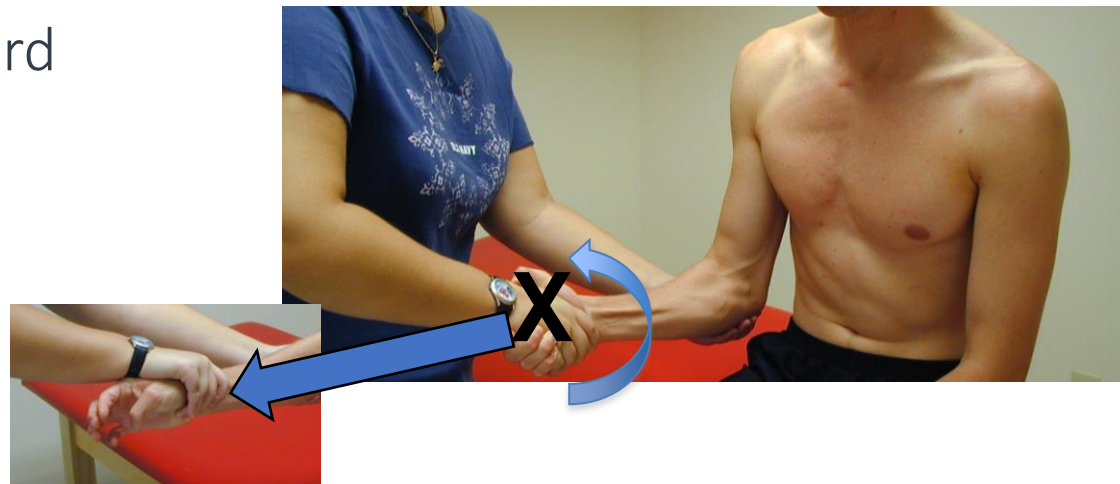
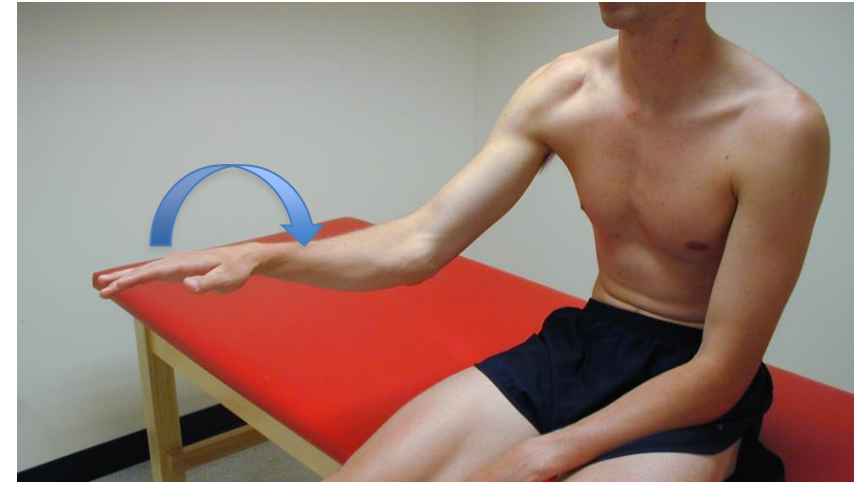
- **Position-** short sit, arm at side, elbow flexed 90° , neutral forearm rotation
- **Movement-** turn palm up to ceiling
- **Resistance-** “lumbrical grip” around distal radius and ulna, rotating toward neutral or pronation
- **Stabilization-** distal humerus



Forearm Pronation

Proator Teres, Pronator Quadratus

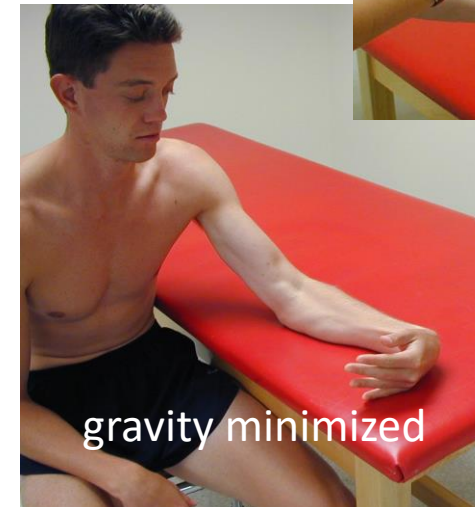
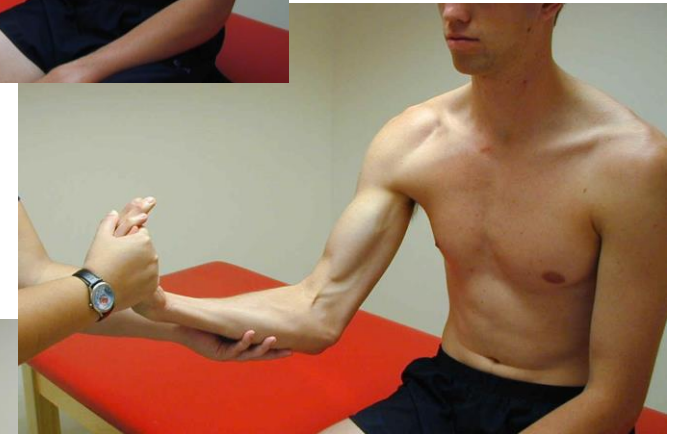
- **Position-** short sit, arm at side, elbow flexed 90° , neutral forearm rotation
- **Movement-** turn palm down to the floor
- **Resistance-** “lumbrical grip” around distal radius and ulna, rotating toward neutral or supination
- **Stabilization-** distal humerus



Wrist Flexion

Flexor Carpi Radialis, Flexor Carpi Ulnaris

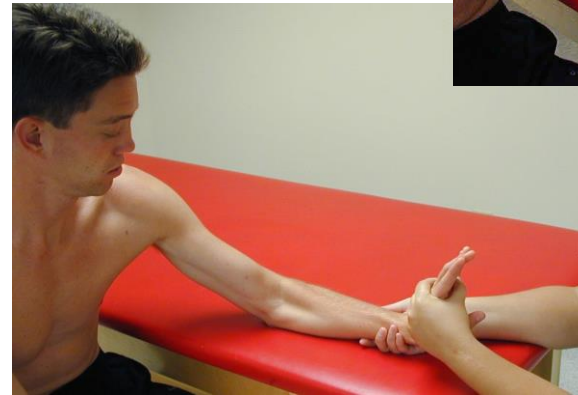
- **Position-** short sit, arm at side, elbow flexed 90° , forearm supinated (or sit with forearm supinated, supported on table)
- **Movement-** flex wrist
- **Resistance-** palm of hand into wrist extension
- **Stabilization-** forearm



Wrist Extension

Extensor Carpi Radialis Longus, Extensor Carpi Radialis Brevis, Extensor Carpi Ulnaris

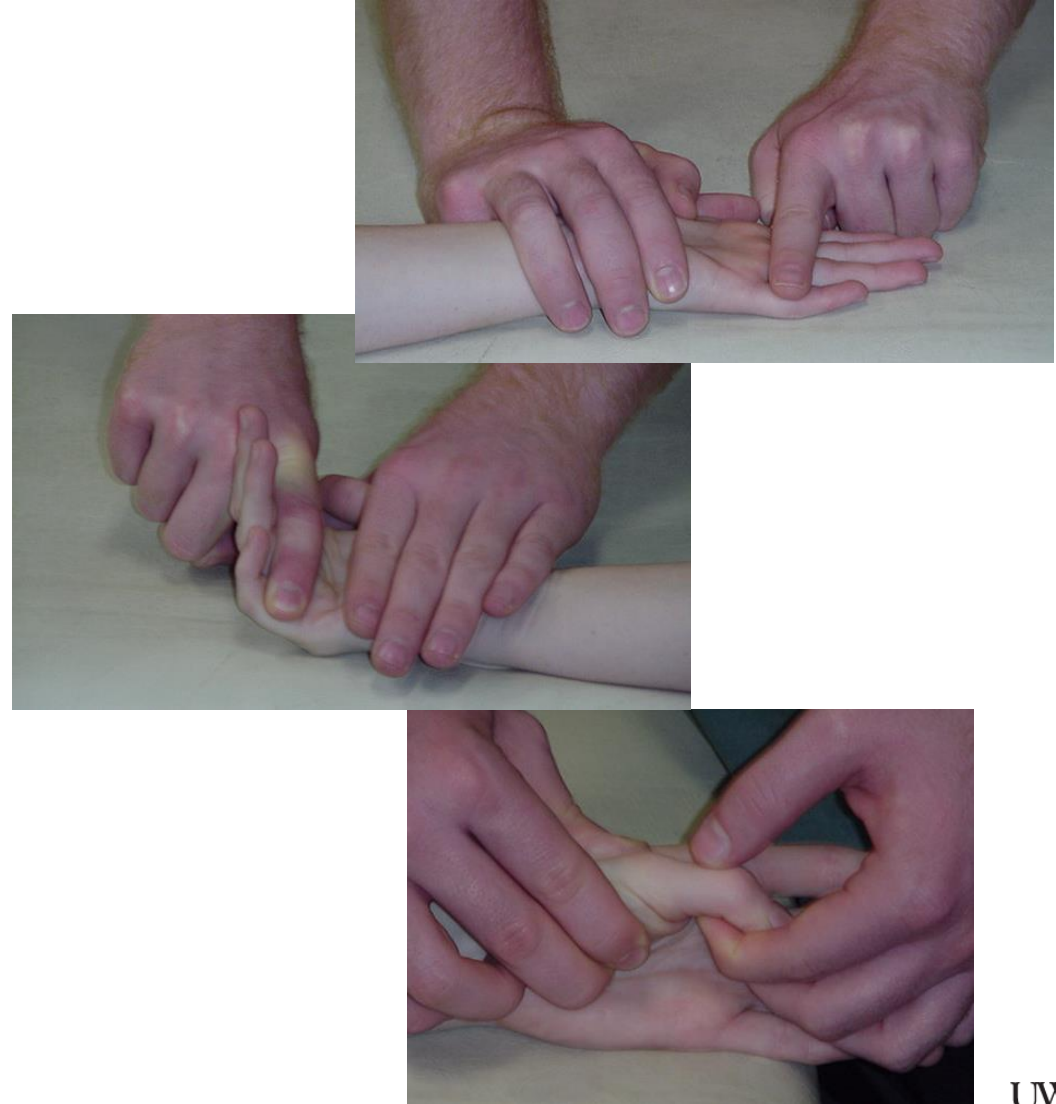
- **Position-** short sit, arm at side, elbow flexed 90° , forearm pronated (or sit with forearm pronated, supported on table)
- **Movement-** extend wrist
- **Resistance-** dorsum of hand into wrist flexion
- **Stabilization-** forearm



Metacarpal-Phalangeal Flexion

Lumbricals and Interossei

- **Position-** sit with forearm supinated, supported on table
- **Movement-**
 - flex metacarpal phalangeal joints of digits 2-5
 - flex metacarpal phalangeal joints of thumb
- **Resistance-** palmar surface of proximal phalanges
- **Stabilization-** wrist and palm of hand



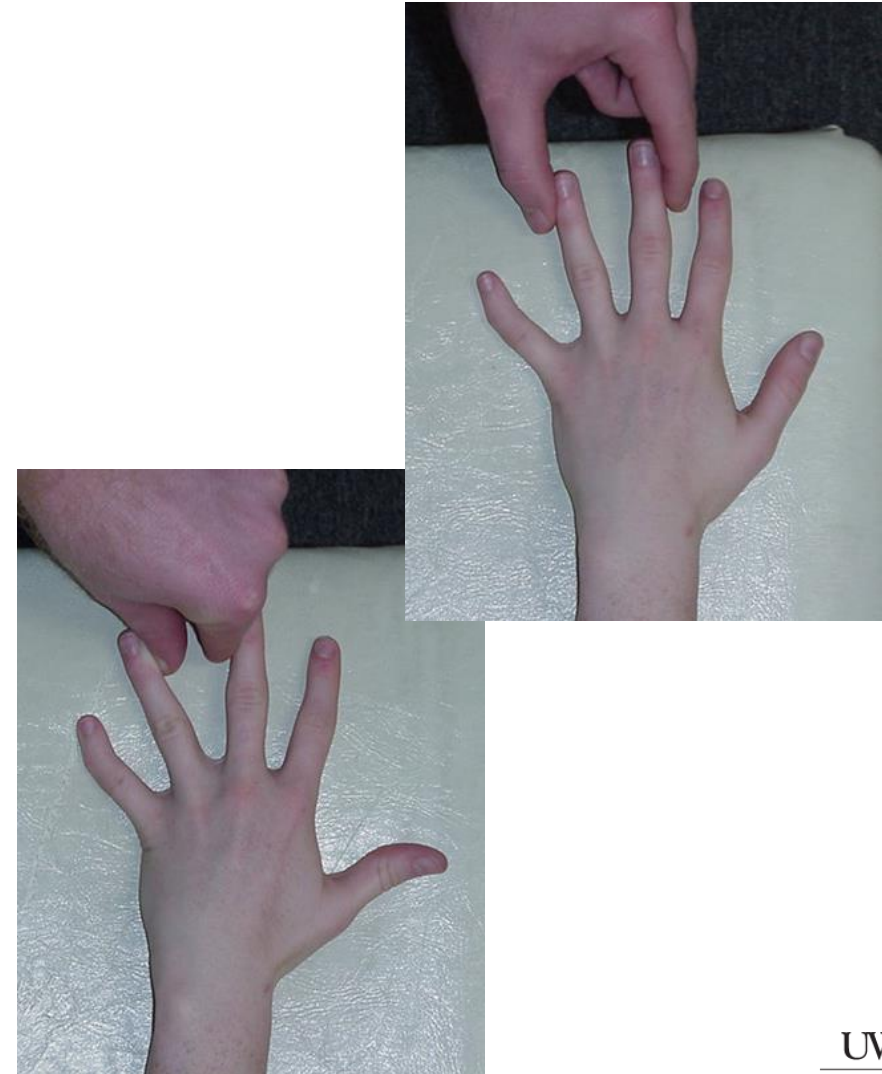
Matacarpal-Phalangeal Extension

- **Position-** sit with forearm pronated, supported on table
- **Movement-**
 - Extend matacarpal phalangeal joints of digits 2-5
 - Extend matacarpal phalangeal joints of thumb
- **Resistance-** dorsal surface of proximal phalanges
- **Stabilization-** wrist and palm of hand



Finger Abduction and Adduction

- **Position-** sit with forearm pronated, hand flat and palm in contact with support surface
- **Movement-**
 - Abduction- spread fingers
 - Adduction- bring fingers together without flexing metacarpal phalangeal joints
- **Resistance-**
 - Abduction- lateral borders of middle phalanges
 - Adduction- medial border of middle phalanges
- **Stabilization-** wrist and palm of hand



Thumb Abduction and Adduction

- **Position-** forearm supported
 - Abduction- forearm neutral, thumb toward ceiling
 - Adduction- forearm pronated
- **Movement-**
 - Abduction- lift thumb toward ceiling
 - Adduction- pull thumb to lateral border of palm
- **Resistance-**
 - Abduction- head of first metacarpal toward lateral border of p
 - Adduction- distal proximal metacarpal of thumb
- **Stabilization-** wrist and hand



MANUAL MUSCLE TESTING

Lower Extremity



Hip Flexion

- **Position-** short sit, post pelvic tilt, hold edge of table
- **Movement-** hip flexion in sagittal plane from 90°-120°
- **Resistance-** anterior surface of thigh proximal to knee
- **Stabilization-** opposite pelvis



Hip Extension

- **Position-** prone with hips extended
- **Movement-** hip extension in sagittal plane from 0°-10°
- **Resistance-** posterior surface of thigh proximal to knee
- **Stabilization-** pelvis



Hip Abduction

- **Position-** side lie slightly toward prone, stabilize with hand in front of body
- **Movement-** hip abduction in frontal plane from 0° - 45°
- **Resistance-** lateral surface of thigh proximal to knee
- **Stabilization-** pelvis



Hip Adduction

- **Position-** side lie, stabilize with hand in front of body
- **Movement-** hip adduction in frontal plane from 0°-20°
- **Resistance-** medial surface of thigh proximal to knee
- **Stabilization-** upper leg



Hip Medial Rotation

- **Position-** Sit with hips and knees flexed 90°
- **Movement-** medially rotate thigh to move foot laterally
- **Resistance-** lateral surface of ankle
- **Stabilization-** distal thigh, do not allow lateral pelvic tilt



Hip Lateral Rotation

- **Position-** Sit with hips and knees flexed 90°
- **Movement-** laterally rotate thigh to move foot medially
- **Resistance-** medial surface of ankle
- **Stabilization-** distal thigh, do not allow lateral pelvic tilt



Hip Abduction/Adduction

Quick Screen

- **Position-** short sitting with knees flexed over edge of treatment table
- **Movement-** bilateral hip abduction followed by adduction
- **Resistance-**
 - bilateral distal lateral thigh (tests abduction)
 - bilateral distal medial thighs (cross arms to push with pectoral muscles during adduction)
- **Stabilization-** none



Knee Extension

- **Position:** Sitting with 45-60° hip flexion (leaning back), thigh supported on table, knee flexed to 90°
- **Movement:** Extend knee completely
- **Resistance:** just proximal to ankle joint with knee flexed 10-20°
- **Stabilize:** Thigh



Knee Flexion

- **Position-** Prone with hips and knees extended
- **Movement-** flex knee in sagittal plane
- **Resistance-** posterior surface of distal leg
- **Stabilization-** distal thigh



Ankle Dorsiflexion

- **Position:** Sit with knee flexed over edge of table
- **Movement:** DF of ankle
- **Resistance:** dorsal forefoot into PF
- **Stabilization:** Leg, proximal to ankle

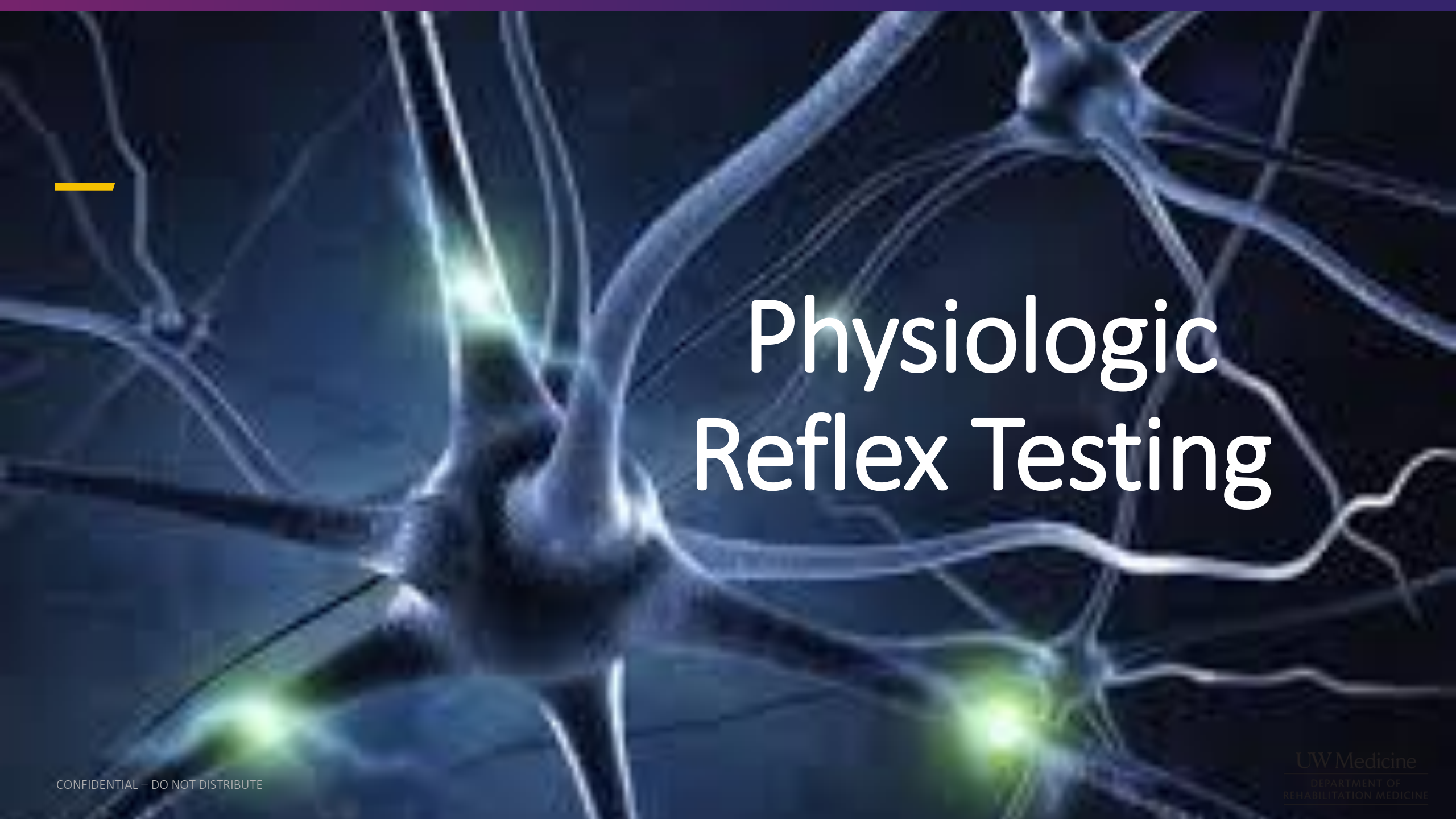


Ankle Plantarflexion

- **Position:** Stand on one foot
- **Movement:** Raise up on toes
- **Resistance:** Body weight
- **Stabilization:** lightly support with hands

Grade: 1 repetition = Fair, 3
 5 repetitions = Good, 4
 10 repetitions = Normal, 5





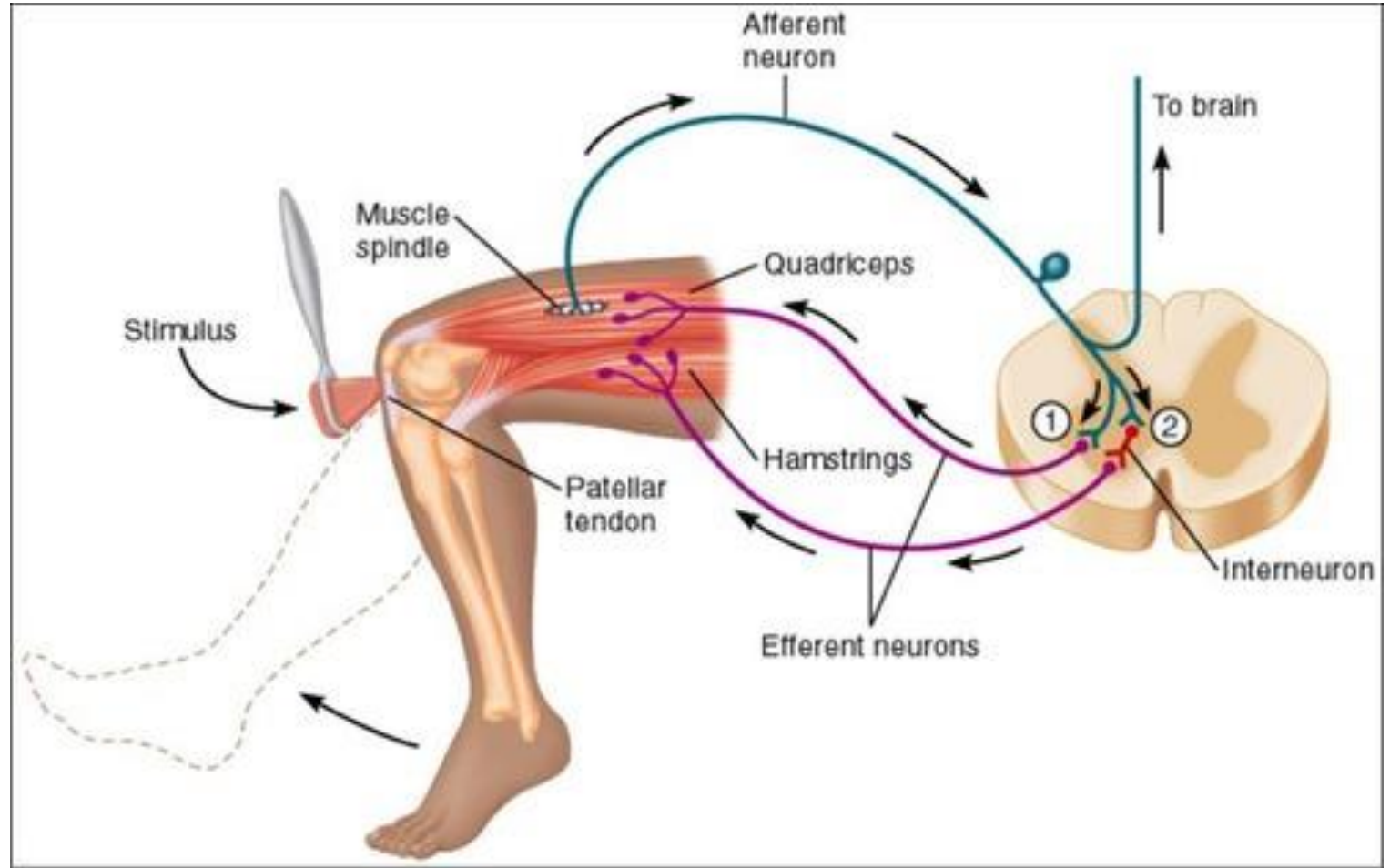
A microscopic image of neurons with glowing green synapses, set against a dark blue background. The neurons are depicted as a network of branching fibers with several bright green points of light at the junctions, representing synaptic activity.

Physiologic Reflex Testing

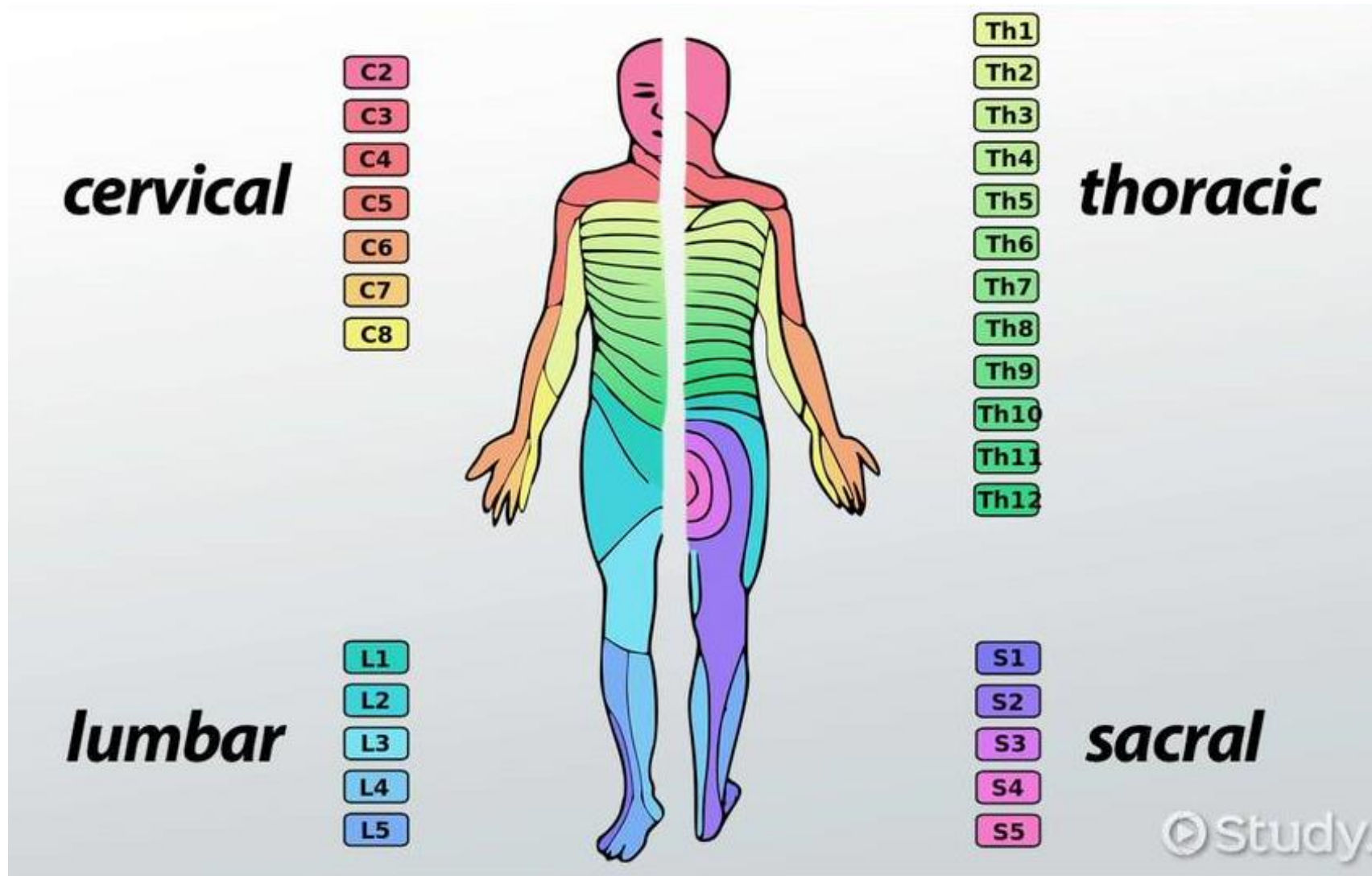
Physiologic Reflex Testing

Assesses integrity of the reflex arc

- “Typical” monosynaptic reflex
 - Mammalian “knee jerk”
- Performed with muscle in mid-range
- Muscle must be relaxed
- Sharply tap the muscle tendon
 - Stretches 1A afferents of neuromuscular spindle



Mapping the Spinal Cord



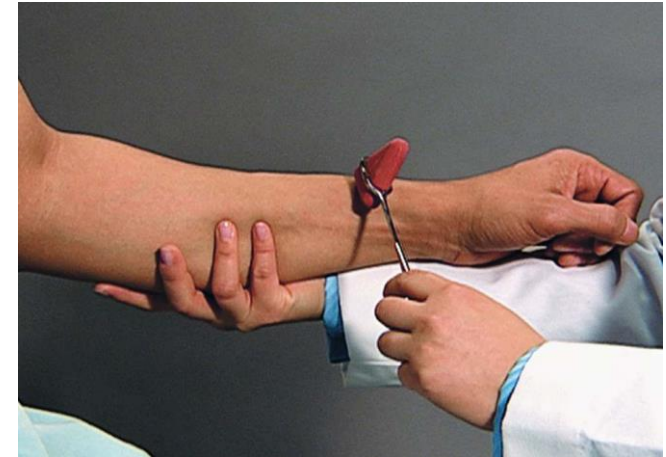
Physiologic Reflex Testing


Muscle	Nerve root	Peripheral nerve	Response
Biceps	C5,C6	Musculocutaneous	Slight contraction of elbow flexors
Brachioradialis	C5,C6	Radial	Slight contraction of elbow flexors, slight wrist extension or radial deviation
Triceps	C6,C7	Radial	Slight contraction of elbow extensors
Quadriceps	L2,L3,L4	Femoral	Slight contraction of knee extensors
Hamstrings	L5,S1,S2	Sciatic, tibial branch	Slight contraction of knee flexors
Achilles	S1,S2	Tibial	Slight contraction of plantar flexors

Physiologic Reflex Testing

Grade	Description
5+	Sustained clonus
4+	Very brisk, hyper reflexive, with clonus
3+	Brisker or more reflexive than normal
2+	Normal
1+	Low normal, diminished
0	Absent, no response

Physiologic Reflex Testing



A microscopic image of several neurons with visible cell bodies and branching axons. Small, colored dots (yellow, red, and teal) are placed at various points along the axons, likely representing specific points of interest or measurement. The text "Pathologic Reflex Testing" is overlaid in the center in a large, white, sans-serif font.

Pathologic Reflex Testing

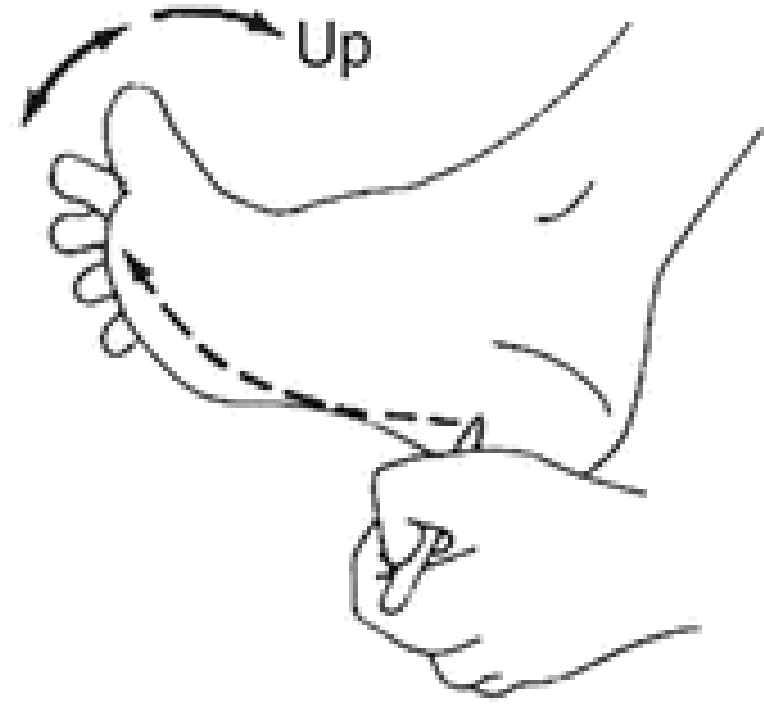
Pathologic Reflex Testing

- Babinski

Normal plantar response



Extensor plantar response
(Babinski sign)



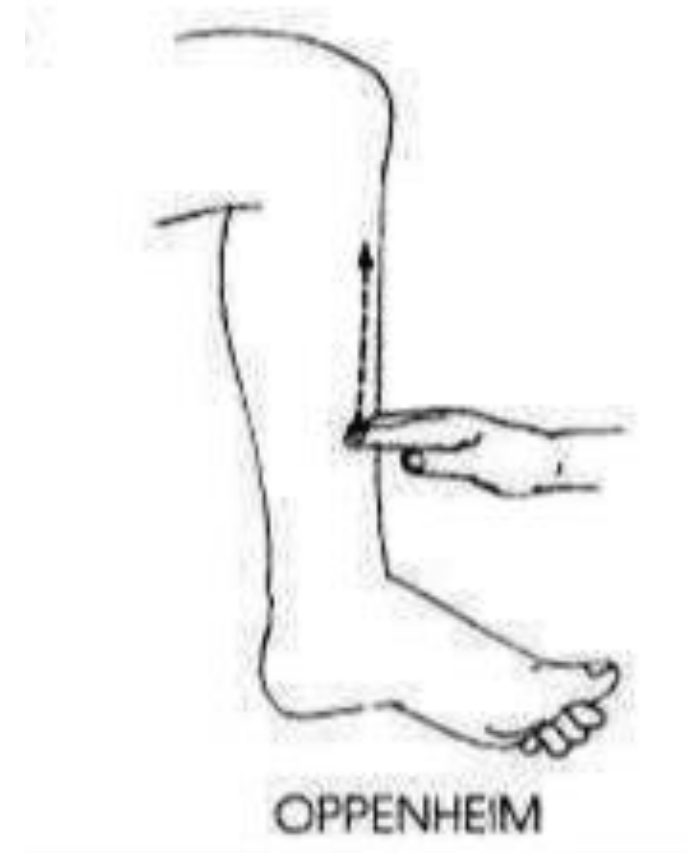
Pathologic Reflex Testing

- Gordon
 - Firmly squeeze calf
- Positive test
 - Dorsiflexion of great toe



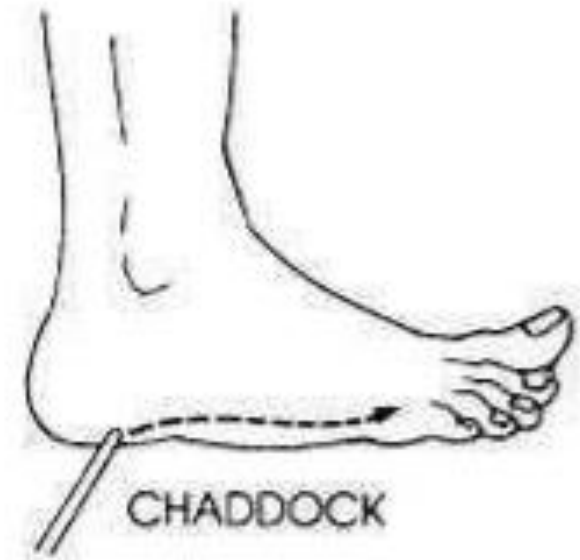
Pathologic Reflex Testing

- Oppenheim
 - Firmly press on shin and run thumb and knuckles along anterior medial tibia toward foot
- Positive test
 - Dorsiflexion of great toe



Pathologic Reflex Testing

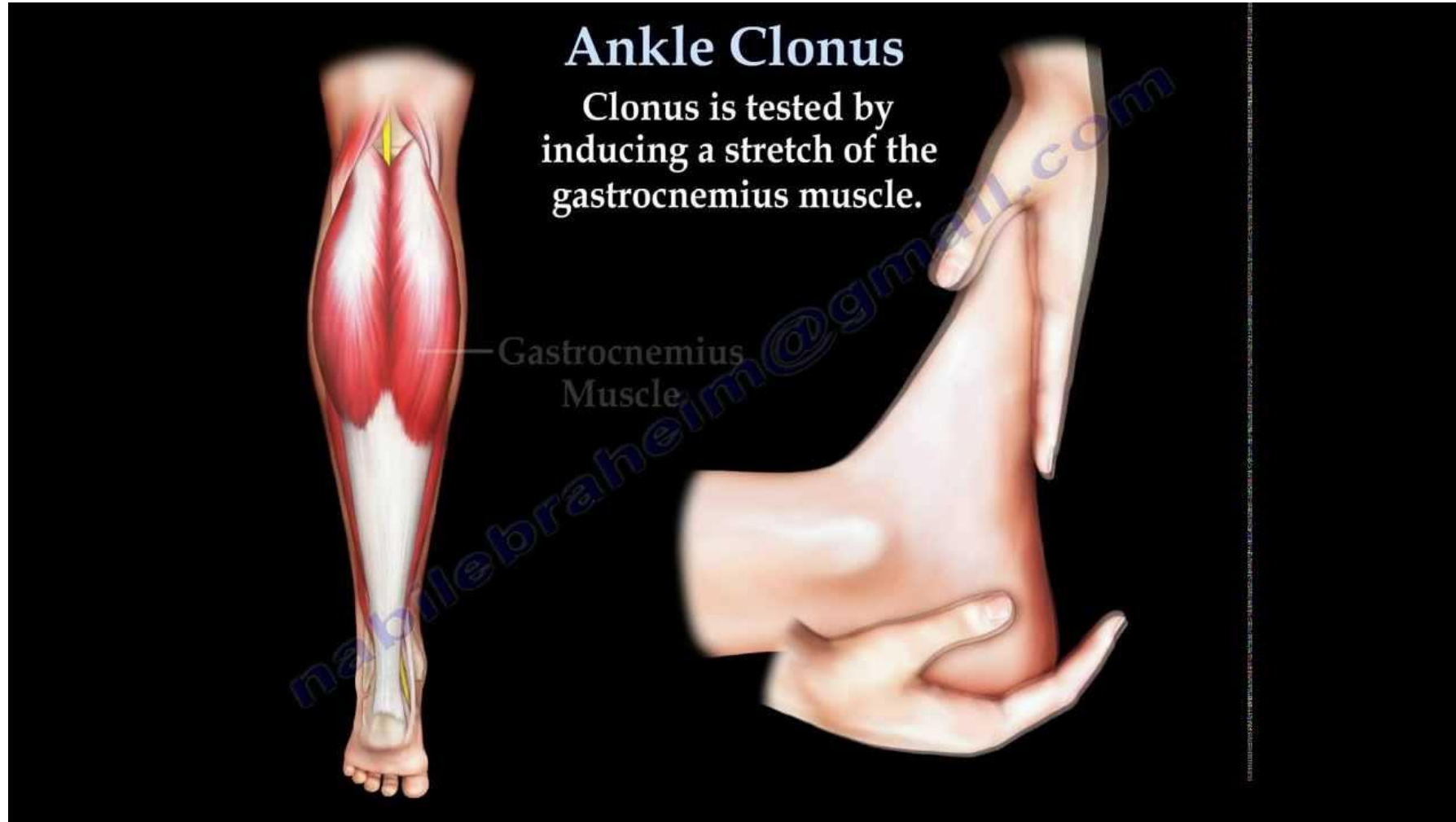
- Chaddock
 - Stroke side of foot with a blunt point from external malleolus to 5th toe
- Positive test
 - Dorsiflexion of great toe



Assessing Muscle Tone

Modified Ashworth Scale	
Grade	Description
0	No increase in muscle tone
1	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension
1+	Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM*
2	More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
3	Considerable increase in muscle tone, passive movement difficult
4	Affected part(s) rigid in flexion or extension

Assessing Clonus



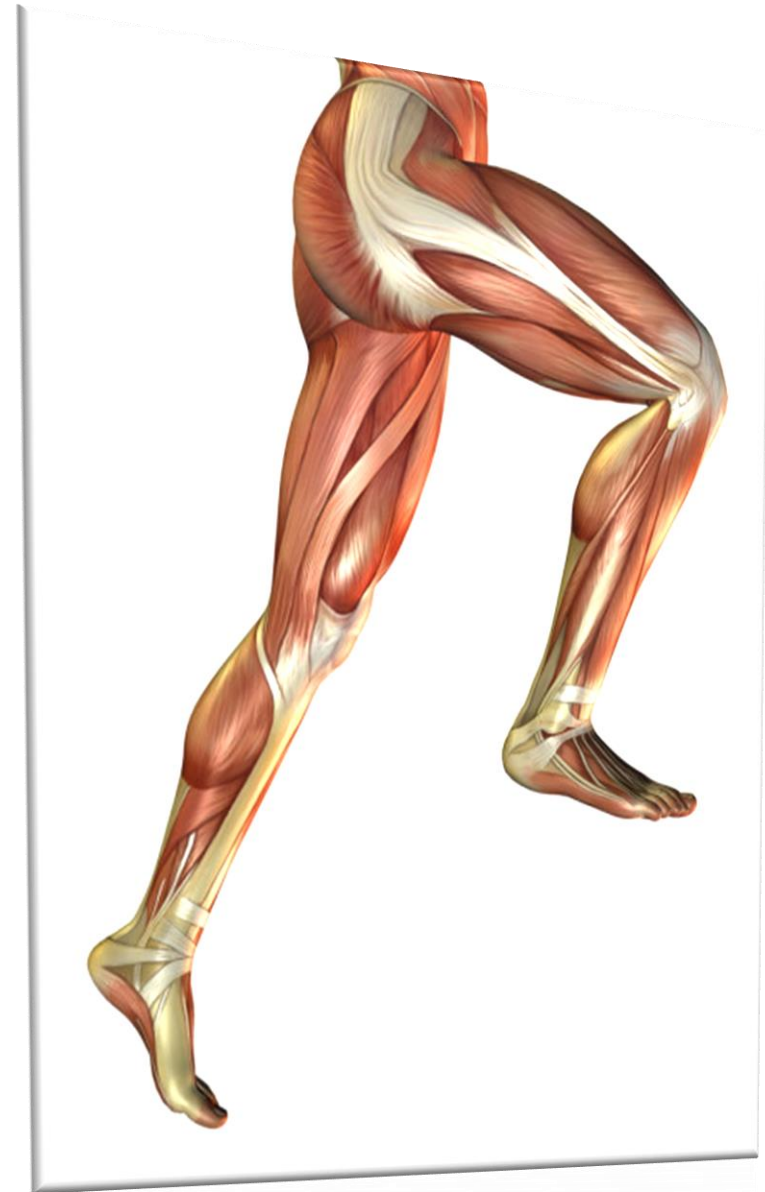
Evaluating Findings to Determine Diagnosis

Factor	Central Impairment	Peripheral Impairment
Muscle Tone	↑	↓
Muscle Atrophy	∅	↓
Physiologic Reflexes	↑	↓
Pathologic Reflexes	+	—

<https://www.youtube.com/watch?v=PPPgTq3L6k4>

MUSCLE LENGTH TESTING

Lower Extremity



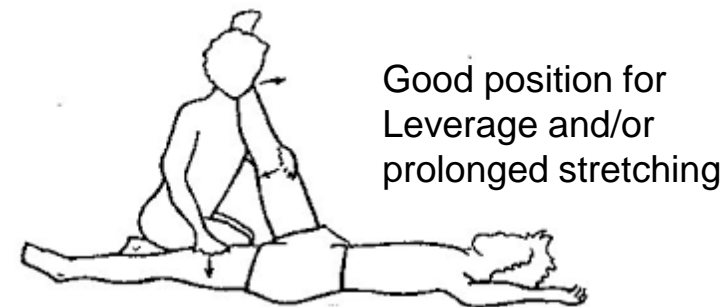
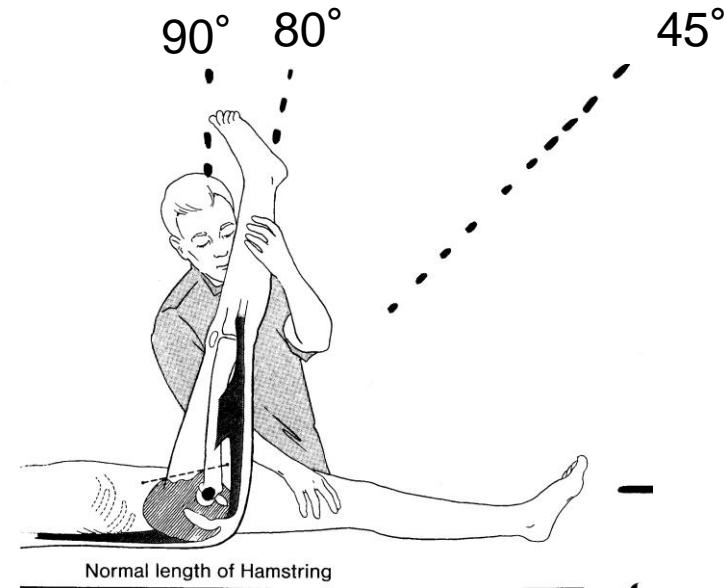
Principles of Muscle Length Testing



- A muscle must be short enough to provide stability of a joint and long enough to allow normal mobility.
- To test length, a muscle must be simultaneously stretched across all joints that it crosses
- Range of muscle length is typically measured in
 - Degrees of motion (Goniometer)
 - Angle or tilt (Inclinometer)
 - Inches (Tape measure)

Hamstrings - Straight Leg Raise

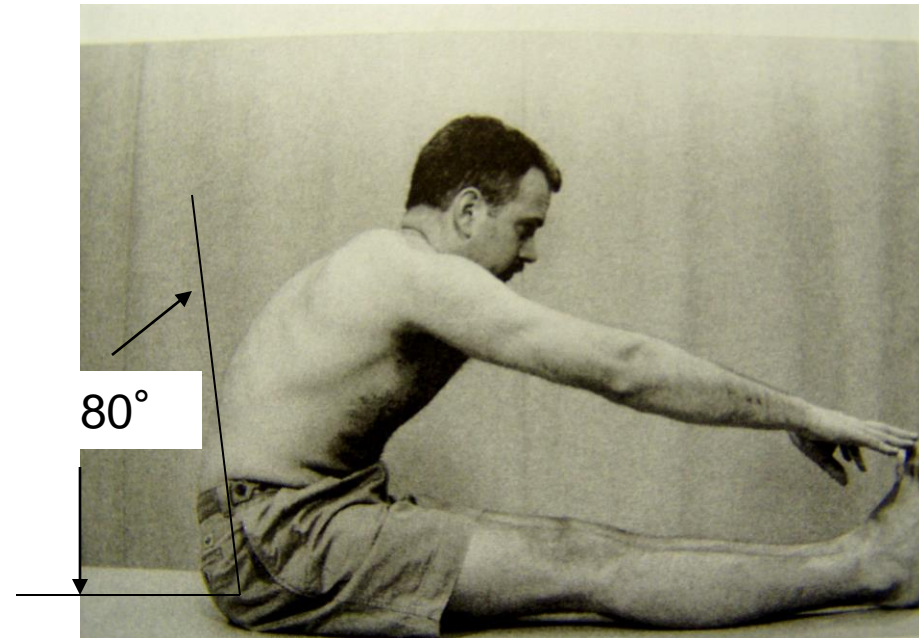
- **Position-** Supine, lumbar spine and pelvis flat, legs fully extended.
- **Movement-** passively lift test leg w/ knee extended, hip neutral, ankle relaxed.
- **Measurement-** Goniometetry of hip flexion.
- **Interpretation-** Normal 70-80° of motion.
 - To rule out glut max, flex knee and re-measure hip flex ROM



Hamstrings & Lumbar Extensors

Sit and Reach Test

- **Position-** long sit, ankles relaxed.
- **Movement-** flex spine to reach fingers to toes.
- **Measurement-** inclinometer
 - Sacrum at 80° angle with surface of table.
 - Lumbar spine should flatten, but not reverse curve.
- **Interpretation-**
 - Sacral angle >80° indicates excessive hamstring length.
 - Reversal of the lumbar curve indicates excessive lumbar spine flexion.
 - Thoracic spine observed for excessive or localized kyphosis.



Hamstrings & Lumbar Extensors

Sit and Reach Test

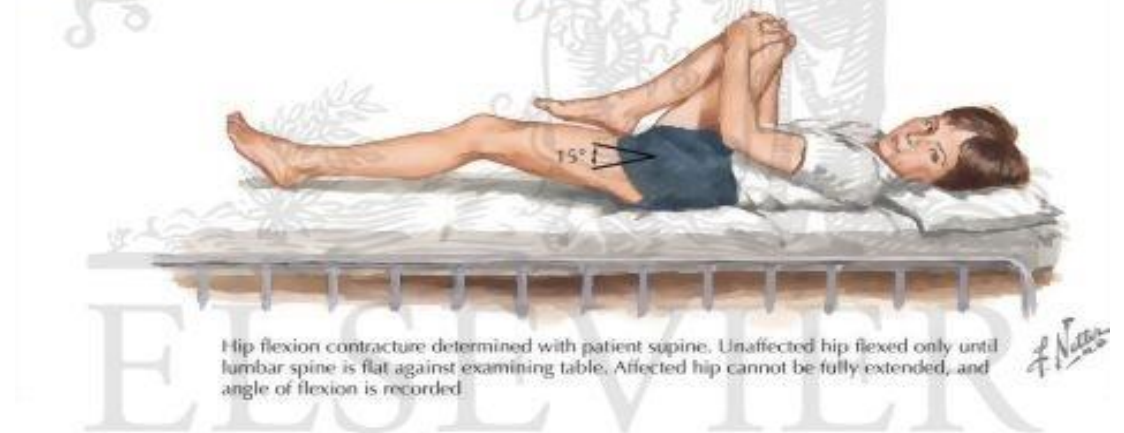
Modified



Hip Flexors

MODIFIED THOMAS TEST

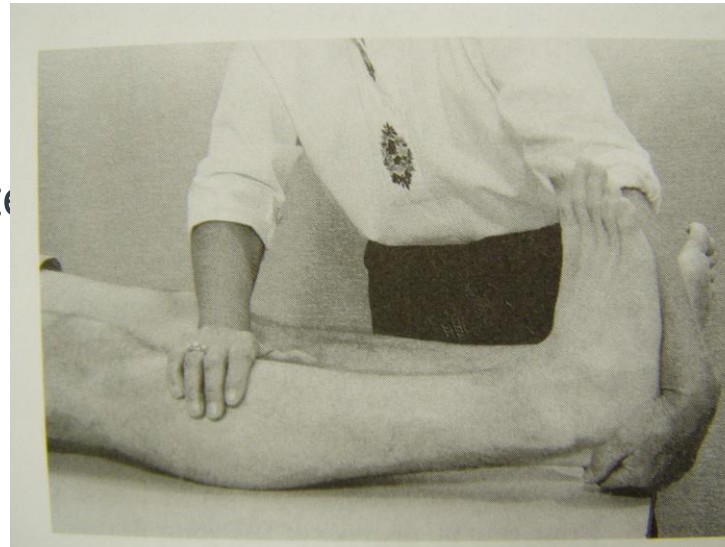
- **Position-** Supine
 - Assist B knees to chest
 - sacrum in contact w/ table
- **Movement-** test limb lowered to the table with knee relaxed. Don't let the lumbar spine move.
- **Normal-** Thigh contacts table with hip neutral rotation/abd/add
- **Measurement-** goniometric angle between femur and surface of table (i.e. Thomas Test 10° hip flexion R)



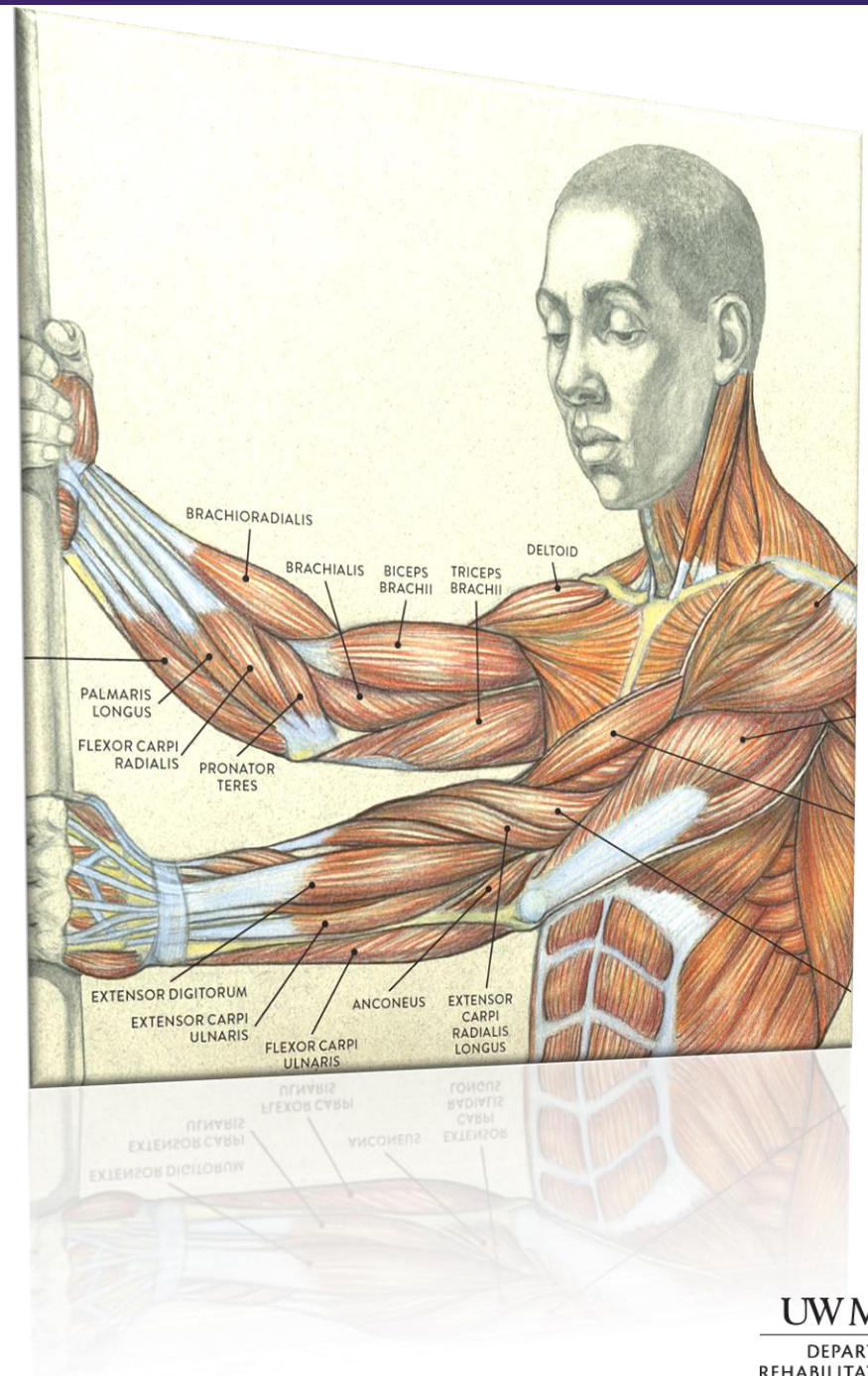
© ELSEVIER, INC. – NETTERIMAGES.COM

Gastroc vs Soleus Length

- **Position-** supine
- **Movement-** examiner performs ankle DF
- **Stabilization-** leg
- **Measurement-** ankle DF goniometry
- **Interpretation-**
 - Knee flexed, < 0-20° DF motion indicates shortening of soleus.
 - Knee extended, < 0-10 DF indicates shortening of gastrocnemius



Goniometry



Purpose of Goniometry and Manual Muscle Testing

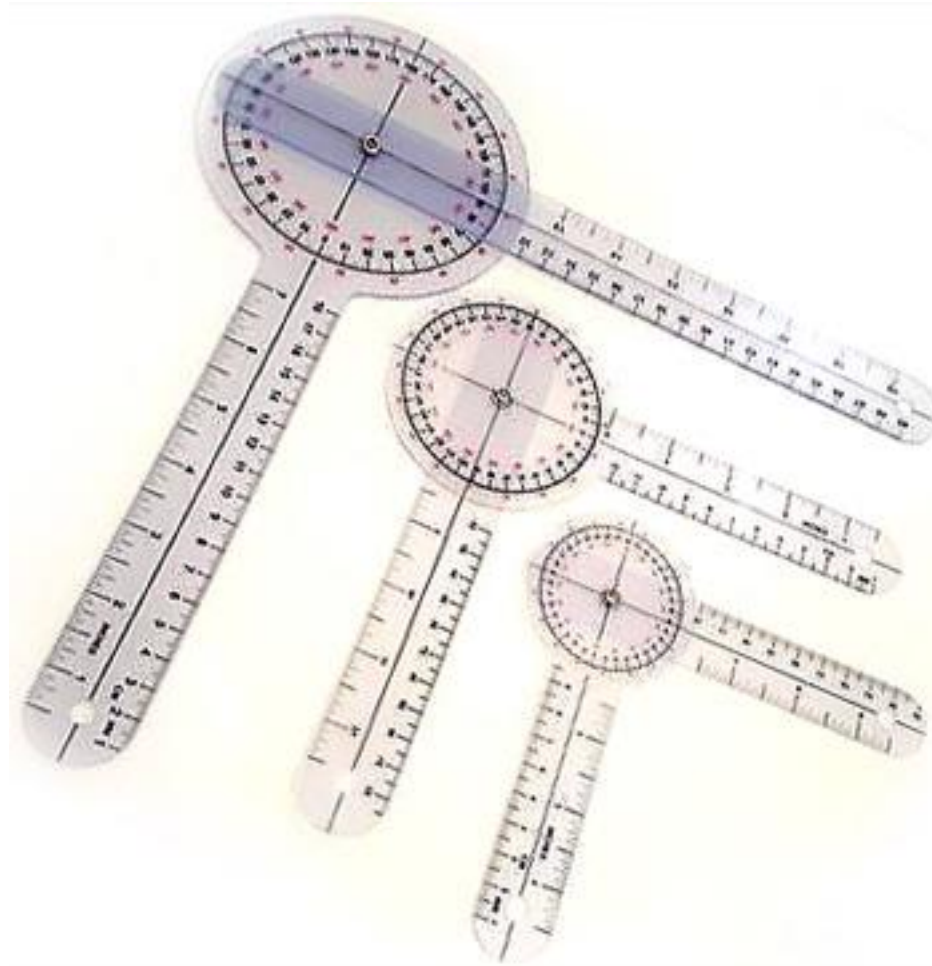


- Guides the medical professional
 - Identify specific impairments
 - Contribute to diagnosis of underlying pathology
 - Select stretching and strengthening exercises that will meet specific patient needs
 - Make decisions regarding patient's ability to mobilize safely

RANGE OF MOTION

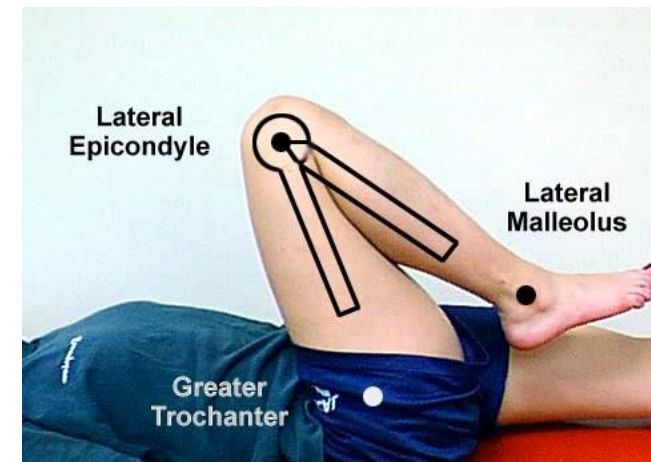
Goniometry

Upper Extremity



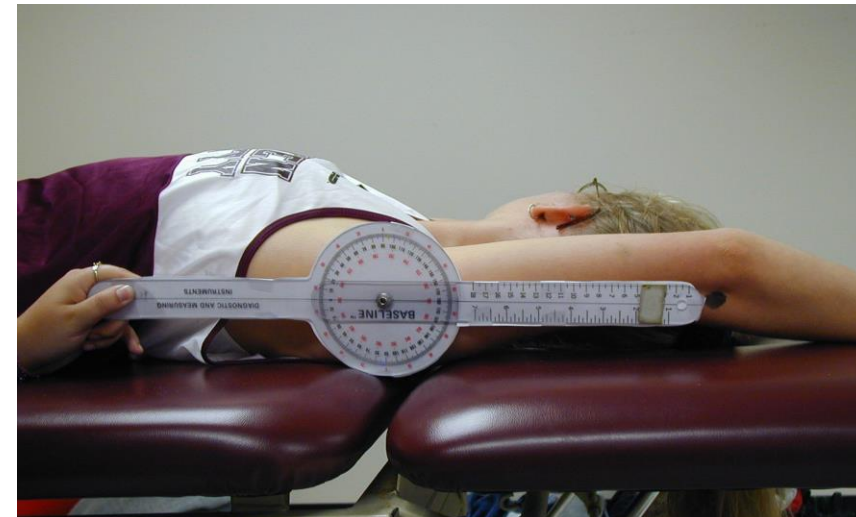
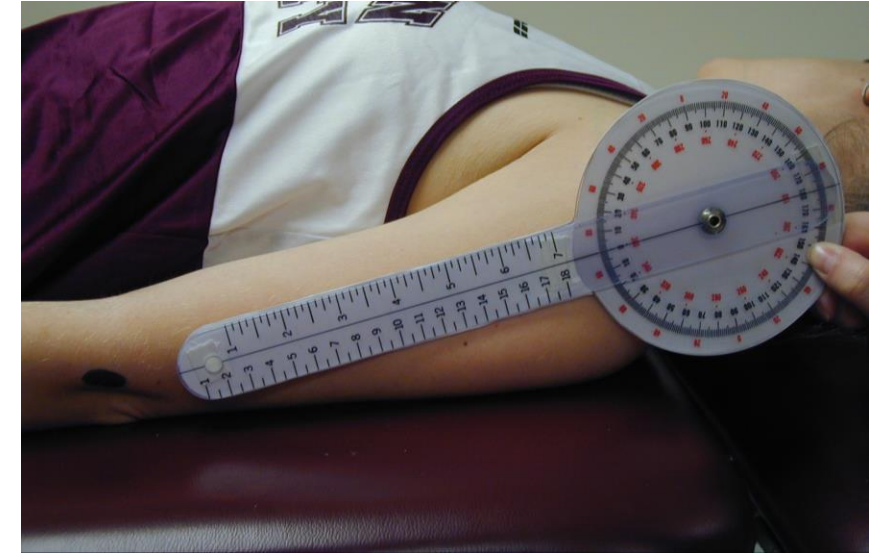
Goniometry - Principles

- Know the “0” position for each joint
 - “anatomical position”
- Identify arms of goniometer
 - Stationary... includes the axis with angle measures
 - Moving... the other one
- Orient your goniometer to the same position as your patient and set at “0” for motion to be measured
- Move your goniometer through expected range of motion.... Identify which set of angle measures you need to read
- Complete PROM or AROM and estimate ROM
- Preset goniometer to that end position angle
- Position the patient and measure
- ...Get help if you don't have enough hands.
 - Your patient might be your helper!



Shoulder Flexion

- **Position-** supine, begin arm at side
- **Axis-** head of humerus
- **Stationary Arm-** midline of lateral trunk
- **Moving Arm-** midline of humerus toward lateral epicondyle
- **Stabilization-** Torso. Do not allow spine extension.



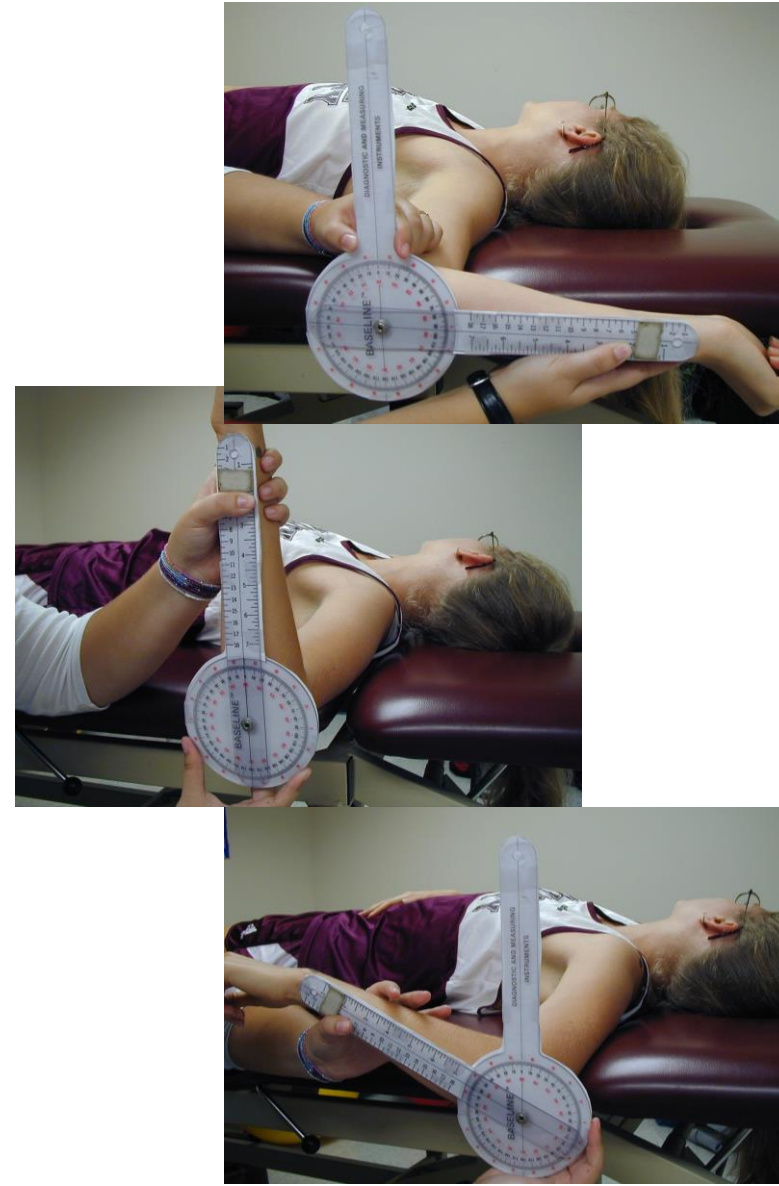
Shoulder Abduction

- **Position-** supine, begin arm at side
- **Axis-** head of humerus
- **Stationary Arm-** parallel to lateral border of trunk
- **Moving Arm-** midline of humerus toward medial epicondyle
- **Stabilization-** Torso. Do not allow side bending.



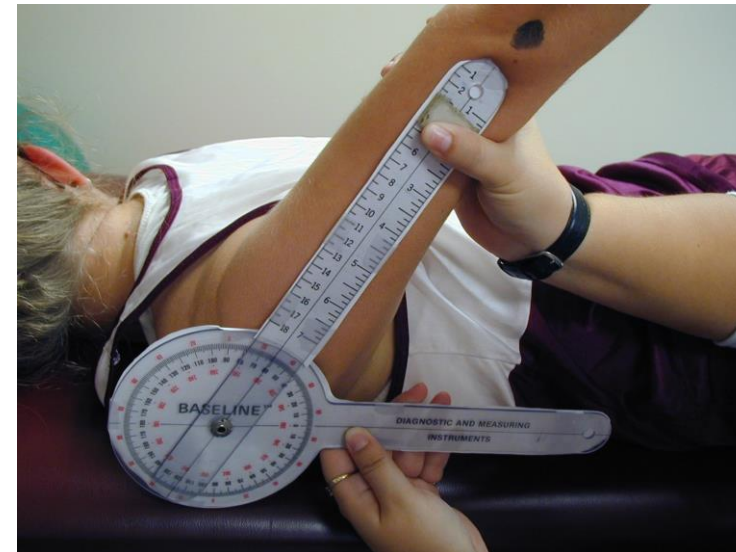
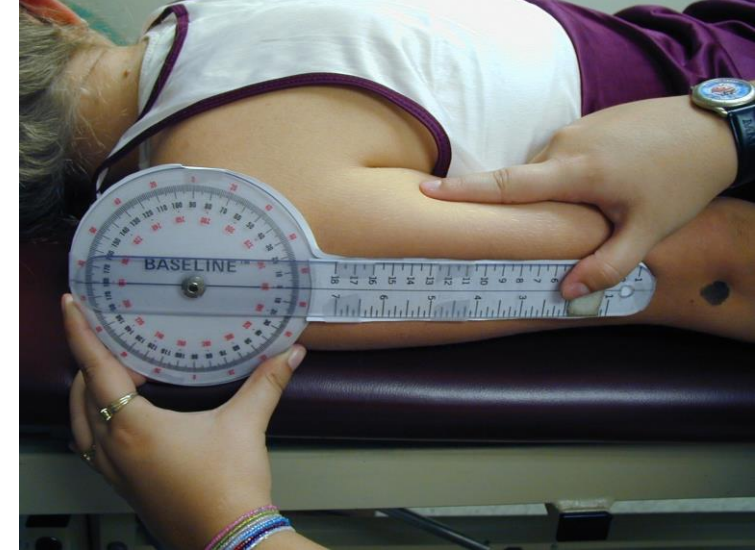
Shoulder External & Internal Rotation

- **Position-** supine, shoulder abducted 90° , humerus horizontal
- **Axis-** olecranon, projecting along shaft of humerus to humeral head
- **Stationary Arm-** vertical or horizontal
- **Moving Arm-** midline of radius toward lateral radial styloid process
- **Stabilization-** Humerus



Shoulder Extension

- **Position-** prone, arm at side
- **Axis-** head of humerus
- **Stationary Arm-** midline of lateral trunk
- **Moving Arm-** midline of humerus toward lateral epicondyle
- **Stabilization-** Scapula. Do not allow anterior tilt of scapula.



Elbow Extension and Flexion

- **Position-** supine, arm at side, distal humerus supported so hand does not contact surface when elbow fully extended
- **Axis-** lateral epicondyle of humerus
- **Stationary Arm-** midline of humerus toward humeral head
- **Moving Arm-** midline of ulna toward ulnar styloid
- **Stabilization-** Humerus



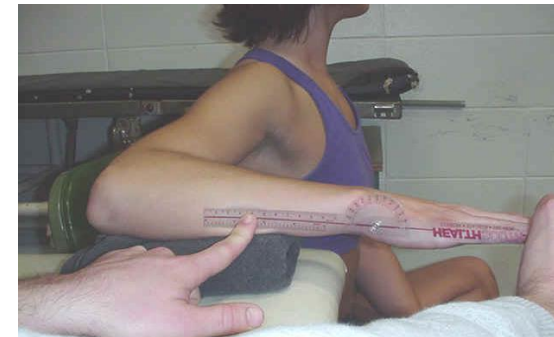
Forearm Pronation and Supination

- **Position-** seated or supine, arm at side, elbow flexed 90°
- **Axis-** head of third metacarpal, projecting to proximal radio-ulnar joint
- **Stationary Arm-** parallel to midline of humerus
- **Moving Arm-** distal posterior radius and ulna
- **Stabilization-** Humerus. Do not allow shoulder abduction.



Wrist Flexion and Extension

- **Position-** supine
- **Axis-** head of humerus
- **Stationary Arm-** midline of lateral trunk
- **Moving Arm-** midline of humerus toward lateral epicondyle
- **Stabilization-** Torso. Do not allow spine extension.



Finger flexion

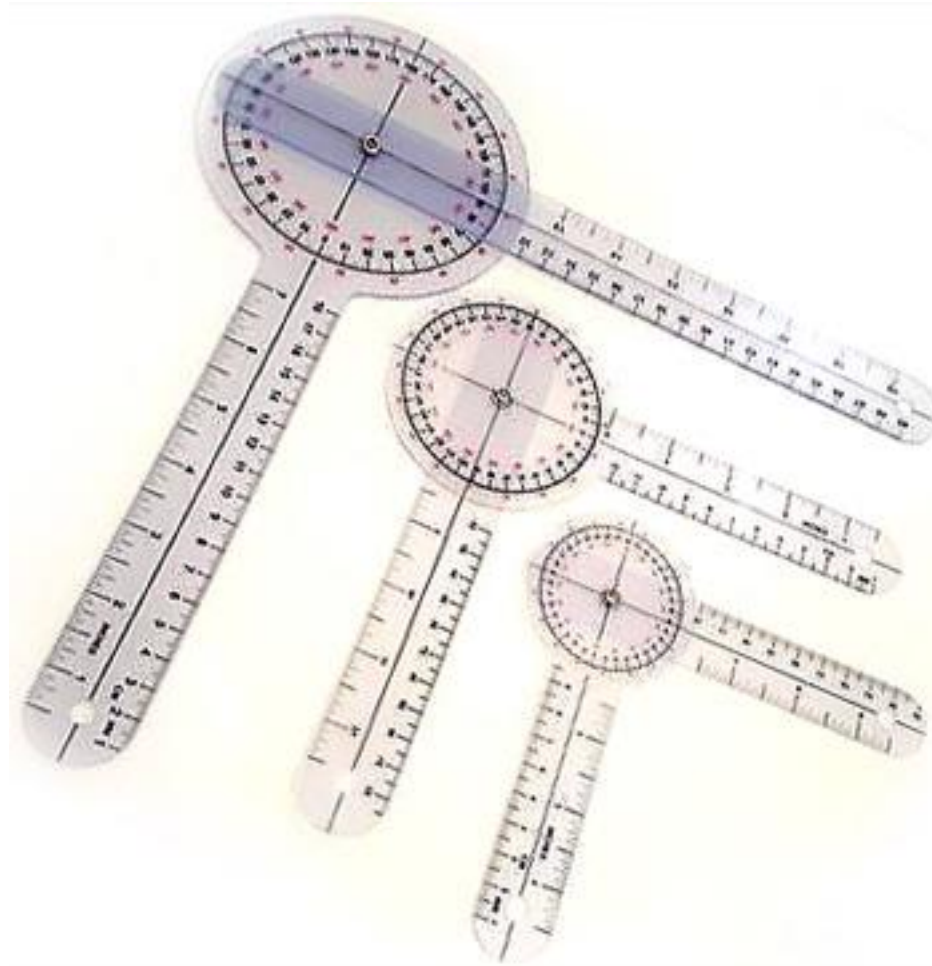
- Each individual joint can be measured when indicated



RANGE OF MOTION

Goniometry

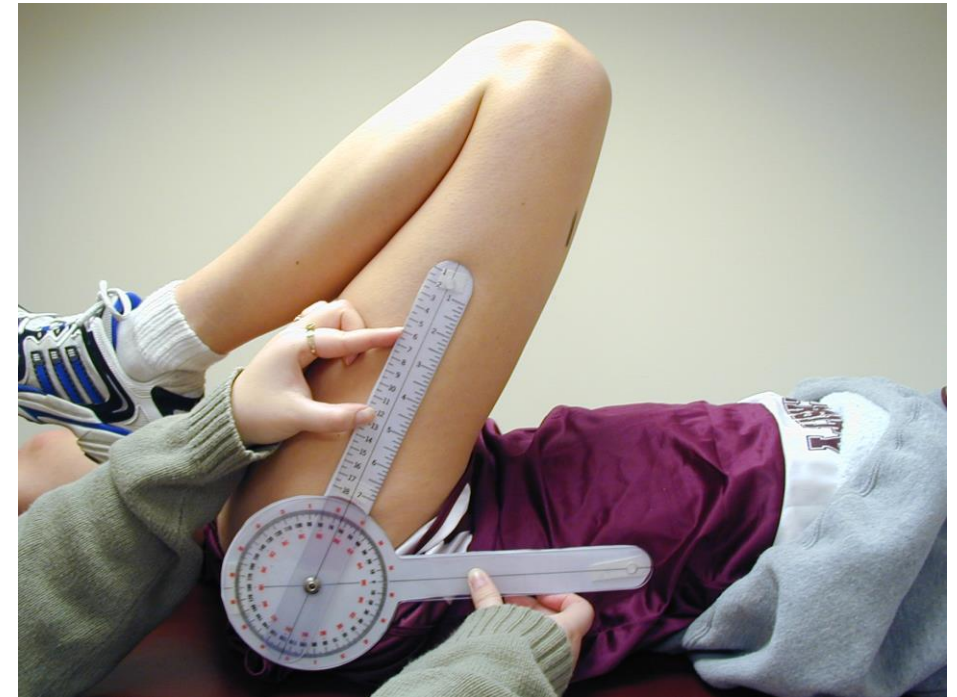
Lower Extremity



Hip Flexion (0°-115° to 125°)

w/ knee flexed

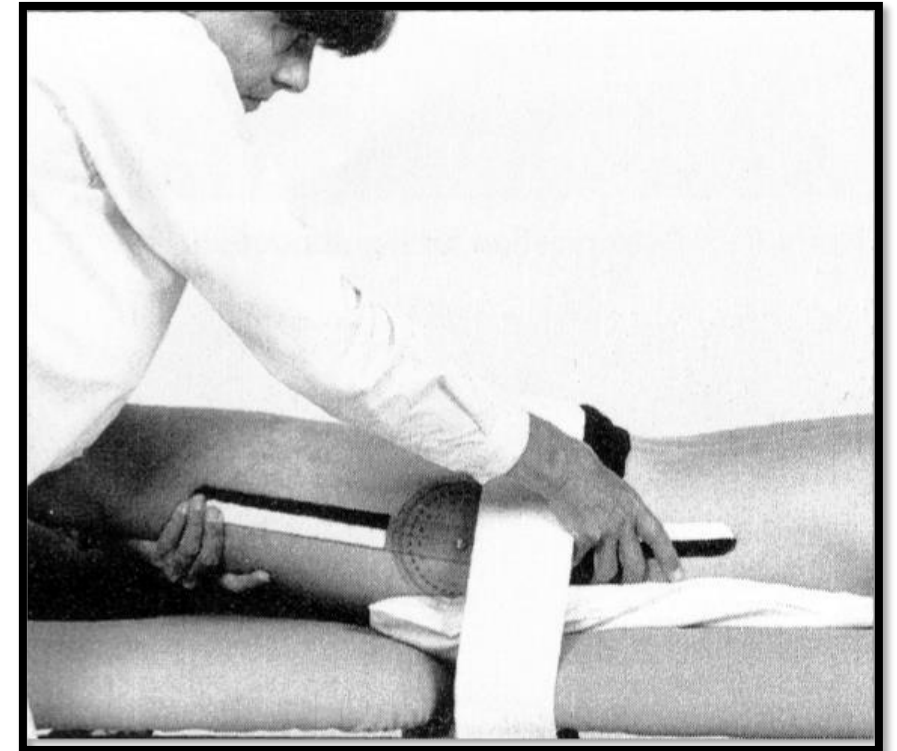
- **Position-** supine, knee extended, end with knee fully flexed.
- **Axis-** 1 finger breath superior/anterior to greater trochanter
- **Stationary Arm-** parallel to long axis of trunk
- **Moving Arm-** midline of femur toward lateral epicondyle
- **Stabilization-** pelvis stabilized by opposite LE. Do not allow posterior pelvic tilt.



Hip Extension (0-10°)

- **Position-** prone, knee extended
- **Axis-** 1 finger breath superior/anterior to greater trochanter
- **Stationary Arm-** parallel to long axis of trunk
- **Moving Arm-** midline of femur toward lateral epicondyle
- **Stabilization-** pelvis stabilized by opposite LE or strap.

Do not allow anterior pelvic tilt.



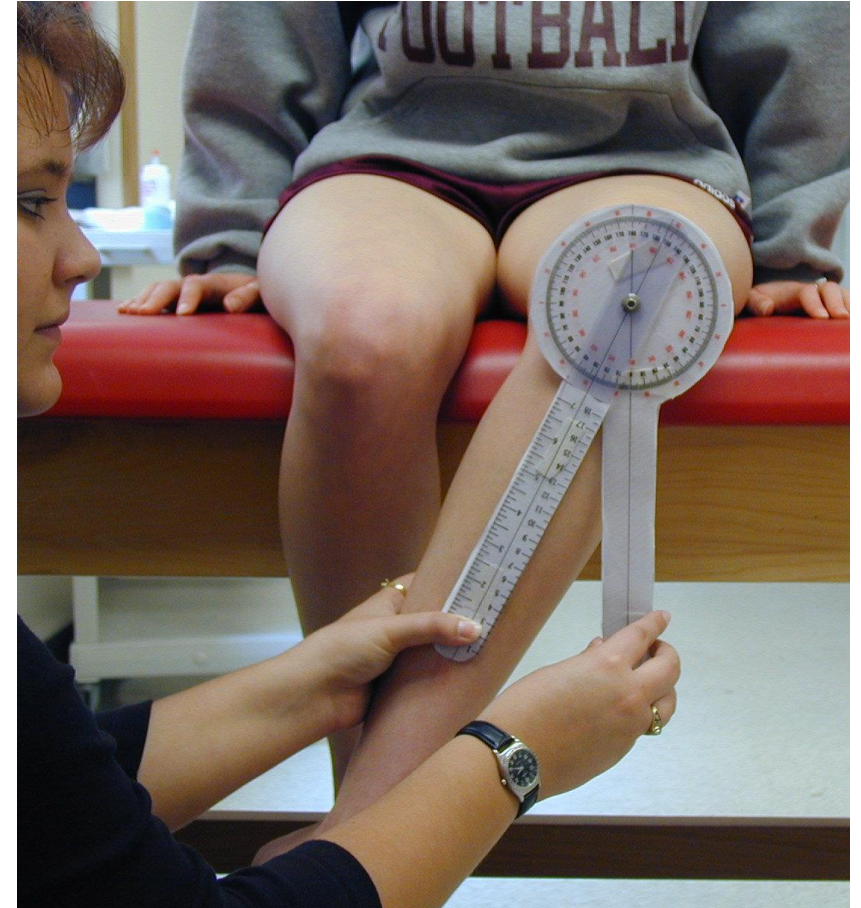
Hip Medial Rotation (0-45°)

- **Position:** Sitting hip and knee flexed 90°
- **Axis:** patella, projecting to hip joint
- **Stationary Arm:** vertical or parallel to table edge
- **Moving Arm:** Parallel to tibia
- **Stabilize:** Thigh and pelvis



Hip Lateral Rotation (0-45°)

- **Position:** Sitting hip and knee flexed 90°
- **Axis:** patella, projecting to hip joint
- **Stationary Arm:** vertical or parallel to table edge
- **Moving Arm:** Parallel to tibia
- **Stabilize:** Thigh and pelvis



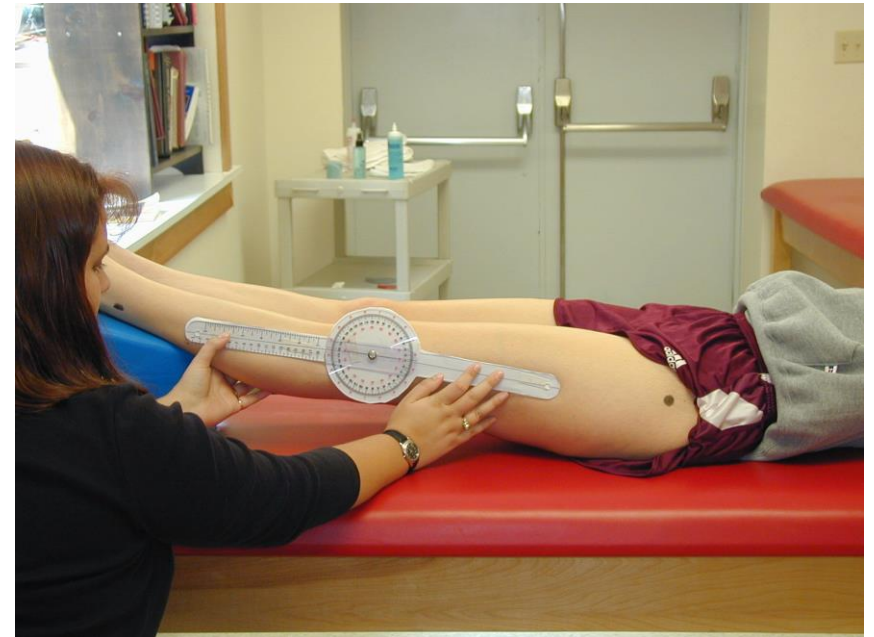
Knee Flexion (0-120° to 130°)

- **Position:** Supine with hip flexed 90°
- **Axis:** Lateral epicondyle of the femur
- **Stationary Arm:** Parallel to femur, toward greater trochanter
- **Moving Arm:** Parallel to fibula, toward lateral malleolus
- **Stabilize:** Thigh



Knee Extension (0°) and Hyperextension

- **Position:** Supine with hip extended, support heel on towel roll
- **Axis:** Lateral epicondyle of the femur
- **Stationary Arm:** Parallel to femur, toward greater trochanter
- **Moving Arm:** Parallel to fibula, toward lateral malleolus
- **Stabilize:** Thigh



Ankle Dorsiflexion 0-20°

- **Position-** supine, knee flexed 20°-30°
OR sitting with knee flexed
- **Axis-** one inch distal to lateral malleolus
- **Stationary Arm-** fibula toward fibular head
- **Moving Arm-** lateral midline of calcaneus
- **Stabilization-** leg



Ankle Plantar Flexion 0-30/50°

- **Position-** supine, knee flexed 20°-30°
OR sitting with knee flexed
- **Axis-** one inch distal to lateral malleolus
- **Stationary Arm-** fibula toward fibular head
- **Moving Arm-** lateral midline of calcaneus
- **Stabilization-** leg



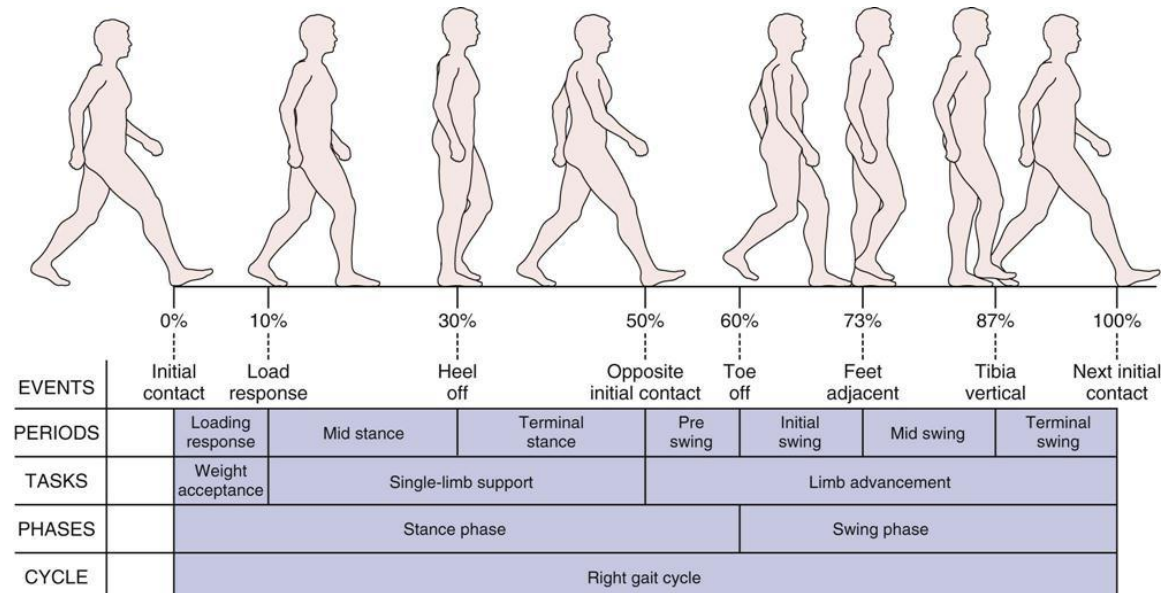


EXAMINATION – GROSS MOVEMENT & FUNCTION

Examination – Movement

(Wichmann et al, 2008)

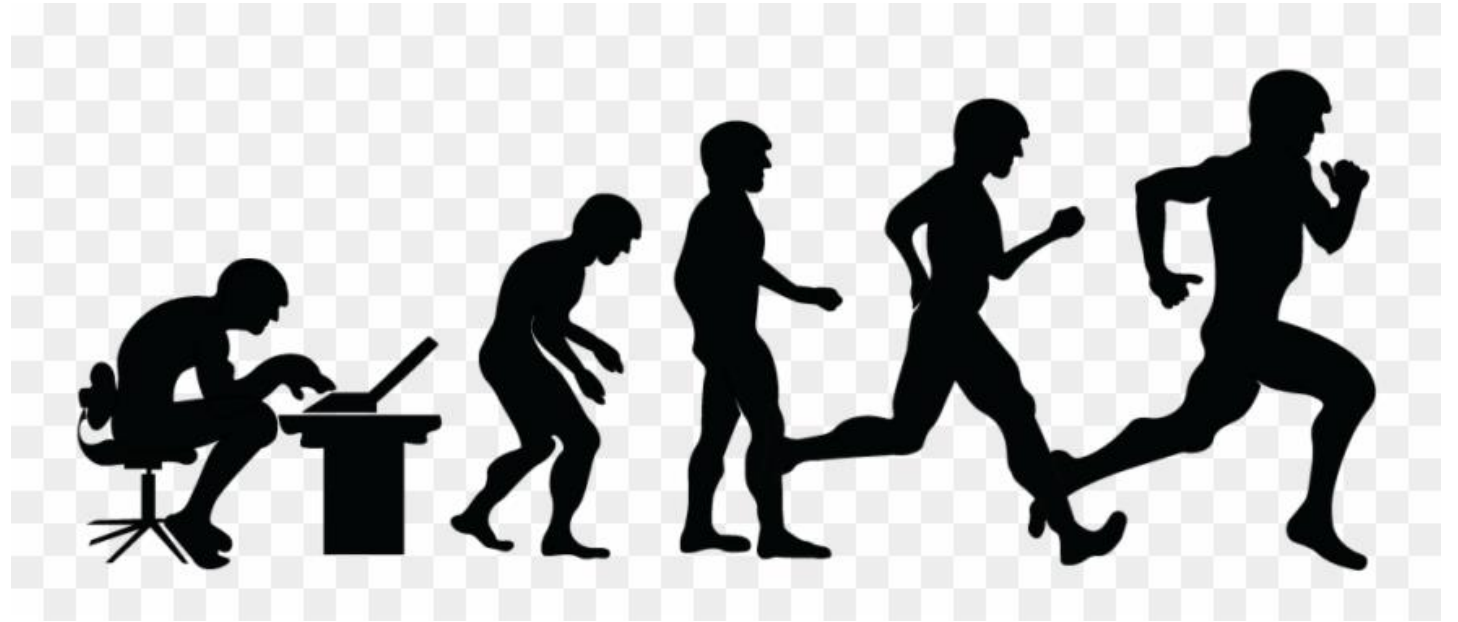
- Ambulation
 - Measured by speed, distance, and/or quality
 - **Gold standard: Observational Gait Analysis**
 - **Rancho Observational Gait Analysis**



Examination – Movement

(Wichmann et al, 2008)

- Transfers/transitions
 - Supine \leftrightarrow side lying
 - Side lying \leftrightarrow sit (EOB)
 - Supine \leftrightarrow sit (EOB)
 - Sit (EOB) \leftrightarrow stand
 - Sit (EOB) $\leftarrow \rightarrow$ sit (chair)
 - Stand \leftrightarrow floor



Berg Balance Test

(Berg Balance Test, 2013)

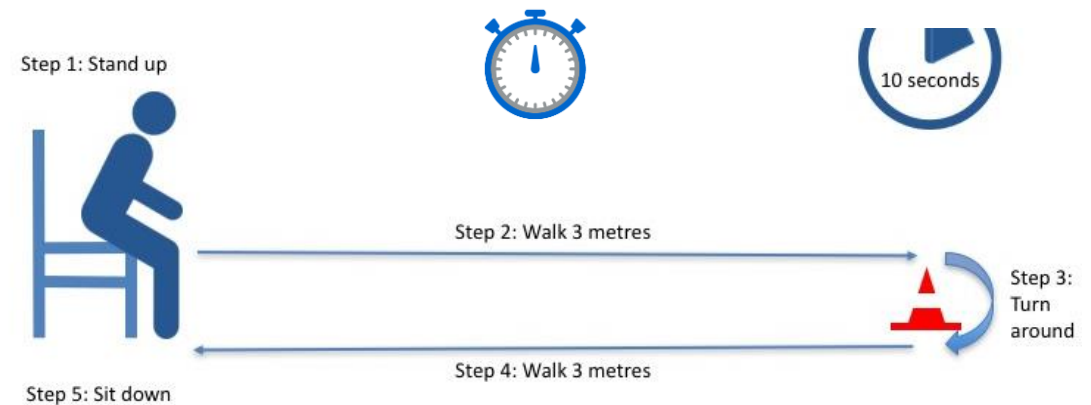
- Measures fall risk & degree of impairment
 - 14 items
 - Score 0-56

Sit to stand	4 Ind (independent)	3 uses hands	2 several tries	1 minimal aid	0 mod-max assist	<input type="checkbox"/>		
Standing Unsupported	4 2 minutes	3 2 min + supervision	2 30 sec unsupported	1 many tries for 30 sec	0 can not stand 30 sec	<input type="checkbox"/>		
Sitting Unsupported	4 2 minutes, safe	3 2 min + supervision	2 30 sec	1 10 sec	0 can not sit 10 sec	<input type="checkbox"/>		
Standing to sitting	4 safe, no hands	3 uses hands	2 uses back of legs	1 uncontrolled descent	0 needs assist	<input type="checkbox"/>		
Pivot transfer	4 safe, min use of hands	3 safe, use of hands	2 verbal cuing/SBA	1 assist x 1	0 assist x 2	<input type="checkbox"/>		
Standing eyes closed	4 10 seconds, safe	3 10 seconds, SBA	2 3 seconds	1 eyes not closed, steady	0 unable, LOB	<input type="checkbox"/>		
Stand feet together	4 Ind c feet, 1 min, safe	3 Ind c feet, 1 min, SBA	2 Ind c feet, 30 sec, SBA	1 help c feet, >15 sec	0 help c feet, <15 sec	<input type="checkbox"/>		
Reaching	4 >10 inches	3 >5 inches	2 >2 inches	1 needs supervision	0 unable, LOB	<input type="checkbox"/>		
Picking up object	4 able and safe	3 able, SBA needed	2 unable, keeps balance	1 unable, needs SBA	0 unable, LOB	<input type="checkbox"/>		
Look over shoulders	4 able, equal	3 able, unequal	2 partial turn, safe	1 partial turn, needs SBA	0 unable, LOB	<input type="checkbox"/>		
Turn 360 R&L	4 able, <4 sec	3 one way only, <4sec	2 one way only, >4sec	1 close SBA or VCs	0 unable, LOB	<input type="checkbox"/>		
Alternate foot to stool	4 8 steps < 20 sec	3 8 steps > 20 sec	2 4 steps with SBA	1 2-4 steps with min A x 1	0 unable, LOB	<input type="checkbox"/>		
Tandem stance	4 tandem, 30sec	3 staggered, 30sec	2 small step, 30sec	1 needs help, 15 sec	0 unable, LOB	<input type="checkbox"/>		
Single leg stance	4 Ind, > 10sec	3 Ind, 5-10sec	2 Ind, 3-5sec	1 <3sec, stays standing	0 unable, LOB	<input type="checkbox"/>		
Goal status = G8979 Current Status = G8978 Discharge Status = G8980						<div><input type="checkbox"/></div> <div>TOTAL</div>		
Total Score	0	1-11	12-22	23-33	34-44		45-55	56
Degree of impairment	100%	80%	60%	40%	20%		10%	0%

Timed Up and Go

(Timed Up and Go, 2013)

- Assesses mobility, balance, walking ability, and fall risk
- The task is to stand up from a chair, walk 3 meters at a comfortable and safe pace, turn around, walk back to the chair and sit down
- Patients may use assistive devices and/or bracing
- Instructions
 - Patient starts sitting in a chair with their back against the chair back
 - Timer starts when patient is instructed to "Go"
 - Timer stops when patient is seated
- Document the time (seconds), level of assist, and type of assistive devices and/or bracing used



6-Minute Walk Test

(6-Minute Walk Test, 2013)

- Sub-maximal exercise test used to assess walking endurance and aerobic
- The task is to walk as far as possible in six minutes
- Patients may use assistive devices and/or bracing
- Instructions
 - Tell the patient the aim of the test
 - Inform the patient they're allowed to slow down, to stop, or to stand and rest, but the timer will keep going
 - Instruct the patient to begin walking when they are ready
 - Provide encouragement after each minute of the test; no other communication should occur during the test
- Document the distance (meters), level of assist, and type of assistive device and/or bracing used



Consider the Patient's Usual Activities



QUESTIONS?

