Beyond Mice and Keyboards

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Link

- Go here for lots of supporting information including the slides

www.handtherapyhub.com> WHE 2024>14 documents

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Material and Information

- Wash U PT School **pt.wustl.edu**
  - Education tab
- Shirley Sahrmann, PT, PhD, FAPTA and colleagues
- Nexus Motion: Maiko Morotani, PT, DPT
- MSI Program

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This Talk

- An introduction…whet your appetite
- Focus will be on an **introduction** to the concept of adding a comprehensive musculoskeletal evaluation to a traditional ergonomic evaluation
  - Detailed patient intake form or pre-assessment survey (patient)
  - Pictures and video (patient)
  - Handouts (therapist)
  - Equipment recommendations (therapist)
  - Patient education (therapist)

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Combine

- Inanimate components of the workspace
  - Work demands (hours, writing, phone, reading)
  - Geometry of the space (work area)
  - Geometry of the furniture (desk, chair, tray)
  - Geometry of the tools (phone, keyboard, monitor, mouse, lighting)
- Physics of the musculoskeletal system
  - As therapists we are rigorously trained in movement analysis and assessment

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Specialists

- Cardiologist
- Podiatrist
- Orthopedic Surgeon
- Neurologist
- Endocrinologist

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Our Identity

- No longer technicians
- We are capable of thorough evaluation of the movement system and
- Identification of a musculoskeletal diagnosis
  - What is wrong with the movement machine
- Different from the execution of a battery of eponymized "Special Tests"

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"Office Work"

- An Olympic Event
- Yet…no training regimen to be found

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What Is MSI?

- Movement Systems Impairment Syndromes: Shirley Sahrmann, PT, PhD, FAPTA
- Structured, detailed musculoskeletal evaluation
- It is an evaluation and treatment philosophy based on kinesiology, anatomy and physics
- Results of the evaluation lead to treatment interventions
- Focus is on
  - Assessment of movement: patterns, quality, deficits, excesses
  - Assessment of alignment
  - Assessment of muscle performance, strength, length, "stiffness", neuromuscular control
  - Identify inducers of faulty movement patterns
    - Repeated movements in daily activities
    - Sustained alignments

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What is MSI?

- Pain
  - The site and the cause of pain are often **not** in the same location
  - Pain most often arises from tissues that are stressed by subtle impairments in movement or alignment
  - Majority of musculoskeletal pain syndromes are the result of cumulative microtrauma from stress of repeated movements or sustained alignments (daily activities)
  - Hypermobility of a link in the system is often the pain generator/pain site
- Faulty alignments and movement patterns can be tolerated for some time before they induce pain

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What is MSI?

- An MSI evaluation can be done even in the setting of no complaints
- It gives you information about how the machine is working
  - Elucidate areas of potential concern
- Their research has resulted in the defining of Movement System Impairment Syndromes for each area of the body
  - Collections of kinesiological impairments named for the principal impairment
  - Examples: Scapular downward rotation syndrome, scapular depression syndrome

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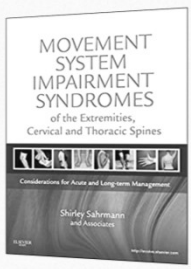

https://pt.wustl.edu/education/movement-system-impairment-syndromes-courses/

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Key Concepts

- Path of Least Resistance
  - Relative flexibility
  - Relative stiffness
  - Joint hypomobility
    - What moves is what hurts, usually
- The way everyday activities are performed is critical (repetition/alignment)

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Key Concepts

- You get what you train
- Presence of a muscle does not mean it is being used properly
- It is not "the exercise" but, rather, achieving the desired movement
- Cause and Source
  - Impaired scapular upward rotation; supraspinatus tendinopathy

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- What muscle groups are creating the most tension, which are ineffective
- In a multi-joint system, movement will occur at the joint that moves the most easily. Think: serratus anterior, trapezius, rhomboids, cuff muscles
  - Imagine lateral rotators very stiff. Upon internal rotation, scapula will wing because cuff muscles are stiffer than serratus anterior and lower trap

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What is a COEE?

- Certified Office Ergonomic Evaluator
- Trained to assess and evaluate office workstations
- Trained to adjust equipment
- Trained to see musculoskeletal risk factors
- Up-to-date on current products

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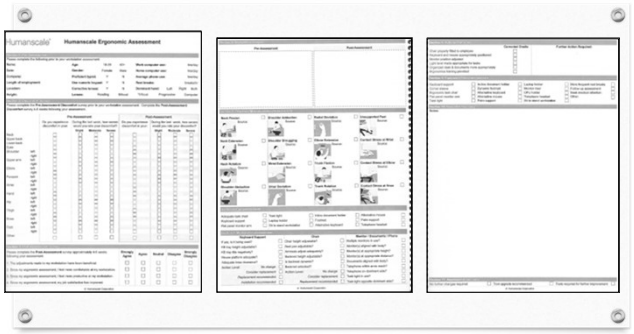

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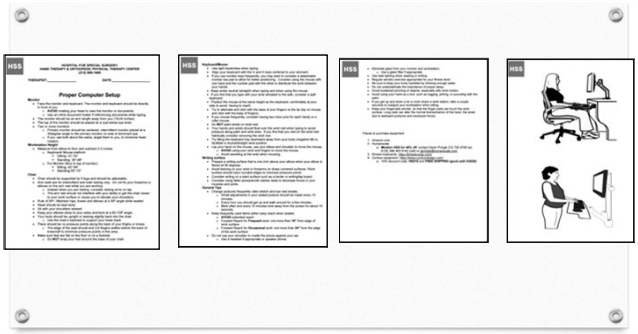

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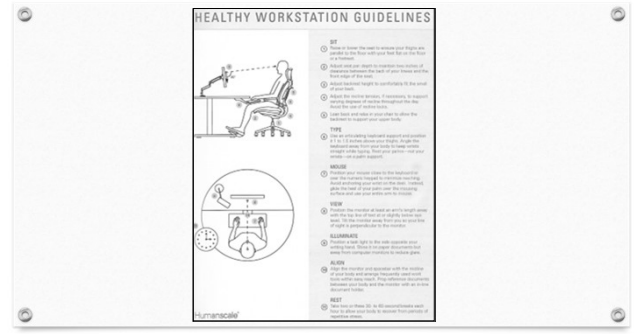

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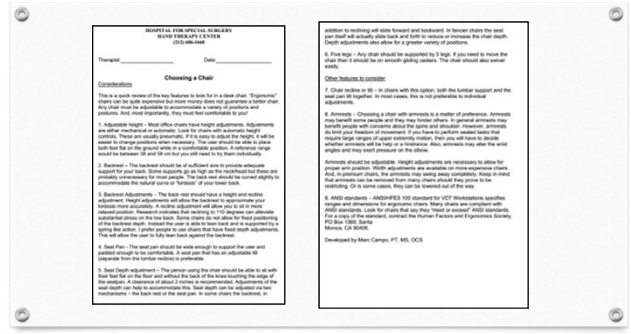

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Therapist Value Added

- Musculoskeletal evaluation
- Tailored exercise prescription

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Subjective

- Thorough pain description
  - Type, intensity, duration, provocative maneuvers, location
- Physical work demands

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Evaluation

- Sites of nerve compression
- Upper limb tension testing
- Median
  - Carpal tunnel
  - Pronator teres
- Ulnar nerve
  - Cubital tunnel
- Radial nerve
  - DRSN

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Butler DS. The Sensitive Nervous System

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Components of Musculoskeletal Evaluation

- Alignment
- Movement
- Muscle Length/Stiffness
- Muscle Performance
- Neuromuscular control
- Muscle Strength
- Standing
- Supine
- Prone
- Quadriped
- Sitting

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Challenge

- A thorough upper quarter exam is lengthy and detailed
  - Extends to cervical spine, thoracic spine, abdominal muscle function
- Impossible to do justice to the beautiful complexities of the MSI approach
- Attempt to highlight common patterns seen in office workers, knowing that there are many more details to the considered
- Special attention to alignment

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Muscles: Scapulohumeral (7)

- External Rotators: Suprapinatus, Infraspinatus, Teres minor
- Internal Rotators: Subscapularis, Teres major
- Deltoid
- Coracobrachialis

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Muscles: Axioscapular

- Serratus anterior
- Rhomboid major/minor
- Trapezius
- Levator scapula
- Pectoralis minor

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Muscles: Axiohumeral

- Latissimus dorsi
- Pectoralis major

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Muscles

- Scapulo-ulnar: triceps long head
- Scapulo-radial: biceps long and short heads

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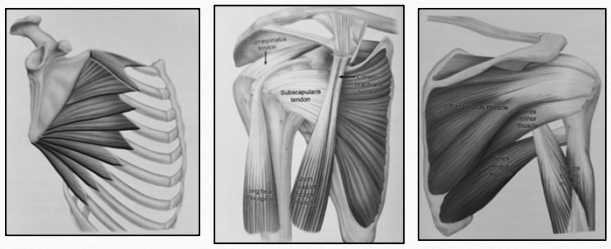

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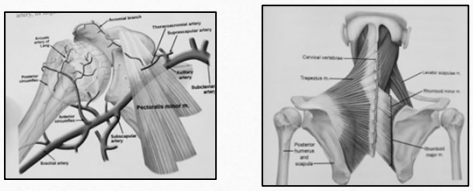

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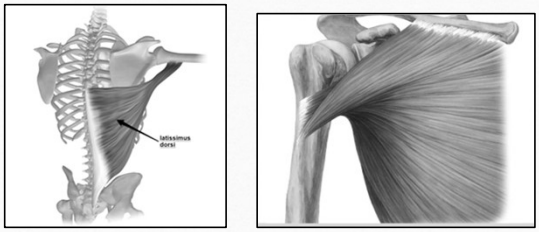

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Sitting

- Alignment: head, neck, thorax, shoulders, scapula, clavicle, humerus
  - Head position: sagittal view, forward head
  - Cervical spine: upper cervical extension
  - Thoracic spine: kyphosis? Flattened curve?
  - Shoulders: humeral head position on glenoid
  - Scapula: position on the thoracic spine: abd/adduction, tilt, depression/elevation
  - Clavicle: scapular position will drive clavicle position
  - Humerus: internal/external rotation at glenohumeral joint

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Sitting

- Active range of motion
  - Thoracic flexion, rotation, side bending
  - Bilateral shoulder flexion
  - Shoulder abduction
  - Shoulder external rotation
  - Cervical range of motion
    - With passive elevated shoulder girdle test

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Sitting

- Serratus anterior muscle performance
  - Face the patient
  - Shoulder FF to 120-130, slight horizontal adduction (hand in front of nose)
  - Check PROM: abd/upward rotation
  - Apply resistance to distal end of humerus (pulling down)
  - Attempt to downwardly rotate scapula

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Sitting

- Upper trapezius muscle performance
  - Resist ability to bring acromion toward the occiput
  - Shoulder shrug
  - Over active?
  - Elongated?

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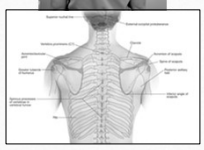
Standing-Scapula

- Slope of shoulders
- Vertebral spinous process 3" from root of scapula
- Vertebral border vertical or slight upward rotation
- 30-40° anterior to frontal plane (internal rotation)
- 10-15° anterior tilt
- Root of scapular spine at T3

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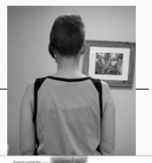
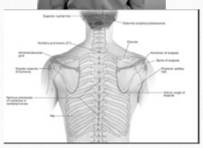
Standing-Scapula

- Upward/downward rotation
- Ab/adducted position
- Elevated/depressed
- Anteriorly/posteriorly tilted
- T2-T7

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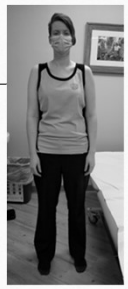
Standing-Humerus

- Internal/External rotation
  - Antecubital crease 30° anterior to the frontal plane
  - Scapular position will influence this
- Clavicle horizontal or slight upward slope



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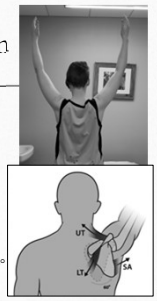
Standing Active Motion

- Bilateral shoulder forward flexion
  - Scapula should upwardly rotate, posteriorly tilt 10˚ and externally rotate
  - Acromion should align with C6/7
  - Root of the spine of the scapula at T3
  - Inferior angle should reach midaxillary line by end of arm elevation
  - Vertebral border of the scapula should reach 55-60°
  - Root of spine should remain 3" from spinous processes
  - Assess glenohumeral creases
  - Assess glenohumeral rotation during elevation. Should externally rotate 60°



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Supine

- Alignment
  - Head position
  - Cervical spine
  - Thoracic spine
  - Shoulders: humeral head
  - Scapula: influence of pectoralis minor/major
  - Humerus

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Supine

- Length test:
  - Pectoralis minor
    - Towel roll under distal humerus, forearms resting on abdomen
    - Posterior acromion 1" off the table
    - Assess flexibility while watching for rotation or elevation of rib cage (abdominal contribution)

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Supine

- Length test:
  - Pectoralis major
    - Sternal fibers: Passive unilateral shoulder forward flexion, arm about 45° away from head, shoulder in ER
      - Compensatory motion: anterior/inferior glide of the humeral head, trunk rotation, rib elevation
    - Clavicular fibers: Horizontal abduction with shoulder ER
      - Compensatory motion: anterior glide of humeral head, trunk rotation

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Supine

- Length test:
  - Latissimus dorsi
    - 1. Hooklying. Active bilateral forward flexion
      - Watch for: lumbar extension, ribcage elevation, shoulder IR
    - 2. Hooklying. Unilateral passive forward flexion with shoulder ER
      - Watch for: lumbar extension, ribcage elevation

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Supine

- Length test:
  - Scapulohumeral muscles
    - Hooklying. Passive unilateral shoulder forward flexion with shoulder in ER
      - Watch for: lateral border of the scapula protrudes >1/2" from thorax. May also see posterior tilt of scapula, humeral head anterior glide, or scapular abduction
      - Tease out teres major contribution: IR shoulder at end range

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Supine

- Length test:
  - **Biceps**: towel roll under distal humerus
    - Actively extend elbow and pronate forearm: watch scapular motion
    - Passively extend elbow: compare pronation vs supination
      - Watch for anterior tilt of scapula or anterior glide of humeral head

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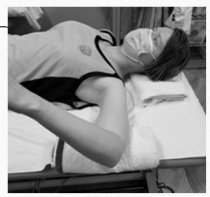
Supine

- Posterior glenohumeral capsule and external rotators
  - Humerus in 90 degrees of abduction, elbow flexed to 90 degrees, towel rolls under distal humerus to put humerus in plane of scapula
    - Assess active and passive internal rotation
    - Compensatory motion: anterior tilting of the scapula or humeral head anterior glide



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Supine

- Anterior glenohumeral capsule and internal rotators
  - Humerus in 90 degrees of abduction, elbow flexed to 90 degrees, towel rolls under distal humerus to put humerus in plane of scapula
    - Assess active and passive external rotation
    - Compensatory motion: posterior tilting of the scapula, scapular adduction/external rotation or humeral head anterior glide

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Prone

- Shoulder IR/ER muscle performance
  - Shoulder abducted to 90 degrees, forearm hanging off the table, towel roll under proximal shoulder to put scapula and humerus in the same plane and to align scapula on the thorax.
    - Active ER
      - Watch for humeral head anterior glide, scapular anterior tilt, scapular internal rotation, scapular depression, scapular up/downward rotation
    - Active IR
      - Watch for humeral head anterior glide, scapular anterior tilt, scapular internal rotation, scapular elevation, glenohumeral horizontal abduction, and elbow extension

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Prone

- Lower trapezius muscle performance
  - Pillow under chest
  - Towel under forehead
  - Humerus in line with fibers of lower trapezius and externally rotated
  - Palpating at T12
  - Head hand cradles arm
  - Foot hand in axilla to position scapula in adduction and depression
  - Stabilize contralateral pelvis when applying resistance

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Prone

- Middle trapezius muscle performance
  - Pillow under chest
  - Towel under forehead
  - Palpating at T3, root of spine of scapula
  - 90° abduction/external rotation/elbow extended
  - Foot hand supports GH joint
  - Head hand supports arm at elbow
  - Resistance to distal arm at wrist. Stabilize opposite trunk

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Prone

- Rhomboid muscle performance
  - Positioning same as middle trapezius
  - Shoulder in internal rotation (thumb down)

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Quadriped

- 90° hip flexion, flat back, hands under shoulders, elbows unlocked
  - Rocking backward (heel sitting)
    - Watch for cervical extension, lack of scapular motion (upward rotation and elevation)
    - Cue to maintain chin toward Adam's apple and make posterior neck long.
      - If not able to rock backwards: assume levator scapulae stiffness (not short)
  - Unilateral shoulder flexion
    - Watch for ability to rotate thoracic spine, and quality of scapular movement
  - Cervical flexion / extension
    - Watch for ability to flex cervical spine

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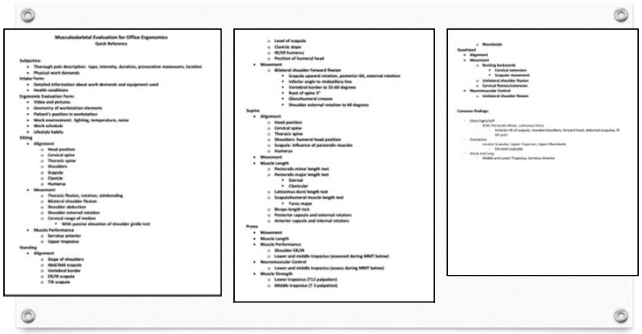

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Impaired Alignment

- Downwardly rotated
  - Inferior angle is medial to the root of the spine of the scapula
  - Levator scapulae and rhomboid muscles are short & upper trapezius is long
  - Serratus anterior may be long
- Depressed
  - Superior border of the scapula is lower than T2
  - Upper trapezius is long
  - Pec major and latissimus dorsi contribute to this holding this positioning

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Impaired Alignment

- Elevated
  - Elevation of the superior angle of the scapula but not the acromion
    - Levator scapulae muscle is short
  - Elevation of the entire scapula
    - Upper trap is short
- Adducted
  - Vertebral border of the scapula is less than 3" from the spinous processes
  - Rhomboid and middle trapezius muscles short
  - Serratus anterior is long

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Impaired Alignment

- Abducted
  - Vertebral border of the scapula is more than 3" from the spinous processes
  - Internally rotated more than 30° anterior to the frontal plane
  - Serratus anterior and pectoralis major are short
- Tilted/Tipped
  - Inferior angle protrudes
  - Shortness of the pectoralis minor

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Impaired Alignment

- Winged
  - Weakness of serratus anterior
  - Flat thoracic spine, scoliosis
- Upwardly Rotated
  - Root of the spine of the scapula is medial to the inferior angle
  - Short upper trapezius muscle

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Humerus and Shoulder

- IR/ER: humeral head stays centered on glenoid, no obvious translation
- No > 1/3 of humeral head anterior to the acromion

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Postures Unique to Workstation

- Neck flexion/extension/rotation
- Shoulder abduction/adduction/shrugging
- Wrist extension/ulnar deviation/radial deviation
- Elbow extension
- Trunk flexion/rotation
- Unsupported feet
- Contact stress: wrist, elbow, knee

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Common Findings

- Short/tight/stiff
  - SCM, Pectoralis Minor, Latissimus Dorsi
    - Anterior tilt of scapula, rounded shoulders, forward head, abducted scapulae, IR GH joint
- Overactive
  - Levator Scapulae, Upper Trapezius, Upper Rhomboids
    - Elevated scapulae
- Weak and Long
  - Middle and Lower Trapezius, Serratus Anterior

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Common Findings

- Weak/lengthened supinators
- Weak/lengthened triceps
- Stiff/short biceps, pronators, latissimus, upper trapezius
- Weak lower trapezius
- Restricted GH external rotation (adaptive shortening)

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Now What?

- Create a targeted exercise program based on your findings
  - Stretches
  - Strengthening
    - Think about how you are strengthening weak muscles
      - Activate muscles in a shortened position to increase stiffness
    - Just because a muscle is strong doesn't mean it is doing the job
  - Taping: positioning, inhibition, facilitation, nerve mobility
  - Posture
  - Habits

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Forward Wall Slides With Lift Off

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A Few Go-To Exercises

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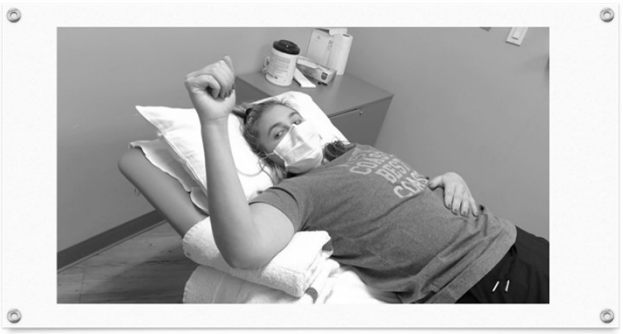

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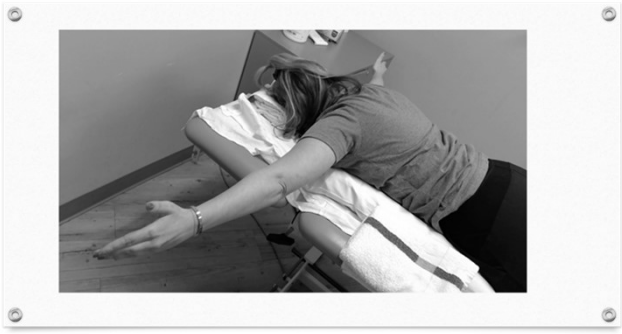

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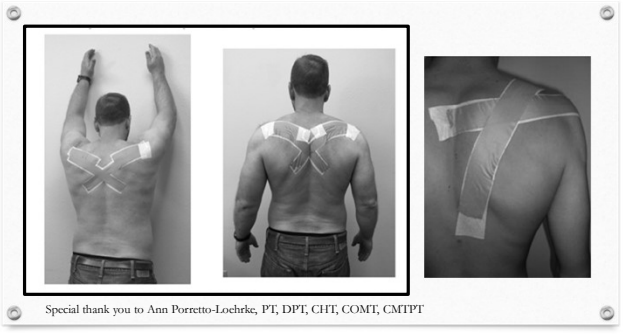

Special thank you to Ann Porretto-Loehrke, PT, DPT, CHT, COMT, CMTPT

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Challenges

- Time
  - Thorough evaluation
  - Exercise prescription
- Desire for passive interventions and fixes that can be purchased
- "Erroneous Absolutes"
  - Example: "Armrests are bad", "Wrist rest are bad"
- Resistance to change

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My Goal

- Revisit your ergonomic evaluation package
- Add a comprehensive, sophisticated, valuable evaluation
- Add a tailored exercise program to address deficits discovered in evaluation
  - Train through movement patterns
  - Strengthen and stretch with precision
  - Train behaviors
  - Use hardware options creatively to fit the patient

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Quick Case Example

- 64 year old computer programmer/project manager
- Large international bank
- Works from home
- Very long days, often 7 days/week
- Runs 40 miles a week
- Enjoys disc golf and hiking

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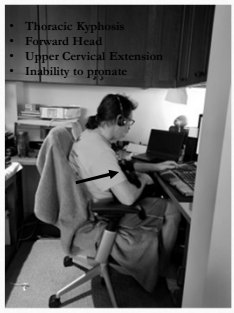
- Thoracic Kyphosis
- Forward Head
- Upper Cervical Extension
- Inability to pronate



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- Footrest =flat of Diet Coke

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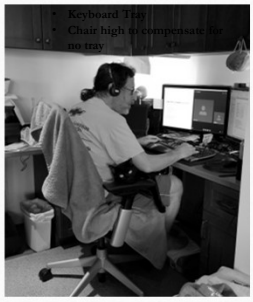
- Keyboard Tray
- Chair high to compensate for no tray



- Monitors low
- Hip flexion >90
- Shoulder Abduction
- Armrest
- Contact pressures

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Predict

- Short pectoralis muscles
- Long middle trapezius/rhomboids
- Anterior humeral head on glenoid
- Abducted scapulae

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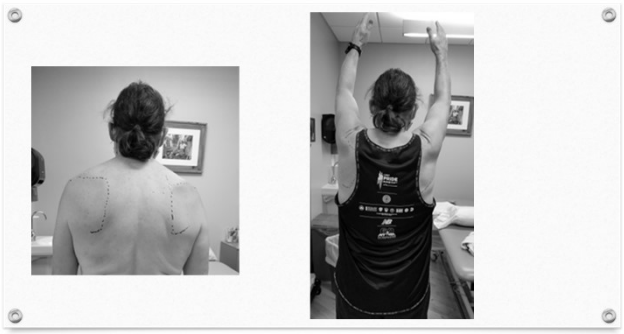

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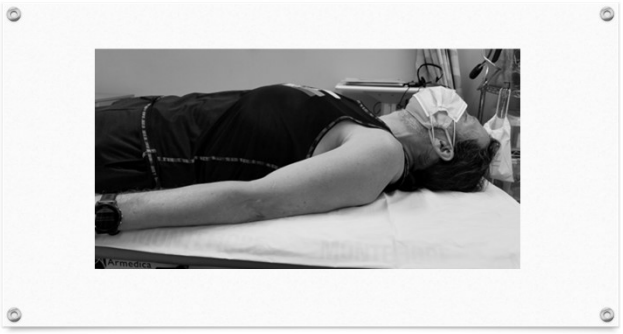

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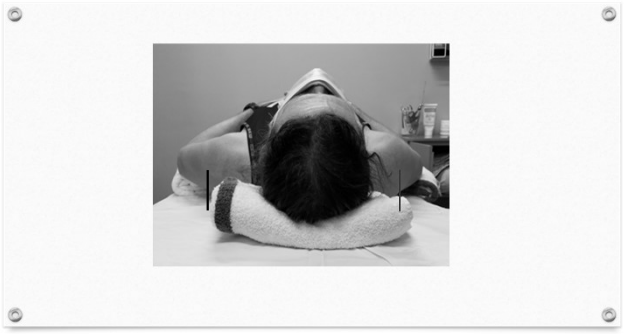

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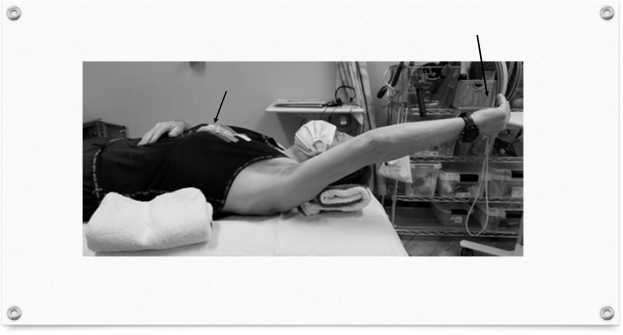

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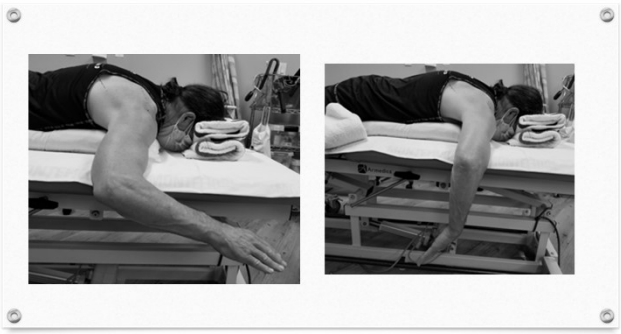

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In Summary

- Importance of a detailed, relevant musculoskeletal evaluation
- Creation of an HEP based on the findings
- Patient education about how they, specifically, fit into and move within their workstation

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Useful Follow Up

- Learnmovementsystem.com
- Maiko Morotani, PT, graduate of Wash U's PT program
- Organizes and runs the MSI courses at Wash U

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Thank You!

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