PT's are Movement System Experts: Let's Start Talking the Same Language!

Washington University in St. Louis School of Medicine
Physical Therapy

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CSM 2019

THE ACADEMY OF HAND & UPPER EXTREMITY PHYSICAL THERAPY

Objectives

- Describe the background of PT's as Movement System Experts
- Discuss the value of using movement-related diagnostic labels to specifically guide physical therapy treatment.
- Recognize the importance of performing a systematic examination of the individual patient, the findings of which lead to the movement-related diagnosis.
- Compare and contrast key features of selected movement system impairment diagnoses for the cervical, shoulder, elbow, and hand regions.
- Describe principles of treatment for selected movement system impairment syndromes and how the movement system diagnosis directs the treatment.

Disclosures

- I teach continuing education courses and co-authored 2 chapters in a textbook on Movement System Impairment Syndromes. This presentation, however, is not intended to promote attendance at courses or purchase of textbooks. My goal is to share our perspective on the analysis of movement and movement system labels.
- Content not to copied without permission

Outline

- History and background related to the movement system and diagnostic labels.
  - Background on Adoption of the Movement System as our area of expertise.
  - Background on establishing diagnosis, diagnosis dialogue,
  - Criteria adopted by APTA for labeling a dx.
  - Importance of pattern recognition and basing the dx assigned on findings from individual patient systematic examination
- Describe the movement system examination used to establish the diagnosis
- Illustrate the key features and clinical reasoning used to assign selected movement system diagnostic labels and how the labels specifically guide treatment for the upper quarter.
  - Link Key findings from the examination to description of selected movement system impairment syndromes of cervical, shoulder, elbow, and hand regions.
  - Compare and contrast dx.
  - Discuss principles of treatment for each syndrome including examples of individual exercises tailored to the specific movement system diagnosis.
- Questions and answers

THE HUMAN MOVEMENT SYSTEM

The Body System for which Physical Therapists are Responsible.

The System of our Expertise - Our Identity

APTA 2013
Sahrmann SA 2014
Gwyer J et al 2015
Jull G et al 2013

The human movement system is the term used to represent the collection of systems (cardiovascular, pulmonary, endocrine, integumentary, nervous, and musculoskeletal) that interact to move the body or its component parts.

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The Importance Of This Definition To Physical Therapy

- Physical therapy means treatment by physical means
  - By name we are defined by *skills and treatment*
- Need to be recognized by our *content area* of expertise not our skills
  - **Movement**

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Recognition for Expertise in a System of the Body is Important

- Highly respected health professions achieved their status by having expertise in an anatomical or a physiological body system
- Pathophysiology of specified anatomical body system
  - Neurologists, orthopaedists, cardiologists, dentists, podiatrists
- Physiological systems
  - Internists (all physiology), endocrinologists

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Movement System Analysis

Requires a Systematic Movement Exam:

To identify:

- primary movement impairment (diagnosis)
- major factors contributing to the movement impairment

Sahrmann 2011

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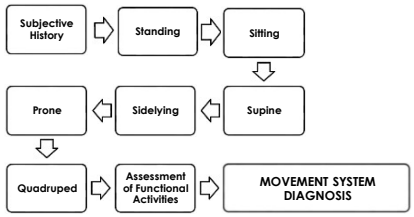
Systematic Movement Exam

- Isolated clinical tests: ROM, MMT, length tests, etc.
- Functional movements identified by subjective exam relevant to symptoms
- Primary Test = preferred movement pattern noting symptom behavior
- Secondary Test = modification of movement pattern correlated with effect on symptoms

Kibler WB 2013, Tate AT 2008, Van Dillen LR 2009

Format of Systematic Movement Exam:

Alignment and Movement Tests in a Variety of Positions



Movement System Experts

⇩

PATTERN RECOGNITION

Loveday T 2013

Pattern Recognition

- Recognize precise pattern and timing of movement at individual joints and across multiple segments
- Identify the pattern of movement noted across the exam during both isolated clinical tests and functional activities

Sahrmann SA 2011

Identify Major Contributing Factors

- Anthropometrics
- Functional habits
  - Prolonged postures: sitting, sleeping, standing
  - Repeated movements: work, fitness activities
- Joint and muscle tissue changes
  - Muscle activation, stiffness, or length
  - Joint flexibility: physiological and accessory

Sahrmann SA 2011

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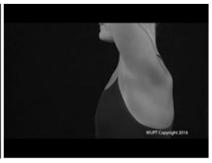
The End Does NOT Justify the Means

Shoulder flexion ROM = 160°

Posterior View

Anterior View



Lateral View

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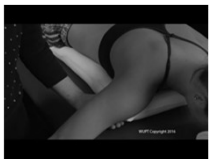
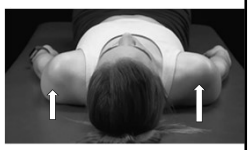
Same Movement Pattern Across Multiple Clinical Tests: Consider Contributing Factors

Supine Latissimus Length



Prone Middle Trapezius MMT

Supine Pectoralis Minor Length



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Same Pattern Noted in Multiple Functional Activities

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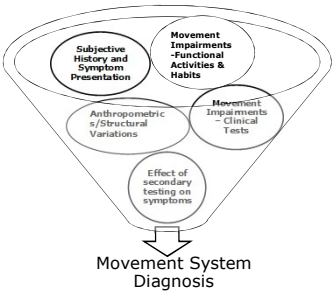
Identifying the Pattern that Leads to the MS Diagnosis



Diagnosis and Physical Therapy

- Physical therapists have been required to make a diagnosis since House of Delegates Actions in 1984.
- The 2015 House of Delegates adopted the position Management of the Movement System, which states, "APTA endorses the development of diagnostic labels and/or classification systems that reflect and contribute to the physical therapists' ability to properly and effectively manage disorders of the movement system."

What Diagnostic Label Should We Use?

So far there is no consensus across the profession.

- Isolated impairments
- ICD 10 codes
- Pathoanatomical diagnosis
- Others

Support for Using Movement System Diagnoses

- Criteria for naming a diagnosis were agreed upon and subsequently approved at the April 2017 Board of Directors meeting.

  APTA Movement System Summit 2016
  APTA Board of Directors Meeting Minutes April 26-29, 2017

- Would a MS diagnosis guide PT treatment better than a pathoanatomic diagnosis?

  Ludewig PM et al 2017; Ludewig PM et al 2013

Criteria for Naming a Diagnosis

Adopted by APTA Board of Directors in 2017

- The following criteria can be used by any stakeholder group that is developing diagnostic classification systems/labels:
  - Use recognized movement-related terms to describe the condition or syndrome of the movement system.
  - Include, if deemed necessary, the name of the pathology, disease, disorder, anatomical or physiological terms, and stage of recovery associated with the diagnosis.
  - Be as succinct and direct as possible to improve clinical usefulness.
  - Strive for movement system diagnoses that span all populations, health conditions, and the lifespan. Whenever possible, use similar movement-related terms to describe similar movements, regardless of pathology or other characteristics of the patient or client.

http://www.apta.org/BOD/Meetings/Minutes/2017/4/26/

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Movement System Impairment Syndromes

- The diagnoses or syndromes presented today are a work in progress and may not be what is eventually adopted by the profession but they are examples of labels that are named using recognized movement-related terms.

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Acknowledgements

- Washington University Program in Physical Therapy
- Shirley Sahrmann and associates for their contributions in the development of these concepts and syndromes.
  - Mary Kate McDonnell for her work on the cervical syndromes
  - Renee Ivens for her collaboration related to the shoulder syndromes
  - Lynnette Khoo-Summers for her collaboration on the elbow and hand syndromes.

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Movement System Impairment Syndromes

- Named for movement direction that increases symptoms and that is impaired. Correction of the movement usually decreases the symptoms.
- The impaired movement direction is believed to be the **cause** of the symptoms that may be associated with a variety of pathoanatomic **sources**.
- Organize & cluster specific tissue adaptations which are the contributing factors for the primary movement impairment.
- Knowing the diagnosis and contributing factors focuses the treatment rather than treating isolated impairments.

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Examples of Movement - Related Diagnostic Labels for the Upper Quarter

- Cervical
  - Flexion; Extension; Rotation
  - Flexion-rotation; Extension-rotation
- Shoulder
  - Scapular Internal Rotation with Anterior Tilt
  - Scapular External Rotation
  - Humeral Anterior or Superior Glide
  - Glenohumeral Medial Rotation
- Elbow
  - Wrist Extension with Pronation Syndrome
- Hand
  - Insufficient finger flexion or extension due to……
  - Thumb CMC hypermobility

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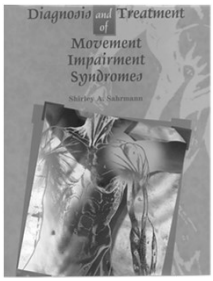
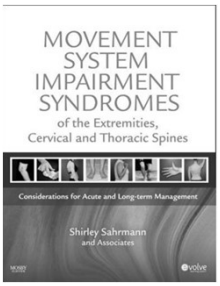


Mosby 2001



Elsevier 2010

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COMPARE AND CONTRAST TWO PATIENTS WITH NECK PAIN WITH DIFFERENT MOVEMENT SYSTEM IMPAIRMENT SYNDROMES.

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Scapular Alignment and Movement Contribute to Cervical Pain Problems

Scapula

- Downward pull may exert compressive force on facets, narrow the intervertebral foramen, and place traction on the brachial plexus.
- The musculature of the shoulder girdle affects the alignment and the stress on the cervical spine structures.

  Ludewig PM, Cook TM. Jrnl Occup Rehab, 1996
  Azevedo D et al Eur J Pain, 2008.
- **The alignment and movement of the shoulder girdle should be addressed in the treatment of cervical pain problems.**

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Key Features - Alignment

Cervical Extension/Rotation
- Thoracic kyphosis
- Cervical lordosis

Cervical Flexion/Rotation
- Erect thoracic spine
- Flat lower cervical spine

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Alignment and Active Cervical Flexion

Forward head - upper thoracic flexion ⇧ | Lower spine - extended | ⇩ Cervical Curve | ⇧ Flexion

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Key Features - Movement

Cervical Extension/Rotation
- Pain with cervical extension
- Limited cervical flexion or spine does not flex at all segments
  - Anterior translation
- Painful and often limited rotation with extension or sidebending
- Compensatory cervical extension during shoulder flexion and quadruped rocking

Cervical Flexion/Rotation
- Pain with flexion and rotation of cervical spine
- Lower cervical spine flexes easily
- Cervical spine flexes more easily than thoracic spine
- Cervical spine rotates during unilateral shoulder flexion

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Active Cervical Rotation and Secondary Test to Unload the Cervical Spine

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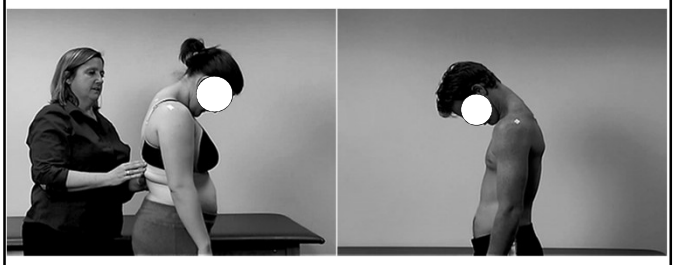
Active Cervical Flexion



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Quadruped Rocking

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Key Features – Muscle Adaptations

Cervical Extension/Rotation

- Long/weak/poor performance intrinsic ***cervical flexors*** (longus colli and capitus)
- Short/stiff extensors
- Extrinsic extensors: levator scapulae and trapezii dominant
- Intrinsic extensors: insufficient activation of splenius and semispinalis

Cervical Flexion/Rotation

- Poor performance of ***cervical extensors***
- Extensors flexible.
- Thoracic spine too extended actively or passively

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Primary Focus of Treatment

Cervical Extension/Rotation

- Improve performance of ***intrinsic cervical flexor*** muscles (control and strength)
- Improve extensibility of posterior cervical muscles
- Limit the amount of cervical extension during ADLs
  - Bifocals
  - Sitting at computer
  - Eating
- Restore and educate regarding sagittal rotation movement
- Minimize anterior translation strategies

Cervical Flexion/Rotation

- Improve performance of ***intrinsic cervical extensors***
- Encourage flexion of thoracic spine to decrease cervical flexion and stress on cervical spine
- Avoid excessive cervical flexion
  - Raise computer screen
  - Use book holder
  - Use cervical pillow

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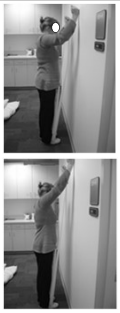
Treatment

Cervical Extension/Rotation



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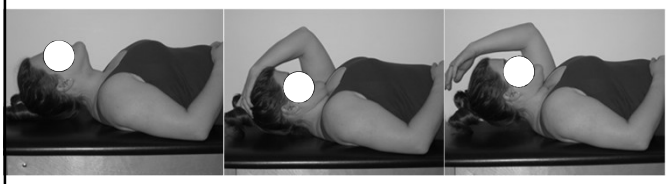
Treatment: Cervical Extension Rotation



Poor function of deep neck flexors requires assistance

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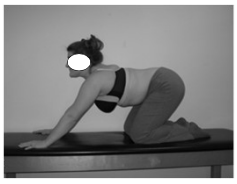
Treatment

Cervical Extension/Rotation



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Treatment

Cervical Flexion/Rotation

- Encourage flexion of thoracic spine to decrease stress on cervical spine
  - Slump! Do not attempt to have very straight thoracic spine and relax neck allowing chin and nose position to be up slightly.
- Improve performance of intrinsic cervical extensors

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COMPARE AND CONTRAST TWO DIFFERENT SHOULDER PAIN SYNDROMES

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Key Features - Alignment

Scapular Internal Rotation

- Scapula > 30 to 40 degrees anterior to frontal plane at rest and/or
- Scapula > 3.5 inches from spine
- Scapula >10-15° anterior tilt at rest and/or
- Scapula downwardly rotated
- Often associated with thoracic kyphosis

Scapular External Rotation

- Scapula is oriented less than 30°anterior to frontal plane
- Vertebral border of scapula is < 6.25 cm (2.5") from vertebral spine
- Clavicle is retracted more than 20-25°
- Associated with flat thoracic spine.

Ludewig PM

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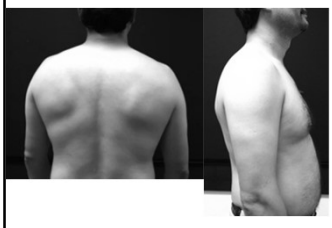
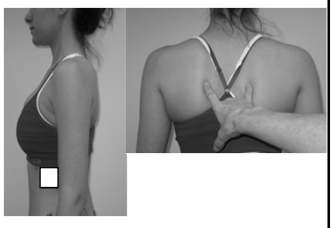
Key Features - Alignment

Scapular Internal Rotation



Scapular External Rotation



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Key Features – Primary Movement Impairments

Scapular Internal Rotation

Excessive scapular internal rotation which occurs:

- with scapular anterior tilt,
- abduction,
- insufficient upward rotation
- either individually or combined.

Scapular External Rotation

Insufficient scapular internal rotation and abduction usually occurs:

- with insufficient scapular upward rotation

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Key Features - Movement

Scapular Internal Rotation

Scapular External Rotation

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Movement Impairments: Scapular Internal Rotation with Insufficient Upward Rotation

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Key Features – Muscle Adaptations

Scapular Internal Rotation

- ***Trapezii not performing well***
  - too long, or not as stiff as muscles that IR and abduct scapula
- Scapulohumeral muscles pulling harder on scapula than serratus anterior and trapezii

Scapular External Rotation

- ***Excessive activation or stiffness of the trapezius*** and rhomboids often prevents normal scapular movement during arm elevation

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Primary Focus of Treatment

Scapular Internal Rotation

- Need more activation of trapezii relative to serratus anterior
- Increase stiffness & activation of posterior axioscapular muscles
- Stretch
  - SH muscles while maintaining scapular position
  - Pectoralis minor

Scapular External Rotation

- Need more activation of serratus anterior relative to trapezius.
- Decrease activation of scapular adductors.
- Increase extensibility of the rhomboids and middle trapezius.
- Cue to relax thoracic spine

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Cues For Shoulder Flexion Exercise Differ Depending on the Diagnosis

Scapular Internal Rotation

- Standing Shoulder Flexion Facing the Wall
  - Cue to avoid excessive scapular internal rotation yet allow scapula to upwardly rotate as arm is elevated.
  - Standing ***closer to wall*** helps avoid scapular IR
  - The purpose of these cues is to increase the activation and stiffness of the trapezius while still encouraging the serratus anterior to work at the appropriate length.

Scapular External Rotation

- Standing Shoulder Flexion Facing the Wall
  - Correct starting alignment by cueing to relax into normal thoracic flexion and relax scapular adductors.
  - Stand a little ***farther from wall*** to encourage scapular IR/abduction
  - Cues to increase performance of serratus anterior:
    - bring scapula out & around.
    - push into wall (from 90°to end ROM)

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Cues For Shoulder Abduction Differ Depending on the Diagnosis

Scapular Internal Rotation

- Standing Shoulder Flexion Back to the Wall
  - Placing the fingertips against the wall encourages:
    - the trapezii to work at a short length
    - a more erect spine.

Scapular External Rotation

- Standing Shoulder Flexion Back to the Wall

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Other Exercises Addressing Contributing Factors to Scapular Internal Rotation Syndrome

Focus on scapular external rotation, not on how far the arm is raised.

Stretch posterior shoulder with scapula stabilized.

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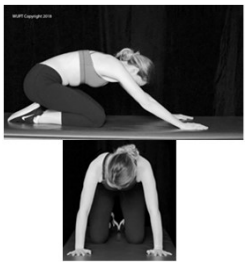
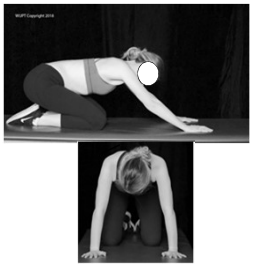
Quadruped Rocking Back: Scapular Internal/External Rotation





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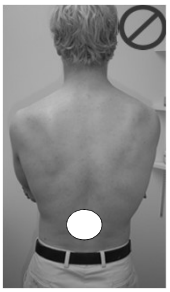
Functional Cues to Correct Scapular Internal Rotation

- Avoid excessive scapular internal rotation/abduction at rest & during arm motions





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Functional Cues to Correct Scapular External Rotation

Encourage the patient to relax the:

- thoracic spine into a normal curve and
- scapular adductors

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PROPOSED MOVEMENT RELATED LABELS FOR THE ELBOW

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Movement System Impairment Diagnoses of the Elbow

1. **Wrist Extension Syndrome with Forearm Pronation (Lateral Elbow Tendinopathy)**
2. **Elbow Hypomobility**
3. **Elbow Flexion Syndrome (Cubital Tunnel Syndrome)**
4. Elbow Valgus Syndrome (valgus extension overload syndrome)
   - With or without extension
5. Elbow Extension Syndrome
6. **Anterior and Posterior Forearm Entrapment Syndromes**
   - **Pronation Syndrome vs. AINS**
   - **Radial tunnel syndrome vs. PINS**
7. Wrist flexion with forearm pronation (medial elbow tendinopathy)
8. Ulnohumeral and radiohumeral multidirectional accessory hypermobility
9. Elbow Impairment

Caldwell CA, Khoo-Summers L 2010

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Wrist Extension Syndrome with Forearm Pronation

Key Features

This syndrome is characterized by lateral elbow pain provoked by **gripping and lifting activities** resulting in overuse of the wrist extensors.

- Symptoms are worse with gripping with the forearm pronated and the elbow extended.
- *Correction: reaching and gripping with forearm supinated decreases symptoms.*

Objective Examination

- Appearance/alignment – distal and proximal UE
- AROM/PROM: fingers, wrist, forearm, elbow, shoulder
- Alignment and movement impairments during relevant functional activities
- Joint mobility
- Muscle/tendon length tests: wrist and finger flexors and extensors, pronator teres
- Strength
- Tests for source of symptoms
- Palpation

Wrist Extension Syndrome with Forearm Pronation

Aggravating functional activities

- Based on the history, examine performance of individual functional activities for the movement impairment that may be contributing to the symptoms.
- Pay particular attention to the movement patterns of the shoulder, elbow, forearm, wrist and fingers.

Examination of Functional Activities

- Observation of functional activities is often more helpful than AROM in identifying key alignment and movement impairments.
- AROM provides helpful information regarding movements that are painful that can be retested subsequent visits

Impairments Noted During Functional Activities

Watch for habits that may incorporate frequent or prolonged use of wrist and finger extensors:

- Example:
  - Expressing self with hand gestures while talking
  - Constant contraction of finger extensors: Holding fingers off mouse instead of relaxing fingers on mouse

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Patient Case : Aggravating Functional Activities

Note Distal Alignment

- Constant contraction of finger extensors: Holding fingers off keyboard on left > right.

Corrected

Her extrinsic finger extensors were short and stiff; 50° wrist flexion with fingers Flexed; 80° wrist flexion with fingers extended

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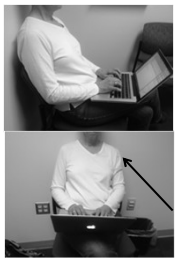
Impaired Proximal Alignment May Contribute to Increased Stresses on Distal Tissues

Preferred



Left scapula forward and depressed> right

Corrected

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Potential Impact of Proximal Alignment and Movement on Lateral Elbow Pain

- Modification of associated impairments in shoulder girdle alignment and movement is often necessary to decrease the stresses on the injured tissues at the elbow.
  - Scapular IR and shoulder MR are common impairments
- Poor proximal alignment and muscle function may:
  - Alter muscle activation and force distally — Kibler WB 2004 & 2006; Sciascia A 2012, Chu SK 2016
  - Change the forces placed on the distal muscles — Furuya S 2010
  - Be correlated with decreased distal strength — Mandalidis D 2008
- Example:
  - Shoulder medial rotation changes the orientation of the forearm changing the forces on the forearm.
  - Shoulder medial rotation also decreases the need for the patient to move through full forearm pronation.

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Weak But Growing Evidence that Modification of Associated Impairments in the Shoulder Girdle May be Important

- Glaser R, Bhatt JB, Chavez A, Yung E. Management of lateral epicondylalgia targeting scapular muscle power deficits: A case series. *J Hand Therapy 2016; (29)e5-36.*
- Day JM, Bush H, Nitz AJ, Uhl TL. Scapular muscle performance in individuals with lateral epicondylalgia. *J Orthop Sports Phys Ther* 2015; 45(5):414-424.
  - Serratus anterior strength ↓'d on involved side compared to uninvolved in patients with Lateral Elbow Tendinopathy.
- Bhatt JB 2013
  - Case report on Lateral Elbow Tendinopathy – symptoms resolved with treatment of only middle and lower trapezius strengthening
- Lucado AM 2012
  - Weakness of lower trapezius in symptomatic group more than controls (tennis players)
- Mandalidis D 2008
  - Found some correlation between lower grip strength and lower shoulder strength
- Alizadehkhaiyat O 2007
  - Weak rotator cuff in patients with Lateral Elbow Tendinopathy compared to controls

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Modification of Symptoms During Functional Activities

Modification of symptoms may also be achieved by:

- Decreasing the stresses on the wrist extensors by avoiding use of the muscle when it is lengthened and/or in the extremely shortened range.

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Wrist Extension Syndrome (with forearm pronation)

Gripping with elbow flexion and extension:

- Excessive range of wrist extension with excessive glenohumeral abduction.

❖ *Correction: small decrease in glenohumeral abduction and maintain wrist in neutral.*

- During elbow flexion with forearm in neutral rotation, 90° of GH abduction, and scapular abduction, the wrist extends excessively

❖ *Correction is to avoid extreme range of wrist extension by small increase in scapular adduction.*

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Patient Case: Subjective History

- **Chief complaint:** 59 y/o right hand dominant male with constant left lateral elbow pain of insidious onset.
- Pain aggravated with:
  - Gripping, twisting doorknobs, removing jar lid
  - Lifting
  - Prolonged typing at the computer
- **Job:** computer work and travel.
- **Fitness:** tennis - not limited by his left elbow pain.

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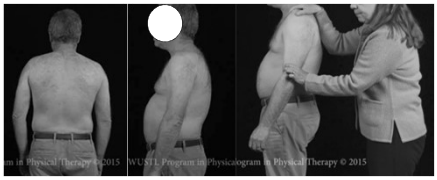
Standing Alignment: Trunk, Shoulder, Elbow, Forearm, and Fingers

Scapular internal rotation, anterior tilt, and abduction;
Humeral medial rotation, thoracic kyphosis and increased finger flexion



Feel resistance to passive supination.
Normal carrying angle.

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Muscle Length Tests

Assess <u>stiffness</u>, not just length.

- Use a light touch as when assessing for R1 during joint mobility testing
- Note the resistance through the range, not just the end range.

Watch for subtle compensatory movements during length tests

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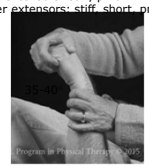
Length Tests

Wrist and Finger Flexors Stiff

Wrist extensors: stiff, pnful
Finger extensors: stiff, short, pnful



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Objective Examination: Function

- Primary test: lifting small box with left hand was painful
  - Noted forearm was pronated
- Secondary test: lifting with supination pain decreased.

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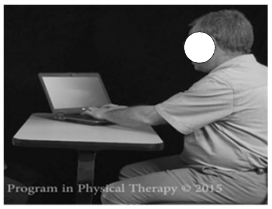
Functional Testing



Correction

- Laptop positioned diagonally on right side with no support to arm when typing on the computer. Does not use external mouse.
- Pain increases after prolonged period of time

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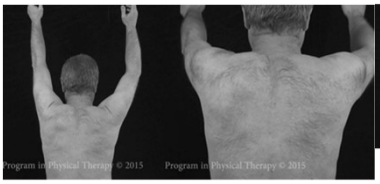
Proximal Impairments - Standing Shoulder Flexion



video

Scapular internal rotation and insufficient upward rotation
Glenohumeral medial rotation

Program in Physical Therapy

Shoulder ROM and Length Tests

- ROM normal for glenohumeral MR and LR.
- Horizontal adduction limited greater with LR than MR.
- Latissimus length test – difficult to maintain glenohumeral LR.
- Pectoralis Minor – stiff.

Program in Physical Therapy

Diagnosis

- **Movement Diagnosis**:
  - Wrist Extension Syndrome with Forearm Pronation with
  - Contributing scapular internal rotation, anterior tilt, and humeral medial rotation.
- **Primary Focus of treatment:**
  - Decrease stresses on wrist extensors by:
    - Modifying work alignment/posture.
    - Modifying pattern of reaching, lifting, and gripping.
    - Correcting proximal impairments.
    - Improving pattern of muscle use.

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Treatment

Patient Education

- Alignment at computer
  - Sitting close to desk to support forearms and shoulders
  - Correction of trunk, shoulder and head alignment
- Lifting with short lever (flexed elbow) and forearm supinated
- Use as needed during the day:
  - Forearm strap
  - Ice

Exercises

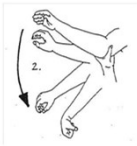
- Take frequent breaks to stretch:
  - Wrist and finger extensors while avoiding compensatory humeral MR.
  - Finger flexors with palm flat on table
- Frequent active forearm supination – stretch pronator teres and increase activation supinator.
- Standing shoulder flexion with back to wall
  - cues to avoid active wrist extension and increase shoulder LR

Treatment: Stretching Exercises

- Watch for subtle compensatory movements
- Stretch finger flexors passively to avoid active use of wrist and finger extensors
- Progress stretch by gradually incorporating all joints across which muscle crosses.

Patient Education

Modify Habits, Work, And Sports Activities



Balance rest with activity:

- Avoid using hands for repetitive gesturing while talking
- Avoid repetitive or prolonged contraction of the finger and wrist extensors
  - Take breaks to stretch frequently throughout the day.
    - This seems to help relax wrist extensors, not just stretch.
- May need to change tools; vary method of grip throughout the day
- Use splint only if needed to remind patient to avoid aggravating activities
- Forearm strap – **contraindicated if suspect radial tunnel syndrome**.

PROPOSED MOVEMENT RELATED LABELS FOR THE HAND

Hand Movement Based Diagnoses

- Insufficient Finger and/or Thumb Flexion due to… (eg. Flexor tendon adhesion)
- Insufficient Finger and/or Thumb Extension due to….
- Finger (or thumb) Flexion Syndrome (with or without rotation)
- Insufficient Thumb Opposition/Palmar Abduction due to…
  - Later stages of OA of CMC of thumb
  - Contracture of 1st web space
- Thumb CMC Accessory Hypermobility (Early Stages of OA)

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THUMB CMC HYPERMOBILITY = EARLY STAGES OF OA OF CMC JOINT OF THUMB

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Thumb CMC Accessory Hypermobility

- Pain is located at the CMC joint, but the alignment and movement impairments occur at all joints of the thumb.
  - The CMC joint may be extended/abducted or adducted/flexed.
  - The impairments of the CMC joint are associated with:
    - MP flexion with IP hyperextension or
    - MP hyperextension with IP flexion
  - The impairments result in loss of the longitudinal arch of the thumb
  - Correction of the impairments by restoring the longitudinal arch decreases the symptoms.
- The adaptive changes of the muscles include:
  - Overused adductor pollicis and FPB relative to
  - APL, APB, OP
- Patients assigned this diagnosis must have a modifiable movement pattern.

Caldwell CA and Khoo-Summers 2010

Program in Physical Therapy

Classification of OA of CMC of Thumb

Eaton RG, 1987

Stage I: early stage

- articular contours are normal
- may have slight widening of joint space
- hypermobility of the CMC joint
- pain exacerbated by pinch activities

Stage IV: late stage

- complete deterioration of CMC joint and in addition the ST joint is narrowed with sclerotic and cystic changes apparent.

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Symptoms of OA of CMC of Thumb

- Slowly developing joint pain, stiffness and limitation of motion
- Pain occurs after use of thumb
- Pain is relieved by rest early in disease, but may be persistent in later stages
- Difficulty with functional activities due to pain
- More common in women than men
  - onset in fifth to seventh decades of life Wajon A. et al, 2003

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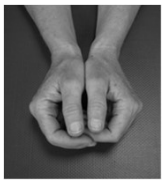
Causes of OA of CMC of Thumb

- Interplay between:
  - Genetic factors
  - Mechanical stresses – We can affect these!
    Glickel SZ, 2001
    Cooney et al, 1981
  - Modification in metabolic capacity of cartilage to repair itself
  - Trauma
  - Secondary underlying bony changes
    Weiss S et al 2000



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OA of the CMC of the Thumb: Does the Quality of Movement Matter?

We can't stop the process of degeneration but if we intervene in the early stages, *maybe* we can slow down the process ……

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Factors Contributing to Alteration in Mechanical Forces or Movement of the Thumb

Most commonly during function, the thumb is in a position of adduction and flexion Cooney WP et al 1981
- Adductor pollicis is very active in power grip and key pinch.

Contributes to overuse of the adductor and underuse of the abductors.

Ligament laxity
- Most of the ligaments are taut with the thumb in abduction, extension and opposition.

Neumann DA, Bielefeld T. 2003

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Muscle Torque Potential at CMC of Thumb

- The adductor pollicis has the greatest torque potential of any of the muscles that cross the CMC joint of the thumb.
- The strong pull of the adductor pollicis and the other thumb intrinsic muscles that insert on the distal end of the 1st MC cause stresses that contribute to flexing and adducting the 1st MC.
- This results in dorsoradial subluxation of the 1st MC on the trapezium

Neumann DA, Bielefeld T. 2003;33:386-399

Hunter JM, et al 1990;
Neumann DA, Bielefeld T.2003

Program in Physical Therapy

Factors Contributing to Alteration in Mechanical Forces or Movement of the Thumb

Balanced muscle forces help the ligaments maintain correct joint alignment. Cooney WP, et al, 1977

- Common Muscle Impairments:
  - Insufficient function of the APL, APB, and opponens to help stabilize the CMC
  - Stiffness, shortness, and overuse of the MP flexors (FPB) and adductor of the thumb
  - Weak EPB

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Examination of OA of CMC of Thumb

- Observation: Alignment and Appearance
- AROM: ROM and Quality of Movement
- PROM
- Strength
- Special Tests (Crank and Grind Test)
- Palpation

Program in Physical Therapy

Thumb CMC Accessory Hypermobility: Movement Impairments During Pinch

- The CMC joint may be either extended/abducted or adducted/flexed.
- The impairments at the CMC joint are associated with either:
  - MP flexion with IP extension or (**boutonniere**)
  - MP extension with IP flexion and result in loss of the normal longitudinal arch of the thumb. (**swan neck**)

Good Thumb alignment

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You Get What You Train:
Lateral Pinch

Poor Alignment

Unable to maintain the arc of pinch during functional activities and produces symptoms

Correction of arc of pinch decreases or abolishes symptoms.

Results in increased stresses to CMC joint

Corrected Alignment

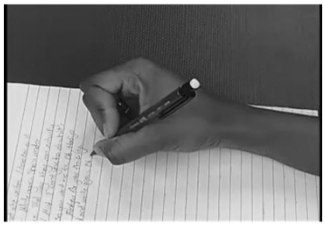
Program in Physical Therapy

Good Thumb Alignment During Writing

Program in Physical Therapy

Note Arc of Pinch and Position of CMC Joint of Thumb During Writing

Good Thumb Alignment



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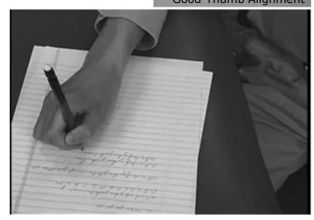
Writing - Note Amount of CMC Adduction or Abduction

Good Thumb Alignment



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Correction of Alignment and Movement During Writing

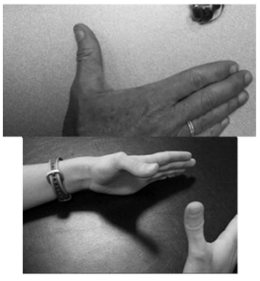
23 Year-old Patient with Thumb CMC Accessory Hypermobility and Finger Swan neck deformities (early stages)

Patient was a PT student. C/o thumb pain and collapse when doing joint mobilization techniques. In addition to splint prescribed exercises for FPB and educated patient regarding alignment and movement impairments and how to correct them.

Thumb CMC Accessory Hypermobility Movement Impairments During **Active Thumb Extension**

CMC extends relatively more than MP
- APL overused relative to EPB
- FPB short or stiff

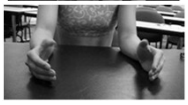
IP extends relatively more than MP
- EPL overused relative to EPB



Thumb CMC Accessory Hypermobility Movement Impairments During **Active Thumb Extension**

- MP extends relatively more than CMC

- CMC adducts
  - EPL dominates over APL



Thumb CMC Accessory Hypermobility Movement Impairments During **Active Palmar Abduction**

- MP abducts relatively more than CMC
  - Adductor overused relative to opponens pollicis and APL, and APB.
- *Correction of movement impairments listed above decreases or abolishes symptoms.*

normal

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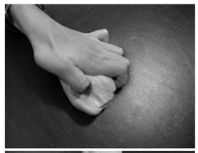
Movement Impairments During **Active or Resistive Thumb Flexion**

- Excessive CMC adduction
  - Increased use adductor pollicis vs. abductor pollicis brevis
- Insufficient IP flexion



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Conservative Treatment of OA of the CMC of the Thumb

- Patient Education
- Splints
- Exercises
- Joint protection
- Adaptive equipment
- Modalities
- Joint Mobilization (not performed commonly)

There is currently inadequate evidence to determine the effectiveness of therapy. Moe RH 2009

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Patient Education is Key

- Educate the patient regarding their impaired movement pattern and how to correct it during their functional activities.
- Exercise: practice correcting the movement pattern during the therapy sessions
  - eg. during writing, maintain the arc of the pinch
  - avoid collapse of the 1st MC into adduction and flexion
- Use assistive devices, splinting or taping as needed to correct the alignment, precision of movement, or decrease forces on the joint.
- Modify tools used at work when possible
  - ie. hairdressers have different options available regarding scissor styles that help in modifying the movement pattern

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Exercises: Correcting the Movement Pattern in the Early Stages

- May need to start with active place and hold
  - Passively place the joint in correct alignment and then isometrically contract muscles to maintain position.
- Performing the exercises with the joint in the corrected alignment activates the appropriate muscles
- Progress to active through the ROM and then resistive

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Exercises (stages I and II)

- The Goal is to
  - Help to stabilize the CMC joint subluxation. Pellegrini Jr. VD, 1992
  - Palmar abduction (APB) places the thumb in the position of maximal stability of the CMC joint. Poole JU, Pellegrini VD, 2000
    - Strengthen thumb abduction, opposition and ?? 1st DI Anakwe RE 2011
  - Avoid adduction deformity Valdes K JHT 2012
    - Maintain the 1st web space Valdes K JHT 2012
- Begin isometric progressing to resistive exercises for palmar abduction and thumb extension after the acute symptoms have subsided. Pellegrini Jr. VD, 1992; Valdez K 2012

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Functional Activities and Assistive Devices (to decrease stress on CMC of Thumb)

- Avoid strong grip and pinch
  - Use of jar opener
  - Use of dycem or rubber pad to increase friction when opening jar
  - Use of key holder
  - Build up circumference of grip on handles

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Principles for Orthoses

- Effectiveness: splinting is most effective in earlier stages of disease Day CS, Gelberman R 2004
- Purpose:
  - Rest the joint to decrease inflammation and pain
  - Support the joint to alter the stresses on the painful structures Beasley J, JHT 2012
  - Allow more painfree function
  - Stretch the 1st web space
- Position the thumb with the CMC joint abducted because this is the position of maximal congruence of the joint
  - Consider the position of the MP joint Moulton M, et al 2001

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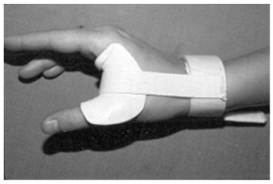
Use Splint As Needed To Support The Joint While Training New Alignment And Movement Pattern.

Weiss S et. al. 2004
Wajon A 2000
Galindo A et al 2002
Moulton M, et al 2001
Beasley J. JHT 2012

Use Splints As Needed For Increasing Soft Tissue Extensibility

- Progressive stretching of web space with splinting to be worn at night
- Augment splint use with exercises to actively and passively stretch the 1st web space using correct pattern of movement



INSUFFICIENT FINGER FLEXION DUE TO……..

Insufficient Finger Flexion

- The principal impairment will be **limited active finger flexion range of motion** but the key to prescribing the appropriate intervention is differentiating between the sources/structures causing the limited flexion.
- Most commonly secondary to a trauma or injury or after a period of immobilization to allow for tissue healing.
- Initially these patients may be assigned a diagnosis such as flexor tendon laceration s/p repair, stage 1 but after the acute phase of treatment a Movement System Impairment diagnosis may direct treatment better.

Caldwell CA, Khoo-Summers L 2010

Insufficient finger flexion may be <u>due to</u>:

- Flexor tendon adhesion
- Extensor tendon adhesions
- Weakness of flexors
- Rupture of flexor tendon
- MP collateral ligament shortness/adhesion
- Shortness of extrinsic extensor muscles
- Shortness of the Interossei and lumbricals
- IP joint dorsal capsule shortness/adhesions
- Swan neck deformity
- Shortness of the ORL
- Ligament sprain

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THANK YOU!

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