MOVEMENT SYSTEM IMPAIRMENT SYNDROMES OF THE LUMBAR SPINE WITH CONSIDERATIONS OF THE HIP

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Movement System Impairment (MSI) Syndromes
- Impairment level of the organism
  - Any abnormality of anatomical, physiological or psychological function.
- Syndromes
  - Collection of impairments based on observable abnormalities, primarily kinesiological, and their relationship to symptoms
    - Correction decreases or eliminates the symptoms
    - Named for principal impairment – the movement direction most consistently affecting the symptoms
    - Other impairments are contributing factors – sub pathological

The Challenge: Keeping the Acute Problem From Becoming Chronic
- Acute symptoms subside
  - With time
  - With variety of interventions addressing symptoms
- Recurrence is common
  - Pathoanatomic structures considered the cause
  - The impaired movement not considered a cause
    - Therefore has not been identified & addressed.
- To minimize recurrence –
  - Identify the movement cause & contributing factors
  - Develop a treatment program that includes
    - Patient specific exercises
    - Correction of performance of basic daily activities
    - Correction of performance of work, recreation, fitness, & sports activities

Key Concepts I
- Path of least resistance for motion
- Relative Flexibility
  - Intra-joint, intrinsic accessory motion mobility
  - Inter-joint, physiological motion, e.g. back vs Hip
- Relative Stiffness: passive tension of muscle & connective tissue
- Motor Learning
  - Joint (micro-instability) hypermobility causes the pain
  - Accessory motion
  - Range & frequency
  - What moves is what hurts

MSI Syndromes - Assumptions
- LBP is associated with movement in a specific direction
  - Subgroups can be identified
  - Repeated movements & sustained alignments
    - cause development of a joint’s accessory motion to occur too readily usually in a specific direction – relative flexibility
  - Induce muscle and connective tissue changes contributing to relative stiffness behavior.
  - Motor performance to motor learning adaptations
  - Relative flexibility, relative stiffness, and motor learning combine to contribute to the development of a path of least resistance for movement
- The neuromusculoskeletal tissue changes combine with biomechanical interactions.
  - The increased accessory motion, both in range and repetitions, contributes to microtrauma of the joint because of the micro-instability.
  - Musculoskeletal pain is a progressive condition associated with degenerative changes and is affected by lifestyle

Movement System Diagnoses
- Musculoskeletal
- O’Sullivan Class
- Tissue Impairments (Pathoanatomic)
- Mechanical Diagnosis (MDT)
- MSI Syndromes (Neuromusculoskeletal)
- Neurological
- Cardiopulmonary
Kinesiopathologic Model of Movement System – A Theoretical Construct

Musculoskeletal → Nervous → Cardiac-Pulmonary – Endocrine

INDUCERS
- Repeated movements
- Sustained alignments

Personal Characteristics – intrinsic
- Activity Demands – extrinsic

Tissue Adaptations
- Relative Stiffness of muscle & connective tissue
- Relative Flexibility
- Motor Learning

Joint Accessory Hypermobility

Path of Least Resistance

Micro → Macro trauma

Key Concepts II

- The way everyday activities are performed is the critical issue
  - Repeated movements and
  - Sustained alignments

Key Concepts III

- You get what you train
  - (many strategies to create moments at a joint or within a limb)
- Presence of a muscle does not mean appropriate use
- No magic in an exercise except if the desired motion is evident

How Much Does the Hip Contribute?

Muscular

Lumbar Rotation
- Hip rotators, abductors
- L Flexion
- Hip extensors
- L Extension
- Hip flexors

Structural

Lumbar Rotation
- Femoral anteversion / retroversion
- L Flexion
- Cam impingement
- Pincer impingement
- L Extension

Muscular Factors – Affect Low Back

Hip Flex/Abd. Flexor

Hip Extensors Short

The Lumbar Spine Syndromes

Chronic Conditions
- Extension
- Extension-rotation
- Rotation
- Primary and Secondary

Acute Conditions - usually
- Flexion
- Flexion-rotation
Movement System Impairment Syndromes

- Identify the cause of the dysfunction
- Identify the contributing factors
  - Tissue & motor control impairments
- Organize specific tissue impairments
  - Minimizing treatment of isolated impairments
  - Usually limited in effectiveness
- Provide a direction for intervention
  - Do not require identification of a specific pathoanatomical structure (source)
- Based on anatomy and kinesiology

Lumbar Flexion Syndromes

Young – Tall - Acute

Kendall: Muscles Testing & Function 1983

Case Presentation: low back pain - flexion
Long psoas

Tx:
- Shorten Hip flex
- Back ext

What is his natural unsupported sitting alignment?

Lumbar Flexion Syndrome

40 yr old ultra-marathonist
Executive

Case Presentation: Low Back Pain – flexion
Young – tall – flexible: student/diver
Sit-up exercises

Abdominals not short
Relative flexibility: abdominals > hip extensors > back ext

64 yo MD – DDD scoliosis

Post

Lumbar Flexion Syndrome
Kinesiopathologic Model

Base Modulator Support

Muscular Skeletal Nervous Cardio/pulmonary

Lumbar Extension Syndromes

Old – short – chronic
Variation in contributing factors

Patients with Low Back Pain

Case Presentation: Low Back Pain

- What was her sport
- Why does she stand in this alignment?
- Why is she standing with her trunk swayed back?
- Are her hip flexors short?

Abdominal vs Hip Flexor Stiffness

General Joint hypermobility

Lumbar Extension Syndrome

Case Presentation: Low Back Pain

Initial Visit Two Weeks Later

Abdominals too short contributing to kyphosis and swayed back posture
rectus abdominis anti-gravity muscle

Lumbar Extension Syndrome
Case Presentation: low back pain

Lumbar Extension Syndrome

The MSI Examination

- Purpose: assess symptoms and relationship to
  - Alignment and movement, movement pattern
  - Of the trunk and of the extremities and how they affect the spine
  - Preferred (natural movement) & corrected movement
  - Biomechanically linked system, therefore movement at one segment affects other segments, particularly adjoining segments
- Format: standing, supine, sidelying, prone, quadruped, sitting, walking

The Examination

- Standing: Sx, position; alignment; forward bending; return; sidebending; rotation; single-leg standing
- Supine: position; Hip ext/knee flex; pass & act hip/knee flexion; hip abd/lat rot;
- Sidelying: position; hip lat rot; hip abd
- Prone: position, knee flex; hip rot
- Quadruped: position; rocking back; shoulder flex
- Sitting: knee ext
- Standing: back to wall
- Gait:

Lumbar Rotation Syndromes

- Pain side bending, rotating, flex & ext
- Signs and not symptoms
- Types: primary & secondary

Patient with Low Back Pain

Observe her pelvis while walking; note structural characteristic of hips

Alignment
Rotation

Side lying Hip Lateral Rotation (L)

Side lying Hip Abduction (L)

Prone Knee Flexion

Relative Flexibility/Stiffness

Prone Hip Rotation

Muscles: Springs in series & in parallel

Most important: Flexibility of joint of spine NOT stiffness or shortness of muscles: RELATIVE

Passive stretch of stiff & stiff muscle in series cogulation of least stiff muscle
Walking – Corrected

Relative flexibility: abdominals vs hip flexors
Thumbs Monitoring ASIS

Pelvic Tilt Indicated by Right Thumb Moving as Hip Extends

Continued Anterior Pelvic Tilt – Thumb Moves Further Distally

If Pelvis & Spine Were Stable, No Pelvic Tilt, LE Would Remain Suspended

Relative Stiffness/Flexibility

- Anterior pelvic tilt, hip is flexed
- Lumbar spine more flexible than hip flexors
- No pelvic tilt, hip is flexed
- Lumbar spine is not flexible
Rotation - Primary

Herniated disc scheduled for surgery
Max pain when rotated

Rotated Spine
Increases when rocking backward

Hip flexion limited – most likely structural

Treatment Effect

Before

After quadruped rocking

8/23

Initial visit

8/29

5 days later

Case Presentation: Low back pain with left radiculopathy
6 months post-partum - twins

Successive Visits

8/23

8/29

9/5

Right iliopsoas pulling

> Left iliopsoas

Rotation to left when rocking back
Natural standing: Right foot on footstool

Takes stretch off of the iliopsoas
Movement Exam
Generic

Essential Activities

Standing
• Appearance
• Alignment
• Forward bend & return
• Single Leg standing
• Step up & down
• Walk
• Reach forward – overhead and out to side
• Sit to stand

Recumbent
• Roll to both sides
• Scoot
• Lying to sitting and reverse
Diagnostic Movement Exam

Standing

- Appearance (size, structural proportions, general fitness)
  • Overweight, athletic, tall, short, long trunk, “apple or pear”

Alignment
  • Iliac crest height; pelvic rotation, paraspinal asymmetry = rotation
  • Marked lumbar lordosis, marked anterior pelvic tilt, thoracic kyphosis, swayback = extension
  • Flat back, high iliac crest, posterior pelvic tilt = flexion
  • Symptoms = increased lumbar curve = extension; kyphosis/swayback = extension
  (compression with well developed abdominal muscles)

Forward bending: corrected forward bending
  • Increased lumbar flexion, decreased hip flexion, Sx = flexion
  • Decreased Sx with hip flexion only = flexion

Standing continued

- Return from forward bending: corrected return from forward bending
  • Lumbar extension & Sx with return = extension
  • Decreased Sx with hip extension, not lumbar extension = extension

Sidebending: corrected sidebending
  • Sx, moves at one segment = rotation
  • Decreased Sx with correction = rotation

- Rotation
  • Sx = extension

Backbending
  • Sx = extension

- Single leg stance
  • Hip drop, lateral trunk flexion = rotation
  • Lateral pelvic tilt = rotation
Supine

- Hip Extension with knee flexion (flexor length test)
  - Anterior pelvic tilt 1st 50%, note symmetry, change with abduction = extension/rotation
- Position – Sx = extension
- Log roll test – indication of femoral ante or retroversion,
  - note resistance & change in ROM with abduction
- Position of hips and knees extended vs. hips and knees flexed
  - Sx with LEs extended = extension
  - Sx decreased with hips/knees flexed = extension
- Unilateral hip and knee flexion (passive and active)
  - Note weight of LE, onset of any stiffness, hip flexion ROM
  - Sx during passive flexion, if becomes active = extension
  - At end of ROM, pelvis posterior tilts = flexion
  - Sx and/or lumbopelvic rotation = rotation
  - Hip flexion <120 deg = FAL flexion
  - Active Sx, lumbopelvic rotation = extension-rotation
  - Note the extent of hip extension of contra-lateral LE.

Sidelying

- Rolling
  - Asymmetrical timing of upper trunk & lower trunk – pelvis = rotation
- Position
  - Sx = rotation
- Hip abduction/lateral rotation from flexion
  - Lumbopelvic rotation in relation to thorax = rotation
- Hip ab & adduction
  - Pelvic tilt = rotation

Prone

- Position
  - Sx = extension
- Knee flexion – passive - active
  - Lumbopelvic rotation, Sx = rotation
  - Anterior pelvic tilt, Sx = extension
- Hip lateral rotation – neutral & abducted
  - Lumbopelvic rotation, Sx = rotation
  - Note ROM? femoral version
- Hip medial rotation – neutral & abducted
  - Lumbopelvic rotation, Sx = rotation
  - Note ROM? Femoral version
Quadruped

- Alignment
  - Lumbar flexion, <90 deg of hip flexion = flexion
  - Paraspinal asymmetry = rotation
  - Lumbar extension, Sx = extension

- Rock backward
  - Lumbar flexion = flexion
  - Lumbar rotation = rotation

- Shoulder flexion
  - Trunk rotation = rotation
LUMBAR MOVEMENT EXAMINATION
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A. STANDING:
1. Appearance (size, structural proportions, general fitness)
   a. Overweight, athletic, tall, short, long trunk, “apple or pear”
2. Alignment
   a. Iliac crest height; pelvic rotation, paraspinal asymmetry = rotation
   b. Marked lumbar lordosis, marked anterior pelvic tilt, thoracic kyphosis, swayback = extension
   c. Flat back, high iliac crest, posterior pelvic tilt = flexion
3. Forward bending: corrected forward bending
   a. Increased lumbar flexion, decreased hip flexion, Sx = flexion
   b. Decreased Sx with hip flexion only = flexion
4. Return from forward bending: corrected return from forward bending
   a. Lumbar extension & Sx with return = extension
   b. Decreased Sx with hip extension, not lumbar extension = extension
5. Sidebending; corrected sidebending
   a. Sx, moves at one segment = rotation
   b. Decreased Sx with correction = rotation
6. Rotation
   a. Sx, rotates off axis = rotation
7. Backbending
   a. Sx = extension
8. Single leg stance
   a. Hip drop, lateral trunk flexion = rotation
   b. Lateral pelvic tilt = rotation

B. SUPINE:
1. Hip Extension with knee flexion (flexor length test)
   a. Anterior pelvic tilt 1st 50%, note symmetry, change with abduction = extension/rotation
2. Log roll test – indication of femoral ante or retroversion, note resistance & change in ROM with abduction
3. Position of hips and knees extended vs. hips and knees flexed
   a. Sx with LEs extended = extension
   b. Sx decreased with hips/knees flexed = extension
4. Unilateral hip and knee flexion (passive and active)
   a. Note weight of LE, onset of any stiffness, hip flexion ROM
   b. Sx during passive flexion, if becomes active = extension
   c. At end of ROM, pelvis posterior tilts = flexion
   d. Sx and/or lumbopelvic rotation = rotation
   e. Hip flexion <100 deg = FAI, flexion
   f. Active- Sx, lumbopelvic rotation = extension-rotation
      a. Note the extent of hip extension of contra-lateral LE.
5. Hip abduction/lateral rotation from flexion
   a. Lumbopelvic rotation 1st 60% = rotation
6. Lower abdominal muscle performance inferred by lumbopelvic motion
   a. Early & greater than ½” motion = poor performance

C. Sidelying
   1. Position
      a. Sx = rolling
   2. Hip abduction/lateral rotation from flexion
      a. Lumbopelvic rotation in relation to thorax = rotation
   3. Hip ab & adduction
      a. Pelvic tilt = rotation

D. Prone
   1. Position
      a. Sx = extension
   2. Knee flexion – passive - active
      a. Lumbopelvic rotation, Sx = rotation
      b. Anterior pelvic tilt, Sx = extension
   3. Hip lateral rotation – neutral & abduced
      a. Lumbopelvic rotation, Sx = rotation
      b. Note ROM? Femoral version
   4. Hip medial rotation – neutral & abduced
      a. Lumbopelvic rotation, Sx = rotation
      b. Note ROM? Femoral version

E. Quadruped
   1. Alignment
      a. Lumbar flexion, <90 deg of hip flexion = flexion
      b. Paraspinal asymmetry = rotation
      c. Lumbar extension, Sx = extension
   2. Rock backward
      a. Lumbar flexion = flexion
      b. Lumbar rotation = rotation
   3. Shoulder flexion
      a. Trunk rotation = rotation

F. Walking
   1. Lumbopelvic rotation = rotation