Diagnosis & Treatment of Common Hip and Knee Musculoskeletal Conditions: Movement System Impairment Syndromes (MSI) Approach

Shirley Sahrmann, PhD, PT, FAPTA and Associates

Presented by: Sylvia Czuppon, PT, DPT, OCS
Associate Professor
Physical Therapy and Orthopaedic Surgery
Twitter: @czuppons

Program in Physical Therapy
Washington University in St Louis
School of Medicine

Objectives
• Describe the MSI approach to evaluation and treatment of neuromusculoskeletal pain conditions.

• Discuss principles to guide treatment.

• Recognize the importance of individualizing exercise programs for each patient.

Pain Models:
• Pathokinesiologic Model: Pathology is source of pain

• Kinesiopathologic Model: Imprecision of movement results in pathology

Website: https://pt.wustl.edu/Education/ContinuingEducation/Pages/ContinuingEducation.aspx

Mosby 2001
Elsevier 2010

About Me
• 2002: MS, PT – Washington University
• 2010: OCS
• 2011: DPT – Washington University

• Current position: Associate Professor, Physical Therapy and Orthopaedic Surgery, Washington University School of Medicine

• Have been teaching in the entry-level WU DPT program and MSI continuing education courses since 2003.

• czuppons@wustl.edu
What is MSI?
(Movement System Impairment Syndromes)

- Utilizes the kinesiopathologic model to drive evaluation and treatment of neuromusculoskeletal pain conditions
- Deviations in alignment and the precision of joint motion (movement impairment) create microtrauma that can lead to macrotrauma
  - In cases of trauma, alterations of normal movement or alignment will perpetuate the pain

Why Does Movement Become Impaired?

- Repeated movements and prolonged postures associated with everyday activities induce adaptive changes in movement system components.
- The adaptive changes vary because of intrinsic (genetics, sex, age) and extrinsic (fitness, work activity) factors.

Why Does Movement Become Impaired?

- The body follows the law of physics and follows the path of least resistance for motion which contributes to subtle hypermobility.
- The way everyday activities are performed reinforces this hypermobility and the movement pattern.
- Muscle performance is determined by the pattern of movement. Altered movement patterns impair proper muscle performance.

Working Theory

- Musculoskeletal pain is:
  1. Related to lifestyle similar to many other health conditions
  2. A progressive condition
    - Starting with acute pain – first indication of tissue damage
    - High recurrence rate - leading to chronic problem
  3. The result of tissue changes associated with
    - Aging-related degeneration and
    - Activity-induced tissue injury from impaired joint movement

The Challenge: Keeping the Acute Problem From Becoming Chronic

- Acute symptoms subside
  - With time
  - With variety of interventions addressing symptoms
- However recurrence is common!
  - Pathoanatomic structures are traditionally considered the cause.
  - Unfortunately, the impaired movement is not considered as cause.
    - Therefore has not been identified & addressed.

The Challenge: Keeping the Acute Problem From Becoming Chronic

- To minimize recurrence, must 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
**MSI Approach**

- **PT expertise = Human Movement System**
  - [http://www.apta.org/MovementSystem/](http://www.apta.org/MovementSystem/)
- Knowledge of normal alignment and movement pattern is the basis of our practice

**Movement Exam → Diagnosis**

- PTs must establish a diagnosis of the condition they are treating to ensure most effective treatment (APTA House of Delegates 1994, 1995)
- Diagnosis named according to the impairment(s) observed
  - Frequency
  - Magnitude
  - Production of symptoms
  - Response to modification of movement
- Diagnosis directs treatment

**MSI Approach**

- Systematic examination used to evaluate, diagnose and treat neuromusculoskeletal pain problems
  - Based on anatomy and kinesiology
  - Exam is based on symptom alleviation, not just provocation

**Movement Exam**

- To date, whether the movement impairment is the cause or result of the pain is unknown.
  - But if during the exam, correcting the movement impairment immediately alleviates the symptoms, then treatment may be most effectively directed by a movement diagnosis (Ludewig PM 2009, Kibler WB 2013)

**Movement Examination**

- Consists of:
  - Alignment tests
  - Movement tests performed in a variety of positions (standing, supine, prone, quadruped, sitting)
  - Analysis of functional activities
**Movement Examination**

- During the examination, the patient's preferred alignment and movements are analyzed to determine their precision and effect on symptoms.

- The preferred pattern is followed immediately by a secondary test modifying the movement to determine the effect on symptoms.

- Goal: Determine the pattern of movement which most consistently elicits symptoms and when corrected, decreases symptoms.

**2 Categories of MSI Syndromes of the Hip**

**Femoral Syndromes**

- Accessory motion impairments
  - Joint related symptoms
  - Ex. Femoral Anterior Glide – groin pain, impingement
  - Ex. Femoral Posterior Glide – buttock pain, sciatica

**Hip Syndromes**

- Physiological motion impairments
  - Contractile tissue symptoms
  - Ex. Hip Adduction – lateral hip pain, trochanteric bursitis, gluteus medius tendinopathy
  - Ex. Hip Extension with Knee Extension – buttock pain, hamstring pain

**Femoral MSI Syndromes**

- Anterior Glide
  - with medial rotation
  - with lateral rotation

- Posterior Glide
  - with medial rotation

- Multidirectional Accessory Hypermobility
  - With knee movement

- Hypomobility with Superior Glide

**Physiological Hip MSI Syndromes**

- Adduction
  - With medial rotation

- Extension with Knee Extension
  - With medial rotation

- Lateral Rotation

- Hip Flexion

**Early evidence for movement pattern impairments with pre-arthritic hip disease**

- Van Houcke, J Clin Biomech, 2013
- Kumar D, PM&R, 2014
- Harris-Hayes M, JOSPT, 2016
  - Preliminary study

Case Reports:

- Austin AA, JOSPT, 2008
- Khoo-Summers L, Man Ther, 2015
- Lewis, C, Man Ther, 2015
LATERAL HIP PAIN (BURSITIS, GM TENDINOPATHY)

Hip Adduction with Med Rotation

• Symptoms:
  • posterior lateral hip pain
  • sciatica (lengthened piriformis)
  • lateral thigh pain (ITB)
  • pain in WB activities in standing or prolonged sitting

• Common Referring Diagnoses:
  • sciatica
  • hamstring strain
  • ischiogluteal bursitis
  • ITB fasciitis
  • gluteus medius strain/tendinopathy
  • trochanteric bursitis
  • snapping hip syndrome
  • other

Hip Movement Impairments

ANTERIOR HIP PAIN (IMPINGEMENT, LABRAL PATHOLOGY)

Symptoms

• Pain in anterior groin, anterolateral hip particularly with sitting, walking, sleeping

• Painful hip flexion

• Possibly mechanical complaints of clicking, "popping", locking, giving way

• May or may not have radiographic diagnosis of FAI

FEMOROACETABULAR IMPINGEMENT (Bony overgrowth)

• Deep acetabulum
• Large femoral neck

Without abnormalities
Sylvia Czuppon, PT, DPT, OCS

Patients (and you) may ask . . .

• “If it’s a structural problem, how can it get better without surgery?”

Non-operative Care First

• PT*
• Activity modification*
• Medication
• Injections
• Rumored not to work

* Wall PD, PM&R, 2013 (Review)

References Supporting Non-operative Care

• Emara K, J Orthop Surg, 2011
• Yazbek PM, JOSPT, 2011
• Hunt D, PM&R, 2012
  • 44% of patients with pre-arthritis intra-articular hip disorders improved with non-operative care alone (not all FAI)
  • 35% of those with a dx of FAI responded to non-operative care
• Wall PD, PM&R, 2013 (Review)
  • Very limited experimental data
  • Non-operative treatment regimens, particularly PT, need to be evaluated more extensively and rigorously

Femoral Anterior Glide

• Excessive flexibility of anterior hip joint structures as result of maintained hip extension creates a path of least resistance to anterior glide

• Most common diagnosis with FAI patients
Femoral Anterior Glide:
Focus of Treatment
• Correct alignment and gait
• Restore precise hip flexion

Femoral Anterior Glide:
Focus of Treatment
• Improve performance of posterior hip muscles
  • Improve timing of gluteus max versus hamstrings during active hip extension
• If excessive femoral medial rotation noted, also will need to address strength of deep hip LRs

Weak or painful iliopsoas

Normal

Imprecise spinning of femoral head during hip flexion

KNEE MOVEMENT IMPAIRMENTS
Movement System Diagnoses for the Knee
- Tibiofemoral Rotation
  - With Valgus
  - With Varus
- Tibiofemoral Hypomobility
- Knee Extension (with or without Superior Glide)
- Knee Hyperextension
- Tibiofemoral Accessory Hypermobility
- Patellar Lateral Glide
- Knee Impairment

Is the knee a “victim”?
- Consider effect of hip on the knee
  - Alignment of hip joint (structural impairments)
  - Strength of hip muscles
  - Length of hip muscles
- Consider effect of ankle/foot on the knee
  - Pronated ankle/foot
  - Rigid foot
  - Stiff ankle – limited DF

Structural & Alignment Impairments
Femoral Version (ante or retro)
- Hip Medial Rotation
- Genu Valgum
- Genu Varum
- Tibial Varum
- Tibial Torsion
- Genu Recurvatum
- Ankle Pronation/Supination

Hip Medial Rotation
Preferred Alignment
Corrected Alignment

Genu Varus
Patellofemoral Pain Syndrome – “Anterior Knee Pain”

- Pain along anterior, medial > lateral knee especially with squatting, stairs, prolonged sitting, running
- Regarded as more common in women than men
- Not related to Q angle
- May or may not be related to quadriceps activation

3rd annual PFP Consensus Statement, Witvrouw et al BJSM 2013

Patellar vs. Femoral Movement

Open Chain (Non-weightbearing)
- Left knee

Closed Chain (Weight-bearing)
- Modified from Powers CM et al 2003

Effects of Prolonged Genu Recurvatum

Kendall Muscles Testing & Function 1993

Tibial Torsion vs. Tibial Lateral Rotation

???

Patellofemoral Pain Syndrome – “Anterior Knee Pain”

- Muscle performance
  - Weaker hip extensors
  - Delayed/shortened gluteus medius activation

- Poor proximal mechanics (trunk and hip)

Anterior knee pain
- Eckhoff DG et al 1997
- Jones RB et al 1995

Patellofemoral pain
- Hefzy MS et al 1991
- Lee TQ et al 2001
- Powers CM et al 2003
- Li G et al 2004
- Salsich GB et al 2007
- Noehren B et al 2012

Patellofemoral Pain Syndrome – “Anterior Knee Pain”

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• Little movements mean a lot! A small movement impairment can be detrimental to joint
Movement System Diagnosis: Tibiofemoral Rotation

- Knee pain associated with impaired rotation of the tibiofemoral joint in transverse or frontal plane
- Excessive femoral MR relative to tibia AND/OR
- Excessive tibial LR relative to femur

Excessive flexibility at knee compensating for lack of hip lateral rotation

Focus of Treatment

- Alignment
  - Must account/accommodate for structural impairments
- Functional activities
  - Sleeping, sit to stand, stairs, gait
- Therapeutic exercises focused on strengthening posterolateral hip muscles
- Stretching
  - TFL/ITB, gastroc/soleus
  - Monitoring relative flexibility of TFJ

“Muscle performance is determined by the pattern of movement. Correction of faulty patterns is best achieved by training the correct pattern and not by isolated ‘strengthening’ of a muscle.

... The critical issue is how an activity is performed not just performing the activity.”

(MSI Syndromes of the Extremities, 2011)
**General Treatment Goals**

- Redistribute movement to appropriate joints
- Correct the movement pattern that is causing the tissue to become painful rather than direct treatment to the affected tissue.
- Training proper movement patterns will induce appropriate muscular (strength, length) and biomechanical adaptations that will reinforce the development of optimal neuromuscular action.

**Treatment**

- Movement Diagnosis directs treatment
- Correct alignment and movement during functional activities
- Prescribe corrective exercise program:
  - Emphasizes precise motion
  - Individualized to the patient
- Practice performing movements using the corrected or modified strategy

**Treatment of Relative Flexibility**

Incorporate the following principles into functional activities and exercises as often as possible

- Prevent repeated stretching of flexible site
- Improve performance of stabilizing muscles
  - Active contraction at desired length
- Stiffen and shorten long muscles
- Stretch short/stiff muscles

**Educate patient about how daily habits and preferred alignments contribute to movement patterns.**

**Treatment: Fitness activities**
Take Home Messages

- The body follows the *path of least resistance* for motion which contributes to subtle hypermobility.
- The way everyday activities are performed reinforces this hypermobility and the movement pattern.
- Muscle performance is determined by the pattern of movement. Altered movement patterns impair proper muscle performance.

**Take Home Messages**

- During exam, when a movement does not appear ideal or causes symptoms, try to modify movement.
  - Doing this repeatedly during the exam helps confirm diagnosis
- Think "big picture" – how do the findings of the exam relate to one another?
- Diagnosing is based on pattern recognition

**Take Home Messages**

- Treatment:
  1) Correct the pattern of motion to restore more precise joint motion
  2) Correct functional activity performance
  3) Individualized to each patient

**Questions?**