

Movement System Impairment Syndromes

Using Movement for Diagnosis and Treatment: a
Clinical Framework

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APTA Vision Statement

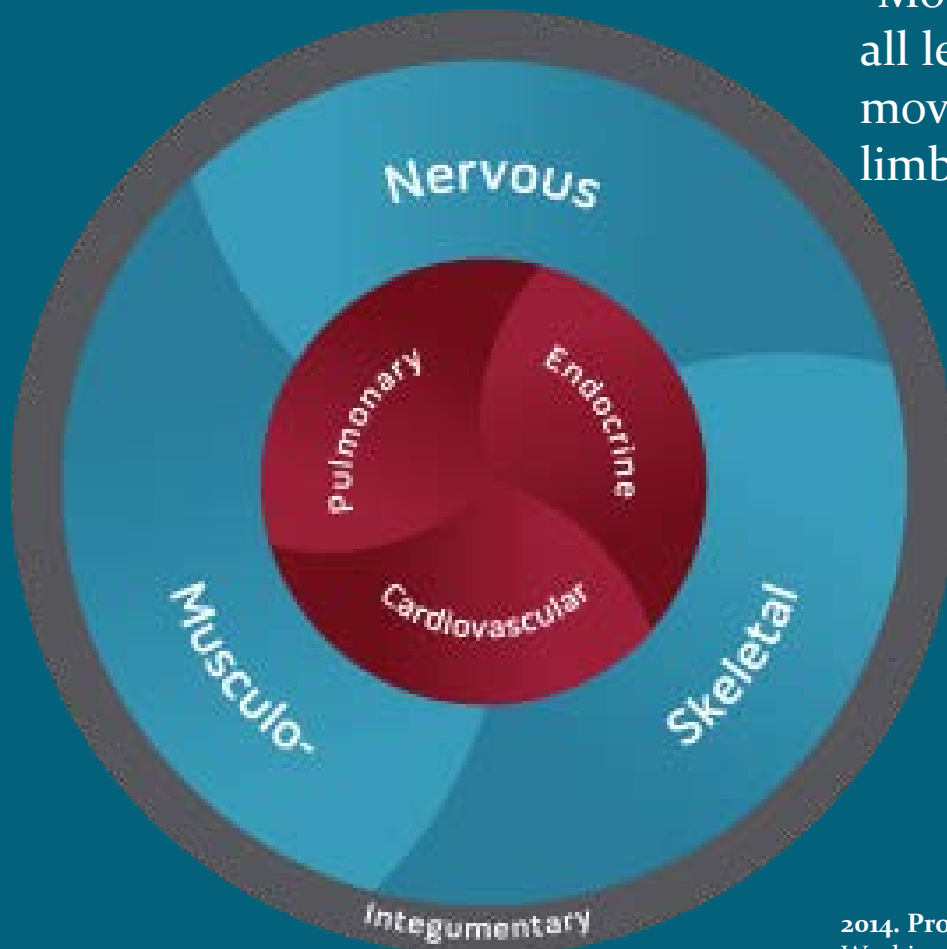
- Transforming society by optimizing movement to improve the human experience.
 - APTA House of Delegates 2013
- “The movement system is the term used to represent the collection of systems (cardiovascular, pulmonary, endocrine, integumentary, nervous, and musculoskeletal) that interact to move the body or its component parts.”
 - White Paper: Physical Therapist Practice and the Movement System. APTA. August 2015

Basic requirements of a movement system practitioner are:

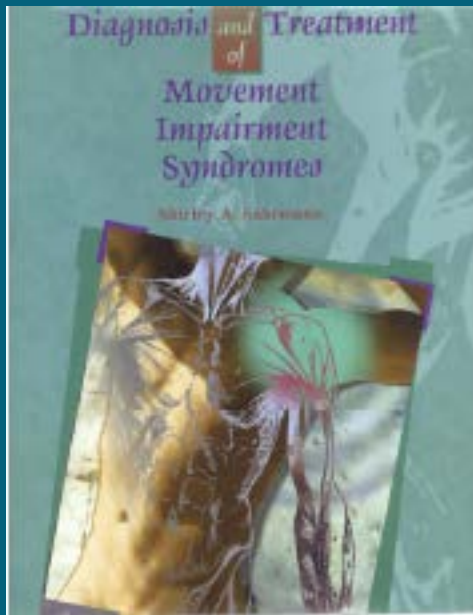
- In depth, integrative knowledge of the movement system and its component elements (anatomical structures and physiological functions)
- The ability to evaluate and diagnose movement dysfunction in the clinical setting (using observation, instruments, or both)
- The ability to identify physical impairments across various body systems (eg, integumentary, musculoskeletal, cardiorespiratory, neurological, endocrine, genitourinary) that may be contributing to dysfunctional movement, such as muscle weakness, limited joint range of motion, limited oxygen exchange, or impaired motor control
- The ability to design an intervention program to address underlying impairments as well as the movement dysfunction itself

Movement System

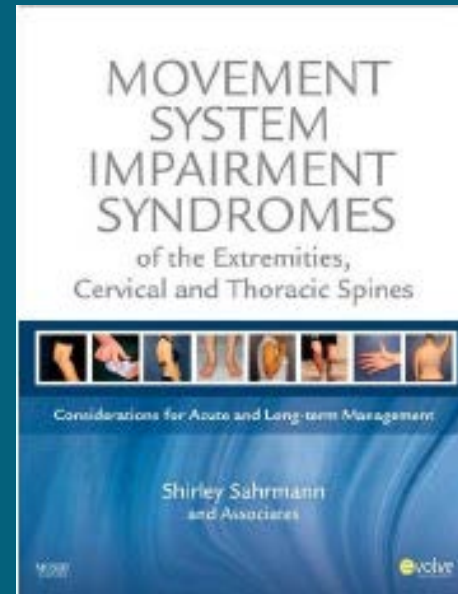
“Movement is an essential function of life at all levels of living organisms. From ions moving through membranes to moving your limbs to moving in your environment”



MSI: Movement System Impairment



Mosby 2002



Elsevier 2010

What is MSI?

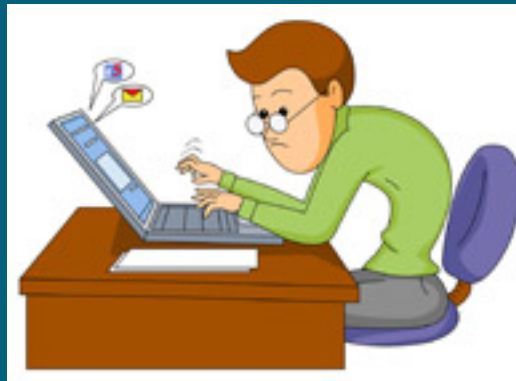
- Classification-based system to direct treatment to correct faulty movement patterns
- Many treatment approaches use classifications to drive treatment
 - McKenzie
 - Maitland
 - Treatment-based Classification (TBC) System

What makes MSI different?

- Movement System Impairment classifications focus on determining **MOVEMENT** dysfunction rather than **TISSUE** dysfunction
- Treatment aimed at correcting the **movement dysfunction** to address the abnormal physical stress perpetuating the tissue trauma rather than treat a specific structure
 - e.g. hip extension with medial rotation vs. hamstring tendinitis

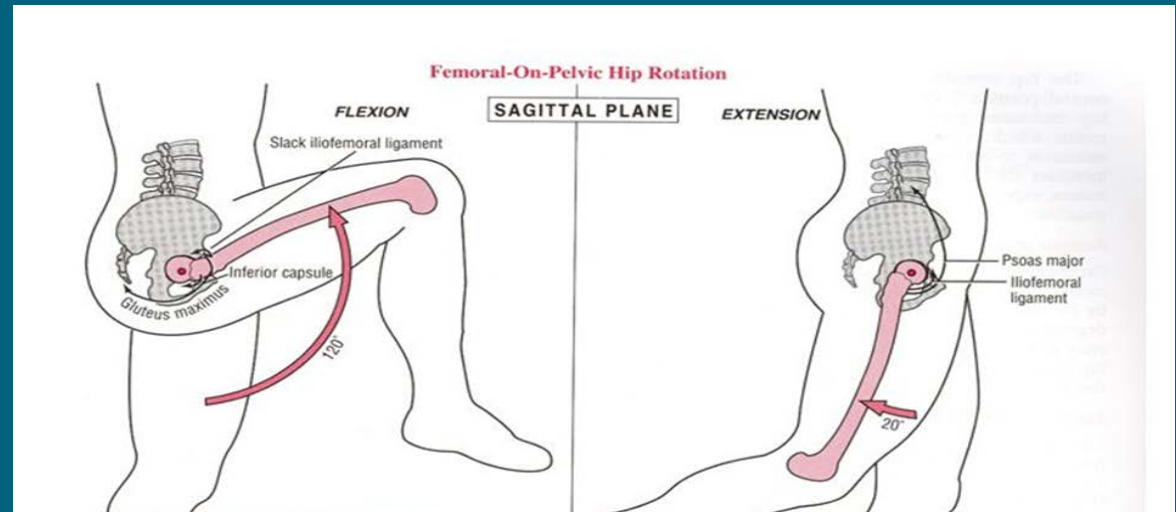
Theoretical Framework

- Musculoskeletal pain is related to life activity
- Repeated movements and sustained postures change tissues and movement patterns over time



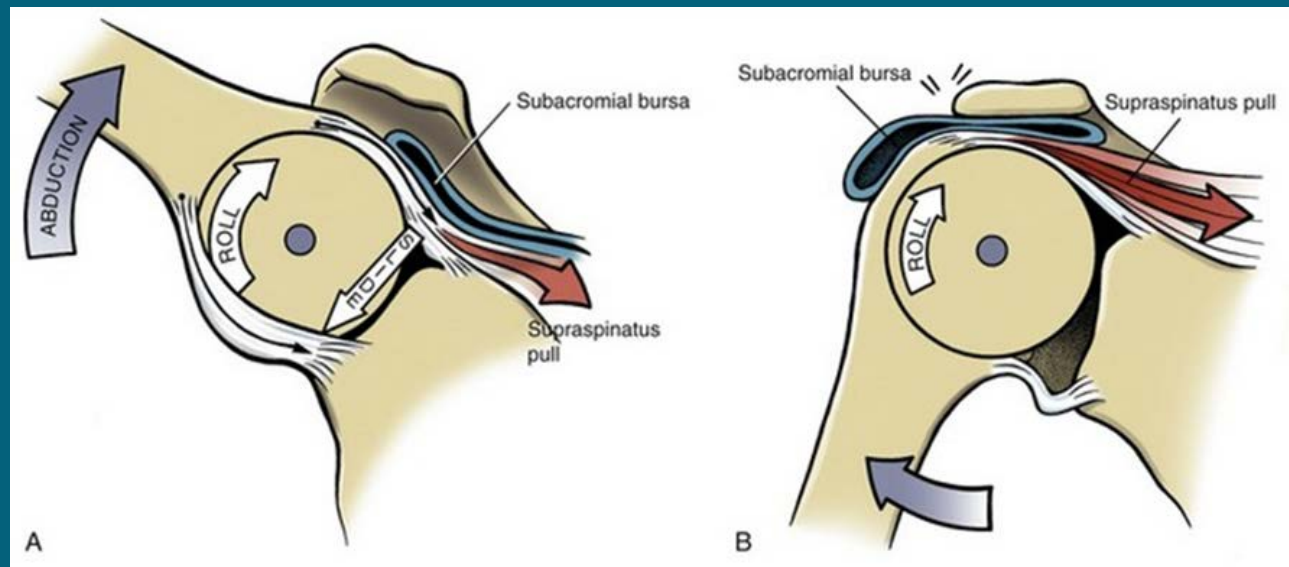
Effects of altered movement

- Altered tissue stress leads to micro-instability of joints with excessive accessory motion in one or more directions
- Excessive shearing forces from altered joint contact pressures accelerate joint degeneration



Effects of altered arthrokinematics

- Excessive motion leads to microtrauma of soft tissues
- Continued altered movement leads to pathology



What does that mean?

- Progression of altered movement:
 - driven by everyday activities
 - self-perpetuating
 - will lead to altered joint mechanics
 - will accelerate joint degeneration
 - will lead to stiffness imbalances
 - will lead to dyskinesia and altered motor control
 - will lead to tissue failure

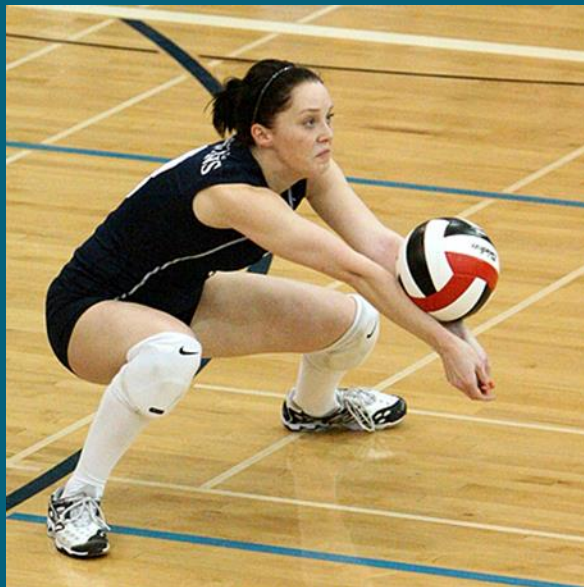


Do movement strategies drive pathology?



What pathology do they look like they are waiting for?

Repetitive movements drive pathology?



What injuries do we expect?
Should we just wait for injury to occur?

Sustained Postures drive pathology?



Any concerns?

Movement drives pathology

- Correct movement dysfunctions, eliminate the altered tissue stresses
 - Prevent recurrence of acute problem
 - Prevent acute problems from becoming chronic problems
 - Slow degeneration of joint surfaces
 - Reduce overuse injury
- Movement system will change over time with aging and activity
 - Therapist as life span practitioner

Movement System Impairments: Key Concepts

- Microinstability and Relative Flexibility
 - Motion always chooses the path of least resistance
 - Affected by passive tension of muscle and connective tissue
- Strength related to activity
 - “Presence of a muscle does not mean appropriate use”

How to Identify Dysfunction: The Movement Examination

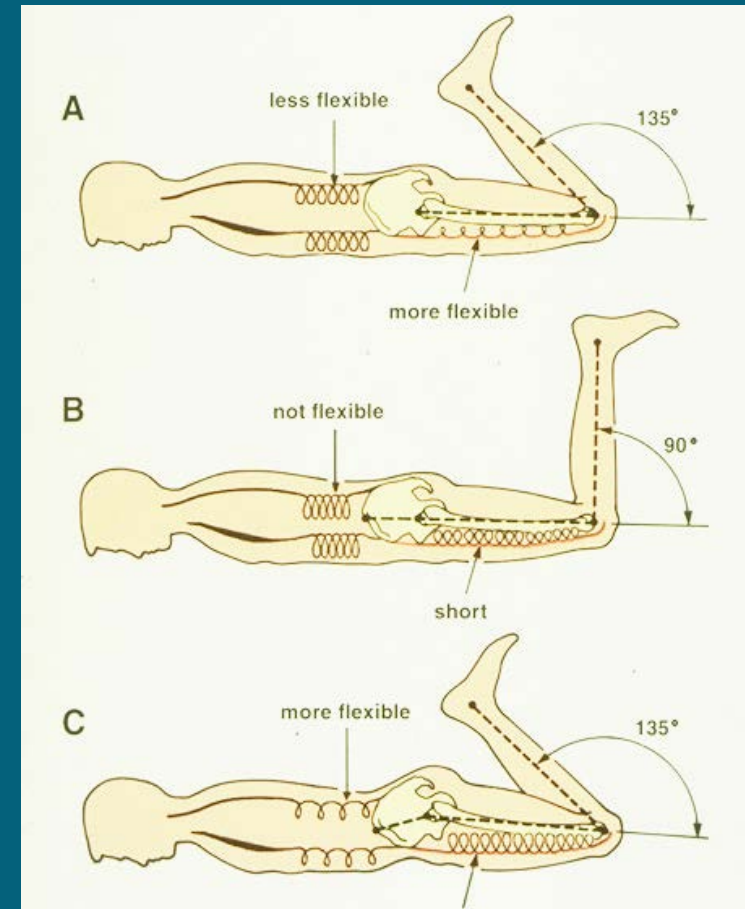
- Patient's preferred alignment and movement strategies are analyzed to determine their precision and effect on the chief complaint
- The patient's preferred pattern is followed immediately by a secondary test modifying the movement to determine the effect on the chief complaint
 - Comparable sign

Determining Movement System Impairments: What's the process?

- Identify movement dysfunction
 - What's too short/stiff/long/weak via standardized exam
- Identify contributing factors
 - Intrinsic factors (anatomic variations, comorbidities)
 - Extrinsic factors (physical environment, job description)
- Identify activities contributing to movement dysfunction
- Educate patient
 - Their movement dysfunction
 - Appropriate movement patterns
 - Corrective exercises

Movement System: Arriving at a Diagnosis

- Focus of the exam is to identify the site that is relatively too flexible or moves too much
- Strength and length test focused on identifying relative flexibility/stiffness more than absolute strength
- Movement impairments – when corrected – that best alleviate the symptoms determines diagnosis



Movement System: The Diagnosis

- Named for the movement dysfunction that causes the pain:
 - Lumbar flexion/rotation syndrome
 - Femoral anterior glide syndrome
 - Tibiofemoral rotation syndrome



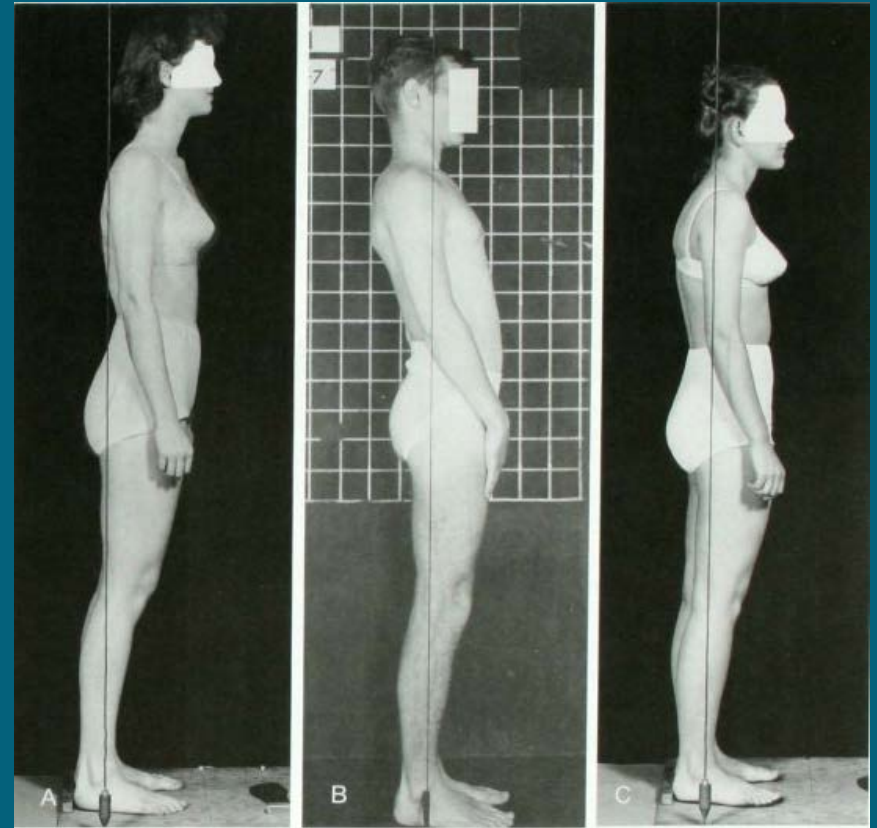
Why make a movement diagnosis?

- Diagnosis guides treatment
- Diagnostic label illustrates recognition of the underlying problem
 - We are not support staff for physicians, we are experts in our own right
- Focuses treatment on painful activity rather than painful structure which may fluctuate or be multivariate
- If correcting the movement impairment decreases or eliminates symptoms, treatment may be most effectively directed by movement diagnosis.

Standardized Examination

Components

- Standing alignment
- Standing movement
- Supine movement
- Sidelying movement
- Prone Movement
- Quadruped alignment
- Quadruped movement
- Sitting
- Functional tasks
 - Bed mobility, transitions, sleeping postures, stair ascent, gait, work and/or recreational activity



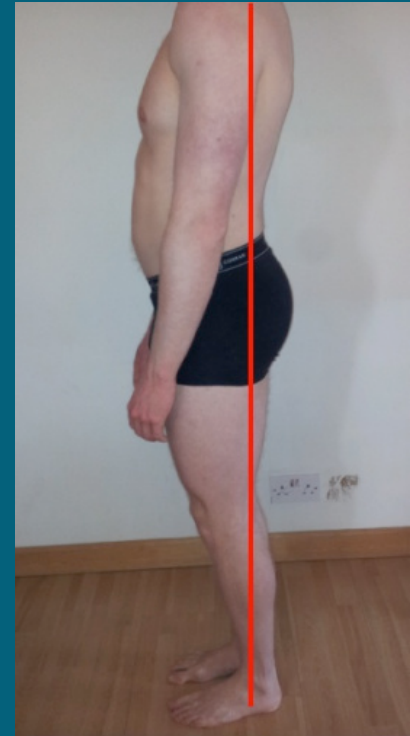
Kendall, 1993

What do I look at?

- Influence of multiple factors at rest and with movement in several postures and functional activities:
 - Alignment
 - Muscle length
 - Muscle stiffness
 - Muscle strength
 - Neuromuscular recruitment
 - Gross movement patterns

Where to start?

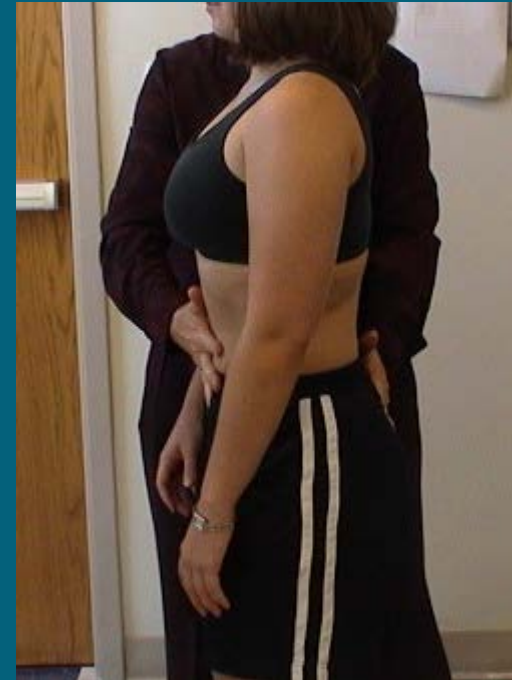
- Alignment
 - Length-tension relationship
 - Passive stiffness of tissues
 - Asymmetry
 - Localized hypertrophy
- Influence of strength
 - Hypertrophy increases passive stiffness of muscle



Standing Alignment: Example



Preferred alignment
vs.
Corrected alignment



What is short? What is long? What would corrective exercise would we prescribe?

Finding the movement dysfunction:

(Most of this you already do in your standard LQ eval)

- Standing:

- Forward bend/return

- Curve reversal? Timing hip/lumbar flexion? Painful?
 - Improved with correction?

- Sidebending

- Shift? Assymetry? Painful? Correction helpful?

- Rotation

- Assymetry? Painful? Correlation with spinal kinematics?

- Single limb stance

- Pelvic rotation? Hip drop? Balance strategy? Weakness?



The LQ Exam: Supine

- Hip Flexor Length test (Thomas Test)
 - Do they have full hip extension? If not, how do they compensate?
- Supine position
 - Painful? Able to achieve full hip/knee extension?
- Single knee to chest – active and passive
 - Hip ROM? compensatory lumbar movement? Painful?
- Fallouts – active and passive
 - Hip ROM? Compensatory movement? Motor control?
- Abdominal strength
 - Upper abdominals/leg lowering/lower abdominal progression
- Any other supine testing that is appropriate
 - SLR/joint mobility testing/active SLR for hip control, etc.

The LQ Exam: Sidelying

- Rolling from supine to sidelying
 - Segmental strategy? Lead with arm vs. leg? Painful?
- Sidelying position
 - Painful? Improved with support? Towel at waist/pillow under leg/pillow under arm
- Clamshell
 - Posterior gluteus medius strength/motor control/painful?
- Any other tests that may be relevant
 - Hip abduction strength/hip adduction strength/sidelying segmental mobility, etc.

Sidelying Exam: Example



Preferred Alignment:
what do we see?

Hip abduction/external rotation with
load: what do we see?

What moves too much? How does the
angle of gravity influence the load?



The LQ Exam: Prone

- Rolling sidelying to prone – strategy
- Position
 - Full hip extension? Compensation? Painful? Improved with support under abdomen? Under hips? Under feet?
- Knee flexion – active and passive
 - ROM? Lumbar/pelvic movement? Painful?
- Hip internal/external rotation with knee flexed
 - ROM? Lumbar/pelvic movement? Painful? Motor control?
- Gluteus maximus strength test
 - Lumbar/pelvic movement? Painful?
- Active hip extension with knee extended
 - Timing of gluteals vs. hamstring? Lumbar/pelvic movement? Painful?

Prone Exam: Example



Prone knee flexion preferred – what do you see?



Prone knee flexion with lumbar spine stabilized – what happened?

The LQ Exam: Quadruped

- Alignment
 - Hip/lumbar/thoracic/scapular/cervical
 - Spinal rotation? Asymmetry of muscle bulk
- Rock back
 - Relative flexibility of hip versus lumbar spine
 - Spinal rotation? Pelvic rotation?
- Alternating shoulder flexion
 - Lumbar/pelvic rotation? Closed chain hip strength? Weight shift? Timing of axial stabilizers relative to limb movers

Quadruped Exam: Example



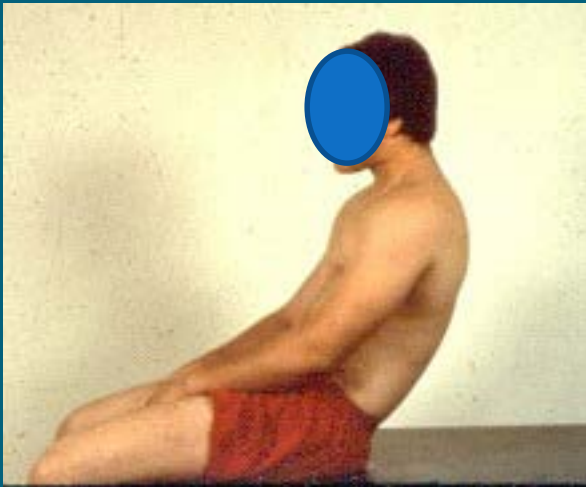
What's long?
What's short?
What is hypermobile?



The LQ Exam: Sitting

- Position
 - Lumbar spine/pelvic/thoracic/cervical alignment
- LAQ
 - Lumbar/pelvic movement? Hamstring length? Relative flexibility of hips vs. spine? Quad/hamstring strength tests
- Sitting hip flexion
 - Relative flexibility of hips and spine? Psoas strength test
- Other tests that may be appropriate
 - Myotomal screen
 - Reflexes
 - Sensation screen

Sitting Exam: Example

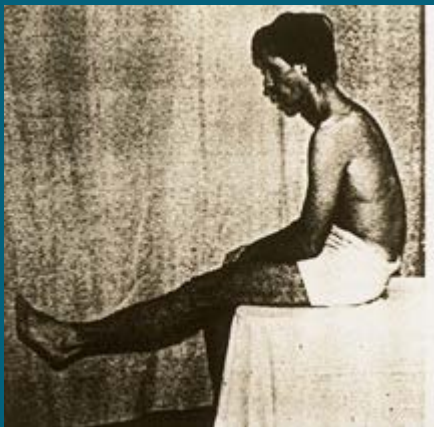


Preferred alignment – what do you see?

What is long/weak?

What is short/stiff?

What is hypermobile?

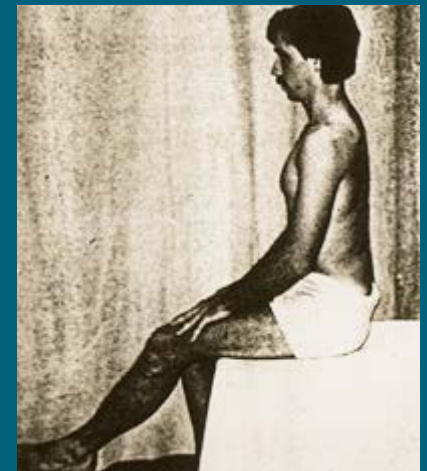


Knee extension with preferred posture

Vs.

Knee extension with corrected posture

What is short? What is long? What is hypermobile?



The LQ Exam: Back to the Wall

- Flatten spine
 - Relative flexibility of hips vs. spine
 - Abdominal control/activation in functional position
- Bilateral shoulder flexion
 - Lumbar/pelvic movement?
 - Trunk control with extremity movement in simplified functional activity
 - Upper body washing/dressing/lifting overhead

LQ Exam: Functional Activity

- Sit to stand
 - Ankle alignment - toes under patella? Sufficient dorsiflexion? Inversion/eversion? Toes stay on the ground?
 - Knee alignment – valgus collapse? Internal rotation/excessive screw-home? Posterior knee translation with knee extension?
 - Hip alignment – enough hip flexion? Rotation? Even loading right vs. left legs?
 - Spinal/pelvic alignment – sufficient anterior trunk lean? Lumbar extension at terminal stance? Swayed stance with posterior pelvic tilt? Spinal/pelvic rotation?

Sit to Stand: Example



The LQ Exam: More functional activity

- Stair ascent
 - Ankle mobility – sufficient dorsiflexion? Inversion/eversion deviation? Toes stay on the step?
 - Knee alignment – over malleoli? Tibial angle? Centered over the foot? Posterior translation with extension? Valgus collapse? Medial femoral rotation with knee extension?
 - Hip alignment – trendelenburg? Pelvic rotation?
 - Spinal alignment – shoulders over foot? Lumbar extension? Sway with posterior pelvic tilt?

Stair Ascent: Example



Preferred alignment vs. Corrected alignment

The LQ Exam: More functional activity

- Gait
 - Alignment – how does that standing alignment move?
 - Keeps deviation? Deviation changes? Painful?
 - Sufficient hip extension at terminal stance?
 - Appropriate heel rise to indicate appropriate gluteal/quadriceps/triceps surae synergy?
 - Pelvic rotation with hip extension?
 - Self-propagating dysfunction – spine will become more flexible and hips will become stiffer
- Any other activity the patient mentions is aggravating and necessary to their function
 - Sleeping positions, household chores, picking objects off floor, child care activity, fitness activity

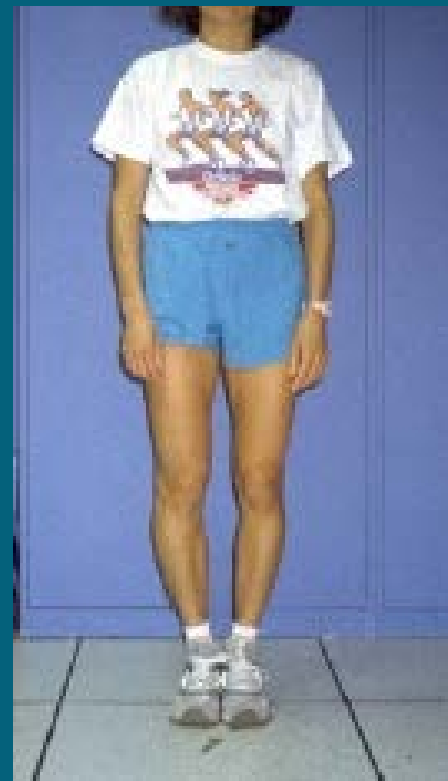
Exam completed - now what?

- Synthesis of common movement faults/pain producers/movement corrections to determine diagnosis
- Tests which generate symptoms become treatment
 - Alternating fallouts, clamshells, supine march, prone windshield wipers, quadruped rocking

How about a case study?

- Patient is 24 year old Olympic level marathon runner with lateral knee pain
- Prior treatment: 8 ultrasound treatments

- What do you see?
- Which knee is painful?



Case Study: Alignment



- Structural tibial varum
- Medial rotation femur
- Lateral rotation tibia
- Arrow indicates hypertrophy of biceps femoris
- Note increased muscle bulk lateral calf in standing
- Lateral tibial deviation in sitting suggests femoral rotation

Case Study: Functional Activity

- Single limb stance
 - Preferred alignment
- Genu varum
- Pelvic rotation
- What diagnosis would we pick?



Case Study: Synthesizing the data

- Alignment dysfunction:
 - Tibial Varum
 - Genu Varum
 - Medial Rotation of femur/lateral rotation of tibia
- Do we suspect a stiffness issue?
- Do we suspect a strength issue?
- How will we decide?

Case Study – Correction helpful?

- Preferred alignment



- Corrected alignment



Case Study: What's the diagnosis?

- Alignment consistent with excessive femoral medial rotation
- Functional activity consistent with excessive rotation in tibiofemoral joint
 - Tibiofemoral rotation syndrome!
- Expected contributing factors
 - Weak posterior gluteus medius/intrinsic lateral rotators, lower abdominals?
 - Short/stiff TFL/ITB, gastroc

Case Study: What's the treatment?

- “Practice contracting your posterior hip during stance”
- Movement corrections with:
 - Sit to stand, step ups, single limb stance
- Strengthening exercise:
 - posterior hip (glute max, glute med, lateral rotators)
- Lengthen what is short or stretch what is stiff:
 - Hamstring, gastroc, TFL/ITB

Putting it together

- The way an activity is performed induces tissue changes that alter joint motion
- Gravity will affect muscle activation and joint alignment
- You get what you train for
- No such thing as a magic exercise
 - Create the desired movement to correct the imbalance of the system

How am I going to use this with my patient/client on Monday?

- Observe functional positions/activities
 - Sleeping position, sit to stand, ADLs
- Ask what activities are bothersome and then watch them do those activities
- When your client performs an activity and says, “that hurts” can you correct their movement dysfunction?
- Select an activity that incorporates functional movement instead of novel exercise
 - Wall slides vs. cable column, bridges vs. standing multi-hip, step ups vs. leg press

Other considerations

- Motor control
- Neuromuscular recruitment patterns
- Chronic pain and movement dysfunction
- Pain and contextual cues with functional activity vs. movement system dysfunction
- HOW MUCH MORE CAN FIT INTO ONE LECTURE?

WHO HAS QUESTIONS??

- What about the upper quarter?
 - Shoulder, elbow/wrist/hand, cervical spine?
- What are the limitations of this treatment approach?
 - Patient motivation
 - Changing the way you move is hard!
 - Cognitive participation
 - May not be sufficient to address acute episodes of pain
 - Faulty movement may be the cause of acute pain or the result of acute pain
 - May need drugs or other intervention first
- Want to see a demo of an exam?

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