Biomechanical Factors Related to Mechanical Low Back Pain

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Non-specific low back pain
Activity related

• “My back tightens up when I run”
• “I get low back pain when I walk distances”
• “I get back pain when I squat and/or lift”
• Probable tissue sources
  • Facet joints
  • Paraspinal muscles

Lumbar Facet Joints

• Essential for spinal stability
• Distributes forces across the spinal column
  – Load sharing
• Facet compression caused by
  – Lateral flexion
  – Rotation

Muscular Anatomy

• Support and stabilize the spinal column
• Deep layers anchored to the pelvis

Trunk Stabilizers

Trunk Muscles
Abdominals
Obliques
Paraspinals

Trunk Stability vs. Pelvis Stability

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Pelvis Stabilizers

Hip/Pelvis Muscles

Gluteus Medius
Gluteus Maximus

Pelvis or Trunk Instability?

Excessive Spinal Motion as a Compensation for Hip Abductor weakness

Uncompensated
Compensated

Hip Abductor Weakness & Lateral Trunk Lean

Courtesy of John Popovich

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Uncompensated

Compensated

Left Sided Low Back Pain & Running

Hip Abductor Weakness
Paraspinal/Quadratus Lumborum Muscle Overuse

“Transient” Scoliosis

Facet Joint Degeneration on Side of Compression

“Transient” Scoliosis

Porterfield, JA and DelRosa, C. Mechanical Low Back Pain. 1998.

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Greater frontal and transverse plane trunk excursions in persons with hip abductor weakness

Greater activation of erector spinae and external obliques in persons with hip abductor weakness

Increased facet loading during simulated pelvic obliquity in the frontal and transverse planes

Intradiscal pressure highest in lateral flexion

Causes
- Compensatory for hip abductor weakness

Penalties
- Ipsilateral facet joint compression
- Contralateral paraspinal muscle overuse

What is the True “Core” of the Problem?

Gluteus Medius
Gluteus Maximus: "The Tri-planar Muscle"

- Extensor
- Abductor
- External Rotator

Excessive Pelvis Motions as a Compensation for Hip Flexor Tightness

Hip Extension-Terminal Stance

Hip Extension-Toe Off

Hip Flexor Tightness & Low Back Pain

- Excessive pelvis motions to compensate for hip flexor tightness
  - Anterior pelvic tilt
  - Transverse plane pelvic rotation

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Low Back Pain With Walking

- Inadequate shock absorption
- Backward trunk lean
- Pelvic drop/lateral trunk lean
- Inadequate hip extension

What are the consequences of impaired lower extremity shock absorption on the spine?

- Disc Compression?
- Increased facet loading?
- SI joint dysfunction?

Compensatory Anterior Pelvic Tilt

Inadequate Hip/Knee Flexion

Loading Response

- Potential Causes
  - Quadriceps weakness
  - Hip extensor weakness
  - Muscle or joint pain (avoidance)

Extended Trunk

Loading Response

- Causes
  - Compensatory for hip extensor weakness
- Penalties
  - Increased lumbar lordosis
  - Increased facet compression
Kinetics & Muscle Control: Loading Response

- Hip flexion moment
  - Glut max
  - Hamstrings
- Knee flexion moment
  - Quadriceps
- Ankle plantarflexion moment
  - Dorsiflexors

Excessive Pelvic Drop

Stance Phases

- Causes
  - Hip abductor weakness
- Penalties
  - Increased spine stress
    - Facet joint compression
  - Muscle overuse
    - Paraspinals
    - Quadratus Lumborum

Inadequate Hip/Knee Extension

Terminal Stance

- Causes
  - Hip flexor tightness
- Penalties
  - Reduced stride length
  - Compensatory pelvis motions

Limited Stride Length

Is Gluteus Maximus Weakness Related to Contralateral Hip Flexor Tightness?

Limited Hip & Knee Flexion

Deceleration

- Causes
  - Weakness of knee extensors and/or hip extensors
- Penalties
  - Decreased shock absorption
  - Increased spine compression

Low Back Pain With Running

- Inadequate shock absorption
- Backward trunk lean
- Pelvic drop/Lateral trunk lean
- Inadequate hip extension
Extended Trunk Deceleration

- Causes
  - Compensatory for hip extensor weakness
- Penalties
  - Increased lumbar lordosis
  - Increased facet compression

Excessive Pelvic Drop Deceleration

- Causes
  - Hip abductor weakness
- Penalties
  - Facet joint compression
  - Compensatory paraspinal activity

Lateral Trunk Lean

- Causes
  - Compensatory for hip abductor weakness
- Penalties
  - Ipsilateral facet joint compression
  - Contralateral paraspinal muscle overuse

Limited Hip Extension Toe off

- Causes
  - Hip flexor tightness
- Penalties
  - Increased vertical COM displacement
  - Compensatory pelvis rotation, anterior tilt & lumbar extension

Low Back Pain With Squatting & Lifting

Hip Strategy vs. Knee Strategy

Implications for Trunk Posture

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Hip Strategy: Squat

Knee Strategy: Squat

Hip Strategy: Lift

Knee Strategy: Lifting

Knee Strategy: Lifting

Hip vs Spine Extension

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Treatment Paradigm

• Flexibility
• Activation
• Strengthening
• Movement re-education