Core Instability/Stabilization – Assessment, Myths And Evidence

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I have no commercial, financial, or research relationships or interests within the past 12 months that affect my ability to provide a fair and balanced presentation for the proposed CME activity.
Objectives

- Understand the anatomy/definition of core stability
- Be familiar with the evidence for core stability and injury prevention/rehabilitation
- Understand a simple, office-based evaluation of the core musculature
- Prescribe home-based strengthening program for core muscles
Closed kinetic chain theory suggests a relationship between both ends
- Stable base at the hip
- Abductors must counterbalance adduction moment of the femur
- Uncompensated adduction forces absorbed by tissues farther down the kinetic chain
- Injury (ITB, AT) = hip abductor and rotator weakness

What is “Core Stability”?

- “Core”
  - Lumbopelvic region
  - Hip muscles often act as prime movers of LE, not just as stabilizers (Fredericson 2000, Chaudhari 2006, Pollard 2007)
  - Role of trunk muscles in LE/UE athletic performance not as well understood

Konrad 2005
What is “Core Stability”?

“Stability”
- The ability of the system to return to its original position or state in response to an internal or external perturbation
- Can be static or dynamic
- NOT the same as stiffness or strength
- Physics-based definition (existence of potential energy well) can sometimes be useful
How do we usually measure core stability?

- **Strength & Endurance**
  - Army Physical Fitness Test
  - Presidential Physical Fitness Test
  - McGill 1999
  - Leetun 2004

- **Supine Control**
  - Abdominal Muscle Test (Gilleard 1994)
How do we usually train core stability?

Strength of prime movers

Endurance in static holds

Flexibility
What is “trunk motor control”?

- Combination of factors that combine to result in active movement of lumbar spine and pelvis
  - Strength
  - Endurance
  - Muscle activation patterns
- Either to accelerate, decelerate or stabilize the trunk
Assessing Overall Movement (Actively)

- Flexion…………….40-60 degrees
- Extension…………20-35  “
- Side bending………15-20  “
- Rotation……………3-18  “

- Repetitive Motions
- Sustained Positions
- Combined functional movements
Assessment of Instability

- Muscular strength
- Muscular flexibility
- Ligamentous laxity
- Static versus dynamic
Postural Muscles

- Stabilize the body against gravity (tonic)
- Hamstrings, erector spinae, iliopsoas, TFL, Upper trapezius, levator scapulae, suboccipital, SCM, lattisimus dorsi, pectoralis major
- Often these become tight or hyper-facilitated
- Need to be stretched or inhibited (slow twitch)
Phasic Muscles

- Prime movers that explore and manipulate
- Gluteals, rectus abdominus, quadriceps, middle & lower trapezius, rhomboids, serratus anterior, deep cervical flexors
- Often become weak or inhibited
- Need to be strengthened or facilitated (fast twitch)
Gluteus Medius Assessment/Strengthening
Gluteus Maximus Assessment/Strengthening
Think Global, Act Local!

- **Global** – large torque-producing linking pelvis to thorax, superficial
- **Local** – deep, insertions into lumbar vertebrae, control intersegmental motion
First Thing: Always Think Neutral Spine!

- Position of least pain
- No one “magic” spot
- Difficult to teach
- “Pull the navel toward the spine” or flattening the stomach, belly away from the belt
- Should be taught in many, and mastered in all positions
Transverse Abdominus

- “Maintains abdominal contents”
- Inhibits rectus abdominus, agonistic to multifidi
- Fires first with unilateral shoulder movement! *(Hodges & Richardson 97’)*
- Palpate slightly medial (& distal) to the ASIS
- Co-contraction of multifidi and transverse abdominus assists with pelvic neutral
Transverse Abdominus – Assessment/Training
Muscle recruitment not changed much with feet unanchored, legs elevated or trunk twisted

Reverse curl, knees to chest, limits psoas involvement, while isometric reverse curl decreases disc pressure

No single abdominal exercise can maximally train all trunk flexors and minimize intervertebral joint pressures
Iliopsoas

- Exerts a compressive force between two vertebral segments, increasing lumbar stability:
- Provides for locking mechanism
- Increases intradiscal pressure, pushing nucleus pulposus against annulus fibrosis, allowing for greater spinal stabilization
Quadratus Lumborum

- Primary stabilizer of the spine
- Most active lumbar muscle during activity
What’s The Problem?

- Strong ligaments
- Many muscles
- Is instability a function of ligamentous or muscular breakdown?
- Does it matter?
- We still train these muscles!
Examination For Stabilization
Segmental Mobility

- The most sensitive method of identifying localized hypermobility & hypomobility
- Requires experienced techniques *(practice!)*
- Palpation skills a must to isolate levels
- Assess soft tissue, interspinous spaces, bony landmarks
- Note tenderness, accessory movement
- Note spacing, approximation, A/P, fixation, compression, distraction
Don’t Forget The SI Joint!

- Hypermobility
- Hypomobility
- Forward bending, backward bending, side-bending, rotation
  - (bilateral issues with forward/backward, unilateral with side-bending & rotation)
SI Joint Muscular Contribution
Multifidi

- The primary intersegmental stabilizer
- Palpate just lateral to spinous process
- Short reaction time – near central axis of rotation, large cross-sectional fiber area (type 1 fibers)
- Emphasize resistive extension (*endurance*)
- Necessary to prevent hyperlordosis with hip extension (*active tonically with anti-gravity*)
- Quadruped single leg raise
Biofeedback Can Be Helpful!

- Bringing psychological events to conscious awareness
- Permits awareness of neural recruitment of muscles by transducing electrical activity
- Enhance neuromuscular control for both force production and relaxation
Lumbopelvic Neuromuscular Training (LNMT) And Injury Rehabilitation: A Systematic Review

- *Clin J Sport Med (Briggs et al., In Press)*
- Assess quality of evidence for LNMT following musculoskeletal injury
- 1990 – March 2012; PubMed and EMBASE
- 2 reviewers determined if study met inc/excl criteria

<table>
<thead>
<tr>
<th>Levels of Evidence</th>
<th>Description</th>
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<tbody>
<tr>
<td>Strong</td>
<td>Consistent findings among multiple high-quality RCTs</td>
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<tr>
<td>Moderate</td>
<td>Consistent findings among multiple low-quality RCTs and/or high-quality RCT</td>
</tr>
<tr>
<td>Limited</td>
<td>One low-quality RCT</td>
</tr>
<tr>
<td>Conflicting</td>
<td>Inconsistent findings among multiple trials</td>
</tr>
<tr>
<td>No evidence</td>
<td>No RCTs</td>
</tr>
</tbody>
</table>
## Search Strategy

<table>
<thead>
<tr>
<th>Specific Search</th>
<th>Term Combination</th>
<th>Items Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Body Region”</td>
<td>Ankle OR Foot OR Knee OR Hip OR “Lower Extremity” OR Lumbar OR Back OR Shoulder OR Elbow OR Wrist OR Hand OR “Upper Extremity”</td>
<td>497757</td>
</tr>
<tr>
<td>“Lumbopelvic Terms”</td>
<td>Trunk OR Core OR Lumbopelvic OR Spine</td>
<td>246883</td>
</tr>
<tr>
<td>“Training Characteristic”</td>
<td>Strength OR Stability OR Neuromuscular OR Control OR Stabilization OR Stabilisation</td>
<td>1613558</td>
</tr>
<tr>
<td>“Intervention”</td>
<td>Training OR Rehabilitation OR “Physical Therapy” OR Physiotherapy OR Intervention OR Exercise</td>
<td>1006591</td>
</tr>
<tr>
<td>“Injury”</td>
<td>Injury OR Pain</td>
<td>812622</td>
</tr>
</tbody>
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The final search was limited to English text, human subjects, and between dates January 1\textsuperscript{st} 1990 through March 15\textsuperscript{th} 2012 with duplicates being removed. A similar search strategy was employed for EMBASE.
<table>
<thead>
<tr>
<th>Study Inclusion and Exclusion Criteria</th>
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</thead>
<tbody>
<tr>
<td><strong>Inclusion Criteria</strong></td>
</tr>
<tr>
<td>Study Type</td>
</tr>
<tr>
<td>• Randomized controlled trials (RCT)</td>
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<tr>
<td>• Controlled clinical trials (CCT)</td>
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<tr>
<td>Population:</td>
</tr>
<tr>
<td>• Ages: 13-65 years old</td>
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<tr>
<td>• MSK injury/diagnosis/repair/reconstruction:</td>
</tr>
<tr>
<td>* LBO, tendonopathy, strain, sprain, fracture, diskectomy etc.</td>
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<tr>
<td>Interventions:</td>
</tr>
<tr>
<td>• Exercise targeting: “core”, “trunk”, or “lumbopelvic region”</td>
</tr>
<tr>
<td>Outcomes:</td>
</tr>
<tr>
<td>• Any combination of the following:</td>
</tr>
<tr>
<td>* Injury rate, postural control, proprioception, pain, range of motion, swelling muscle strength, disability questionnaires, return to activity/sport, any component of the International Classification of Functioning, Disability and Health (ICF)</td>
</tr>
</tbody>
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<th>Exclusion Criteria</th>
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<tbody>
<tr>
<td>Systemic diseases</td>
</tr>
<tr>
<td>• “Multiple sclerosis, osteoporosis, Guillian-Barre syndrome, etc.</td>
</tr>
<tr>
<td>Non-MSK conditions</td>
</tr>
<tr>
<td>• “Scoliosis, pregnancy, neural tube defects, etc.</td>
</tr>
<tr>
<td>Neurologic injury</td>
</tr>
<tr>
<td>• Stroke, spinal cord injury, brain injury, paresis, radiculopathy, etc.</td>
</tr>
<tr>
<td>• LBP with neurological inclusion symptoms (e.g. stenosis, leg pain, sciatica, radiculopathy, etc.)</td>
</tr>
<tr>
<td>Bony surgery</td>
</tr>
<tr>
<td>• * Joint fusions, displaced fractures, joint replacements, etc.</td>
</tr>
<tr>
<td>Orthoses/ prosthetics</td>
</tr>
<tr>
<td>• Shoe orthotic</td>
</tr>
</tbody>
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Inclusion/Exclusion criteria were assessed at each stage of the systematic review process (Figure). Starred, “*” criteria are listed as examples.
LNMT Systematic Review – Results

- Total articles found meeting search criteria (RCT or CCT) – 29; 3 (LE), 26 (lumbar), NO UE studies
- Data extraction; subject demographics, injury, intervention, outcome measurements
- 2/3 LE and 9/26 lumbar RCTs – high methodological quality (van Tulder et al scale)
- LE 6.3 (4-9) and lumbar 5.1 (2-9)
- LE studies – hamstring strains, meniscus pathology, ACL tears
Results – Lumbar Spine

- 26 studies accepted; 24 LBP (various definitions), 2 post-op lumbar diskectomy
- 11 – 156 subjects, tremendous variability in the programs/interventions (pain, Oswestry, Roland Morris, trunk strength/endurance, trunk/hip mobility
- 7 – strong evidence; 17 – moderate; 2 – strongly ineffective
References

Thank-You!