Getting to the Core: Assessment and Intervention Strategies

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What is Core Stability?

- Inter-segmental Vertebral Stability
- Spine Stability

Bergmark 1989
Acta Orthopeadica Scandinavia
Supplement #230
Volume 60, 1989 (53 pgs)
Intersegmental Vertebral Stability

- Intersegmental or “Local” Dynamic Stabilizers
- Transverse Muscle Fiber Orientation
  - Transverse Abdominis
  - Multifidi
  - Pelvic Floor
  - Diaphragm
Spine Stability

- Spine Stability or “Global” Dynamic Stabilizers
- Vertical Muscle Fiber Orientation
  - External Oblique
  - Erector Spinae
  - Rectus Abdominis
  - Quadratus Lumborum
Core Stability =
Intersegmental Vertebral Stabilizers + Spine Stabilizers

- Intersegmental or Local Muscles
  - Directly control lumbar/spinal segments
  - Provide an Independent Deep Corset Action

- Spine or Global Muscles
  - Control Movement
  - Typical of Therapeutic Exercise programs for the trunk or back
  - Inappropriate to utilize without FIRST training intersegmental stabilizers

Neuromuscular Control
Source of the Confusion: Research Models

Hodges Model
Focuses on inter-vertebral stability

McGill Model
Focuses on spine stability

Courtesy of Darin Padua, PhD, ATC
What is Stability? (research)

- Stability is required to prevent joint injury
- Definition of Stability
  - Ability of a loaded structure to maintain static equilibrium after perturbation around the equilibrium position
Core Stability =
Intersegmental Vertebral Stabilizers + Spine Stabilizers

Perturbation

Courtesy of Darin Padua, PhD, ATC
Intersegmental Vertebral Stability + Spine Stability Dynamic Equilibrium

Courtesy of Darin Padua, PhD, ATC
Inter-vertebral Instability

Spine Stability without Intersegmental Stability ≠ Core Stability

BOTH Must be achieved to promote core stability

Changing the oil & the filter

Courtesy of Darin Padua, PhD, ATC
More About Stability…..

- Lumbo-pelvic
- Pelvo-femoral
- Lumbo-thoracic
- Thoraco-scapula
- Form & Force Closure
  - Role of fascial components
Pelvis as the Key Stone


Creates Soft Tissue Imbalances

- Altered length-tension relationships
  - Some muscles are too tight
  - Some muscles carry undue tension
  - Some muscles are too weak
- Altered biomechanics
  - Static
  - Dynamic
- Excessive loading of tissue with failure
Cascade of Events

- Too Weak
  - Trunk Intrinsics
    - Transverse Abdominis
    - Pelvic floor
    - Diaphragm
    - Multifidi
  - Gluteus maximus
  - Gluteus medius
  - Adductors
Role of Fascial Components
Anterior Oblique Sling of the Global Stabilization System

- External Oblique
- Anterior abdominal fascia
- Contralateral internal oblique
- Adductors

Lee 2004 p. 53
Posterior Oblique Sling of Global Stabilization System

- Latissimus Dorsi
- Gluteus Maximus through
- Thoracolumbar Fascia
Longitudinal Sling of the Global Stabilization System

White Arrows: Muscle~Tendon~Fascial Sling

Black Arrows: Biceps femoris~sacrotuberous ligament~erector spinae

Vleeming 1997 p.63
Longitudinal Sling of Global System

- Peroneii
- Biceps Femoris
- Sacrotuberous Ligament
- Deep Lamina of The TDF
- Erector spinae
Lateral Sling of Global System

- Primary Stabilizer for the Hip Joint
  - Gluteus medius
  - Gluteus minimus
  - Tensor fascia latae
  - Lateral stabilizers of the thoracopelvic region
Throacolumbar Fascia Superior and Deep Lamina

Richardson 1999 from Bogduk 1997
Contralateral Effects of the TLF

- The Gluteus Maximus – Latissimus Dorsi – Thoracolumbar Fascia Connection
- Provides pathway for uninterrupted mechanical transmission between the pelvis and the trunk

Vleeming 1997 p. 247
Motor Development

- Mobility
  - Joint mobilization
  - Flexibility (muscle-tendon)
  - Soft tissue mobility

- Stability
  - Multiple body segments

- Controlled Mobility
  - The coordinated biomechanical and neuromuscular interaction to provide quality of movement or appropriate movement patterns = Motor Control
Vs. Exercise Physiology

- Strength
- Endurance
- Power
- Agility
- Speed

*Core stability requires activation of coordinated neuromuscular recruitment patterns*

Motor Control
Core Stability

Goal:
- To develop a coordinated recruitment pattern between the spinal stabilizers and the trunk stabilizers
  - “Re-groove” motor control patterns
  - Quality of motion

Outcome:
- To provide a stable platform of support from which the limbs may move
How Do We Get There From Here……

The gap between the research and clinical practice…. 
Assessment

- Functional
- Qualitative
- Progressive
- “Functional Failure” is the point of intervention
Intervention

- Quality of Motion is critical
  - details matter
- Progress with small steps
  - vs. leaps and bounds!
  - Use *variable practice* strategies
    - Lateral learning
- Dosage: “A Little Bit ~ Often”  
  *(Sahrmann)*
Intervention Goals

- Initial Goal
  - Create Stability
    - Static ~ Posture
    - Dynamic ~ Function
      - Intrinsic/Local
      - Extrinsic/Global
  - Create *coordinated* stability patterns

- Progress to Endurance
- Progress to Strength
- Agility, Power, Speed, etc.
- FINALLY ~ Sport Specificity
Requires a Renovation
Work Sport Specificity from this Stable Platform
Game Plan:

*Rewire the Motor Control System*

- Repetitive intervention until *new* motor pattern is establish
- MUST be integrated into ADLs
- Be Patient
  - *Takes twice as long to rehab as it did to break!*
- Be Persistent
- Be Consistent
It is a *Renovation* ........

NOT

New Construction!

*It is an “Off” Season Intervention*
Progression

- AFTER the motor control pattern has been rewired ~ THEN And ONLY THEN
  - Progress to next task level
  - Small steps for progression of tasks
  - Lateral learning with each task
How Do We Get There from Here......

- Target Structures for Phase One
  - Intersegmental - Local Stabilizers
    - *Abdominal Hollowing*
      - Activities of Daily Living (ADL’s)
      - Low end movement positions
      - Low end movement patterns
    - Selected movement patterns to promote coordination between:
      - Tr Ab
      - Multifidi
      - Diaphragm
      - Pelvic Floor
Posture

Positioning

✓ Equal Weight on Both Feet
✓ Shoulders Down & Back
✓ Feet “straight” ahead

Activation

✓ Belly Button to the Spine – Tr Ab
✓ Pull Up – Pelvic Floor
✓ Full Breaths - Diaphragm
✓ Squeeze the cheeks
Habitual Patterns
Caused Imbalances or Reinforcing Imbalances??
Motor Learning Principles

- Learning as a process
  - Coordination of Intervertebral Stabilization as *New Skill*
  - Cognitive Phase
  - Associative Phase
  - Autonomic Phase
  - Brain Sweat
    - Variable practice
    - Contextual Interference

A Little Bit ~ Often As Often as Possible™
Facilitated Positioning

- Supine
- Prone
- Quadruped ~ hands and knees
- Static Stance
- Dynamic Stance
- Dynamic Movement Patterns
Belly Button to the Spine

Concave Hand Vs Convex Hand
Knee to Chest ~ on the floor

Foot Lift to just clear the floor
Upper Extremity Movement with Stable Trunk
Knee Roll Out

Watch for:
✓ Pelvic Rocking
✓ Pelvic Rotation
✓ Anterior Pelvic Tilting
Foam Roller - Supported

Using Knee Flexion To Change Lever Arm

Blanket/Towel

Upper Extremity With Stable Trunk
Hand/Arm Integration

Flexion

Abduction

✓ No Hand Support
✓ Active Arm Motion
Prone Positioning:
integration of scapula stabilization

Scapula Positioning
✓ Down
✓ Then Back

Trunk Stability
✓ Tr Ab
✓ Multifidi (ES)

C-Spine Loading
Prone Extension

- Belly Button to Spine
- Pull Up

Prone: abdominal organs = resistance to TrAb
Successful Intersegmental Vertebral Stabilization….

- No longer need to “suck your gut in”……
- Motor patterns will be
  - Automatic (motor learning)
  - Coordinated
- Adaptation of corrective posture
- Replacement of detrimental habitual movement patterns
- Selected rebalancing activities as needed…..
How Do We Get There from Here……

- Target Structures for Phase Two
  - Spine – Global Stabilizers
    - *Abdominal Bracing*
    - Increase the demand for stability
      - Side bridging
      - More complex movement patterns
        - Cable rows
    - Add unstable surfaces
      - Gym Ball
      - Discs
  - Selected movement patterns to promote coordination between:
    - External Oblique
    - Erector Spinae
    - Rectus Abdominis
    - Quadratus Lumborum
  - Promote coordination between intersegmental and spine stabilizers
Foam Roller Balancing

- Supine Balancing in Neutral Spine
- Lower Quarter Positioning
  - Hips at 90 degrees
  - Knees at 90 degrees
  - No contact between legs
T I Y

✓ Position Shoulder Girdle
✓ Align the Spine

ROW

Overhead Reach

External Rotation

✓ 3 sets of 30 repetitions
✓ Slowly add resistance
Quadruped & UE

Extension

I

T

Y
Quadruped
Unstable Surface

Watch for trunk stability

Vary the surfaces ~ variability of training
Un-Stable Surfaces
Be Creative!!

Unstable Surface

Feedback
Single Foot Balance Assessment

Maintain Neutral Pelvic Position

Shoes On

Barefoot

Barefoot: Toes Up
Single Foot Balance
Uneven Surface

Watch for Rotational Deviations
Single Foot Balance Variable Practice
Integrated Pattern of Recruitment

Unstable Surface

Diagonal Patterns
Prone Extension....
“Push Up Plus”
“Bridge”
Where do We Go From There……

- Add in stability above and below
  - Lumbo-pelvic
    - Force closure ~ soft tissue/neuromuscular/motor control
  - Pelvo-femoral
  - Lumbo-thoracic
  - Thoraco-scapula

- Address performance goals
  - Strength
  - Power
  - Endurance
  - Agility
  - Etc.
Summary

- **Multidimensional System:**
  Intersegmental vertebral stability + Spine stability = Core Stability

- ✓ System mobility
- ✓ System stability
Florence & Henry Kendall

1950’s to Present
Shirley Sahrmann

- Student of Kendall’s
- 1980’s to Present

“Review of Length Associated Changes In Muscle”
Grossman, et al.
Physical Therapy
December 1982
Vladimir Janda – Czechoslovakia 1970’s to Present
Clinical Research

Carolyn Richardson

✓ Jull
✓ Hodges
✓ Hides

✓ Australian
✓ 1980’s to present
Stuart McGill

- Biomechanist
- Spinal Stability

- Primary focus on spine stability
  - Large population of LBP
  - The spine is easier to model
  - Grant Funding

- General Exclusion of the pelvis

- Some work on SIJ modeling
  - Relative to LBP
Vleeming

MOVEMENT, STABILITY & LOW BACK PAIN
The essential role of the pelvis

Edited by
Andry Vleeming
Vert Mooney
Thomas Dorman
Chris Snijders
Rob Stoeckart

1997

Movement, Stability & Lumbopelvic Pain
Integration of research and therapy

2007