Exercise therapy that consists of individually designed programs, including stretching or strengthening, and is delivered with supervision may improve pain and function in chronic nonspecific low back pain.
Who Benefits from Lumbar Stabilization Training

- Spondylolisthesis and Spondylosis (O’Sullivan et al, 1997)
- Hypermobility on PE not Hypomobility (Fritz et al, 2005)
- Chronic LBP (Goldby et al, 2006)
- Unilateral LBP indicative of multifidus atrophy (Hides et al, 1996, 2001)
- CPR: Aberrant motion, + PIT, SLR > 90°, < 40 years of age (Hicks et al, 2005)
- Pregnancy – Posterior Pelvic Dysfunction (Stuge et al, 2004)
- Consider lumbar stabilization LE strains (Sherry and Best, Cowan et al 2004)
- Consider combined approach: manual therapy & lumbar stabilization (Niemesto et al, 2003)
Neutral Posture

Position or range of movement defined by the patient’s symptoms, pathology, and current musculoskeletal restrictions. The most stable and asymptomatic position for each individual task. Usually the mid-range of the available degrees of pain-free motion (Robison, 1992)

Why Not Posterior Pelvic Tilt?

- Muscle Activity and Lumbar Posture (Sapsford et al, 2001)
  - Lumbar flexion: ↑ EO Activity
  - Lumbar neutral or extension = TrA
- Relaxation phenomenon of the extensor muscles in full flexion (Floyd & Silver, 1951)

Neutral Position is a Functional Position

- Most Efficient
- Least Symptomatic
- Variable Between Patients
- Changes as Pathology Changes
- Patient Must Master
Pelvic Clock

- Explore lumbar motion
- Close the left facets with 6:00 to 9:00
- Close the right facets with 3:00 to 6:00

Seated Clock

Standing Clock

Demo Break

1. Pelvic Clock
2. Find Lumbar Neutral “Roll up/down”
3. Multiple Postures: Quadruped, Seated, Supine, and Prone
Active Straight Leg Raise Test

Teyhen et al (2009)

Muscle Thickness Between Groups Comparison

Abdominal Drawing-In Maneuver

“Draw your navel up towards your head and in toward your spine without moving your pelvis. Continue to breathe normally as you do this.”
Abdominal Drawing-In Maneuver

- Symmetrical response in both groups
- Preferential TrA thickness change
- Diminished TrA thickness in the LBP group

Teyhen et al (2009)

Kiesel et al, JOSPT 2007
n = 20 controls, 56 LBP
ADIM
TrA

Correct Transversus Abdominis Action

EdgePac Inc.
Training Postures: Quadruped

Gravity

TrA Facilitation Techniques

- Abdominal Sling
  - Slight upward support of lower abdominal wall
- Counting
  - Expiration
- Pelvic Floor Coactivation

Training Postures: Supine with 5lb Object
TrA Facilitation: Prone on Elbows

TrA Testing

- Hooklying Position
- Palpate medial to ASIS
- Slowly draw in lower stomach toward spine
- Palpate for contraction quality, symmetry, and global substitution
- Ideal Function
  - Hold 10 seconds x 10 repetitions with minimal effort

Common Substitutions

- Holding his or her breath (Richardson & Jull 1995; Glass et al, 1999; Hagins et al, 1999; Richardson et al, 1999)
- Pelvic tilt (Glass et al, 1999; Hagins et al, 1999; Richardson et al, 1999)
- Increased weight bearing through the heels (Richardson et al, 1999)
- Excessive external oblique activity (Richardson & Jull, 1995)
- Fast-phasic contraction (Whittaker, 2004)
**Common Substitution:**
Note inhalation, crease above umbilicus, no significant lower abdominal contraction

From Richardson: Therapeutic Exercise for Spinal Stabilization in Low Back Pain

---

**“Sucking In”**

From Richardson: Therapeutic Exercise for Spinal Stabilization in Low Back Pain

---

**Abdominal Muscles:**
**Rest**

**SST:** Superficial Soft Tissue

**EO:** External Oblique

**IO:** Internal Oblique

**TrA:** Transversus Abdominis

Teyhen et al, 2005
**Optimal Contraction**

**Suboptimal Contraction**

---

**Non-Invasive Volitional Assessment**

- Prone Drawing-In Test
- After the action is understood
- 70 mmHg to 60 mmHg
- 10 second hold
- Up to 10 repetitions

Richardson et al 2004
**Application to Function**

- ADIM should be incorporated into more functional activities (i.e. sitting, standing, & walking)
- For example—if the pt. c/o pain while sitting at work, the ADIM procedure should be advocated for use in that position to control symptoms (i.e. sit on physioball).
- The ultimate goal is to re-train the TrA to work in the intended feed-forward pattern.

**Let’s Try It!**

- Find Neutral
- Try the Abdominal Drawing-In Maneuver
- Try in sitting, quadruped, supine, prone, standing, and walking
- Try different facilitation techniques
- Watch for substitution patterns
- Let’s View it on Ultrasound

**TrA Progression**
Pelvic Floor: “The floor for the core”

Incontinence & LBP

Association between LBP and incontinence and respiratory dysfunction is stronger than BMI

- 38% of women with incontinence will have LBP
- 35% of elite female athletes have urinary incontinence
- 52% patients with LBP or pelvic floor dysfunction have both conditions
- In 82% of these patients, the symptoms started as LBP
- 66% of women with recurrent SUI post-surgical intervention will have LBP

In 2004, Smith et al., Kjolhede & Ryden found that:

Role of Pelvic Floor

Pelvic Floor-Dysfunction

- Subjects with SJJ pain and +ASLR test demonstrated excessive PF decent prior to motor control intervention
- This impairment resolved following a 12-week motor control program

O’ Sullivan & Beals Man Ther. 07
Perineal Ultrasound Imaging of Pelvic Floor Muscles

- Dietz et al, 2001

Trans-Abdominal View
Whittaker, 2004

RUSI: Pelvic Floor
Case Study
- 35 yo female
- Soldier
- Basic combat training
- 6 wk history of pain over the left SIJ
- LLE weakness

Tests & Measures:
RUSI Pelvic Floor Muscles
- Minimal lift of the pelvic floor muscles noted
RUSI Pelvic Floor Muscles

- Improvement noted after feedback training

Outcomes

- 2 months after initiating physical therapy
  - Patient completed all requirements to graduate from basic combat training
    - a 15 kilometer road march with a 15 kilogram ruck sack
    - the Army Physical Fitness Test
    - basic marksmanship
    - obstacle courses
  - Per patient:
    - SIJ region pain resolved
    - SUI symptoms were resolved
    - No reported leakage with any of the physical activities required during training
- 6 month telephonic follow-up

Demo Break: Pelvic Floor Elevation Exercises
Multifidus: a sampling of the evidence

- 80% of all LBP demonstrated atrophy (Kader et al, 2000)
- LM atrophy more pronounced on side of Sx (Mattila et al, 1986, Hides et al 1994)
- ↓ EMG activity @ unstable segment (Sihvonen et al, 1995)
- ↓ endurance if LBP (elite rowers) (Jorgenson, Biedermann, Roy)
- ↑ atrophy/fatty infiltrate in pts w/ poor outcome after surgery (5 yr p/o) (Ford et al, 1983)
- ↑ atrophy assoc w/ poor outcomes after laminectomy (Rantanen et al, 1993, 1994)
- ↑ recovery of muscle after surgery in those w/ favorable post-op outcomes (Sihvonen et al, 1995)
- MRI demonstrates static and dynamic differences in lumbar paraspinal mm in CLBP and normals during Roman Chair exercise (Flicker et al, 1993)

Prognostic Capability

- Clinical Prediction Rule (plus):
  - + Prone Instability Test
  - < 40 years
  - + Aberrant movements
  - + SLR > 90
  - + Presence lumbar hypermobility
- Motor Control
  - + TrA activation
  - + LM activation
- Decreased LM activation associated with clinical signs
- Hebert et al, Arch Phys Med Rehabil, 2010
Multifidus: Fatty Infiltration
Kjaer et al, 2007

- MRI:
  - 0-10% Normal
  - 10-50% Slight
  - >50% Severe

- 14% of adolescents (n = 442) had fat infiltration

412 Danish Adults
- 81% had fatty infiltration
- Strong association between those with severe infiltration and low back pain

Person with left sided pain
Low Back Pain: Asymmetry 31% ± 8%
No Low Back Pain: 3 ± 4%

Multifidus cross-sectional area differences with low back pain
Hides et al, 1994
**Multifidus**

Hides et al 1996

N = 41 patients (Control vs. Specific Exercise Group)

4 & 10 weeks: symptom resolution both groups, atrophy persisted control group

---

**LM Training....Swelling**

- Because of their role in controlling the motion segment, it may be advantageous to attempt to preferentially activate the deep fibers in rehabilitation

- Numerous clinical studies have reported utilizing volitional activation of the multifidus (swelling) as part of an intervention package for LBP

---

**Palpation of the Multifidus**

From Richardson: Therapeutic Exercise for Spinal Stabilization in Low Back Pain

“Gently swell out your muscles under my fingers without moving your spine or pelvis. Hold the contraction while breathing normally.”
LM Swelling

- Assess symmetry
  - Rest
  - Contracted
- Segmental dysfunction
  - Rest
  - Contraction
  - Difficulty
- Substitutions

LM Swelling Video
Facilitation Technique

- **Weight Shifts**
  - Volitional activation
  - Split Stance
  - Patient palpates
  - Weight shift to activate LM
  - Assess for timing and magnitude of contraction
  - Compare R vs. L

Facilitation Technique

- **Facilitation:**
  - Weight shift
  - Swell
  - Shift back
  - Hold (swell)
  - Relax

Facilitation Technique

- **Arm Lifts**
  - Split stance
  - Patient palpates
  - Opposite arm lift
  - Assess for timing and magnitude of contraction
  - Compare R vs. L
  - Add load as needed
Facilitation Technique
- Sidelying
  - Rotation
  - Lateral Flexion

Facilitation Technique & Testing
Contralateral Loaded Prone Arm Lift:
- Palpate over LM
- Assess for activation during arm lifting
- Feel for activation from of LM vs. Erector Spinae
- Compare R vs. L

Use 1.5-3.0 lbs load
Lumbopelvic Motor Control: Moving Evidence into Action

---

**Prone Arm Lift**

**Prone Leg Lift**

**Horizontal Side Support**

**Multifidus Swell**

**Seated Rotation**

**Side-Lying Hip Draw**

**Quadruped Rotation**

---

**Erector Spinae**

*Image: Watanabe et al 2004*
Demo Break

Role Pelvic Stabilization

- Isometric torque of lumbar extensor muscles
- 12-Week Program (n=77)
- 3 Groups: P-STAB, NO-STAB, CONTROL
- 1x per week, 8-12 reps to exhaustion
- P-STAB: 23.5% increase, No-Stab -1.2% (no difference in increased weight load during training)
- Suggest: substitution HS/Glut with No-STAB (Graves et al, Arch Phys Med Rehabil, 1994)
- Results repeated (Smith et al, J Back Musculoskelet Rehabil, 2011)
- Lumbar stabilization resulted in greater lumbar extensor strength and functional improvement compared to dynamic strengthening (Moon et al, Ann Rehabil Med 2013)

The Strong Get Stronger and the Weak Stay Weak
Lumbopelvic Motor Control: Moving Evidence into Action

**Pelvic-Hip Dissociation Exercises**

- Bend at hips
- **Variation**

**Improving CSA**

- 59 patients with CLBP
- 3 Different Rehab Programs
  - Stabilization Training (n=19) – O’Sullivan exercises
  - Stabilization Training with Dynamic Resistance Training (n=20)* (Prone/Quad with weights)
  - Stabilization training combined with dynamic-static resistance training (n=20)* (+5 sec hold)

**TRAINING PRINCIPLES**

1. Simple weight shifts
2. Progress to unilateral movements of UE/LE
3. Progress to contralateral movement of UE/LE
4. PNF Patterns
TRAINING PRINCIPLES

- Progress From Sagittal and Frontal Planes of Movement to Multiple and Combined Planes

Change in limb and trunk postures and unbalancing trunk movements increases muscle activities
Arokoski et al, 2001

TRAINING PRINCIPLES

- Progress From Large, Gross, Simple Movements to Smaller, Isolated, & Complex Movements

TRAINING PRINCIPLES

- Monitor Weight-Bearing Tolerance
- Progress from Stable to Unstable Positions to decrease stability (balls, foam rolls, wobble boards, trampoline)
GENERAL PRINCIPLES

- Short to Long Lever Arms
- Minimal or No Weights to Weights
- Stable to Unstable Postures
- Cardinal Planes to Combined Motions
- Passive & Active Pre-Positioning as Needed
- Frequent Cueing to No Cueing
- Relate Exercise Postures to Functional Tasks
- Endurance: Perfect Practice = Perfect Performance

EXERCISE PRESCRIPTION

- PERFECT PRACTICE MAKES PERFECT PERFORMANCE!
- Focus on time not repetitions
- Focus on endurance of stabilizers rather than just strength.
  - Since stabilization is main function of these muscles, sustained, sub-maximal efforts will be the key to effective training.
- Low back exercises are most effective when performed daily (Mayer et al., Spine, 1985)
“Move It and Move On”
Tim Flynn

“Fire It and Fire On”

Who Benefits from Lumbar Stabilization Training
- Spondylolisthesis and Spondylolysis (O’Sullivan et al, 1997)
- Hypermobility on PE not Hypomobility (Fritz et al, 2005)
- Chronic LBP (Goldby et al, 2006)
- Unilateral LBP indicative of multifidus atrophy (Hides et al, 1996, 2001)
- CPR: Aberrant motion, + PIT, SLR > 90°, < 40 years of age (Hicks et al, 2005)
- Pregnancy – Posterior Pelvic Dysfunction (Stuge et al, 2004)
- Consider lumbar stabilization LE strains (Sherry and Best, Cowan et al 2004)
- Consider combined approach: manual therapy & lumbar stabilization (Niemesto et al, 2003)