

Evaluation of Lumbopelvic/Core Stability

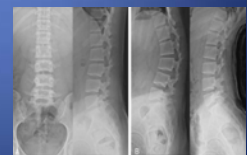
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- ## Overview and Objectives
- Focus is on **examination/assessment** of lumbopelvic/core stability
 - Define core instability, stability
 - Examine and assess the local and global stabilization systems
 - Evidence based exam for clinical signs of instability
 - Determine if stabilization treatment necessary/beneficial

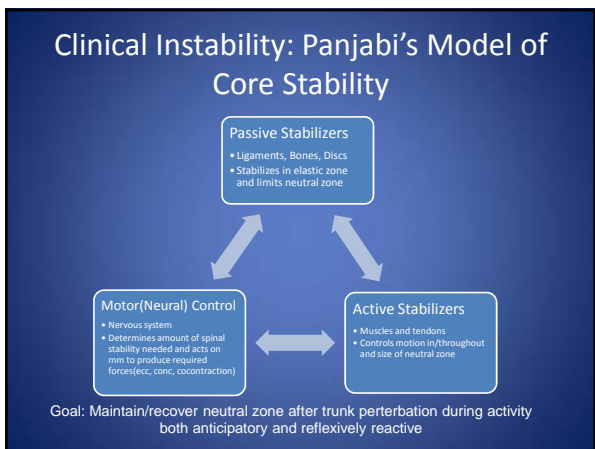
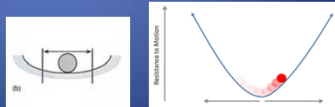
- ## What is Core Instability?
- Previously described as ligamentous laxity that produced excessive movements in an intervertebral joint at endrange



- ## Radiographic Instability
- Age <37 years
 - Total extension > 26 degrees
 - Any hypermobility of the lumbar spine
 - Lack of hypomobility of the lumbar spine*
 - Lumbar flexion >53 degrees*
 - +L.R. =12.8; -L.R. =.72
 - Fritz et al. Eur Spine J 2005¹

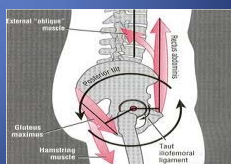


- ## Clinical Instability: Panjabi¹⁸
- Neutral zone of Z joint stability: “ a measure of spinal laxity in the vicinity of the neutral position.”
Abnormal increase in size of the neutral zone leads to pain secondary to strain
 - Inability of the spine under physiological loads to maintain its normal pattern of displacement to avoid neurological damage or irritation, development of deformity, and pain



Stability of the SI joint

- Closed pack position: sacral flexion and posterior innominate rotation
- Max ligamentous tension and joint congruency
- Facilitates maximum load bearing and load transfer
- combination of this and muscular control creates a self locking mechanism



Local Stabilization System

- Pelvic Floor
- Transversus Abdominus
- Multifidus
 - rapid atrophy within 24 hrs of pain onset/recovery not automatic
 - Multifidus fat infiltration and atrophy strongly associated with LBP⁶
 - Delayed firing in deep core with arm movements with h/o LBP^{5,14}
 - Higher recurrence rates of LBP in a control vs stab group at 2-3yr f/u.⁴

Local Stabilization System

- Diaphragm
- Psoas
- Internal Oblique
- Rotatores, Musculi Interspinalis, Intertransversarii mediales and laterals

Global Stabilization System

- Long erector spinae
- Rectus Abdominus
- External Oblique
- Longissimus thoracis

Hip Musculature Contributions

- Gluteus maximus
 - stab pelvis/trunk through tension in thoracolumbar fascia
- Gluteus medius
 - frontal plane stability
- Hip Ers:
 - precise eccentric control with gait to control IR moments
- Assist with SI locking for load transfer

Clinical Signs of Instability

- Lumbar CPR: Stability Classification³
 1. Age < 40
 2. Aberrant movement present
 3. SLR > 91 average
 4. (+) Prone instability test
 - K=.80, ICC.94²,
 - responding to stab program: +LR 1.7, -LR .48³
 5. FABQ PA>8
 6. Segmental hypermobility
 - ≥3 findings = +LR 18.8

Clinical Signs of Instability

1. Lumbopelvic rhythm
2. Pattern of SB/rotation toward paraspinal bulk
3. Passive hip ROM
4. Active leg raise(sagittal)
5. Active leg raise(frontal)
6. Bent knee fall out

3/6 + findings used as criteria for stab training with sig improvements in pre-post testing pain and disability^{10,11}

Subjective Examination

- **Age <40, FABQ PA > 8**
- H/o chronic, recurrent LBP with frequent episodes of acute attacks
- Inconsistent symptoms
- C/o giving away, catching, locking episodes
- Manipulation provides short term relief only
- Poor outcomes with general exercise

Subjective Examination

- Increased symptoms with:
 - sustained wbing positions
 - static positions
 - sharp pain with quick movements
- Decreased symptoms with:
 - manipulation-short term
 - NWB or external support



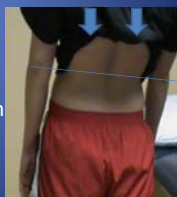
Objective Examination: Inspection

- **Paraspinal fullness greater then 1/2in on one side**
 - pain and limited SB toward and increased rotation towards bulk
- **Reversal/Alteration of lumbopelvic rhythm**
- **Aberrant movement**
 - (+) Gowers sign
 - hinging, fulcruming



Objective Examination: Inspection

- Single leg squat test (repetitive)
- Compression test
 - superior to inferior force applied to spine through shoulders
 - look for points of hinging
- Decreased pain with deep contraction during provocative movement (ex: SLR, Fabers, quadrant)



Objective Examination: AROM


- Forward flexion test
 - standing flexion, PSIS best palpated at endrange
 - cranial PSIS on painful side indicates fixation
 - cranial PSIS on nonpainful side indicates hypermobility of involved side
 - K= .32-.55

Winkel et al. 1997




Objective Examination: AROM

- **Stork Test**
 - resting standing position
 - palpate PSIS on stance leg and sacral base/L5, patient completes uninvolvement hip flexion
 - PSIS should move posterior and slightly laterally on stance leg
 - positive test: PSIS moving ant-sup.
 - denotes sacral unlocking and altered load transfer

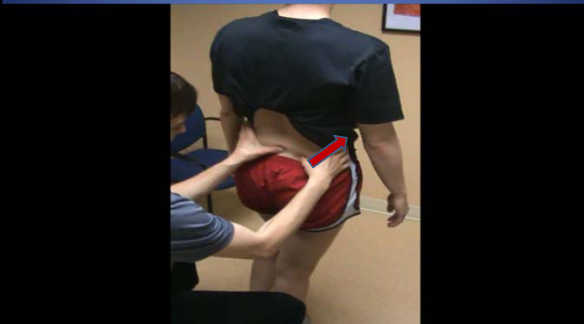


PSIS
L5/Sacral Base

(-) Stork Test with Sacral Locking




(+) Stork Test with Unlocking




Objective Examination: AROM/PROM

- **PROM hip flexion**
 - positive if pain before 120 flexion
- **SLR for average ROM: >91**
- Motion control testing
- **ASLR, BKFO**
- **SL SLR**
- **Prone SLR**
- With and without compression



Objective Examination: AROM/Motion Control Testing


- **Active SLR**
 - supine, complete active SLR 8 inches from table without compression
 - assess: stability of pelvis and difficulty/provocation for lifting
 - reliability: ICC.83¹²
 - validity: ID post pelvic pain since pregnancy sn .87, sp .94¹²
 - altered kinematics of diaphragm and pelvic floor present with + test¹⁷



Viserling's SLR test.

Objective Examination: AROM/Motion Control Testing

- **Active SLR**
 - retest adding compression: (+) is dec difficulty/pain
 - anterior ilium: pelvic floor and TA
 - posterior ilium: sacral multifidus
 - pubic ramus: hip add and/or rectus abdominus⁸
 - thorax to pelvis: obliques



Objective Examination: AROM/Motion Control Testing

- **Bent knee fall out**

- supine hooklying
- eccentric lowering into hip abduction/ER
- positive test: pelvic rotation during first 50% motion
- if symptoms increased, pelvic stab. should improve pain
- reliability: $K=.38-.60$ ^{9,23}



Objective Examination: AROM/Motion Control Testing

- **Sidelying SLR**

- sidelying position with bottom leg slightly flexed, top leg extended
- test is hip abduction with 10 degrees hip extension and slight ER
- look for substitutions: flexing hip and rolling or hiking of pelvis early in motion



Sidelying SLR Poor Form Video Clip

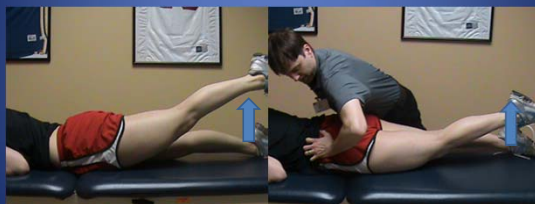


Objective Examination: AROM/Motion Control Testing

- **Prone SLR**

- prone position, lift leg 8-10 inches off table
- assess neutral spine and firing pattern: TA, ipsilateral glut/HS, contralateral multifidus f/b ipsilateral, contralateral ES f/b ipsilateral^{16,20}
- $k=.72-.76$ for agreement on deviation in frontal, transverse, sagittal plane¹⁵
- gluteus maximus time to contract reduced with compression²²

Objective Examination: AROM/Motion Control Testing



Prone SLR Bad Form Video Clip



Prone SLR Good Form Video Clip



Objective Examination: PROM

- **Lumbar and SI PA glides**

- reliability:²¹
- ID of osseous structures K=.53
- motion assessment K=.17
- pain assessment K=.42



- determining hypomobility K=.71⁷
- determining **hypermobility** K=.29⁷



Objective Examination: PROM

- **Lumbar and SI PA glides**

- validity: poor agreement K=.04 with MRI⁷
- segmental findings predictive of radiographic instability and response to stabilization treatments?
- findings of hypermobility: failure rates were 83.3% with manipulation treatment and 22.25% with stabilization treatment¹

Objective Examination: PROM

- **Prone Instability Test**

- prone with hips over edge of plinth, feet on floor.
- 2 parts: PA glide, repeat PA glide with feet off floor
- positive if second test less painful
- reliability: K=.80, ICC =.94²
- validity: likelihood of pt responding to stab. program
- (+)LR= 1.7, -LR .48³

Objective Examination: PROM

- **Prone Instability Test Part I and II**



Objective Examination: PROM

- **SI provocation testing cluster**

- immediate pain=inflammation, systemic condition, hypermobility²⁴
- delayed pain = stiffness, up to 2 min hold²⁴

Objective Examination: Motor Control and MMT

- Assess the local system
 - for volitional activation and endurance
 - if volitional control noted then check for reflexive co-contraction



Objective Examination: Motor Control and MMT

- Pelvic Floor
 - pt in hooklying palpate for activation with ulnar aspect of hand
 - cue for kegels, stopping flow of urine

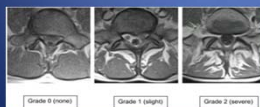
Objective Examination: Motor Control and MMT

- Transversus Abdominus
 - pt in prone, stabilizer set to 70mmHg
 - inferior edge of stabilizer at level of ASISs
 - drawing in with relaxed normal breathing
 - stop test if inability to hold x10 sec for 10 reps at a given level
 - goal ≤ 64 mmHg(range 68-60mmHg)



Objective Examination: Motor Control and MMT

- Multifidus
 - same position as TA test, palpate in the gutter just adjacent to spinous process(check different levels)
 - cues include: swelling, attempt to extend the back without moving, cone concept
 - if they cannot activate...try unilateral isometric HS activation near full extension engage



Objective Examination: Motor Control and MMT

- Check the Reflex
 - if volitional contraction noted, check pelvic floor-TA and TA-multifidus reflexive activation



Objective Examination: Motor Control and MMT

- Assess the global system***athletes
 - trunk endurance testing (McGill)
 - ¼ sit up sustained, Biering-Sorensten, side bridge,
 - compare to norms and ratios



Objective Examination: Motor Control and MMT

- Hip adductor/abductor MMT
 - normal testing method
 - disproportionate weakness of adductors to abductors indicative of hypermobility (irritation/displacement) of pubic symphysis^{8,19}
- Gluteus maximus and hip ER MMT

References

1. Fritz, Julie M., Julie M. Whitman, and John D. Childs. Lumbar spine segmental mobility assessment: an examination of validity for determining intervention strategies in patients with low back pain. *Archives of physical medicine and rehabilitation* 2005;86(9): 1745-1752.
2. Hicks, Gregory E., et al. Interrater reliability of clinical examination measures for identification of lumbar segmental instability. *Archives of physical medicine and rehabilitation* 2003;84(12): 1858-1864.
3. Hicks, Gregory E., et al. Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. *Archives of physical medicine and rehabilitation*. 2005;86(9): 1753-1762.
4. Hides, Julie A, Gwendolen A. Jull, and Carolyn A. Richardson. Long-term effects of specific stabilizing exercises for first-episode low back pain. *Spine*. 2001;26(11): 243-248.
5. Hodges, Paul W., and Carolyn A. Richardson. Inefficient muscular stabilization of the lumbar spine associated with low back pain: a motor control evaluation of transversus abdominis. *Spine*. 1996;21(22): 2640-2650.
6. Kjaer, Per, et al. Are MRI-defined fat infiltrations in the multifidus muscles associated with low back pain? *BMC medicine*. 2007;5(1): 2.
7. Landel, Rob, et al. Intertester reliability and validity of motion assessments during lumbar spine accessory motion testing. *Physical Therapy*. 2008;88(1): 43-49.
8. Lee D. *The Pelvic Girdle: An Approach to the Examination and Treatment of the Lumbo-Pelvic-Hip Region*. 3rd ed. Edinburgh: Scotland: Churchill Livingstone, 2004.
9. Luomajoki, Hannu, et al. Reliability of movement control tests in the lumbar spine. *BMC Musculoskeletal disorders*. 2007;8(1):90.

References

10. Luomajoki H, Kool J, de Bruin ED, Airaksinen O: Movement control tests of the low back; evaluation of the difference between patients with low back pain and healthy controls. *BMC Musculoskeletal Disorders* 2008, 9:170.
11. Luomajoki, Hannu, et al. Research Improvement in low back movement control, decreased pain and disability, resulting from specific exercise intervention. *Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology*. 2010; 2(11).
12. Mens, Jan MA, et al. Reliability and validity of the active straight leg raise test in posterior pelvic pain since pregnancy. *Spine* 2001;26(10): 1167-1171.
13. McGill, Stuart. *Low back disorders: evidence-based prevention and rehabilitation*. Human Kinetics 1, 2002.
14. Moseley, G. Lorimer, Paul W. Hodges, and Simon C. Gandevia. Deep and superficial fibers of the lumbar multifidus muscle are differentially active during voluntary arm movements. *Spine*. 2002;27(2): 29-36.
15. Murphy DR, Byfield D, McCarthy P, Humphreys K, Gregory AA, Rochon R: Interexaminer reliability of the hip extension test for suspected impaired motor control of the lumbar spine. *Journal of manipulative and physiological therapeutics*. 2006, 29(5):374-7.
16. Oh, Jae-Seop, et al. Effects of performing an abdominal drawing-in maneuver during prone hip extension exercises on hip and back extensor muscle activity and amount of anterior pelvic tilt. *The Journal of orthopaedic and sports physical therapy*. 2007;37(6): 320-324.
17. O'Sullivan, Peter B., et al. Altered motor control strategies in subjects with sacroiliac joint pain during the active straight-leg-raise test. *Spine*. 2002;27(1):1-8.

References

18. Panjabi, M. M. The stabilizing system of the spine. Part II. Neutral zone and instability hypothesis. *Journal of spinal disorders & techniques*. 1992;5(4): 390-397.
19. Rost, Cecile CM, et al. Pelvic pain during pregnancy: a descriptive study of signs and symptoms of 870 patients in primary care. *Spine*. 2004;29(22): 2567-2572.
20. Shermann, S. A. *Diagnosis and Treatment of Movement Impairment Syndromes* Mosby Inc. (2002).
21. Stockkendahl, Mette, Jansen, et al. Manual examination of the spine: a systematic critical literature review of reproducibility. *Journal of manipulative and physiological therapeutics* 2006;29(6): 475.
22. Takasaki, Hiroshi, et al. The influence of increasing sacroiliac joint force closure on the hip and lumbar spine extensor muscle firing pattern. *Manual Therapy*. 2009;14(5): 484-489.
23. Van Dillen, Linda R., et al. Reliability of physical examination items used for classification of patients with low back pain. *Physical Therapy*. 1998;78(9): 979-988.
24. Winkel D, Matthijs O, Phelps V. *Diagnosis and Treatment of the Spine*. Galtersburg, Pa: Aspen Publishers; 1997.