

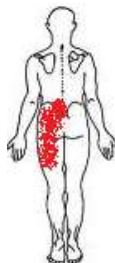


LUMBAR SPINE CASE 2

A.J. Lievre, PT, DPT, OCS, CMPT
Aaron Hartstein, PT, DPT, OCS, FAAOMPT

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Richmond 2018-2019

VOMPTI_CLINICAL REASONING FORM



Body Chart – Initial Hypothesis:

L4-5, 5-S1 disc, facet (somatic) _____

L4-5, 5-1 radiculopathy _____

SIJ pain _____

Extra-articular hip pathology _____



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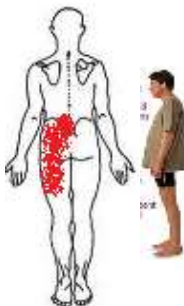
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SUBJECTIVE EXAM

Subjective **Asterisks** Signs/Symptoms: (Aggravating/Easing factors, Description/Location of symptoms, Behavior, Mechanism of injury)

- 37 y/o male, computer programmer with 6 month history of LBP and left LE pain after unloading mulch.
- Symptoms gradually worsening
- Episodic history of LBP off and on for last 5 years. Episodes have become more frequent and more intense
- Previous history of L4/5 HNP and laminectomy which resolved LE symptoms > LBP 7 years ago.
- 1st return of LE symptoms since surgery.
- Constant, variable, deep central and L sided LBP
- Intermittent, variable, deep L post thigh dull ache with diffuse borders
- Still working but commutes 1 hr each way
- Aggs: Sitting 15-20 mins, shaving/brushing teeth, sit to stand transfers, prolonged walking 15 mins, rolling in bed
- Eases: changing positions, rest, activity modification, short distanced walking



Rate your assessment of Severity & Irritability

Justify your assessment with examples from the Subjective Exam &/or Objective Exam

Severity: None, Min, **Max**, Max

Continuous back pain, with intermittent leg pain

Irritability: Non, Min, **Max**, Max

Pain comes on fairly quick and takes time to abate

Stage & Stability?

Acute: Subacute, **Chronic**, Acute on chronic

Stable: Improving, **Worsening**, Fluctuating, Red Flags

Identify any potential risk factors (Yellow, Red flags, non MSK involvement, biopsychosocial)



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STRUCTURE at Fault:

Joints inferior to the painful region	Myofascial tissue superior to the painful region	Non-Contractile tissue superior to the painful region	Neural tissue superior to the painful region	Other structures that must be examined – non-MSK
L4-S1 facets SIJ Hip	Lumbar multifidus Glute med/min, max Piriformis, hamstrings	L4-S1 disc Iliolumbar ligament Pelvis/Sacrum	L4-S1 nerve roots	Visceral? Spondyloarthropathy? Mass?

Primary HYPOTHESIS after Subjective Examination:

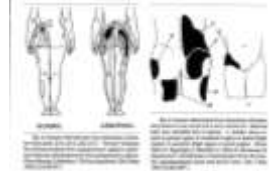
L4-5/S1 somatic/ facet due to clinical instability

Differential List (Rank) list in order to rule out:

SIJ
Hip Pathology

Facet Joint Pain

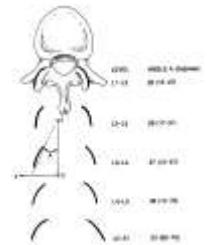
- Joint surface or restraining tissues being strained (capsule/ligaments)
 - Innervated by medial branch of the dorsal rami
- Irritation leads to local back pain and referred pain
 - Typically referred into the buttock and posterior thigh
 - Referral down the leg if stimulus is strong enough



Lumbar Anatomy

Facet Joints

- Lumbar orientation
 - Vertical with “C” or “J” shape mostly in the sagittal plane
 - Facilitates frontal plane motion, some sagittal plane and limits rotation
 - Upper facets resist rotation
 - Lower facets resist anterior translation
 - L4-5 and L5-S1 facets allow more rotation for gait
 - That orientation allows for more torsional forces and annular damage



Lumbar Anatomy

Facet Joints

- Facet Orientation
 - Ideal orientation is 45° from sagittal plane
 - Resists both anterior translation and rotation
 - Greater than 45° provides less resistance to rotation
 - Less than 45° provides more resistance to rotation



Lumbar Biomechanics

Flexion

- Vertebrae rotates anteriorly in the sagittal plane
- Vertebrae translates anteriorly in the sagittal plane
- Lordosis reverses in the upper lumbar spine and decreases in the lower lumbar spine
- Z Joints glide superior/anterior



Lumbar Biomechanics

Flexion

- Anterior sagittal rotation restrained by
 - Joint capsule
 - Supra & Interspinous ligaments
 - Ligamentum flavum & PLL
 - IV Disc
- Anterior sagittal translation restrained by
 - Facet contact
 - Supraspinous ligament
 - IV Disc



Lumbar Biomechanics

Extension

- Vertebrae rotates posteriorly in the sagittal plane
- Vertebrae translates posteriorly in the sagittal plane
- Accentuates lumbar lordosis especially in the lower lumbar spine
- Z Joints glide inferior/posterior
 - Z joint becomes WB

Lumbar Biomechanics

Extension

- Extension restrained by
 - Contact of SP's
 - Contact of facet processes
 - Contact of inferior facet process with lamina of subjacent vertebrae
 - ALL
 - IV Disc



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Lumbar Biomechanics

Rotation

- Spin in the transverse plane around an axis in the posterior vertebral body
 - Very small amount of motion $<5^\circ$



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Lumbar Biomechanics

Rotation

- Rotation restrained by
 - Contact of contralateral facet joint
 - Ipsilateral facet joint capsule
 - IV Disc specifically the annular fibers



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Lumbar Biomechanics

Rotation

- 1/2 of the annular fibers will slacken and the other 1/2 will become taught
 - 3° of rotation can lead to microscopic injury to the annulus
- IAP and SAP compress
 - If rotation continues IAR changes from vertebral body to facet joint
 - Distraction of ipsilateral facets increases and annular fibers are further stressed
 - 12° of rotation can lead to macroscopic injury



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Lumbar Biomechanics

Side Bending

- Vertebrae rotates in the frontal plane
 - May involve conjunct rotation in the transverse plane that is not agreed upon
- Ipsilateral facet glides inferior/posterior (extension)
- Contralateral facet glides superior/anterior (flexion)



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Lumbar Biomechanics

Motion Coupling

- No true consensus
 - May be ipsilateral
 - May be contralateral
 - May depend on starting position or which movement initiates



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Lumbar Biomechanics

Motion Coupling

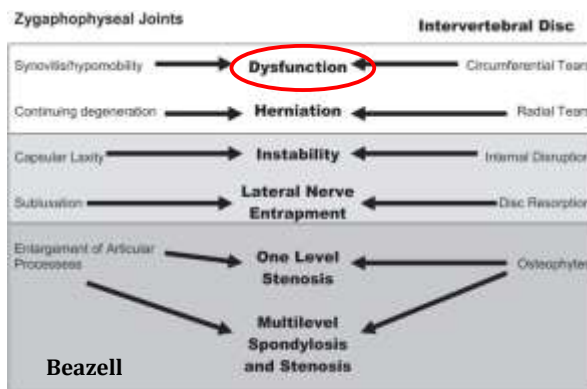
- Fryettes Concept for Thoracic and Lumbar Spine
 - In a neutral position, sidebending and rotation occur in opposite directions
 - In a flexed position sidebending and rotation occur in the same direction
 - Not in extension (still opposite)
 - If motion is introduced in one plane, motion in the other 2 planes will be restricted



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Cascade of Spinal Degeneration



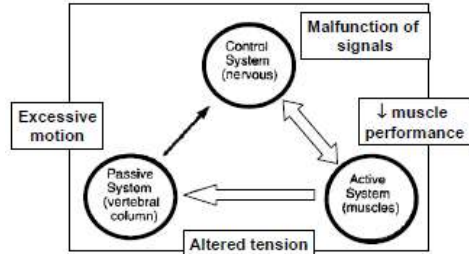


Subjective and objective descriptors of clinical lumbar spine instability: A Delphi study

Chad Cook^{1,2}, Josh Metherell³, Philip A. Rice^{1,2}

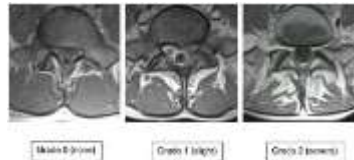
Subjective factors of consensus and rank outcomes for clinical lumbar spine instability, listed in ascending rank.

Descriptor	Round III consensus status	Round II composite scores	Round III composite scores
Reports feelings of "giving way" or back "giving out"	CR	561	527
Self-manipulator who feels the need to frequently crack or pop the back	CR	483	524
Frequent bouts or episodes of symptoms	CR	518	523
History of painful crawling or walking during resting or bending of the spine	CR	466	521
Pain during transitional activities (e.g. sit to stand)	CR	484	510
Greater pain returning to erect position from flexion	CR	493	509
Pain increased with sudden, trivial, or mild movements	CR	496	504
Difficulty with unsupported sitting and lying with supported backrest	CR	477	503
Worse with sustained posture and a decreased likelihood of supported static position that is not painful	CR	470	485
Condition is progressively worsening (e.g. shorter intervals between bouts)	CR	471	480
Long-term, chronic history of disorder	CR	457	476
Temporary relief with back brace or corset	CR	463	476
Reports frequent episodes of muscle spasms	CR	462	454



- Normal back pain episodes last 2-4 weeks and pt becomes pain free
 - Pain free does not mean patient has recovered
 - No spontaneous recovery from the reflex inhibition

Long term inhibition leads not only to muscle atrophy, but fatty infiltration

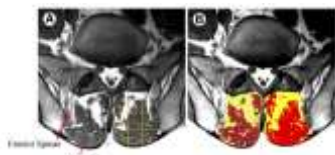


Multifidus Atrophy Is Localized and Bilateral in Active Persons With Chronic Unilateral Low Back Pain

George J. Reinsel, PhD, PT, Alexander Jolly, PhD, PT

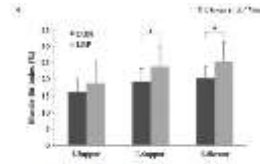
Arch Phys Med Rehabil Vol 89, February 2008

- Chronic unilateral LBP leads to segmental bilateral multifidus atrophy
- Acute LBP = unilateral loss
- Reduces capacity to control intersegmental motion



Manual Therapy

Original article
Increased intramuscular fatty infiltration without differences in lumbar muscle cross-sectional area during remission of unilateral recurrent low back pain
 Roshan (Thang)†, Nelson Capor†, Carol Conroy†, Dip Madhusudan†, Mike Delpire†, Lorenz Gander†



- Increased Muscle Fat Index found in subjects with previous history of LBP as compared with controls
- No noticeable difference in muscle CSA between groups
- Increased MFI may lead to poor muscle performance increasing likelihood of recurrence

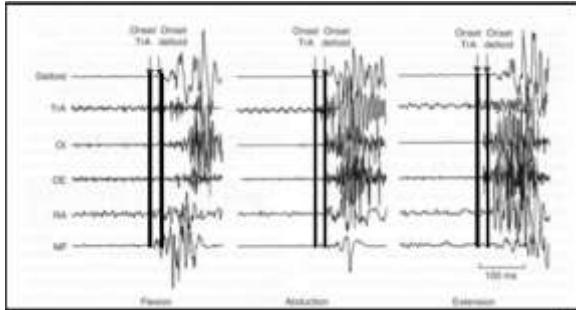
Multifidus Evidence

- 80% of all LBP demonstrated atrophy (Kader et al, 2000)
- LM atrophy more pronounced on side of surgery (Mattila et al, 1986; Hides et al 1994)
- Dec EMG activity at unstable segment (Sihvonen et al, 1995)
- Dec endurance if LBP in elite rowers
- Inc atrophy/fatty infiltrate in those with poor outcomes after surgery (Ford et al, 1983)
- Inc atrophy associated with poor outcomes after laminectomy (Rantanen et al, 1994)
- Inc recovery of muscle after surgery in those with favorable post-op outcomes (Sihvonen et al, 1995)

Evidence for altered neural and active control systems

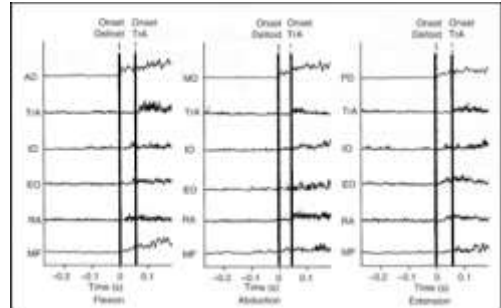
- Delayed TrA contraction in subjects with LBP – Hodges and Richardson, 1996, *Spine*
- Altered lumbopelvic recruitment in presence of SIJ pain – Hungerford, 2003, *Spine*
- Altered abdominal recruitment after exercise intervention – O’Sullivan, 1998, *JOSPT*
- RCT with improved outcomes in instability patients after stabilization training – O’Sullivan, 1997, *Spine*

Feed-Forward Mechanism of TrA



Hodges and Richardson, 1996

Delayed TrA Contraction with Pain



Hodges and Richardson, 1996

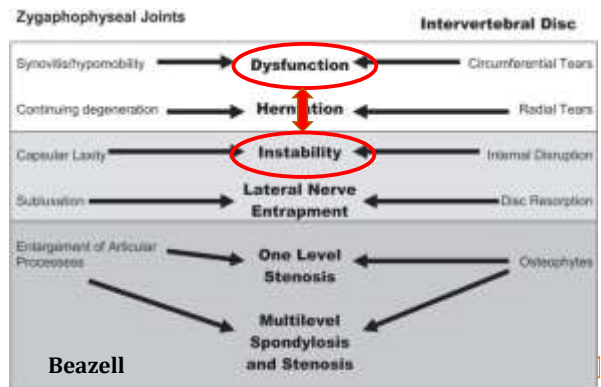
Ultrasound Tissue Doppler Imaging Reveals No Delay in Abdominal Muscle Feed-Forward Activity During Rapid Arm Movements in Patients With Chronic Low Back Pain

Key Points:

- The study sought to assess whether the activation of the lateral abdominal muscles during rapid arm movements in patients with CLBP and pain-free controls.
- Both groups showed feed-forward activity of the lateral abdominal muscles (i.e., onset of activity >50 ms before onset of the primary muscle, the prime mover for the movement).
- The analysis of variance revealed a statistically significant ($P = 0.011$) "group x body side" interaction, which was the result of earlier onset in the CLBP group (as assessed by the abdominal muscles on the right) than on the left side.
- No relationship was found between the onset of the motion (volitional, reaches, arbitrary and pain intensity, pain frequency, pain medication usage, or Roland-Morris disability scores).
- The clinical relevance of the time of onset of lateral abdominal muscle activity remains unclear.

Bezell

Cascade of Spinal Degeneration



Bezell

Lumbar Objective Examination

- Observation/Postural Assessment/Functional Testing
- Lumbar AROM/PROM/Resisted Testing
 - Quadrants
- SIJ Screening
- Neurological Testing
 - Segmental
 - Central
- Neurodynamic Testing
- Provocation Testing
 - PA, Compression, torsion
- **What else to assist R/I primary hypothesis?**



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Objective Examination Modification/Additional Testing

- Lumbar Instability pathology
 - Vertical Compression Test
 - Quadrant and H/I Test
 - Prone Instability Test
 - Endurance Testing



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Vertical Compression Test



(+)



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Lumbar ROM Quadrant Testing

- Quadrant Test: place the spine in the extreme combined movement. Performed when the cardinal planes have been negative or not reproduced all symptoms. May need to do this test to reproduce symptoms from a facet joint.
 - Pt standing
 - Therapist guides patient in each quadrant and overpresses movement
 - Looking for reproduction of symptoms and movement asymmetry
 - Sustain and/or add compression at end of motion if needed



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Front Right Quadrant



Back Right Quadrant



Lumbar ROM Quadrant Testing

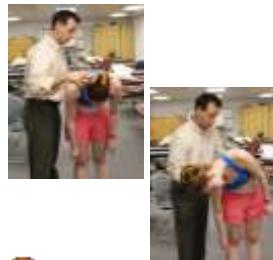
- Front Right Quadrant
 - Flexion/right SB/right rotation
 - Maximally flexes left facets
- Front Left Quadrant
 - Flexion/left SB/left rotation
 - Maximally flexes right facets
- Back Right Quadrant
 - Extension/right SB/right rotation
 - Maximally extends right facets
- Back Left Quadrant
 - Extension/left SB/left rotation
 - Maximally extends left facets

“H” & “I” Testing

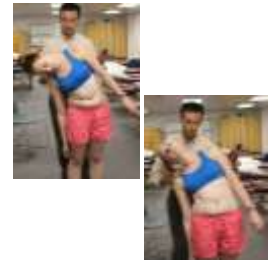
- H and I Test: helps to differentiate between hypomobilities and instabilities when there was limited motion during quadrant testing.
- Takes the patient in each quadrant using different movement orders.
- Inconsistent hypomobilities indicate an instability, consistent hypomobilities indicate true hypomobility.
- “H” test
 - Start with SB to one side then flexion, followed by extension
- “I” test
 - Start with flexion or extension, then SB to either side

“H” & “I” Testing (+)

“I” Test



“H” Test



“H” & “I” Testing

- “H” & “I” Interpretation
 - True hypomobility
 - Patient **cannot** achieve a quadrant regardless of which movement is initiated
 - Motor Control (segmental stability) Problem
 - Patient **can** achieve a quadrant depending on order of movement
 - Example: Limited back left quadrant
 - SB followed by extension (H test) = full motion
 - Extension followed by left SB (I test) = limited motion



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Lumbar Objective Examination

- Observation/Postural Assessment/Functional Testing
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Lumbar Objective Examination

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- SIJ Screening
- Neurological Testing
 - Segmental
 - Central
- Neurodynamic Testing
- Provocation Testing
 - PA, Compression, torsion
- **What else to assist R/I primary hypothesis?**

- Lumbar Instability pathology
 - Vertical Compression Test
 - H/I Tests
 - Prone Instability Test
 - Endurance Testing

Lumbar Biomechanical Exam PAIVM's



(+)
L4/5
Central and L



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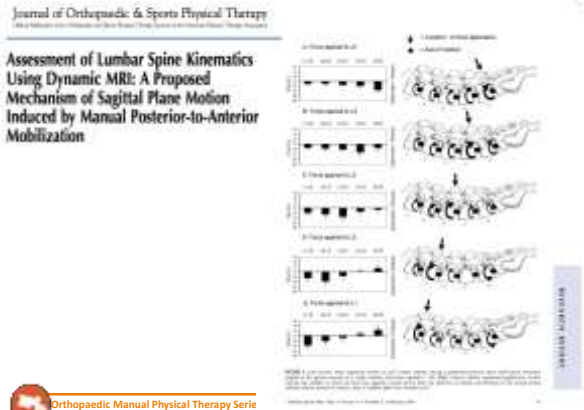


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- Assessing P/A pressure under MRI
 - Extension was always produced at the level being assessed
 - PA pressure to L3-4, L4-5 or L5-S1 produced extension at all other lumbar spinal levels
 - PA pressure to L1-2 or L2-3 produced flexion at the 3 caudal levels



PA Mobility Testing

- Good agreement for pain provocation
- Fair to poor agreement on mobility assessment
 - Better consensus with hypomobility than hypermobility
- Extension is always produced at the level being assessed
- PA to the upper lumbar spine seems to create a flexion moment to the lower lumbar spine

Objective Examination Modification/Additional Testing

- Lumbar Instability pathology
 - Vertical Compression Test
 - H/I Test
 - Prone Instability Test
 - Endurance Testing

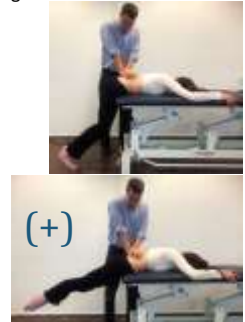
The Interrater Reliability of Physical Examination Tests That May Predict the Outcome or Suggest the Need for Lumbar Stabilization Exercises

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 40 | NUMBER 2 | FEBRUARY 2010

- Good inter-rater reliability found for tests in CPR and additional testing
 - Aberrant motion with AROM
 - Passive SLR
 - Active SLR
 - Passive lumbar extension test
 - Prone instability test
 - Lumbar extension load test

Lumbar Biomechanical Exam Stability Testing

- Prone instability test
- Patient prone, with the trunk supported on the examining table and the feet resting on the floor.
- PT performs a PA pressure to each level of the lumbar spine.
 - If pain is provoked at a certain level, the patient lifts their feet off the floor and the PA pressure is repeated.
 - Positive test if the pt's pain goes away
- Can modify pending irritability and ability of patient



Passive Lumbar Extension



Lumbar Extension Load Test




Active SLR



Lumbar Extensor Endurance Testing

Biering Sorenson Test



• Make sure chin is tucked too

Study	Reliability	Validity	Specificity	LR+	LR-	QUADRUPEDAL
Avila et al. (2002) = 12 months	0.78 ICC	0.5	96	17.6	0.09	0
And et al. (2004) = 21 months	0.78 ICC	94.2	94.4	1.67	0.18	0

Clinical Tests to Diagnose Lumbar Segmental Instability: A Systematic Review

| MARCH 2018 | VOLUME 41 | NUMBER 3 | JOURNAL OF ORTHOPAEDIC PHYSIOTHERAPY

- Looking a tests able to identify structural instability (not functional instability) due to...
 - Severe disc degeneration
 - Discectomy's
 - Laminectomy's
 - Fusions (adjacent segments)
 - Spondylolisthesis

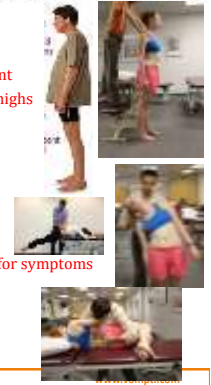


Passive Lumbar Extension

PLE found to be the only test with sufficient sensitivity and specificity and LR+ (8.8)

Physical Exam: "Ashtanka" Signs/Symptoms | Special tests, Movement/Joint Dysfunction, Posture, Palpation, etc)

- "Lazy stander", hangs on "Y" ligaments
- (+) Vertical Compression Test
- Lumbar AROM: (+) Flexion, Ext, Ext/L SB Quadrant
- Poor control upon return from flexion, walks up thighs
- (+) H/I Test with inconsistent Ext/L SB quadrant
- Neuro (-)
- Neurodynamic testing (-)
- Hip and SIJ Clearing (-). Hip IR = 45 (R), 40(L)
- (+) PA for stiffness at T12-L2 and pain at L4-5
- (+) Prone Instability Test L4/5
- (+) PPIVM/PAIVM into Ext/inferior glide at L4/5 for symptoms and guarding/spasm more so than stiffness
- (+) PAIVM into extension glide L1/2 and L5/S1
- ODI = 32% perceived disability
- FABQ (W) = 15



> Are the relationships between the signs on the body (that, the interview, and physical exam consistent)? Do the features fit a recognizable clinical pattern? **Yes** No

Lumbar facet pathology due to clinical instability

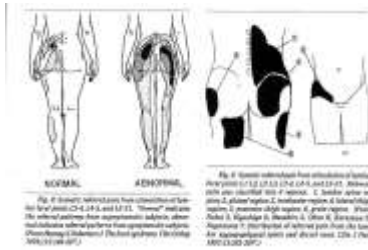
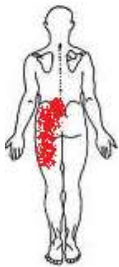


Fig. 4 Normal relationship between adjacent lumbar facets (L4/L5, L5/S1, and L5/S2). "Normal" means the normal anatomy from supine position; anterior, when the lumbar vertebrae are separated at various flexion angles (indicated). The facet surfaces (flexion) are in contact.

Fig. 5 When vertebral facet orientation is altered (more or less L4/L5, L4/L6, and L5/S1). Abnormal relationships (not shown) are also possible. In both cases, the normal relationship is restored when the patient is in the supine position. In the case of L4/L5, the normal relationship is restored when the patient is in the supine position. In the case of L4/L6, the normal relationship is restored when the patient is in the supine position. In the case of L5/S1, the normal relationship is restored when the patient is in the supine position.



Subjective and objective descriptors of clinical lumbar spine instability: A Delphi study

Chad Cook^{1,2}, Jose Michel Bruma³, Philip A. Swan^{2,4}

Objective signs of weakness and test outcomes for clinical lumbar instability, listed in descending rank.

Descriptor	Round 1 (1) consistent (100%)	Round 2 (2) inter-rater (90%)	Round 3 (3) intra-rater (90%)
Poor biomechanical control, including exaggerated bracing or guarding with movement, as well as poor proprioceptive function	CB	317	339
Poor core/abdominal/muscular control, including bracing or shaking	CB	488	331
Decreased strength and reduction of load reaction to level of apparent instability	CB	332	331
Abnormal movement, including thoracic lateral shift during AROM	CB	496	320
Pain with sustained positions and postures	CB	479	301
Gender's sign: Patient walks up thighs when returning from flexion	CB	492	301
Excessive mobility of one of the segments during flexion/extension	CB	491	301
Decreased willingness or apprehension of movement	CB	491	299
Hypersensitivity during passive resistance (PA), forcing into	CB	473	293
Increased muscle guarding/spasm	CB	473	279
Pain posture and postural deviations (are include lateral shift and changes in position)	CB	489	271
Positive spring test (CP, provocative test)	CB	427	266
Progression of walking, shuffling, crawling and prying (level during movement)	CB	247	261
Motor disability between weight bearing and non-weight bearing	NCB	442	260
Hypermobile adjacent segments	CB	437	260
Motor disability between AROM vs. FICOM	NCB	424	256
Pain with palpation, including transverse spine and Spinous	U	428	256
Hypertrophic motor spine	U	438	241
Palpable segmental motion change	U	411	234

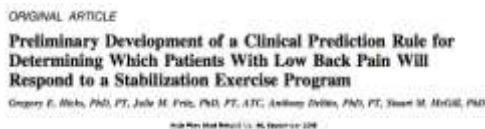
What About Classification?



Classification	Prone Instability (PI)	Prone Instability (PI)
Definition	<ul style="list-style-type: none"> Presence of either three (PI) or four (PI) criteria Onset of LBP within 16 days of the last assessment Asymmetrical hip movements of the pelvis Flexion-rotation of the lumbar spine with a range of motion < 10° 	<ul style="list-style-type: none"> Presence of two or three (PI) criteria Presence of symptoms (LBP) Low FABQ score (< 9) Hypermobility of the lumbar spine Hypermobility of the lumbar spine
Indication	<ul style="list-style-type: none"> Diagnosis of PI Presence of LBP with instability Asymmetrical hip movements Presence of LBP with instability with a range of motion < 10° Flexion-rotation of the lumbar spine with a range of motion < 10° Hypermobility of the lumbar spine Hypermobility of the lumbar spine 	<ul style="list-style-type: none"> Range of motion < 10° Presence of LBP with instability Presence of LBP with instability Presence of LBP with instability Presence of LBP with instability Presence of LBP with instability Presence of LBP with instability
Specific exercise	<ul style="list-style-type: none"> Stabilization exercises with lumbar extension Stabilization exercises with lumbar flexion 	<ul style="list-style-type: none"> Stabilization exercises with lumbar extension Stabilization exercises with lumbar flexion Stabilization exercises with lumbar flexion Stabilization exercises with lumbar flexion
Notes	<ul style="list-style-type: none"> Stabilization exercises with lumbar flexion Stabilization exercises with lumbar extension Stabilization exercises with lumbar flexion Stabilization exercises with lumbar extension 	<ul style="list-style-type: none"> Stabilization exercises with lumbar flexion Stabilization exercises with lumbar extension Stabilization exercises with lumbar flexion Stabilization exercises with lumbar extension
Contraindications	<ul style="list-style-type: none"> Acute fracture of the lumbar spine Acute fracture of the lumbar spine Acute fracture of the lumbar spine Acute fracture of the lumbar spine 	<ul style="list-style-type: none"> Acute fracture of the lumbar spine Acute fracture of the lumbar spine Acute fracture of the lumbar spine Acute fracture of the lumbar spine
References	<ul style="list-style-type: none"> Stabilization exercises with lumbar flexion Stabilization exercises with lumbar extension Stabilization exercises with lumbar flexion Stabilization exercises with lumbar extension 	<ul style="list-style-type: none"> Stabilization exercises with lumbar flexion Stabilization exercises with lumbar extension Stabilization exercises with lumbar flexion Stabilization exercises with lumbar extension



- Predictor Variables
 - Pain does not travel below the knee
 - Onset ≤ 16 days ago
 - Lumbar hypomobility
 - Either hip has > 35° of internal rotation
 - FABQ Work score < 19
- 4 or more variables
 - +LR 24.4



- Predictive Variables for Stabilization Success
 - Age < 40 y/o
 - Average SLR > 91 degrees
 - Aberrant Movement Pattern
 - (+) Prone Instability Test (PIT)
- 3/4 Predictors: (+) LR = 4.0
- Predictor Variables for Stabilization Failure
 - (-) Prone Instability Test
 - No aberrant movement
 - FABQ score < 9
 - No hypermobility observed in the lumbar spine

A Clinical Prediction Rule to Identify Patients With Low Back Pain Who Are Likely to Experience Short-Term Success Following Lumbar Stabilization Exercises: A Randomized Controlled Validation Study

[JANUARY 2018 | VOLUME 44 | NUMBER 1 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY]

- Attempt to validate original study failed
- Aberrant movement and + prone instability test cluster was most responsive to stabilization exercises
 - “modified CPR”



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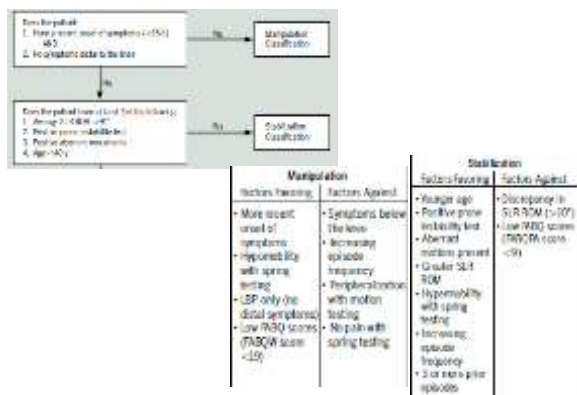
Aberrant Movements

- Painful arc with lumbar flexion
- Painful arc with return from lumbar flexion
- Instability catch
- Gower’s sign
- Reverse lumbopelvic rhythm



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Clinical Dilemma??

- | | |
|---|--|
| <p><u>Manipulation</u></p> <ul style="list-style-type: none"> • Symptoms < 16 days ✓ FABQ (W) < 19 ✓ Hip IR > 35 deg ✓ Hypomobility of L/S ✓ No symptoms distal to knee | <p><u>Stabilization</u></p> <ul style="list-style-type: none"> • SLR > 91 deg ✓ Age < 40 ✓ Aberrant Movement Pattern ✓ Prone Instability Test |
|---|--|

Interventions seem diametrically opposed
– Is there a way to reconcile this difference?



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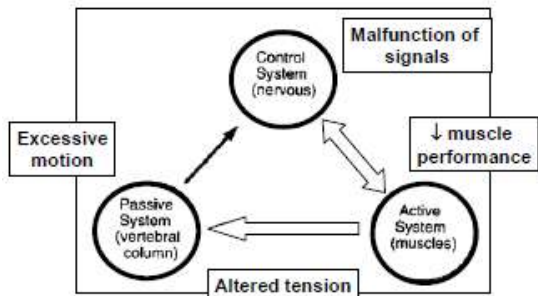


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Level of Recommendation	Intervention
A	INTERVENTIONS - MANUAL THERAPY Clinicians should consider utilizing manual mobilization procedures to reduce pain and disability in patients with mobility dysfunction of the low back and neck-shoulder/neck or hip/pain. Manual mobilization and manual muscle release procedures can also be used to improve segmental mobility and reduce pain and disability in patients with subacute and chronic low back and neck-related lower extremity pain.
A	INTERVENTIONS - TRUNK COORDINATION, STRENGTHENING, AND ENDURANCE EXERCISES Clinicians should consider utilizing trunk coordination, strengthening, and endurance exercise to reduce low back pain and disability in patients with subacute and chronic low back pain with movement coordination impairments and in patients post-lumbar retractorectomy.
A	INTERVENTIONS - PROGRESSIVE ENDURANCE EXERCISE AND FITNESS ACTIVITIES Clinicians should consider (1) moderate- to high-intensity aerobic for patients with chronic low back pain without generalized pain; and (2) incorporating progressive, low-intensity, submaximal fitness and endurance activities into the pain management and health promotion strategies for patients with chronic low back pain with generalized pain.

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Initial Treatment? Where Do We Start?



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➤ What is your primary treatment Objective after initial evaluation?

- **Education:**
Educate pt on condition and importance of stability
- **Manual Therapy: (Specific Technique)**
Lumbar joint mobilization /manipulation to improve mobility adjacent to surgery
- **Exercise Prescription: (Specific)**
Lumbar stabilization therapy
- **Other:**
Belt?

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Initial Treatment?

©2019 Thomas W. Dwyer, DPT, FRCPC
 Licensed Physical Therapist & Writer

Comparison of the Effectiveness of Three Manual Physical Therapy Techniques in a Subgroup of Patients With Low Back Pain Who Satisfy a Clinical Prediction Rule
 A Randomized Clinical Trial

Julius A. Ostroff, PT, PhD,*† Julie M. Pivik, PT, PhD, ATC,†§ Amanda Kulp, PT, PhD,§§
 Heidi E. Chivers, DPT,** Sarah Chalmers, PT, F, Jake Maggi, PT, DSc,†††
 and John S. Childs, PT, PhD††



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Right Side Flexion/Gap Mobilization or Manipulation

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Lumbopelvic Manipulation

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Lumbopelvic / SIJ Regional Manipulation



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Risks

- Haldeman and Rubenstein (spine 1992)
 - Reviewed literature over 77 year period
 - Ten episodes of cauda equina syndrome following lumbar manipulation reported
 - Estimated Risk: <1 per 100 million manipulations



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Risks

- Senstad et al (Spine, 1997)
 - Surveyed 1058 pts treated with spinal manipulation by DC's in Norway
 - 75% of all Rxs included manip to the Lx Spine
 - No severe complications noted
 - 55% reported at least one side effect: local discomfort – 53%, Fatigue – 11%, HA – 12%, Radiating discomfort – 10%



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Why does manipulation work? One Theory

- Reflexogenic effect
- Resets signals
 - Between body and brain and spinal cord
- Allows muscle to reach optimal contraction
 - Breaks up spasm
 - Reduces inhibition



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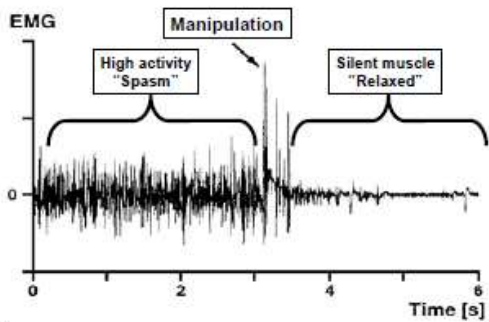
Evidence for reflexogenic effect

- Improves H-reflex: unilateral lumbar HNP
 - Floman, 1997, *Eur Spine J*
- Decreases in quadriceps inhibition in anterior knee pain patients with SIJ manipulation
 - Suter, 1999, *JMMT*
- Decreases EMG response in back muscles
 - Herzog, 1999, *Spine*



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Electrical signal changes in a muscle spasm after manipulation
From: Herzog: Spine, Volume 24(2), January 15, 1999, 146-152

Research article Open Access

The influence of expectation on spinal manipulation induced hypoalgesia: An experimental study in normal subjects
Joel E Bialosky¹, Mark D Bishop¹, Michael E Robinson², Josh A Barabas¹ and Steven Z George^{1*} *BMC Musculoskeletal Disorders* 2009, **9**:19

- Significant increase in pain perception occurred following SMT in participants who received negative expectation suggesting a potential influence of expectation on SMT induced hypoalgesia in the body area to which the expectation is directed



Figure 1 Mean Pain Perception (mmHg) Reported in the Neck, Shoulder, and Hip Locations in the Low Back Pain Condition
Figure 2 Change in Pain Perception (mmHg) Reported in the Neck, Shoulder, and Hip Locations in the Low Back Pain Condition

Spinal Manipulative Therapy for Acute Low Back Pain

SPINE Volume 34, Number 3, pp E1338-E1377
© 2015, Lippincott Williams & Wilkins

An Update of the Cochrane Review

- 20 RCT's examined
 - 6 had low bias risk
- “Manipulative therapy” was considered HVLT, or mobilization
- No evidence to show that “manipulative therapy” was more effective than... when treating acute LBP
 - Adjunct therapy
 - Sham treatment
 - Inert intervention (eg: low grade US)

Spinal Manipulative Therapy for Acute Low Back Pain

An Update of the Cochrane Review

- Some short term pain relief and functional improvements seen in a few of the RCTs examined
- Most pts with acute LBP get better on their own so it is difficult to have interventions show significant improvements.

[CASE REPORT]

ALEXANDER R. BREWER, PT, DPT, DCU • NORMAN N. GILL, PT, DSc, DC, CMT, MPT, OACPT®
CHRISTOPHER J. BRADGEM, PT, DPT, MSc, CMT, MPT • KYLA REISEL, PT, PhD

Improved Activation of Lumbar Multifidus Following Spinal Manipulation: A Case Report Applying Rehabilitative Ultrasound Imaging

OUTCOMES: An increased ability to activate the multifidus during a more acute level of trunk flexion was noted immediately and 1 day after manipulation. Average percent change in thickness of the L4/5 and L5/S1 levels with the probe were 18.3% and 20.6% pre-manipulation, 12.2% immediately post-manipulation, and 20.6% at one month. 25-hour post-manipulation, there was a notable reduction of the multifidus muscle during the application of trunk flexion, greater than 3 days post-manipulation. Other changes included an increase in subjective improvement in the contraction of the multifidus during the acute application of trunk flexion with 20 degrees right, 45 degrees right, and 60 degrees right.

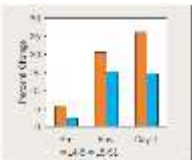


FIGURE 1. Percent change in multifidus thickness. Color represents the percent change in the multifidus thickness at the L4/5 and L5/S1 levels. The multifidus thickness was measured at the L4/5 and L5/S1 levels. Data are presented as mean ± SD.

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Case report
Improved contraction of the transversus abdominis immediately following spinal manipulation: A case study using real-time ultrasound imaging

Nathan W. Gillet, Dorte S. Taylor, Jan E. Lee

WHE. Gillet et al. / Manual Therapy 27 (2007) 280-282

- Effects of spinal manipulation on TrA activation
 - Significant change in TrA resting and contracted “thickness” found with US immediately following HVLA

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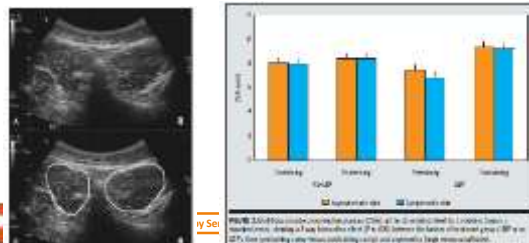
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[RESEARCH REPORT]

KEVIN REBEL, PhD • WARREN STAMPTON, PhD • DAVID MCARDLE, PhD
KEVIN REBEL, PhD • CAMERON BUCHANAN, PhD

Effect of Stabilization Training on Multifidus Muscle Cross-sectional Area Among Young Elite Cricketers With Low Back Pain

JOSPT, Vol 38, Number 3, March 2008



Orthopaedic Manual Physical Therapy Series 2018-2019 | www.vompti.com

Changes in Deep Abdominal Muscle Thickness During Common Trunk-Strengthening Exercises Using Ultrasound Imaging

- Teyhen (JOSPT 2008)
- US assessment of TA and internal oblique contraction (asymptomatic subjects)
 - Best recruitment of TA
 - DIM
 - Quadruped opposite UE/LE with DIM
 - Best recruitment of TA & Int. Oblique
 - Side plank with DIM
 - Abdominal crunch with DIM

Lumbar Stabilization






Exercise Progression – Hicks, et al.

BASIC WITH STABILIZATION, Hicks 1768

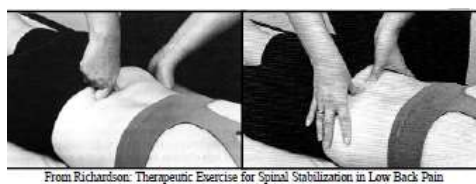
Table 1: Stabilization Exercises With Criteria for Progression of Each Exercise

Primary Muscle Group*	Exercise	Criteria for Progression
Transverse abdominis	Reclining bridging	30 repetitions with 10 s hold
	Bridging with head elevated	30 repetitions per leg with 10 s hold
	Bridging with leg lifts	30 repetitions per leg with 10 s hold
	Bridging with single-leg	30 repetitions with 10 s hold, then progresses to 1 leg
Erector spinae/multifidus	Bridging on standing	30 repetitions with 10 s hold
	Bridging with standing toe exercises	30 repetitions per side with 10 s hold
	Bridging with walking	20 repetitions with 10 s hold on each side
	Distraction arm lifts with bridging	30 repetitions with 10 s hold on each side
Sacrospinal lumbar	Distraction leg lifts with bridging	30 repetitions with 10 s hold on each side
	Single-leg support with knees extended	30 repetitions with 10 s hold on each side
	Single-leg support with knees flexed	30 repetitions with 10 s hold on each side
Sacrospinal abdominals	Single-leg support with knees extended	30 repetitions with 10 s hold on each side
	Single-leg support with knees flexed	30 repetitions with 10 s hold on each side

*Although various muscle groups are differentially activated with each exercise scenario, each exercise progression will promote stability by producing motor patterns of recruitment among all spinal-stabilizing muscles.

Palpation of Multifidus



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

The evaluation of lumbar multifidus muscle function via palpation: reliability and validity of a new clinical test

The Spine Journal • 2003 •

- Multifidus lift test
 - Pt in prone asked to raise contra-lateral UE 5 cm off table
 - Therapist assessed multifidus activation via palpations at L4-5 and L5-S1 interspace
- Inter-rater reliability: (K=.75-.81)
- Validity: Good at L4-5 not L5-S1
 - Reference standard: US

Multifidus Facilitation Techniques

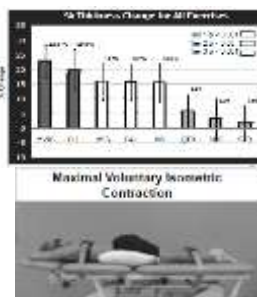
- Weight Shifts
- Contralateral Loaded Prone Arm Lift



Use 1.5-3.0 lbs load

Best Exercise for Multifidus?

- 8 commonly prescribed exercises for LM
- % thickness change measured with RTUS
- Prone MVIC best for thickness change



Balance and Perturbation Training

- Higher postural sway
 - Van Daele et al 2009
- Altered body inclination associated with anticipated postural instability
 - Brumagne et al 2008
- Decreased variability of anticipatory postural adjustments and increased stiffness with perturbations
 - Jacobs et al 2009, Mok et al 2007, Hodges et al 2009



RESEARCH ARTICLE Open Access

An update of stabilisation exercises for low back pain: a systematic review with meta-analysis

Seki et al. BMC Medical Research Methodology 2014, 14:216

Conclusion: There is strong evidence stabilisation exercises are not more effective than any other form of active exercise in the long term. The low levels of heterogeneity and large number of high methodological quality of available studies, at long term follow-up, strengthen our current findings, and further research is unlikely to considerably alter this conclusion.

CRITICAL REVIEW

The myth of core stability

Journal of Backwork & Movement Therapies 2015 14: 84-98

- That certain muscles are more important for stabilization of the spine than other muscles, in particular transversus abdominis (TrA).
- That weak abdominal muscles lead to back pain
- That strengthening abdominal or trunk muscles can reduce back pain
- That there is a unique group of “core” muscle working independently of other trunk muscles
- That back pain can be improved by normalizing the timing of core muscles
- That there is a relationship between stability and back pain

CRITICAL REVIEW

The myth of core stability

- Weak trunk muscles, weak abdominals and imbalances between trunk muscles groups are not a pathology just a normal variation.
- The division of the trunk into core and global muscle system is a reductionist fantasy, which serves only to promote CS.
- Weak or dysfunctional abdominal muscles will not lead to back pain.
- Tensing the trunk muscles is unlikely to provide any protection against back pain or reduce the recurrence of back pain.
- Core stability exercises are no more effective than, and will not prevent injury more than, any other forms of exercise or physical therapy. Any therapeutic influence is related to the exercise effects rather than stability issues.
- Patients who have been trained to use complex abdominal hollowing and bracing maneuvers should be discouraged from using them.

Pattern Recognition

Identify the key subjective and physical features (i.e. clinical pattern) that would help you recognize this disorder in the future.

Subjective	Physical
<p>Episodic nature becoming more frequent</p> <p>Transitional movements painful</p> <p>Back pain with referred pain into the buttock and thigh</p>	<p>Aberrant movement with ROM assessment</p> <p>Inconsistent ROM with H & I testing</p> <p>+ stability testing</p>

Prevalence of Adjacent Segment Degeneration After Spine Surgery

A Systematic Review and Meta-analysis

SPINE Volume 33, Number 7, pp 537-568
©2014, Lippincott Williams & Wilkins

TABLE 2. Subgroup Analysis by Diagnostic Time

Diagnostic Time, yr	Radiograph ASD		Symptomatic ASD	
	Range of Prevalence	Pooled Prevalence	Range of Prevalence	Pooled Prevalence
0 to <1 yr	4.8%–62.6%	21.8% (16.0%–27.6%)	0.0%–24.3%	6.5% (4.8%–8.1%)
≥2 to <3	8.7%–67.2%	33.4% (21.8%–48.2%)	0.0%–35.2%	12.1% (8.7%–16.8%)
≥3 to >10	3.0%–60.6%	37.4% (10.7%–64.1%)	2.8%–39.0%	3.2% (2.9%–4.0%)

ASD indicates adjacent segment degeneration.

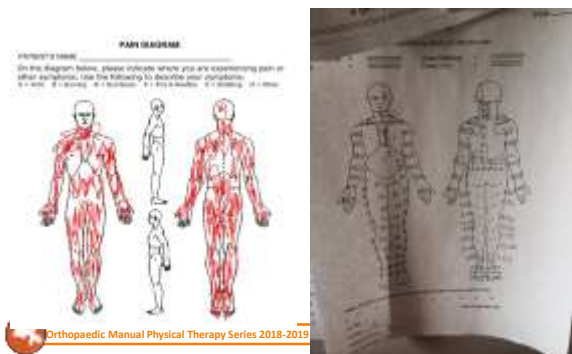
- 94 studies with 34,917 pts included for review
- Spine surgery is associated with significant risk for ASD
- Increased intradiscal pressure, annular stress and mobility found at adjacent segments

Risk for Adjacent Segment and Same Segment Reoperation After Surgery for Lumbar Stenosis

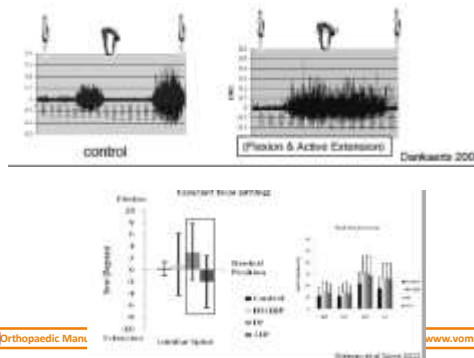
SPINE Volume 33, Number 7, pp 531-539
©2014, Lippincott Williams & Wilkins

- RCT
 - Examined the reoperation recurrence rate after surgery for lumbar stenosis
 - Variables examined for increased risk
 - Demographics
 - Severity of symptoms
 - Obesity
 - Location of surgery (fusion, lami, decompression)
 - Duration of symptoms
 - Only variable that increased risk for future reoperation
 - » Symptoms greater than 12 months prior to first surgery

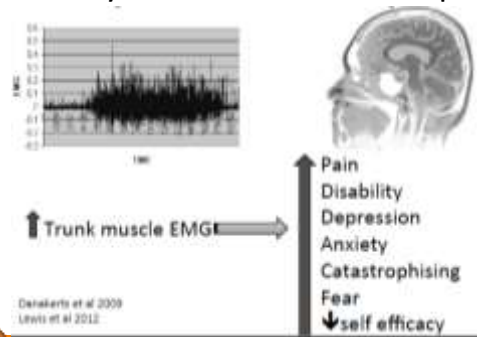
Now, What About Them?



Muscle Activity and Maladaptive Patterns in Chronic LBP



Body and Mind Relationship



Treatment – Cognitive Functional Approach

