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LUMBAR SPINE
CASE 2

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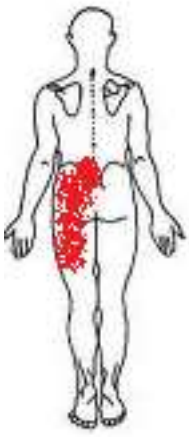
Aaron Hartstein, PT, DPT, OCS, FAAOMPT

Orthopaedic Manual Physical Therapy Series
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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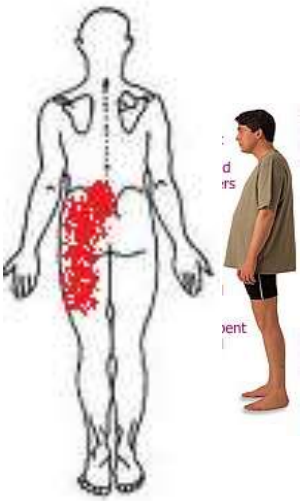
SUBJECTIVE EXAM

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: Non | Min | **Mod** | Max

Continuous back pain, with intermittent leg pain

  - Irritability: Non | Min | **Mod** | 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 in/refer to the painful region	Myofascial tissue in/refer to the painful region	Non Contractile tissue in/refer to the painful region	Neural tissue in/refer 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? Spondyloar thropathy? Mass?

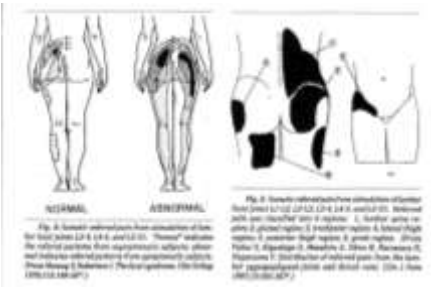
Primary HYPOTHESIS after Subjective Examination: L4-5/5-S1 somatic/ facet due to clinical instability

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



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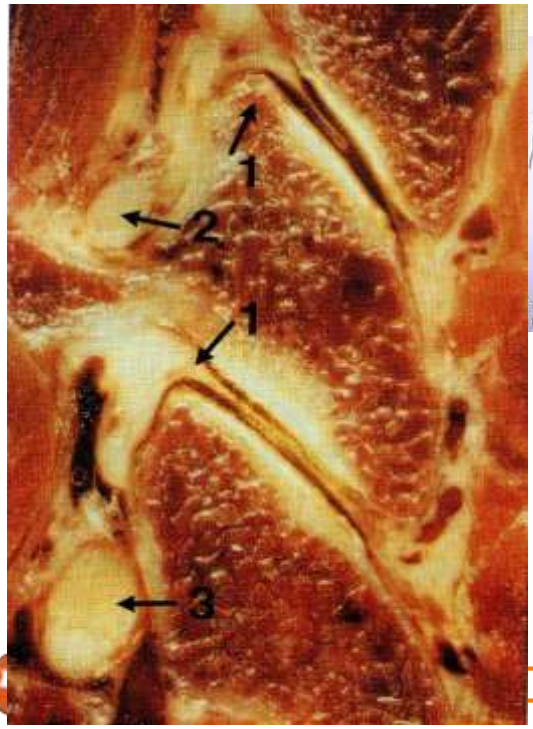
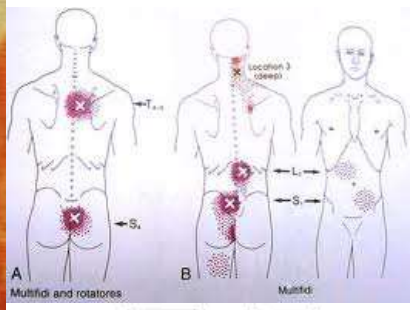
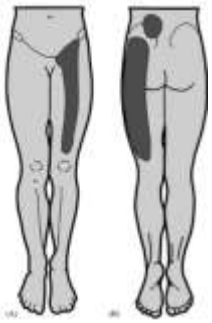


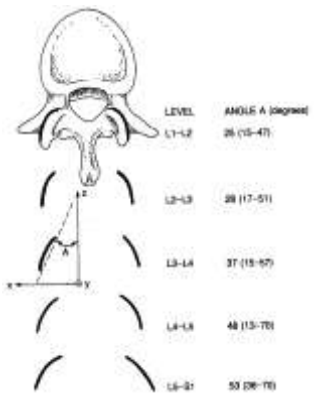




Lumbar Anatomy

Facet Joints

- Lumbar orientation
  - Vertical with "C" or "J" shape mostly in the sagital plane
    - Facilitates frontal plane motion, some sagital 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



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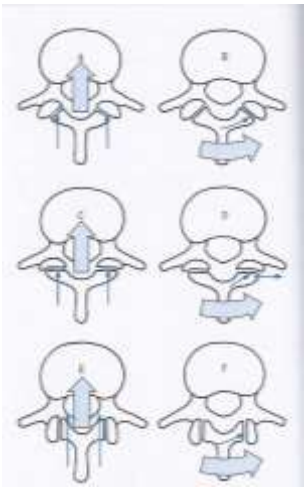
Lumbar Anatomy

Facet Joints

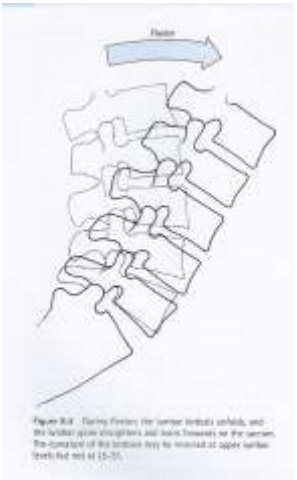
- Facet Orientation
  - Ideal orientation is 45° from sagital plane
    - Resists both anterior translation and rotation
      - Greater than 45° provides less resistance to rotation
      - Less then 45°provides more resistance to rotation



Lumbar Biomechanics

Flexion

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



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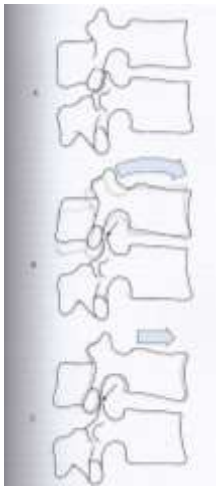
Lumbar Biomechanics

Flexion

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



Lumbar Biomechanics

Extension

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

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Lumbar Biomechanics

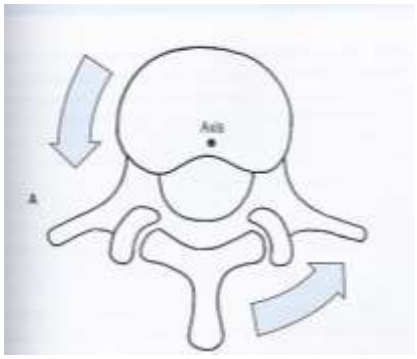
Extension

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

Lumbar Biomechanics

Rotation

- Spin in the transverse plane around an axis in the posterior vertebral body
  - Very small amount of motion <5°



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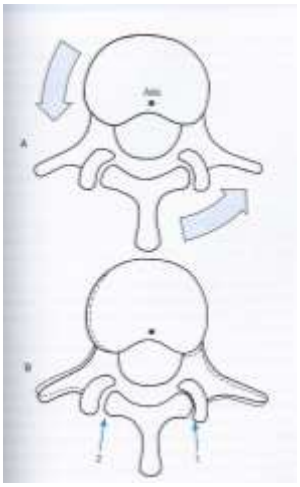
Lumbar Biomechanics

Rotation

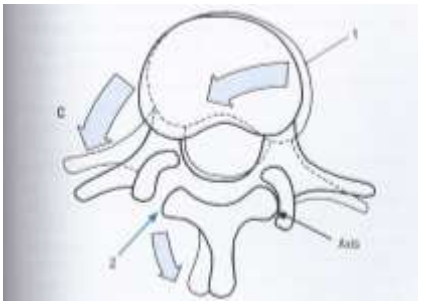
- Rotation restrained by
  - Contact of contralateral facet joint
  - Ipsilateral facet joint capsule
  - IV Disc specifically the annular fibers



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)

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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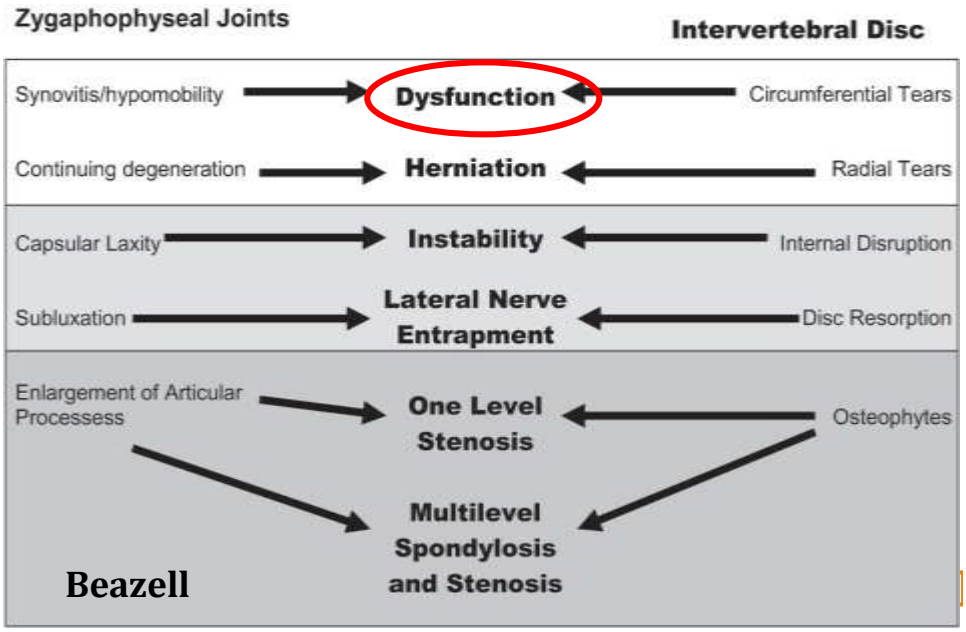
Lumbar Biomechanics

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

Cascade of Spinal Degeneration



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Manual Therapy

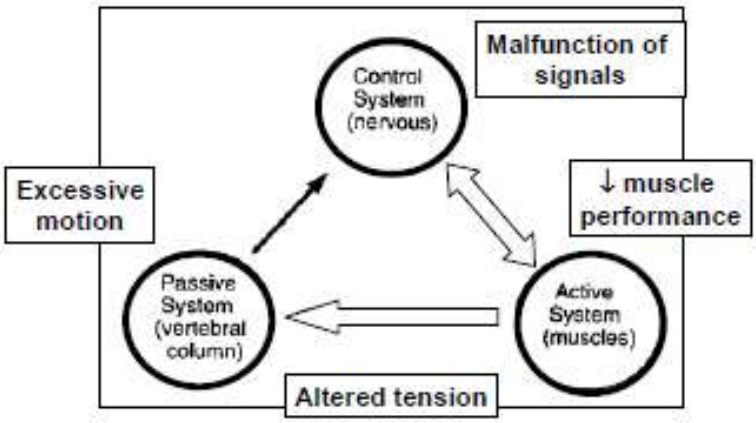
Original article

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

Chad Cook[a,*], Jean-Michel Brismée[b], Phillip S. Sizer Jr[b]

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

Descriptor	Round III consensus status	Round II composite scores	Round III composite scores
Reports feelings of "giving way" or back "giving out"	CR	501	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 catching or locking during twisting or bending of the spine	CR	496	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 better with supported backrest	CR	477	500
Worse with sustained postures and a decreased likelihood of reported static position that is not painful	CR	470	495
Condition is progressively worsening (e.g. shorter intervals between bouts)	CR	471	490
Long-term, chronic history of disorder	CR	457	478
Temporary relief with back brace or corset	CR	463	478
Reports frequent episodes of muscle spasms	CR	482	474



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Spine
© Lippincott-Raven Publishers.
Volume 21(23) 1 December 1996 pp 2763-2769

Multifidus Muscle Recovery Is Not Automatic After Resolution of Acute, First-Episode Low Back Pain
[Exercise and Functional Testing]

Hides, Julie A. PhD; Richardson, Carolyn A. PhD; Jull, Gwendolen A. MPhty

- 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

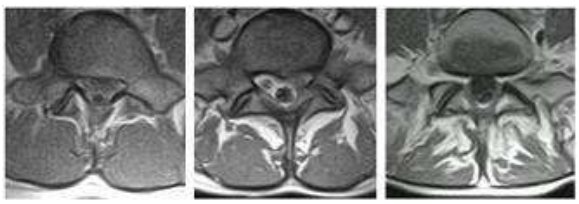
BMC Medicine
Research article
Open Access

Are MRI-defined fat infiltrations in the multifidus muscles associated with low back pain?

Per Kjaer*[1], Tom Bendix[1], Joan Solgaard Sorensen[1], Lars Korsholm[2] and Charlotte Leboeuf-Yde[1]

BMC Medicine 2007,

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



Grade 0 (none) Grade 1 (slight) Grade 2 (severe)

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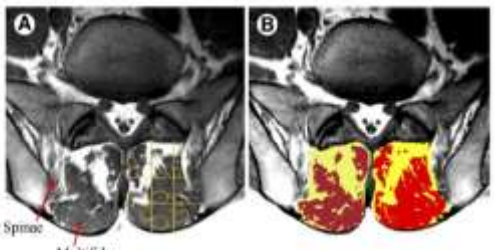
Multifidus Atrophy Is Localized and Bilateral in Active Persons With Chronic Unilateral Low Back Pain

George J. Beneck, PhD, PT, Kornelia Kulig, PhD, PT

Arch Phys Med Rehabil Vol 93, February 2012

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



Contents lists available at SciVerse ScienceDirect

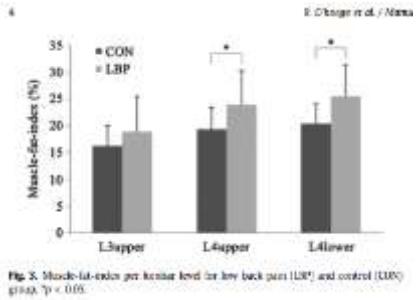
Manual Therapy

journal homepage: www.elsevier.com/math

Original article

Increased intramuscular fatty infiltration without differences in lumbar muscle cross-sectional area during remission of unilateral recurrent low back pain

Roseline D'hooge [a,*], Barbara Cagnie [a], Geert Crombez [b], Guy Vanderstraeten [a,c], Mieke Dolphens [a], Lieven Danneels [a]



- 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

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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*

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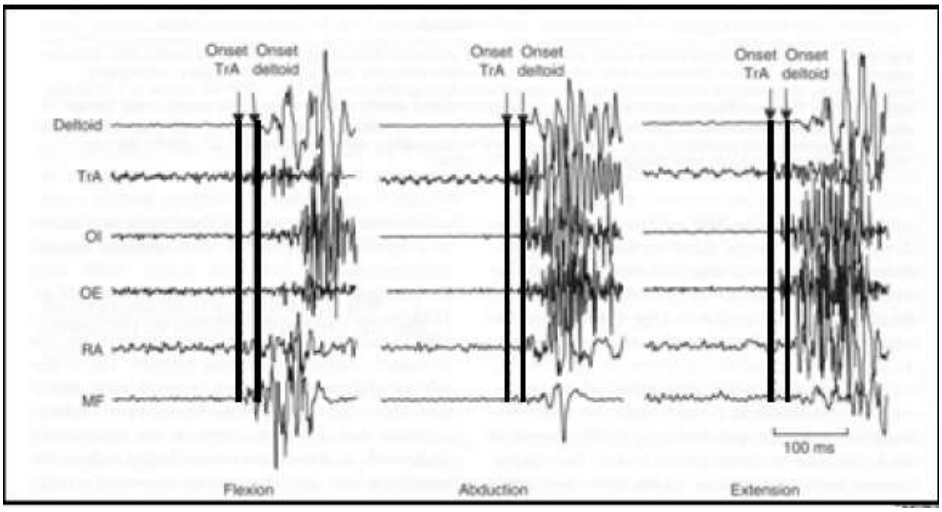
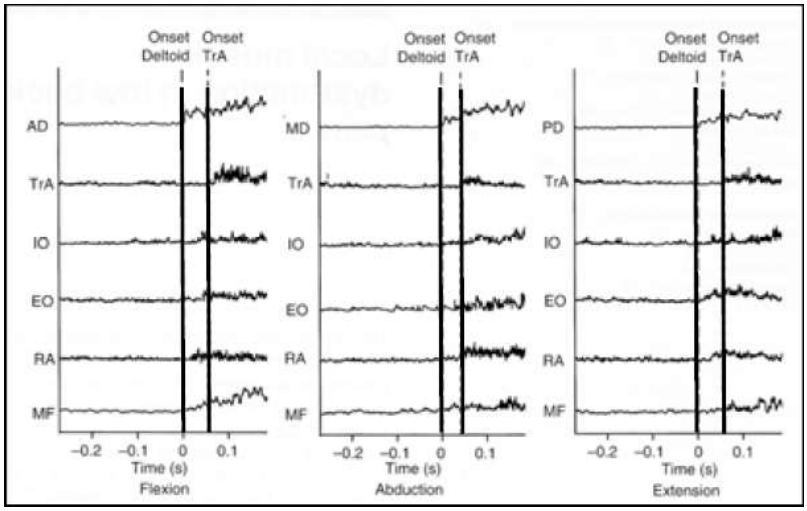
Feed-Forward Mechanism of TrA



Hodges and Richardson, 1996

Delayed TrA Contraction with Pain



Hodges and Richardson, 1996

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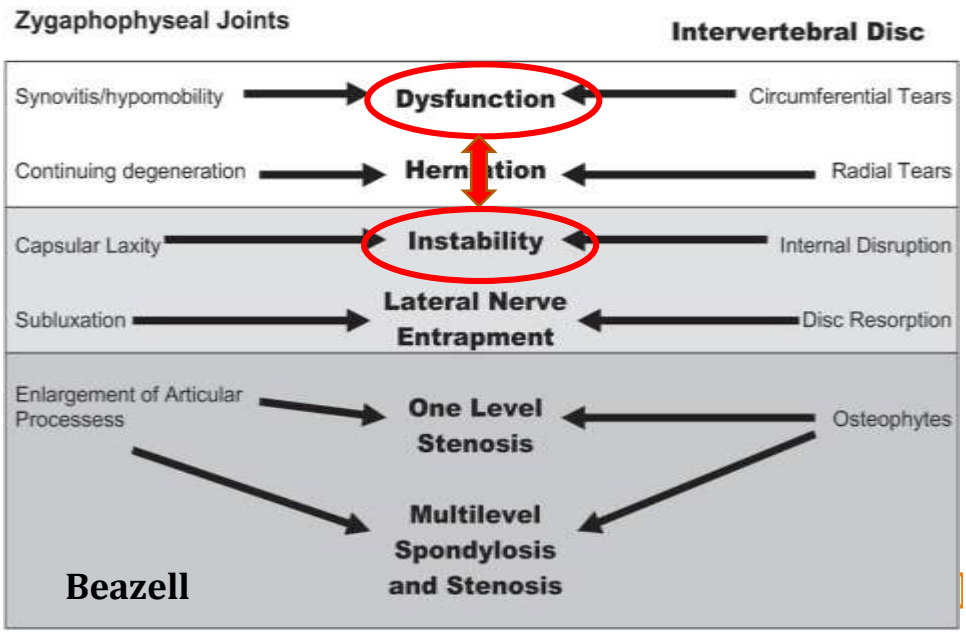
SPINE Volume 35, Number 16, pp 1506–1513
©2010, Lippincott Williams & Wilkins

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

- This study sought to compare the timing of 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 milliseconds after activation of the deltoid muscle, the prime mover for the movement).
- The analysis of variance revealed a statistically significant ($P = 0.015$) "group × body side" interaction, which was the result of earlier onsets in the cLBP group than controls for the abdominal muscles on the right (but not left) body side.
- No relationship was found between the onset of the earliest abdominal muscle activity 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 obscure.

Cascade of Spinal Degeneration



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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?**

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

(+)

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

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"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

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"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

Lumbar Objective Examination

- Observation/Postural Assessment/Functional Testing
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  - PA, Compression, torsion

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Lumbar Objective Examination

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- **What else to assist R/I primary hypothesis?**

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

Lumbar Biomechanical Exam

PAIVM's

(+)
L4/5
Central and L

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Clinical Biomechanics 16 (2001) 80–83
CLINICAL BIOMECHANICS
www.elsevier.com/locate/clinbiomech
ELSEVIER

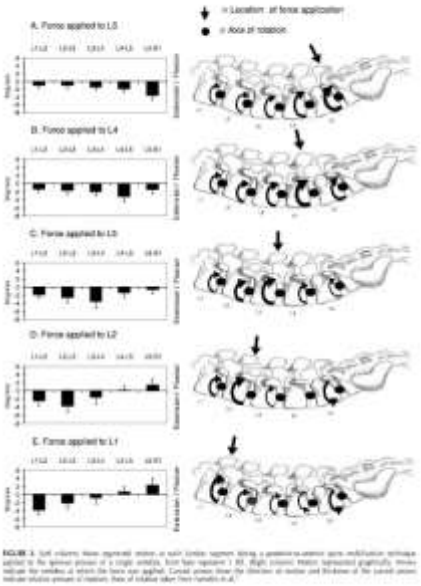
Brief report

Segmental mobility of the lumbar spine during a posterior to anterior mobilization: assessment using dynamic MRI

- 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

Journal of Orthopaedic & Sports Physical Therapy

Assessment of Lumbar Spine Kinematics Using Dynamic MRI: A Proposed Mechanism of Sagittal Plane Motion Induced by Manual Posterior-to-Anterior Mobilization



RESEARCH REPORT

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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

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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 43 | NUMBER 2 | FEBRUARY 2013 |

- 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

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Lumbar Extensor Endurance Testing

Biering Sorenson Test

- Make sure chin is tucked too

Study	Reliability	Sensitivity	Specificity	LR+	LR-	QUADAS Score (0–14)
Arab et al.[1] (men) > 28 seconds	0.78 ICC	92.3	94	15.4	0.08	9
Arab et al.[1] (women) > 29 seconds	0.78 ICC	84.3	84.6	5.47	0.18	9

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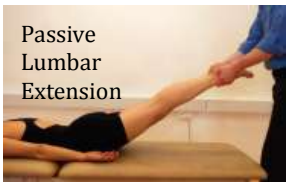
Clinical Tests to Diagnose Lumbar Segmental Instability: A Systematic Review

| MARCH 2011 | VOLUME 41 | NUMBER 3 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

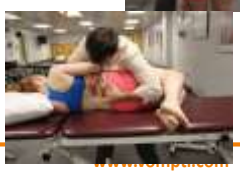
- Looking a tests able to identify structural instability (not functional instability) due to…
  - Severe disc degeneration
  - Discectomy's
  - Laminectomy's
  - Fusions (adjacent segments)
  - Spondylolisthesis



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

Physical Exam "Asterisks" 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



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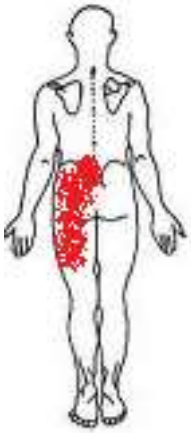
- Are the relationships between the areas on the body chart, the interview, and physical exam consistent? "Do the features fit" a recognizable clinical pattern? **Yes** **No**

Lumbar facet pathology due to clinical instability



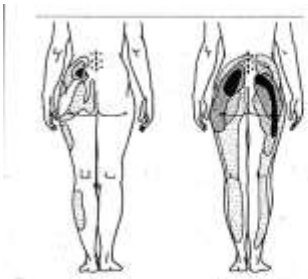


Fig. 4. Somatic referred pain from stimulation of lumbar facet joints L3-4, L4-5, and L5-S1. "Normal" indicates the referral patterns from asymptomatic subjects; abnormal indicates referral patterns from symptomatic subjects. (From Mooney V, Robertson J. The facet syndrome. Clin Orthop 1976;115:149-56*.)

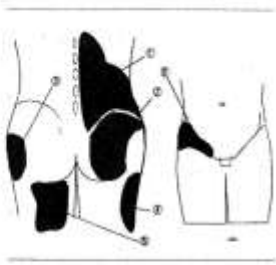


Fig. 5. Somatic referred pain from stimulation of lumbar facet joints L1-L2, L2-L3, L3-4, L4-5, and L5-S1. Referred pain was classified into 6 regions: 1, lumbar spine region; 2, gluteal region; 3, trochanter region; 4, lateral thigh region; 5, posterior thigh region; 6, groin region. (From Fukui S, Kiguchiga O, Muzahiro S, Ohno K, Kurosawa H, Nagasawa Y. Distribution of referred pain from the lumbar zygapophyseal joints and dorsal rami. Clin J Pain 1997;13:133-36*.)

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Manual Therapy 11 (2006) 11–21

MANUAL THERAPY
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Original article

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

Chad Cook[a,*], Jean-Michel Brismée[b], Phillip S. Sizer Jr[b]

Objective factors of consensus and rank outcomes for clinical lumbar instability, listed in descending rank.

Descriptor	Round III consensus status	Round II composite scores	Round III composite scores
Poor lumbopelvic control, including segmental hinging or pivoting with movement, as well as poor proprioceptive function	CR	517	539
Poor coordination/neuromuscular control, including juddering or shaking	CR	488	537
Decreased strength and endurance of local muscles at level of segmental instability	CR	522	533
Aberrant movement, including changing lateral shift during AROM	CR	486	510
Pain with sustained positions and postures	CR	479	507
Gower's sign: Patient walks up thighs when returning from flexion	CR	492	503
Excessive motion of one of two segments during flexion-extension	CR	487	503
Decreased willingness or apprehension of movement	CR	491	494
Hypermobility during posterior–anterior (PA) Spring test	CR	473	493
Increased muscle guarding/spasm	CR	475	474
Poor posture and postural deviations that include lateral shift and changes in lordosis	CR	449	471
Positive spring test (PA provocation test)	CR	447	466
Frequent catching, clicking, clunking and popping heard during movement	CR	447	461
Motion disparity between weight bearing and non-weight bearing	NCR	442	460
Hypomobile adjacent segments	CR	457	460
Motion disparity between AROM vs. PROM	NCR	425	456
Pain with palpation, including interspinous space and ligament	U	428	446
Hypertrophic erector spinae	U	438	443
Palpable segmental position change	U	417	434

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What About Classification?

[CLINICAL COMMENTARY]

JULIE M. FRITZ, PT, PhD, ATC1 • JOSHUA A. CLELAND, PT, PhD, OCS, FAAOMPT2 • JOHN D. CHILDS, PT, PhD, MBA, OCS, FAAOMPT3

Subgrouping Patients With Low Back Pain: Evolution of a Classification Approach to Physical Therapy

| JUNE 2007 | VOLUME 37 | NUMBER 6 | JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY

TABLE 1 SIGNS AND SYMPTOMS ORIGINALLY PROPOSED AS THE CRITERIA FOR PLACING A PATIENT INTO A PARTICULAR CLASSIFICATION AND REVISED CRITERIA BASED ON UPDATED EVIDENCE

Classification	Original Classification Criteria	Updated Classification Criteria
Manipulation	• Asymmetrical lateral flexion ROM (ie, capsular pattern of motion restriction) • Unilateral LBP without symptoms into the lower extremities • Asymmetrical bony landmarks of the pelvis • Positive sacroiliac dysfunction tests (ie, supine long sit test, prone knee bend test, standing flexion test)	• No symptoms distal to the knee • Recent onset of symptoms (<16 d) • Low FABQW score (<19) • Hypomobility of the lumbar spine • Hip internal rotation ROM (>35° for at least 1 hip)
Stabilization	• Frequent recurrent episodes of LBP with minimal perturbation • Hypermobility of the lumbar spine • Previous history of lateral-shift deformity with alternating sides • Frequent prior use of manipulation with dramatic but short-term results • Trauma, pregnancy, or use of oral contraceptives • Relief with immobilization (eg, bracing)	• Younger age (<40 y) • Greater general flexibility (postpartum, average SLR ROM >91°) • "Instability catch" or aberrant movements during lumbar flexion-extension ROM • Positive findings for the prone instability test • For patients who are postpartum: - Positive posterior pelvic pain provocation (P4), and ASLR and modified Trendelenburg tests - Pain provocation with palpation of the long dorsal sacroiliac ligament or pubic symphysis
Specific exercise		
Extension	• Symptoms centralize with lumbar extension • Symptoms peripheralize with lumbar flexion	• Symptoms distal to the buttock • Symptoms centralize with lumbar extension • Symptoms peripheralize with lumbar flexion • Directional preference for extension
Flexion	• Symptoms centralize with lumbar flexion • Symptoms peripheralize with lumbar extension • Diagnosis of lumbar spinal stenosis	• Older age (>50 y) • Directional preference for flexion • Imaging evidence of lumbar spinal stenosis
Lateral shift	• Visible frontal plane deviation of the shoulders relative to the pelvis • Asymmetrical side-bending active ROM • Painful and restricted extension active ROM	• Visible frontal plane deviation of the shoulders relative to the pelvis • Directional preference for lateral translation movements of the pelvis
Traction	• Signs and symptoms of nerve root compression • No movements centralize symptoms	• Signs and symptoms of nerve root compression • No movements centralize symptoms

Abbreviations: ASLR, active straight-leg raise; FABQW, Fear-Avoidance Beliefs Questionnaire-Work Subscale; LBP, low back pain; ROM, range of motion; SLR, straight-leg raise.

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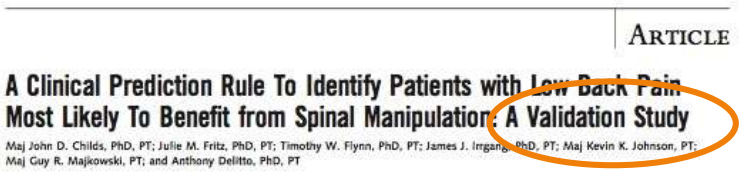
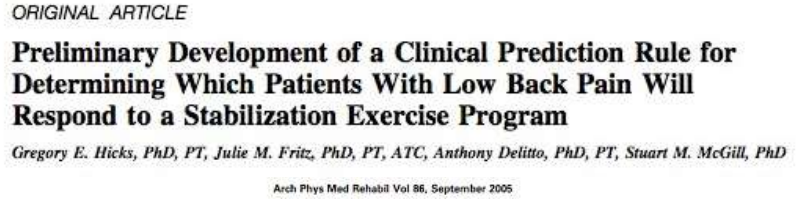


ARTICLE

A Clinical Prediction Rule To Identify Patients with Low Back Pain Most Likely To Benefit from Spinal Manipulation: A Validation Study

Maj John D. Childs, PhD, PT; Julie M. Fritz, PhD, PT; Timothy W. Flynn, PhD, PT; James J. Irrgang, PhD, PT; Maj Kevin K. Johnson, PT; Maj Guy R. Majkowski, PT; and Anthony Delitto, PhD, PT

- 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



ORIGINAL ARTICLE

Preliminary Development of a Clinical Prediction Rule for Determining Which Patients With Low Back Pain Will Respond to a Stabilization Exercise Program

Gregory E. Hicks, PhD, PT, Julie M. Fritz, PhD, PT, ATC, Anthony Delitto, PhD, PT, Stuart M. McGill, PhD

Arch Phys Med Rehabil Vol 86, September 2005

- 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

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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 2014 | 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"

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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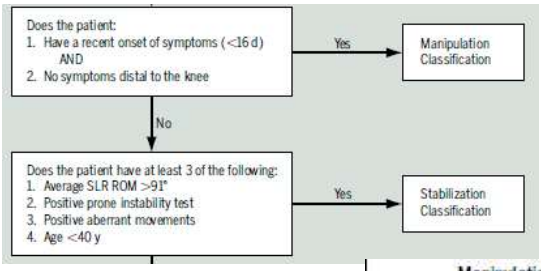


Manipulation	
Factors Favoring	Factors Against
• More recent onset of symptoms • Hypomobility with spring testing • LBP only (no distal symptoms) • Low FABQ scores (FABQW score <19)	• Symptoms below the knee • Increasing episode frequency • Peripheralization with motion testing • No pain with spring testing

Stabilization	
Factors Favoring	Factors Against
• Younger age • Positive prone instability test • Aberrant motions present • Greater SLR ROM • Hypermobility with spring testing • Increasing episode frequency • 3 or more prior episodes	• Discrepancy in SLR ROM (>10°) • Low FABQ scores (FABQPA score <9)

Clinical Dilemma??

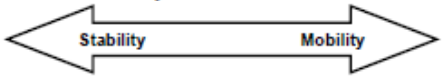
<u>Manipulation</u>

- Symptoms < 16 days
- ✓ **FABQ (W) < 19**
- ✓ **Hip IR > 35 deg**
- ✓ **Hypomobility of L/S**
- ✓ **No symptoms distal to knee**

<u>Stabilization</u>

- 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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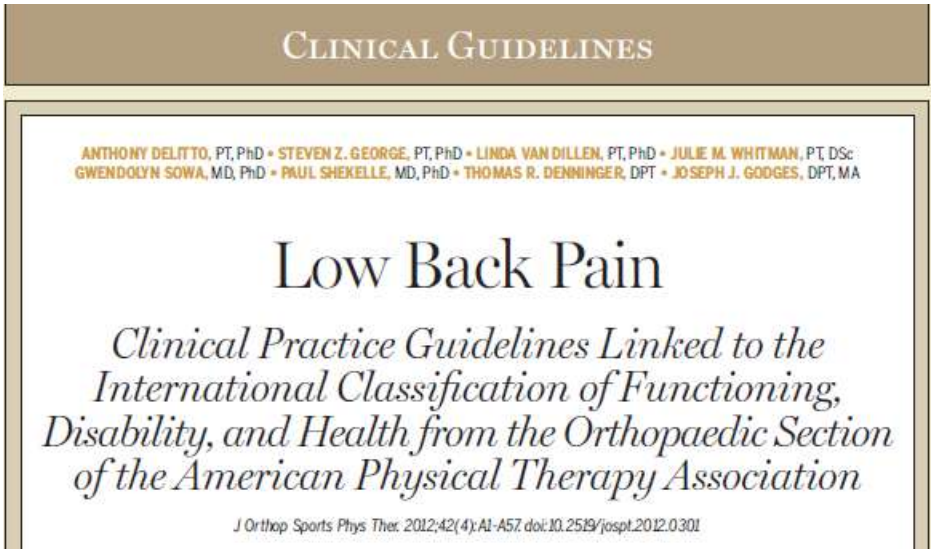

CLINICAL GUIDELINES

ANTHONY DELITTO, PT, PhD • STEVEN Z. GEORGE, PT, PhD • LINDA VAN DILLEN, PT, PhD • JULIE M. WHITMAN, PT, DSc
GWENDOLYN SOWA, MD, PhD • PAUL SHEKELLE, MD, PhD • THOMAS R. DENNINGER, DPT • JOSEPH J. GODGES, DPT, MA

Low Back Pain

Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability, and Health from the Orthopaedic Section of the American Physical Therapy Association

J Orthop Sports Phys Ther. 2012;42(4):A1-A57. doi:10.2519/jospt.2012.0301

A **INTERVENTIONS – MANUAL THERAPY**

Clinicians should consider utilizing thrust manipulative procedures to reduce pain and disability in patients with mobility deficits and acute low back and back-related buttock or thigh pain. Thrust manipulative and nonthrust mobilization procedures can also be used to improve spine and hip mobility and reduce pain and disability in patients with subacute and chronic low back and back-related lower extremity pain.

A **INTERVENTIONS – TRUNK COORDINATION, STRENGTHENING, AND ENDURANCE EXERCISES**

Clinicians should consider utilizing trunk coordination, strengthening, and endurance exercises 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 microdiscectomy.

A **INTERVENTIONS – PROGRESSIVE ENDURANCE EXERCISE AND FITNESS ACTIVITIES**

Clinicians should consider (1) moderate- to high-intensity exercise 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.

GRADES OF RECOMMENDATION	STRENGTH OF EVIDENCE
A Strong evidence	A preponderance of level I and/or level II studies support the recommendation. This must include at least 1 level I study
B Moderate evidence	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation
C Weak evidence	A single level II study or a preponderance of level III and IV studies including statements of consensus by content experts support the recommendation
D Conflicting evidence	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies
E Theoretical/ foundational evidence	A preponderance of evidence from animal or cadaver studies, from conceptual models/principles, or from basic sciences/bench research support this conclusion
F Expert opinion	Best practice based on the clinical experience of the guidelines development team

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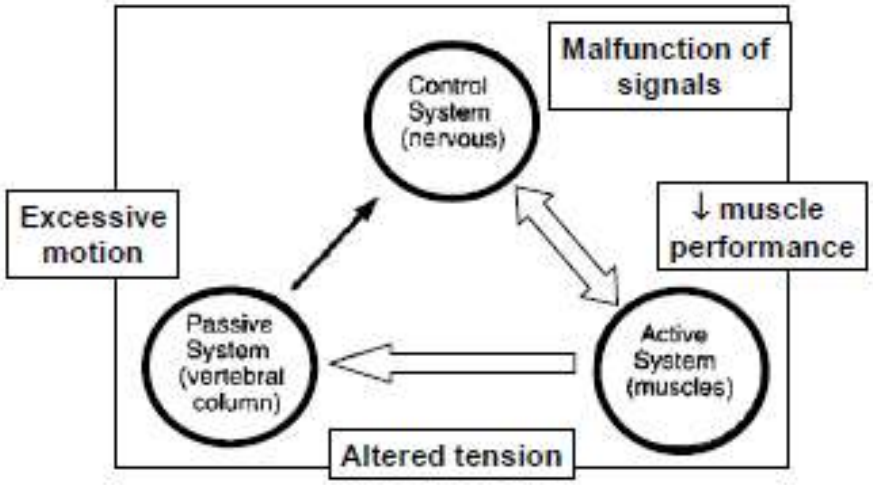
Initial Treatment?
Where Do We Start?



- **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?

SPINE Volume 34, Number 23, pp 2720–2729
©2009, Lippincott Williams & Wilkins

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

Joshua A. Cleland, PT, PhD,*† Julie M. Fritz, PT, PhD, ATC,‡§ Kornelia Kulig, PT, PhD,¶‖
Todd E. Davenport, DPT,** Sarah Eberhart, PT,† Jake Magel, PT, DSc,††
and John D. Childs, PT, PhD‡‡



Right Side Flexion/Gap Mobilization or Manipulation

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Lumbopelvic Manipulation

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

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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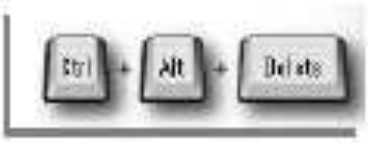
Why does manipulation work? One Theory

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



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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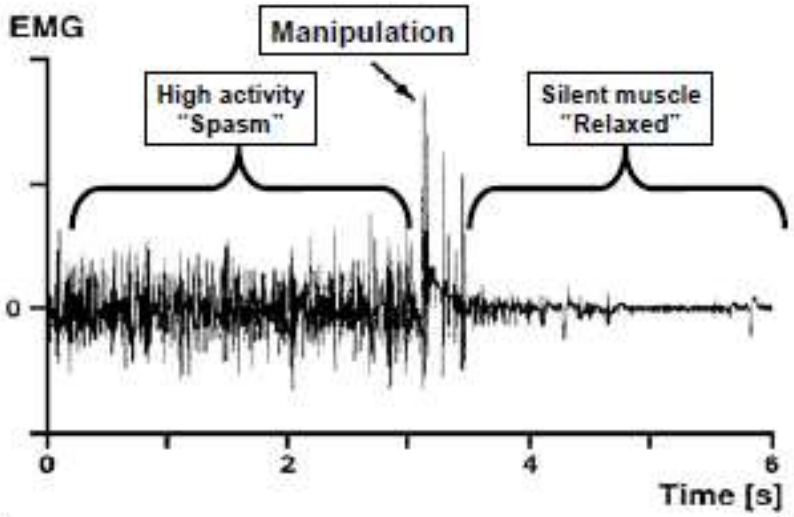

Electrical signal changes in a muscle spasm after manipulation
From: Herzog: Spine, Volume 24(2).January 15, 1999.146-152

Research article **Open Access**

The influence of expectation on spinal manipulation induced hypoalgesia: An experimental study in normal subjects

Joel E Bialosky*[1], Mark D Bishop[1], Michael E Robinson[2], Josh A Barabas[1] and Steven Z George*[1] *BMC Musculoskeletal Disorders* 2008, **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

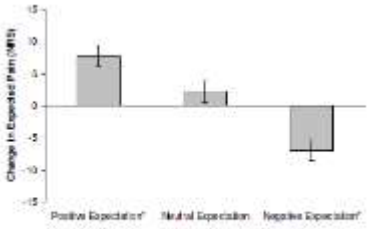

Figure 1
Effect of Instructional Set on Expected Pain in the Low Back. Change in expected pain in the low back follow-

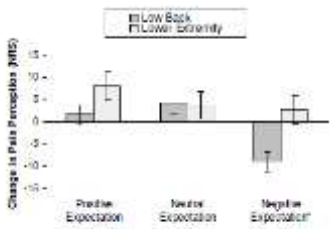

Figure 2
Change in Pain Perception in the Low Back and Lower Extremity by Expectation Instructional Set.

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Spinal Manipulative Therapy for Acute Low Back Pain

SPINE Volume 38, Number 3, pp E158–E177
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An Update of the Cochrane Review

- 20 RCT's examined
  - 6 had low bias risk
- "Manipulative therapy" was considered HVLAT, 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.

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[CASE REPORT]

ALEXANDER K. BRENNER, PT, MPT, OCS[1] • NORMAN W. GILL, PT, DSc, OCS, Cert. MDT, FAAOMPT[2]
CHRISTOPHER J. BUSCEMA, PT, DPT, MTC, Cert. MDT[3] • KYLE KIESEL, PT, PhD[4]

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

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 37 | NUMBER 10 | OCTOBER 2007

OUTCOMES: An increased ability to thicken the multifidus during a prone upper extremity lifting task was noted immediately and 1 day after manipulation. Average percent change in thickness at the L4-5 and L5-S1 levels with the prone arm lift was 3.6% premanipulation, 17.2% immediately postmanipulation, and 20.6% approximately 24 hours postmanipulation. Improvements in the thickening of the multifidus muscle during the upper extremity lifting task were greater than 3 standard errors of the measurement. Other changes included immediate palpable improvement in the contraction of the multifidus during the upper extremity lifting task, along with the patient report of increased ease of lifting.

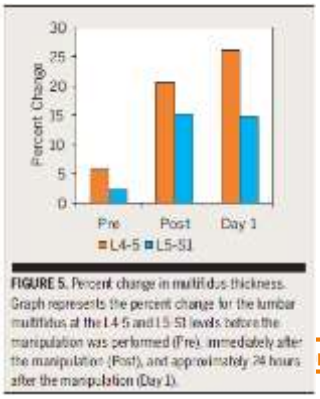

FIGURE 5. Percent change in multifidus thickness. Graph represents the percent change for the lumbar multifidus at the L4-5 and L5-S1 levels before the manipulation was performed (Pre), immediately after the manipulation (Post), and approximately 24 hours after the manipulation (Day 1).

Case report

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

Norman W. Gill[a,*], Deydre S. Teyhen[b], Ian E. Lee[a]

N.W. Gill et al. / Manual Therapy 12 (2007) 280–285

- 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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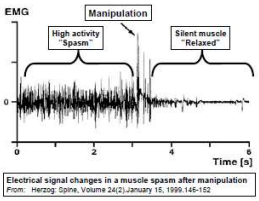
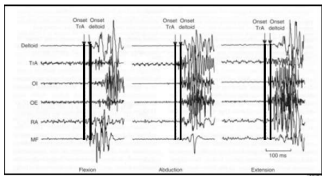


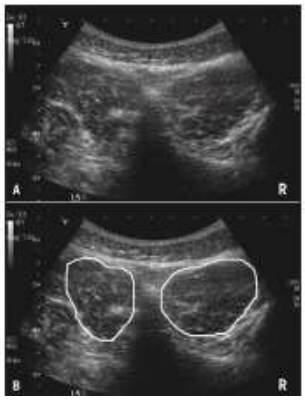


[RESEARCH REPORT]

JULIE HIDES, PhD[1] • WARREN STANTON, PhD[2] • SHAUN MCMAHON, PhD[3]
KEVIN SIMS, PhD[4] • CAROLYN RICHARDSON, PhD[5]

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



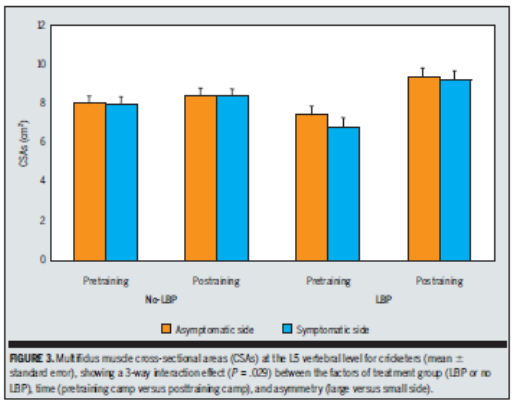


FIGURE 3. Multifidus muscle cross-sectional areas (CSAs) at the L5 vertebral level for cricketers (mean ± standard error), showing a 3-way interaction effect ($P = .009$) between the factors of treatment group (LBP or no LBP), time (pretraining camp versus posttraining camp), and asymmetry (large versus small side).

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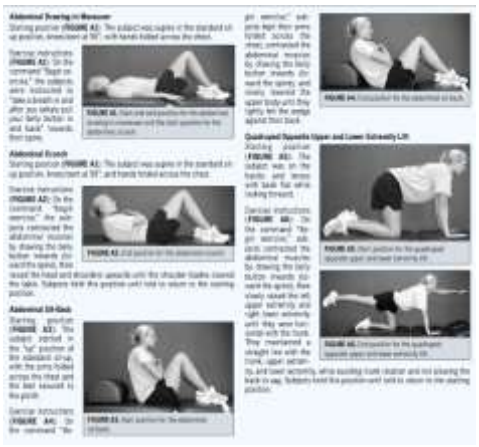
Changes in Deep Abdominal Muscle Thickness During Common Trunk-Strengthening Exercises Using Ultrasound Imaging

- 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



Teyhen et al. 2008

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Exercise Progression – Hicks, et al.

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

Primary Muscle Group*	Exercises	Criteria for Progression
Transversus abdominus	Abdominal bracing	30 repetitions with 8-s hold
	Bracing with heel slides	20 repetitions per leg with 4-s hold
	Bracing with leg lifts	20 repetitions per leg with 4-s hold
	Bracing with bridging	30 repetitions with 8-s hold, then progress to 1 leg
	Bracing in standing	30 repetitions with 8-s hold
	Bracing with standing row exercise	20 repetitions per side with 6-s hold
	Bracing with walking	
Erector spinae/multifidus	Quadruped arm lifts with bracing	30 repetitions with 8-s hold on each side
	Quadruped leg lifts with bracing	30 repetitions with 8-s hold on each side
	Quadruped alternate arm and leg lifts with bracing	30 repetitions with 8-s hold on each side
Quadratus lumborum	Side support with knees flexed	30 repetitions with 8-s hold on each side
	Side support with knees extended	30 repetitions with 8-s hold on each side
Oblique abdominals	Side support with knees flexed	30 repetitions with 8-s hold on each side
	Side support with knees extended	30 repetitions with 8-s hold on each side

*Although certain muscle groups are preferentially activated with each exercise sequence, each exercise progression will promote stability by producing motor patterns of cocontraction among all spinal stabilizing muscles.



Palpation of 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."

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

The Spine Journal ■ (2013) ■

- 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

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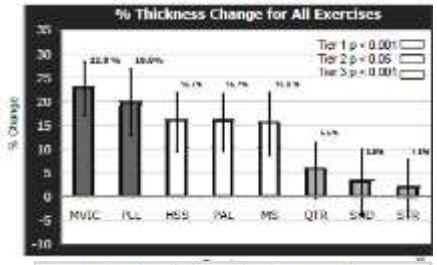
Best Exercise for Multifidus?

- 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

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RESEARCH ARTICLE Open Access

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

Smith *et al. BMC Musculoskeletal Disorders* 2014, 15:416

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 Bodywork & Movement Therapies (2010) 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

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

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Prevalence of Adjacent Segment Degeneration After Spine Surgery

A Systematic Review and Meta-analysis

SPINE Volume 38, Number 7, pp 597–608
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TABLE 2. Subgroup Analysis by Diagnostic Time

	Radiograph ASD		Symptoms ASD	
Diagnostic Time, yr	Range of Prevalence	Pooled Prevalence	Range of Prevalence	Pooled Prevalence
0.5 to ≤2	4.8%–82.6%	21.8% (16.0%–27.6%)	0.0%–24.6%	6.5% (4.8%–8.1%)
>2 to ≤5	8.2%–92.2%	33.6% (21.8%–45.4%)	0.0%–30.3%	12.1% (8.2%–16.0%)
>5 to ≤10	5.0%–60.6%	37.4% (10.7%–64.1%)	2.8%–20.0%	3.2% (2.5%–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 38, Number 7, pp 531–539
©2013, 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

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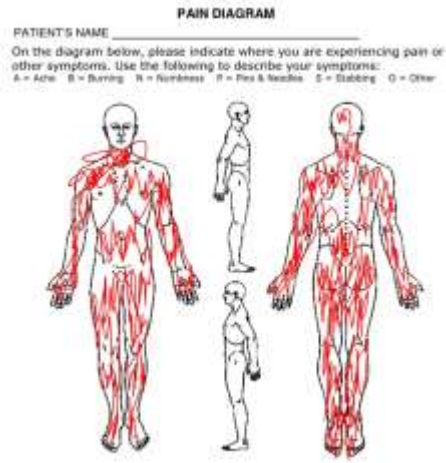
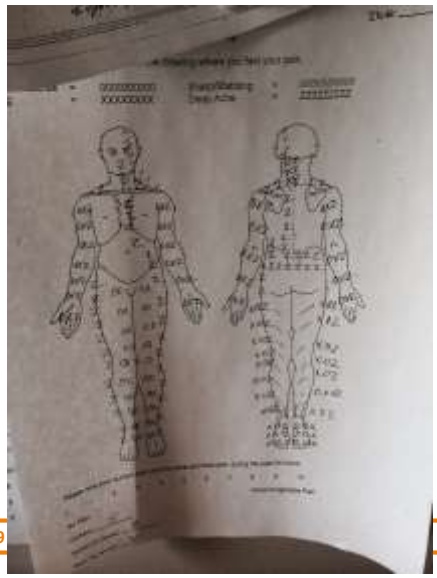
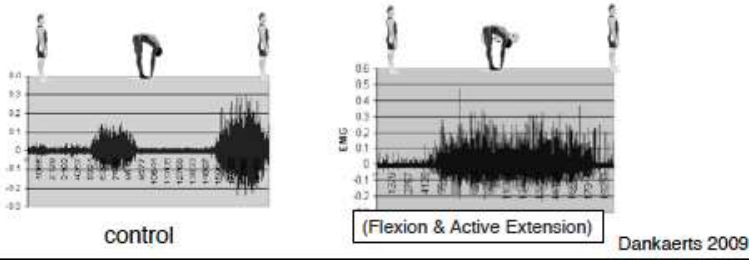
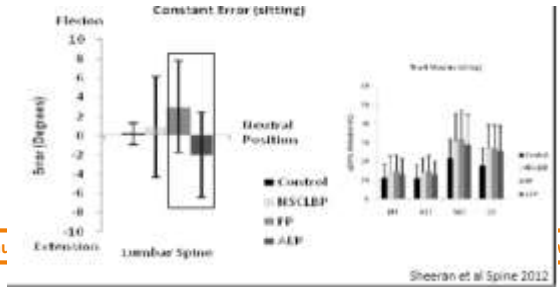
Now, What About Them?





Muscle Activity and Maladaptive Patterns in Chronic LBP





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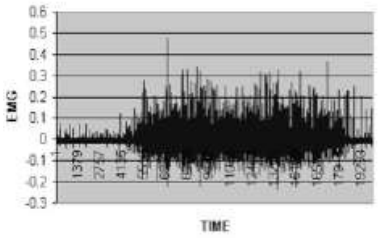
Body and Mind Relationship

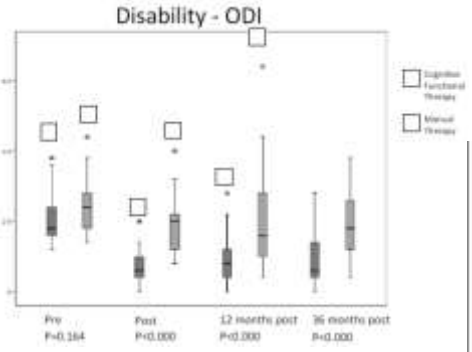


Trunk muscle EMG

Pain
Disability
Depression
Anxiety
Catastrophising
Fear
self efficacy

Danakerts et al 2009
Lewis et al 2012

Treatment – Cognitive Functional Approach



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