The Lumbar Region

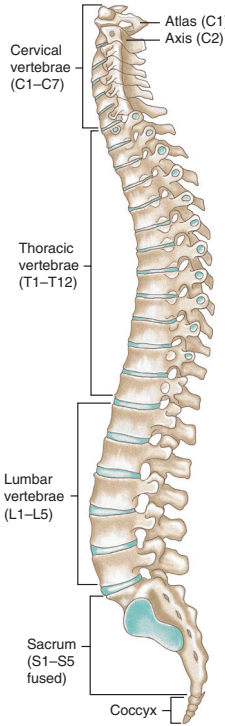

FIGURE 11-1 Vertebral Column (Lateral View)
Clark, RK. *Anatomy and Physiology: Understanding the Human Body.* © 2005 Jones & Bartlett Publishers, LLC

Neuroscreen

Spinal Levels	Myotome		Dermatome	Reflexes
L1–2	Resisted hip flexion (seated)	L1	Inguinal crease	
L3–4	Resisted knee extension	L2	Proximal thigh at the level of greater trochanter	
L4–5	Heel walking	L3	Medial knee	Pateller (L3)
L5	Resisted great toe extension	L4	Medial ankle	
L5–S1	Single leg stance	L5	Web space of great toe and 2nd toe	
S1	Toe walking	S1	Lateral foot	Achilles (S1)
S2	Toe flexion	S2	Posterior medial knee	

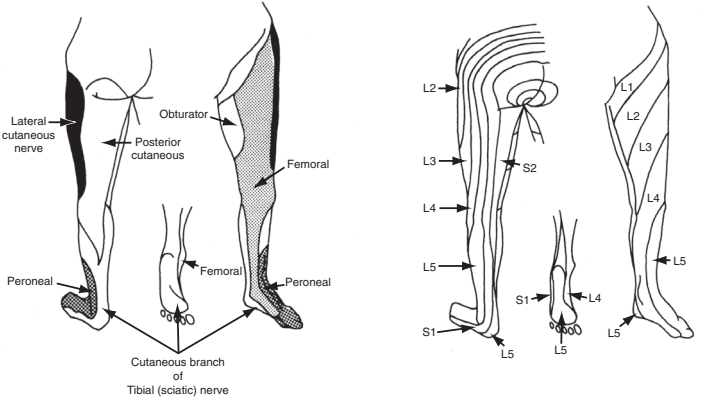

FIGURE 11-2 Sensory Innervation of the Lower Extremity. (A) Peripheral Nerve Innervation (B) Dermatomal (Root) Innervation
Source: Reprinted from *Practical Strategies in Outpatient Medicine, 2nd Edition*, B.B. Reilly, p. 927, © 1991, with permission from Elsevier.

Outcome Tools

ODI—*Oswestry/Modified Oswestry Disability Index*
FABQPA—*Fear-Avoidance Back Questionnaire Physical Activity*
FABQW—*Fear-Avoidance Back Questionnaire Work*
GROC—*Global Rating of Change*
PSFS—*Patient-Specific Functional Scale*

Red Flags for the Low Back Region

Condition	Red Flag Data Obtained During Interview/History	Red Flag Data Obtained During Physical Exam
Back-related tumor[1,2]	Age over 50 years *(axial skeleton pain)* Age < 20–25 years *(pain in long bones of extremities)* History of cancer Unexplained weight loss *(5–10% over 4 weeks to 6 months)* Failure of conservative therapy	Ambiguous presentation in early stages. Constant pain not affected by position or activity; worse with weight bearing, worse at night. Neurological signs in lower extremities
Back-related infection (Spinal osteomyelitis)[3]	Recent infection (e.g., urinary tract or skin infection) Intravenous drug user/abuser Concurrent immunosuppressive disorder	Deep, constant pain, increases with weight bearing; may radiate Fever, malaise, and swelling Spine rigidity; accessory mobility may be limited
Cauda equina syndrome	Urine retention or incontinence Fecal incontinence Saddle anesthesia Global or progressive weakness in the lower extermities	Sensory deficits in the feet (L4, L5, S1 areas) Ankle dorsiflexion, toe extension, and ankle plantar flexion weakness
Spinal fracture[1,5]	History of trauma (including minor falls or heavy lifts for osteoporotic or elderly individuals) Prolonged use of steroids Age over 70 Loss of function or mobility	Point tenderness over site of fracture Exquisitely tender with palpation over fracture site Increased pain with weight bearing Edema in local area
Abdominal aneurysm[6,7]	Back, abdominal, or groin pain Presence of peripheral vascular disease or coronary artery disease and associated risk factors (> 50, smoker, HTN, DM) Symptoms **not** related to movement Stresses associated with somatic LBP	Abnormal width of aortic or iliac arterial pulses Presence of a bruit in the central epigastric area upon auscultation (specific) Absence of palpable pulse (sensitive)
Kidney disorders[8] Pyelonephritis Nephrolithiasis Renal cell carcinoma	Unilateral flank or low back pain Difficulty with initiating urination, painful urination, or blood in the urine Recent or coexisting urinary tract infection Past episodes of kidney stone	Positive fist percussion test over the kidney

Adapted from Boissonnault WG. Chapter by Joe Godges. Primary Care for the Physical Therapist: Examination and Triage. Saunders; 2004 (with permission Godges, J).

1. Bigos S, et al. *Acute Low Back Problems in Adults. Clinical Practice Guideline No. 14. AHCPR Publication No. 95-0642.* Rockville, MD: Agency for Health Care Policy and Research, Public Health Service, U.S. Department of Health and Human Services; December 1994.
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4. Hakelius A, Hindmarsh J. The comparative reliability of preoperative diagnostic methods in lumbar disc surgery. *Acta Orthop Scand.* 1972;43:234–238.
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Red Flags for the Pelvis, Hip, and Thigh Regions

Condition	Red Flag Data Obtained During Interview/History	Red Flag Data Obtained During Physical Exam
Colon cancer[1]	Age > 50 years old Bowel disturbances (e.g., rectal bleeding, black stools) Unexplained weight loss *(5–10% over 4 weeks to 6 months)* History of colon cancer in immediate family Pain unchanged by positions or movement	Later stages: may have hypo- or hyperactive bowel sounds from obstruction Possible tenderness to palpation of abdomen in area of cancer May have ascites First sign may be of metastases to liver, lung, bone, or brain
Pathological fractures of the femoral neck[2,3]	Older females (> 70 years) with hip, groin, thigh, or knee pain History of a fall from a standing position	Severe, constant pain; worse with movement A shortened and externally rotated lower extremity
Osteonecrosis of the femoral head[4] (aka avascular necrosis)	History of long-term corticosteroid use (e.g., in patients with RA, SLE, asthma) History of AVN of the contralateral hip Trauma	Gradual onset of pain; may refer to groin, thigh, or medial knee; worse with weight bearing Stiff hip joint; restrictions primarily in IR, flexion, adduction
Legg-Calve-Perthes Disease[5]	5–8 year old boys with groin/thigh pain	Antalgic gait Pain complaints aggravated with hip movement, especially hip abduction and internal rotation
Slipped capital femoral epiphysis[6]	Overweight adolescent History of a recent growth spurt or trauma	Groin aching exacerbated with weight bearing Involved leg held in external rotation ROM limitations of hip internal rotation

Septic hip arthritis[7]	Child or older adult with vague hip aching who had a recent bacterial infection	Unwillingness to weight bear on or move the involved hip
Inguinal hernia[8]	Pain in groin and/or scrotum in males Consider "sports hernia" (internal disruption of the inguinal canal) in an athlete with unresolving groin pain	Symptoms exacerbated by coughing, sneezing, or resisted sit-up Tenderness in area of inguinal canal
Appendicitis[9]	RLQ pain, then nausea and vomiting Retrocecal appendix may refer pain to right thigh or testicle	Abdominal rigidity, rebound tenderness Positive McBurney's Point Positive psoas and obturator sign
Ovarian cyst[10]	Female of childbearing age Sudden, severe abdominal or pelvic pain Menstrual irregularities and pain	

1. Suadicani P, et al. Height, weight, and risk of colorectal cancer. An 18-year follow-up in a cohort of 5249 men. *Scand J Gastroenterol.* 1993;28:285–288.
2. Tronzo RG. Femoral neck fractures. In Steinburg ME, ed. *The Hip and Its Disorders.* Philadelphia: Saunders. 1991; 247–279.
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4. Stulberg BN, et al. A diagnostic algorithm for osteonecrosis of the femoral head. *Clin Ortho.* 1989;249:176–182.
5. Wenger DR, et al. Current concepts review: Legg-Calve-Perthes disease. *J Bone Joint Surg Am.* 1991;73:778–788.
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8. Kesek P, Ekberg O. Herniographic findings in athletes with unclear groin pain. *Acta Radiol.* 2002;43:603–608.
9. Graff L, Russell J, Seashore J, et al. False-negative and false-positive errors in abdominal pain evaluation: Failure to diagnose acute appendicitis and unnecessary surgery. *Acad Emerg Med.* 2000;7:1244–1255.
10. Kumar S. Right-sided low inguinal pain in young women. *R Coll Surg Edinb.* 1996;41:93–94.
Courtesy of Joe Godges OPT.

General Prevalence for Low Back Pain

Mechanical low back or leg pain	97%
Lumbar sprain/strain	70%
DDD and/or DJD (facet or z-joint)	10%
HNP (bulge, protrusion, extrusion, sequestration)	4%
Osteoporotic compression fracture	4%
Spinal stenosis	3%
Spondylolisthesis (includes pars defect)	2%
Spondylolysis, discogenic, instability	2%
Traumatic fracture	< 1%
Congenital (severe kyphosis and scoliosis, transitional vert.)	< 1%

✪ This information is helpful in two ways:

1. It helps a patient to know that the research shows that almost everyone at some point in their lives will have some form of back pain. Thus they are not the only one suffering. (reducing pain catastrophizing and fear avoidance behaviors)
2. It is valuable to know that the vast majority of instances of back pain is of the sprain/strain variety.

Deyo RA, Weinstein JN. Low back pain. *New Eng J Med.* 2001;344(5):363–70.

Education Modifications for Patients Presenting With Yellow Flags.

Category	Principle
"Abnormal" imaging findings "Disc bulge or degenerative disc disease"	Very rarely a sign of serious disease Commonly found in people without low back pain
Implications of low back pain	No suggestion of permanent damage The spine is strong, even when it is painful Pain does not mean your back has serious damage
Treatment of low back pain	A number of treatments can help control the pain Lasting relief depends on your effort Concentrate on maintaining and improving activity to restore normal function and fitness Utilize positive attitude and adaptive coping skills

Movement Science

Movement Impairments of the Lumbar Spine: *DSM (Directional Susceptibility to Movement)*

Lumbar Extension Syndrome
Lumbar Flexion Syndrome
Lumbar Rotation Syndrome
Lumbar Rotation with Flexion Syndrome
Lumbar Rotation with Extension Syndrome

Key Tests for Lumbar Movement Impairments	
Standing	Forward bending: corrected forward bending Return from forward bending: corrected return from forward bending Sidebending: corrected sidebending Rotation Back bending
Sitting	Sitting alignment: (corrected vs. flexed or extended) Knee extension
Supine	Resting position of hips and knees extended vs. hips and knees flexed Bilateral hip and knee flexion (passive) Hip abduction/lateral rotation from flexion Lower abdominal performance
Prone	Position (pillow vs. no pillow) Knee flexion Hip rotation Hip extension with knee extended
Quadruped	Rocking backward Rocking forward Shoulder flexion
Standing with back to wall	Flatten back

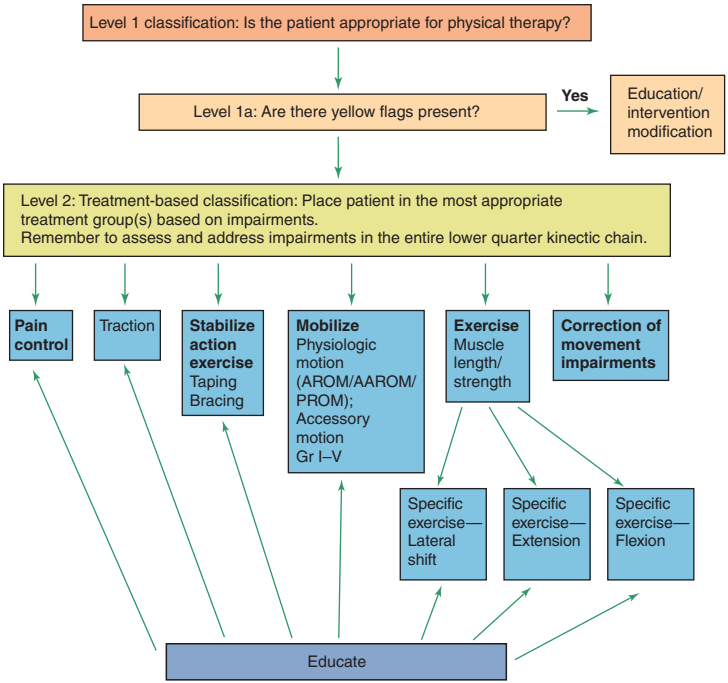

FIGURE 11-3 Treatment-Based Classification for Lumbar and Sacroiliac Region

Lumbar Spine Treatment-Based Classification References

Fritz JM, George S. The use of a classification approach to identify subgroups of patients with acute low back pain: Interrater reliability and short-term treatment outcomes. *Spine*. 2000;25:106–114.

Fritz JM, George SZ. Identifying psychosocial variables in patients with acute work-related low back pain: The importance of fear-avoidance beliefs. *Phys Ther*. 2002;82:973–983.

Childs JD, et al. A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: A validation study. *Ann Intern Med*. 2004;141:920–928.

Hicks GE, Fritz JM, Delitto A, McGill SM. Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. *Arch Phys Med Rehabil*. 2005;86:1753–1762.
Fritz JM, Brennan GP, Clifford SN, Hunter SJ, Thackeray A. An examination of the reliability of a classification algorithm for subgrouping patients with low back pain. *Spine*. 2006;31:77–82.
Fritz JM, Cleland JA, Childs JD. Subgrouping patients with low back pain: Evolution of a classification approach to physical therapy. *J Orthop Sports Phys Ther*. 2007;37:290–302.
George SZ, et al.The Effect of a fear-avoidance-based physical therapy intervention for patients with acute low back pain: Results of a randomized clinical trial. *Spine*. 2003;28(23):2551–2560.

Lumbar Facet Syndrome

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
Associated with post-traumatic facet synovitis[1] Facet joint as source of chronic LBP 31%[2] ≥ 50 years old[3,6]	Nonspecific LBP with a deep and achy quality usually localized to unilateral[5] or bilateral vertebral area[3] Pain exacerbated w/ L/S hyperextension, twisting, stretching, lateral bending, and torsional load[3] Pain worse in the morning, aggravated with rest, and relieved with repeated motions[4]	**Rotation extension Rotation** Pain with extension rotation (quadrant)[6] Back pain worsened with extension from a flexed position[2] Absence of pain with sit to stand[4] Pain radiates across back and often into proximal thigh, groin, and upper lumbar region[1] Prior history of LBP[3] Absence of symptoms with Valsalva maneuver[3] Patient may present with normal gait, absence of leg pain, and absence of muscle spasm[3] However, may have hyperreactive muscle spasms	**Mobilization** **Correction of movement impairment** **Pain control** **Exercise** Flexion biased **Education** Quadrant Palpation for asymmetries in flexion/extension Prone PA palpation

Dworkin G. Advanced concepts in interventional spine care. *JAOA*. 2002;102(9):58–61.
Manchikanti, et al. Prevalence of facet joint pain in chronic spinal pain of cervical, thoracic, and lumbar regions. *BMC Musculoskeletal Disorders*. 2004;5(15):1–7.
Jackson RP, Jacobs RR, Montesano PX. Facet joint injection in low back pain. A prospective statistical study. *Spine*. 1988;13(9):966–71.
Young S, Aprill C, Laslett M. Correlation of clinical examination characteristics with three sources of chronic low back pain. *The Spine Journal*. 2003;3:460–465.
Wilde VE, Ford JJ, McMeeken JM. Indicators of lumbar zygapophyseal joint pain: Survey of an expert panel with the Delphi technique. *Phys Ther*. 2007;87(10):1348–1361.
Laslett M, McDonald B, Aprill C, Tropp H, Öberg B. Clinical predictors of screening lumbar zygapophyseal joint blocks: Development of clinical prediction rules. *The Spine Journal*. 2006;6(4):370–379.

Lumbar Zygapophyseal Joint Pain Referral

Fukui S, et al. Distribution of referred pain from the lumbar zygapohpyseal joints and dorsal rami. *Clin J Pain.* 1997;13:303–307.

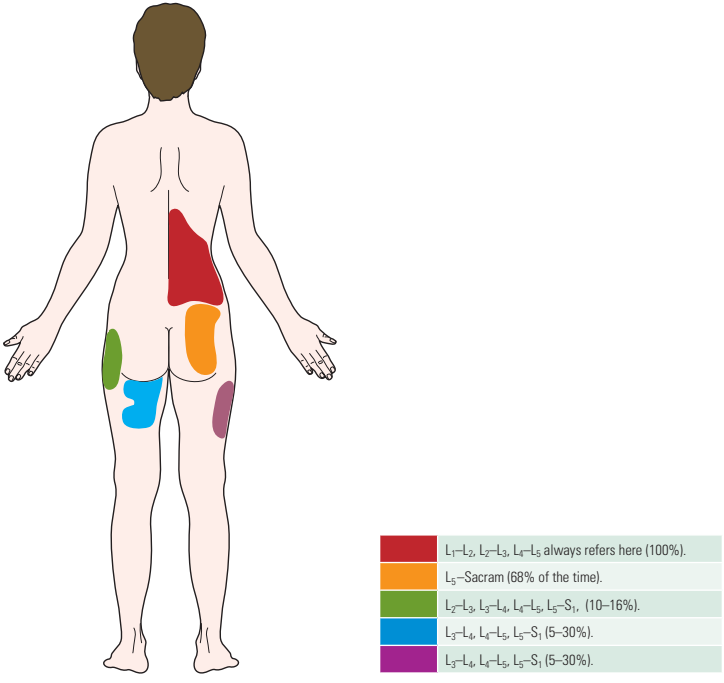

FIGURE 11-4 Fukui Lumbar Facet

◎ ⃠ Clinical Prediction Rule: for Screening out/Ruling in Zygoapophyseal Joint Syndrome

- Age ≥ 50y
- Symptoms best walking
- Symptoms best sitting
- Onset pain is paraspinal
- (+) lumbar extension/rotation test (quadrant).

	Sensitivity	Specificity	+LR	–LR
◎ ≥ 3	85	**91**	**9.7**	0.17
⃠ ≥ 2	**100**	50	2.0	**0.0**

✪ If there are ≥ 3 variables present. patient is about 10 times more likely to have a facet syndrome.

✪ If there are < 2 variables present, the high sensitivity most likely rules out the presence of the facet syndrome.

Laslett M, McDonald B, Aprill C, Tropp H, Öberg B. Clinical predictors of screening lumbar zygapophyseal joint blocks: Development of clinical prediction rules. *Spine.* 2006;6(4):370–379.

FIGURE 11-5 Neutral Gap 1

FIGURE 11-6 Neutral Gap 2

FIGURE 11-7 Neutral Gap 3

Lumbar Local Rotation GPM V

Lumbar Prone PA Palpation

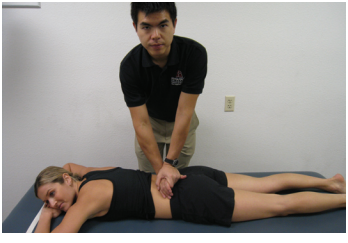

FIGURE 11-8 Lumbar Central PA 1

FIGURE 11-9 Lumbar Central PA 2

FIGURE 11-10 Lumbar Unilateral PA

FIGURE 11-11 Lumbar Unilateral PA 2

Lumbar Hypermobility/Lumbar Motor Control Impairment

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
More common in females Males have more lumbar flexion[5] Females have more lumbar extension[5]	Low back pain with or without referred pain[3] "Recurrent," "constant," "locking," "giving way," and/or accompanied by a feeling of "instability"[7] Catching with return from flexed posture[6] "Worsening condition" patient self-report[6] Frequent need to self-manipulate[6]	**Lumbar rotation-extension** **Rotation** **Rotation-flexion** Palpation of malalignment[3] Excessive passive intervertebral motion[1,2,3] Retrolisthesis—Instability catch[3] "Gower's sign"[3] Pain with sustained postures[6]	**Pain control** **Stabilization Exercise** Abdominal bracing[3] Strengthen transverse abdominis and multifidi[4] **Educate** **Correction of movement impairment** Posterior Shear Test[3] Prone Instability Test[3,4] Beighton Ligamentous Laxity Scale[3] Posteroanterior mobility **CPR for success with stabilization**[4] 1. (+) prone instability test 2. Aberrant movements present 3. SLR > 91 degrees 4. Age < 40

1. Abbott JH, McCane B, Herbison P, Moginie G, Chapple C, Hogarthy T. Lumbar segmental instability: A criterion-related validity study of manual therapy assessment. *BMC Musculoskel Disord.* 2005;6:56.
2. Fritz JM, Whitman JM, Childs JD. Lumbar spine segmental mobility assessment: An examination of validity for determining intervention strategies in patients with low back pain. *Arch Phys Med Rehabil.* 2005;86:1745–1752.
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4. Hicks GE, Fritz JM, Delitto A, McGill SM. Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. *Arch Phys Med Rehabil.* 2005;86:1753–1762.
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CPR for Success with Lumbar Stabilization/Neuromuscular Re-education (Unvalidated)

CPR for Success with Stabilization[4]

1. (+) prone instability test
2. Aberrant movements present
3. SLR > 91 degrees
4. Age < 40

Variables Present	Reliability	Sensitivity	Specificity	+LR	–LR
3 or more	NT	56	**86**	**4.0**	0.52

CPR for Failure with Lumbar Stabilization/Neuromuscular Re-education (Unvalidated)

1. (–) prone instability test
2. Aberrant movement absent
3. Lack of hypermobility with lumbar spring testing
4. FABQ physical activity subscale > 8

Variables Present	Reliability	Sensitivity	Specificity	+LR	–LR
2 or more	NT	**85**	87	6.3	**0.18**

Hicks GE, Fritz JM, Delitto A, McGill SM. Preliminary development of a clinical prediction rule for determining which patients with low back pain will respond to a stabilization exercise program. *Arch Phys Med Rehabil*. 2005; 86:1753–1762.

Ruling in Lumbar Instability

◎ Passive Physiological Intervertebral Movements (PPIVMs) Extension

1. Patient is placed in sidelying position. Patient's elbows are locked in extension, and his or her hands are placed on the ASIS of the assessing examiner.
2. Examiner applies a posterior to anterior (PA) force at the caudal level (i.e., at L5 when assessing L4–L5 mobility).
3. The cephalic segment is palpated just inferior at the interspinous space (i.e., during L4–L5 assessment, the interspinous space is palpated to assess movement). One may repeat on the other side, although most likely results are similar.
4. (+) test is identified by detection of excessive movement during examination.

	Reliability	Sensitivity	Specificity	+LR	–LR
Extension Rotational PPIVMs	NT	22	**97**	**7.3**	0.8
Extension Translational PPIVMs	NT	16	**98**	**8**	0.85

Abbott JH, McCane B, Herbison P, Moginie G, Chapple C, Hogarthy T. Lumbar segmental instability: A criterion-related validity study of manual therapy assessment. *BMC Musculoskeletal Disorders*. 2005;6:56.

FIGURE 11-12 Passive Physiological Intervertebral Movements (PPIVMs) Extension 1

FIGURE 11-13 Passive Physiological Intervertebral Movements (PPIVMs) Extension 2

◎ Passive Physiological Intervertebral Movements (PPIVMs) Flexion

1. Patient is placed in a sidelying position. The hips of the patient are flexed to 90°, and the patient's knees are placed against the ASIS of the examiner.
2. Examiner stabilizes the superior segments by pulling posterior to anterior on the patient's spine. Examiner applies an anterior to posterior force at the caudal level (i.e., at L5 when assessing L4–L5 mobility) by applying a force through the flexed femurs.
3. The cephalic segment is palpated just inferior at the interspinous space (i.e., during L4–L5 assessment, the interspinous space is palpated to assess movement).
4. One may repeat on the other side, although most likely results are similar.
5. (+) test is identified by detection of excessive movement during examination.

FIGURE 11-14 Passive Physiological Intervertebral Movements (PPIVMs) Flexion 1

FIGURE 11-15 Passive Physiological Intervertebral Movements (PPIVMs) Flexion 2

FIGURE 11-16 Passive Physiological Intervertebral Movements (PPIVMs) Flexion 3

	Reliability	Sensitivity	Specificity	+LR	–LR
◎ Flexion Rotational PPIVMs	NT	05	**99**	**5**	0.96
◎ Flexion Translational PPIVMs	NT	05	**99**	**10**	0.95

Abbott JH, McCane B, Herbison P, Moginie G, Chapple C, Hogarthy T. Lumbar segmental instability: A criterion-related validity study of manual therapy assessment. *BMC Musculoskeletal Disorders*. 2005;6:56.

✪ Flexion and extension PPIVMs are predictive of measurable excessive movement on flexion-extension radiographs in patients with recurrent chronic low back pain compared to an asymptomatic control group.

Motion beyond two standard deviations from the reference mean was considered diagnostic of rotational lumbar segmental instability (LSI) and translational LSI.

Beighton Ligamentous Laxity Test

1 point per side (9 total)

1. Hyperextension of elbow > 10°
2. Passive hyperextension of 5th finger > 90°
3. Passive abduction of thumb to forearm
4. Passive hyperextension of knees > 10°
5. Flex trunk with hands flat on floor

FIGURE 11-17 Beighton Elbow Hyperextension

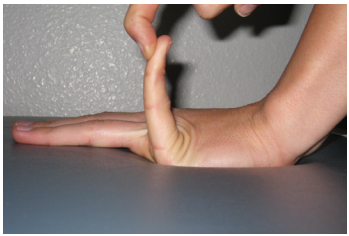

FIGURE 11-18 Beighton Fifth Finger Extension

FIGURE 11-19 Beighton Knee Hyperextension

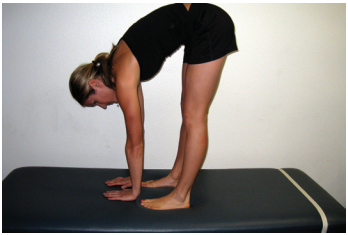

FIGURE 11-20 Beighton Lumbar Flexion

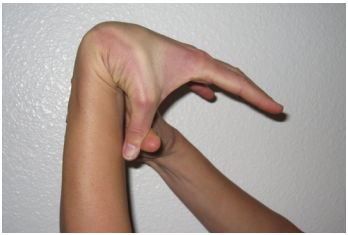

FIGURE 11-21 Beighton Thumb Abduction

Reliability	ICC = 0.79 (Good reliability)

Hicks GE, Fritz JM, Delitto A, Mishock J. Interrater reliability of clinical examination measures for identification of lumbar segmental instability. *Arch Phys Med Rehabil.* 2003;84:1858–1864.

✪ Use of the Beighton Ligamentous Laxity Test gives me a clue about the inherent flexibility of the patient, and though not validated, helps me reason about the potential for injury or the source of injury in my patients.

Prone Instability Test

1. Patient is prone with the torso on the examining table, the legs over the edge of the plinth, and the feet resting on the floor.
2. Examiner performs a PA spring on the low back to elicit back pain using the pisiform grip.
3. Patient is requested to lift his or her legs off the floor by using a back contraction.
4. Examiner maintains the PA force to the low back.
5. (+) test is reduction of painful symptoms (as applied during the PA) during raising of the patient's legs.

FIGURE 11-22 Prone Instability Test 1

FIGURE 11-23 Prone Instability Test 2

Reliability	Sensitivity	Specificity	+LR	–LR
0.69	**61**	57	1.41	**0.69**

✪ This test is of limited value when used on its own outside a cluster of findings.

Fritz JM, et al. Accuracy of the clinical examination to predict radiographic instability of the lumbar spine. *Eur Spine J.* 2005;14(8)743–750.

Abdominal Bracing

1. Position in supine or quadruped.
2. Instruct patient: "Draw navel up toward the head and in toward the spine so that the stomach flattens but spine remains neutral."
3. Palpate for contraction medial to ASIS.
4. Integrate into functional activity.

Abdominal Hollowing

1. **Position:** Supine/neutral spine.
2. Biofeedback unit under small of back.
3. Pump up to 40 mm Hg.
4. Instruct patient: "Draw in belly button towards spine."
5. Spine or pelvis remains stable.
6. Palpate for contraction just medial to ASIS.
7. Rectus abdominis should not flex spine.
8. Proceed with lumbar stabilization sequence.
9. Patient should be able to maintain 40 mm Hg for 10 seconds at a time.
10. *No Valsalva.

✪ Without biofeedback equipment available to most clinicians, Grenier and McGill demonstrate that abdominal bracing is very effective for improving relative "stiffness" of the spine. This will make educating and successful reproduction for patients much easier.[8]

Neuromuscular Re-education[3,4,5,6]

Muscle	Exercises
Transversus abdominis[7]	Abdominal hollowing[7] Abdominal bracing[8] Horizontal side support[9]
Erector spinae and multifidus (in order of lowest to highest EMG amplitude) **Intensity:** 15–18 repetition max[1] **Duration:** 5 sec. isometric hold at end range[1] **Frequency:** 3x/week[1]	**Low-Moderate Intensity** 35%±13% to 44%±12% MVIC[2] Bridging to a neutral spine position with feet on gym ball Supine bridging with spine and hips in neutral **Low-Moderate Intensity** (co-contractions) 32%±11% MVIC to 58%±16% MVIC[2] Horizontal side support **Moderate Intensity** 29%± 11% to 45%±16% MVIC[2] Quadruped upper and lower extremity lifts Prone upper and lower extremity lifts **High Intensity** 92%±14% MVIC[2] Prone extensions to end range with resistance Slow active sitting trunk extension against elastic tubing resistance with the pelvis stabilized

FIGURE 11-24 Horizontal Side Support for Transverse Abdomens

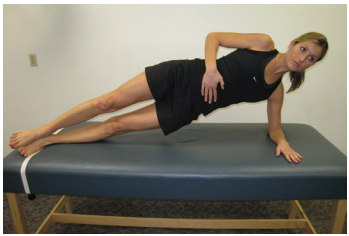

FIGURE 11-25 Horizontal Side Support for Transverse Abdomens

Muscle	Exercises
Oblique abdominals Rectus abdominis	Side bridging[9] Curl ups[9]  
Quadratus lumborum	Side bridging[9] 54% MVIC

1. Danneels LA, et al. Effects of three different training modalities on the cross sectional area of the lumbar multifidus muscle in patients with chronic low back pain. *Br J Sports Med.* 2001;35:186–191.
2. Ekstrom RA, et al. Surface electromyographic analysis of the low back muscles during rehabilitation exercises. *J Orthop Sports Phys Ther.* 2008;38(12):736–745.
3. Hides JA, Richardson CA, Jull GA. Multifidus muscle recovery is not automatic after resolution of acute, first-episode low back pain. *Spine.* 1996;21:2763–2769.
4. Hides JA, Stanton WR, McMahon S, Sims K, Richardson CA. Effect of stabilization training on multifidus muscle cross-sectional area among young elite cricketers with low back pain. *J Orthop Sports Phys Ther.* 2008;38:101–108.
5. Hides JA, Stokes MJ, Saide M, Jull GA, Cooper DH. Evidence of lumbar multifidus muscle wasting ipsilateral to symptoms in patients with acute/subacute low back pain. *Spine.* 1994;19:165–172.
6. Hides JA, Jull GA, Richardson CA. Long-term effects of specific stabilizing exercises for first-episode low back pain. *Spine.* 2001;26:E243–E248.
7. Hides JA, Jull GA, Richardson CA. Long-term effects of specific stabilizing exercises for first episode low back pain. Spine 2001; 26: E243–8
8. Grenier SG, McGill SM. Quantification of lumbar stability by using two different abdominal activation strategies. *Arch Phys Med Rehabil.* Jan 2007; 88:54–62.
9. McGill SM. Low back exercises: Evidence for improving exercise regimens. *Phys Ther.* 1998;78:754–765.

Lumbar Strain

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
7–13% of all sports injuries in intercollegiate athletes are low back injuries Muscle strains (60%)[5] Athletes are more likely to sustain injuries in practice (80%) than during competition (6%)[5] American football (17%) and gymnastics (11%) highest incidence[5]	Broad area of pain[1,2,3] Pain increases with activity or while sleeping[4] **History of trauma to area**[3,4] Movement is restricted[1,3,4]	**Lumbar rotation-flexion** **Lumbar flexion** Bent over (flexed position)[4] Unable to straighten up (move into extension)[4] Unable to maintain a normal posture[4] Trunk and hip muscle weakness[2] **Lifting with flexion, lateral flexion, and rotation**[4] —machine that vibrates[4] —prolonged sitting[4] —motor vehicle collision[4] —falls[4]	**Pain control** **Mobilization** **Education** **Correction of movement impairment** **Stabilization** **Exercise** Muscle length/strength Mobility tests[3,4] Schober Test[4] Palpations[4] L/S ROM and MMT[2,3,4]

1. Leinonen V, et al. Back and hip extensor activities during trunk flexion/extension: effects of low back pain and rehabilitation. *Arch Phys Med Rehabil.* 2000;81(1):32–39.
2. Nourbakhsh MR. Relationship between mechanical factors and incidence of low back pain. *J Orthop Sports Phys Ther.* 2002;32(9):447–457.
3. O'Sullivan PB, et al. The relationship between posture and back muscle endurance in industrial workers with flexion-related low back pain. *Man Ther.* June 2006;11(4):264–271.
4. Saunders HD. *Evaluation, Treatment, and Prevention of Musculoskeletal Disorders.* Chaska, MN: Saunders. 2004;101–117.
5. Keene JS, Albert MJ, Springer SL, Drummond DS, Clancy WG Jr. Back injuries in college athletes. *J Spinal Disord.* 1989;2(3):190–195.

Discogenic Low Back Pain

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
No noted gender difference[3,4] 20–50 years of age 98% of herniated discs occur at L4–L5 and L5–S1[3] Pain usually starts centrally and may progress down the leg, usually below the knee[5]	Cumulative—History of ↑ flexion position[3,4] Initial low back pain (centralized)[1,3] Progressive peripheralization (peripheral neurologic symptoms indicate impingement or irritation of nerve root)[3] Hypomobility (extension most common)[3] Pain in rising from sitting[3] **Pain in sitting**[3,4]	**Lumbar rotation-extension** **Lumbar extension** **Lumbar rotation-flexion** **Lumbar flexion** Sitting: slumped posture[3,4] Use of hands to take weight off low back Standing: lateral shift (50% of patients)/lumbar scoliosis[3] Decreased lumbar lordosis/ posterior pelvic tilt[2,3] Decreased lumbar extension ROM[3,4]	**Pain control** **Specific exercise: Lateral shift** **Specific exercise: Extension** **Traction**[8] **Educate** Maintain lordosis at all times **Correction of movement impairment** SLR (Sn) Crossed SLR (Sp) Observe for centralization Lack of centralization useful for ruling out discogenic involvement[7] and prediciting poor prognosis[6]

1. Lyle MA, Manes S, McGuinness Michael, Iverson, MD. Relationship of physical examination findings and self-reported symptom severity and physical function in patients with degenerative lumbar conditions. *Phys Ther.* 2005;85:120–133.
2. Magee D. *J Orthopedic Physical Assessment.* 4th ed. Philadelphia: Saunders for Elsevier; 2002.
3. Saunders HD. *Evaluation, Treatment, and Prevention of Musculoskeletal Disorders: Spine.* Chaska, MN: Saunders. 2004; 101–117.
4. Young S, Aprill C, Laslett M. Correlation of clinical examination characteristics with three sources of chronic low back pain. *Spine J.* 2003;3(6):460–465.
5. Ohnmeiss DD, Vanharanta H, Ekholm J. Relation between pain location and disc pathology: A study of pain drawings and CT/ discography. *Clin J Pain.* 1999;15(3):210–217.
6. Wernecke M. Centralization phenomenon as a prognostic factor for chronic low back pain and disability. *Spine.* 2001;26(7):758–764.
7. Bogduk N. Commentary on a prospective study of centralization and lumbar and referred pain: A predictor of symptomatic discs and anular competence. *Pain Med J Club J.* 1997;3:246–248.
8. Fritz JM, et al. Is there a subgroup of patients with low back pain likely to benefit from mechanical traction? Results of a randomized clinical trial and subgrouping analysis. *Spine.* 2007;32(26):E793–E800.

✪ Absence of centralization or peripheralization (Sn = 92–95) and absence of sciatica (Sn = 95) greatly reduce the likelihood of discogenic pain.

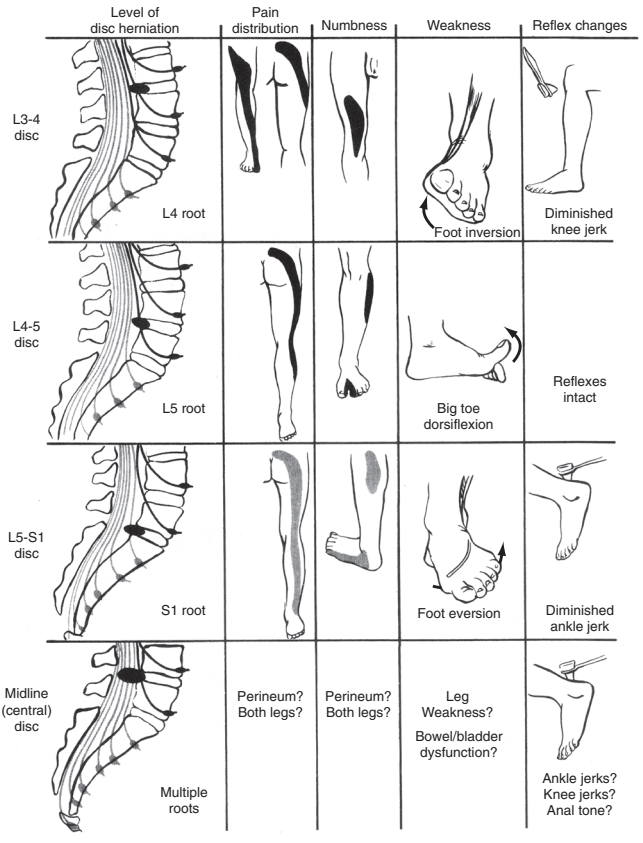

FIGURE 11-26 Common Disc Syndromes: Neurologic Findings
Source: Reprinted from *Practical Strategies in Outpatient Medicine, 2nd Edition*, B.B. Reilly, p. 915, © 1991, with permission from Elsevier.

Sciatica

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
5 per 1000 persons per year in Netherlands 22% among male machine operators[1] 24% among male carpenters[1] 14% among male office workers[1]	Radiating pain in the leg below the knee in one or more lumbar or sacral dermatomes[3–6] Psychological distress in women[2] Hysteria significantly associated with sciatic pain among blue-collar workers[1]	Nerve root tension[3–6] Neurologic deficits[3–6]	**Pain control** **Exercise** **Correction of movement impairment** **Refer out** **Educate** Neuroscreen **SLR** **Crossed SLR**

1. Pietri-Taleb F, et al. The role of psychological distress and personality in the incidence of sciatic pain among working men. *Am J Public Health*. 1995;85(4):541–545.
2. Heliövaara M, Knekt P, Aromaa A. Incidence and risk factors of herniated lumbar intervertebral disc or sciatica leading to hospitalization. *J Chronic Dis*. 1987;40(3):251–258.
3. Stam J. Consensus in diagnosing and treatment of the lumbosacral radicular syndrome [in Dutch]. *Ned Tijdschr Geneeskd*. 1996;140(262):1–7.
4. Ostelo RWJG, et al. Rehabilitation following first-time lumbar disc surgery: A systematic review within the framework of the Cochrane collaboration. *Spine*. 2003;28:209–218.
5. Weber H, Holme I, Amlie E. The natural course of acute sciatica with nerve root symptoms in a double-blind placebo-controlled trial evaluating the effect of piroxicam. *Spine*. 1993;18:1433–1438.
6. Mens JMA, Chavannes AW, Koes BW, et al. NHG-guideline lumbosacral radicular syndrome [in Dutch]. *Huisarts–Wetenschap*. 2005;48:171–178.

Screening out Disc Herniation

⦸ Straight Leg Raise (SLR)

1. Patient should lie on a firm but comfortable surface, the neck and head in neutral position.
2. Examiner supports the patient's leg at the heel, maintaining knee extension and neutral dorsiflexion at the ankle. Clinician raises the leg to the point of symptom reproduction.
3. Patient's trunk and hips should remain neutral, avoiding internal or external rotation of the leg or adduction or abduction of the hip.
4. (+) test is concordant reproduction of symptoms, sensitization, and asymmetry findings.

Reliability	Sensitivity	Specificity	+LR	–LR
NT	**97**	57	2.23	**0.05**

Vroomen PC, et al. Diagnostic value of history and physical examination in patients suspected of lumbosacral nerve root compression. *J Neurol Neurosurg Psychiatry.* 2002;72(5):630–634.

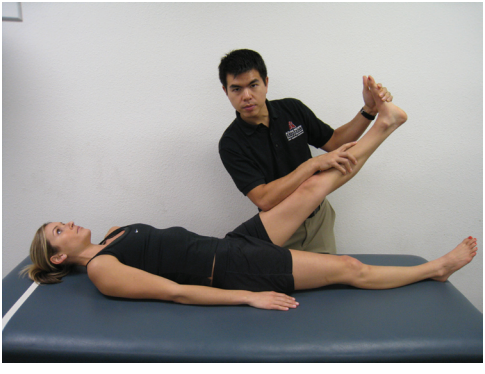

FIGURE 11-27 Straight Leg Raise

Screening out Far Lateral Disc Herniation

⦸ Femoral Nerve Tension Test

1. Patient lies prone in a symmetric, pain-free posture.
2. Examiner places one hand on the PSIS, on the same side of the knee that the examiner will bend into flexion.
3. Examiner then gently moves the lower extremity into knee flexion, bending the knee until the onset of symptoms.
4. Once the symptoms are engaged, examiner slightly backs the leg out of the painful position.
5. At this point, examiner may use plantarflexion, dorsiflexion, or head movements to sensitize the findings.
6. Further sensitization can be elicited by implementing hip extension. Examiner can repeat on the opposite side if desired.
7. (+) test is reproduction of pain in the affected extremity.

Reliability	Sensitivity	Specificity	+LR	–LR
NT	**97**	NT	NA	NA

Porchet F, et al. Extreme lateral lumbar disc herniation: Clinical presentation in 178 patients. *Acta Neurochir (Wien).* 1994;127(3–4):203–209.

FIGURE 11-28 Femoral Nerve Tension Test

Ruling in Disc Herniation

◎ Well Leg Raise (Crossed Straight-Leg Raise)

1. Patient should lie on a firm but comfortable suface, the neck and head in the neutral position.
2. Patient's trunk and hips should remain neutral and avoid internal or external rotation and excessive adduction or abduction.
3. Examiner supports the patient's non-involved leg at the heel, maintaining knee extension and neutral dorsiflexion at the ankle.
4. Examiner raises to the point of symptom reproduction of the opposite, comparable leg.
5. (+) test is identified by reproduction of the patient's concordant pain during the raising of the opposite extremity.

Reliability	Sensitivity	Specificity	+LR	–LR
NT	43	**97**	**14.3**	0.59

Kerr RSC, et al. The value of accurate clinical assessment in the surgical management of the lumbar disc protrusion. *J Neurol Neurosurg Psychiatr.* 1988;51:169–173.

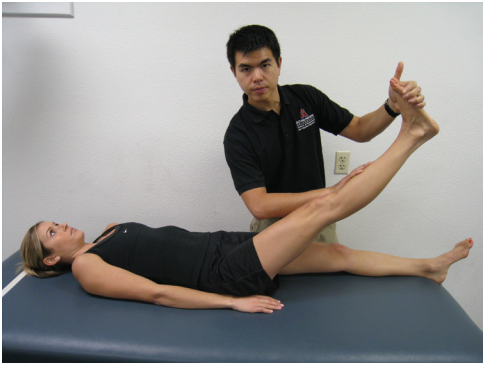

FIGURE 11-29 Well Leg Raise

Straight Leg Raise

1. ✪**Unilateral passive straight-leg raising** may produce leg pain, back pain, or a combination of both but, especially in persons under 30 years of age, has no specific value in the diagnosis of disc protrusion.
2. Negative straight-leg raising, especially in persons under 30 years of age, usually excludes the diagnosis of disc protrusion.
3. The degree of limitation of straight-leg raising is inversely proportional to positive disc protrusion.
4. After age 30, unilateral straight-leg raising is seen less often, but its diagnostic value increases.
5. After age 30, negative straight-leg raising no longer excludes disc protrusion.
6. The **crossed straight-leg-raising test** is a much more reliable clinical sign of disc protrusion.
7. In cases of proven disc protrusion:
   a. Centrally located protrusions produce mainly back pain during straight-leg raising, probably due to tension on sensitive dura;
   b. Intermediately located protrusions produce back and leg pain during straight-leg raising;
   c. Laterally located protrusions usually produce leg pain only during straight-leg raising, probably due to tension on sensitive nerve roots.
   d. Pain patterns observed during straight leg raising are not an accurate predictor of the level of disc protrusion;
   e. A positive crossed straight-leg-raising test usually indicates a more centrally located prolapse.

1. Urban LM. The straight-leg-raising test: A review. *J Orthop Sports Phys Ther.* 1981;2(3):117–133

⦸ Slump Sit Test

1. Patient sits straight with the arms behind the back, the legs together, and the posterior aspect of the knees against the edge of the treatment table.
2. Patient slumps as far as possible, producing full trunk flexion; examiner applies firm overpressure into flexion to the patient's back, being careful to keep the sacrum vertical.
3. While maintaining full spinal flexion with overpressure, examiner asks the patient to extend the knee, or passively extends the knee.
4. Examiner then moves the foot into dorsiflexion while maintaining knee extension.
5. Neck flexion is added to assess symptoms. Neck flexion is released to see if symptoms abate.
6. (+) test is concordant reproduction of symptoms, sensitization, and asymmetry findings.

Reliability	Sensitivity	Specificity	+LR	–LR
NT	**83**	55	1.82	**0.32**

Stankovic R, et al. Use of lumbar extension, slump test, physical and neurological examination in the evaluation of patients with suspected herniated nucleus pulposus: A prospective clinical study. *Man Ther.* 1999;4(1)25–32.

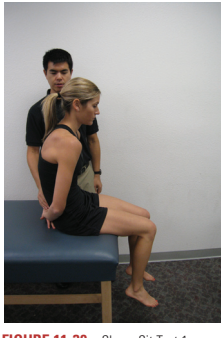

FIGURE 11-30 Slump Sit Test 1

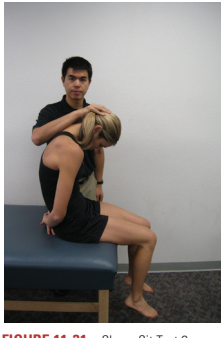

FIGURE 11-31 Slump Sit Test 2

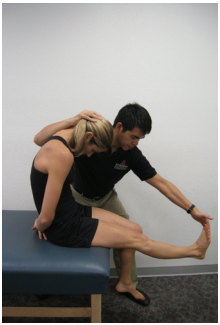

FIGURE 11-32 Slump Sit Test 3

FIGURE 11-33 Slump Sit Test 4

Centralization

1. Patient either stands or lies prone, depending on the intent of a loaded or unloaded assessment.
2. Multiple directions of repeated end-range lumbar testing are targeted. Movements may include extension, flexion, or side flexion (lateral shift).
3. Movements are repeated up to 5 to 20 attempts until a definite centralization or peripheralization occurs.
4. (+) finding is centralization of symptoms and is generally considered a low back dysfunction.

Reliability	Sensitivity	Specificity	+LR	–LR
NT	**9**	79	4.2	**1.2**

Young S, Aprill C, Laslett M. Correlation of clinical examination characteristics with three sources of chronic low back pain. *Spine.* 2003; 3(6)460–465.

✪ Browder, et al. found that people with LBP who centralized and were placed in an extension-biased exercise treatment classification had improved disability scores (ODI) at 1 week, 4 weeks, and at 6 months over a matched group that was instructed in trunk-strengthening exercises.

FIGURE 11-34 Prone on Pillows

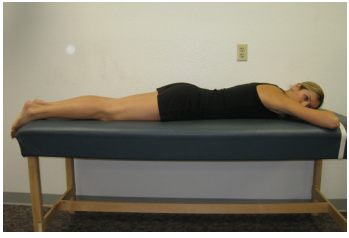

FIGURE 11-35 Prone Lying

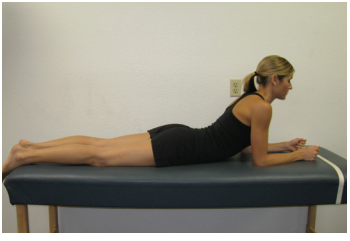

FIGURE 11-36 Prone on Elbows

FIGURE 11-37 Prone Press Ups

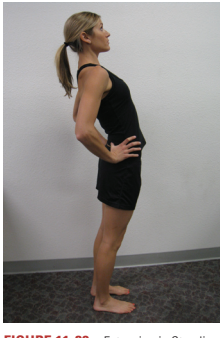

FIGURE 11-38 Extension in Standing

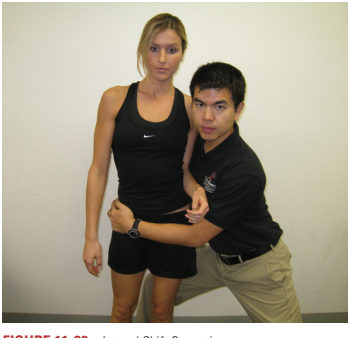

FIGURE 11-39 Lateral Shift Correction

✪ Werneke, et al. also found that individuals who do not centralize via the McKenzie testing protocol during the evaluation may be at higher risk for chronicity, delayed recovery, and possible greater health costs. Patients with leg pain at intake were 4 times more likely to have sick or down time at work.

Browder DA, Childs JD, Cleland JA, Fritz JM. Effectiveness of an extension-oriented treatment approach in a subgroup of subjects with low back pain: A randomized clinical trial. *Phys Ther.* 2007;87:1608–1618.
Werneke M, Hart DL. Centralization phenomenon as a prognostic factor for chronic low back pain and disability. *Spine.* 2001;26:758–765.

Traction

✪ A subgroup of patients with LBP who may benefit from traction exhibit:

1. peripheralization with extension
2. (+) crossed straight-leg raise

These patients may be too irritable to achieve centralization with repeated extension movements though they may fit the extension-biased exercise treatment category. They may benefit from the following protocol utilizing traction along with progressing them into extension-biased exercises.

1. Extension-biased exercise treatment with the addition of traction for the first 2 weeks.
2. Patient is positioned in a prone position.
3. Table is adjusted to maximize centralization, with adjustment of the table (after 3 minutes) to place patient in neutral to extended spine.
4. Static traction for a maximum of 12 minutes (10-minute treatment with 1 minute ramp up and ramp down).
5. Set at 40–60% of the patient's BW.
6. After traction, patient continues to lay prone for 2 minutes, then performs prone press ups before resuming weight bearing.
7. Maximum of 12 sessions.

Fritz JM. Is there a subgroup of patients with low back pain likely to benefit from mechanical traction? Results of a randomized clinical trial and subgrouping analysis. *Spine.* 2007;32(26):E793–E800.

Spondylolisthesis

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
Onset: childhood–adulthood **Increased risk:** adolescents with genetic predisposition, young athletes (hyperextension-type movements), anyone diagnosed with spondylolysis[2] **Type I:** dysplastic (congenital) **Type II:** isthmic (fx of pars) **Type III:** degenerative; secondary to OA (adults > 40 y/o) **Type IV:** traumatic **Type V:** pathologic[2]	LBP[1,5] Tenderness to palpation over level of involvement[4] Back spasms[4] Pain with activity[4]	**Lumbar rotation-extension** **Lumbar extension** **Lumbar rotation** Lumbosacral kyphosis at level of slip resulting in lumbar lordosis above that level[5] Tight hamstrings[1] Cauda equina syndrome (emergent)[1] Restricted ROM in L/S (special note in children)[1,5] Pain with extension[1] Pain with flexion[1] Step-off deformity	**Pain control** **Stabilization** **Exercise** Strengthening abdomen and back muscles (lumbar stabilization)[1,3] Hamstring stretches[3] Pelvic tilt exercises (biofeedback)[3] Aerobic exercises (walking and swimming)[3] Bracing[3,5] **Correction of movement impairment** **Educate** *Historically advised to avoid L/S extension* L/S ROM[1] L/S palpations[1,4] SLR[1] Neurological tests (myotomes, dermotomes, reflexes)[1] MMT trunk[1]

1. Brotzman SB, Wilk KE. *Clinical Orthopedic Rehabilitation*. 2nd ed. Philadelphia, PA: Mosby; 2003.
2. Mac-Thiong JM, Labelle H. A proposal for a surgical classification of pediatric lumbosacral spondylolisthesis based on current literature. *Eur Spine J*. 2006;5:1425–1435.
3. O'Sullivan PB, Phyty DM, Twomey LT, Allison, GT. Evaluation of specific stabilizing exercise in the treatment of chronic low back pain with radiologic diagnosis of spondylolysis or spondylolisthesis. *Spine*. 1997;22(24):2959–2967.
4. Oatis CA. *Kinesiology: The Mechanics & Pathomechanics of Human Movement*. Philadelphia, PA: Lippincott Williams & Wilkins; 2004.
5. Seitsalo S, Schlenzka D, Poussa M, Osterman K. Disc degeneration in young patients with isthmic spondylolisthesis treated operatively or conservatively: A long-term follow-up. *Eur Spine J*. 1997;6:393–397.

Lumbar Compression Fractures

History	Sensitivity	Specificity
Age > 50	0.84	0.61
Age > 70	0.22	**0.96** ◎
Trauma	0.30	**0.85** ◎
Corticosteroid	0.06	**0.995** ◎

Deyo RA, Jarvik JG. Diagnostic evaluation of low back pain with emphasis on imaging. *Ann Intern Med*. 2002;137:586–597.

Spinal Stenosis

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
Most common in people over 50 years old[2]	Lumbar back pain with progression of lower extremity pain (unilateral or bilateral)[3]	**Lumbar rotation-extension** **Lumbar extension**	**Specific exercise—Flexion** **Mobilization** **Stabilization**
Effects 1 in 1000 people to the extent that they need surgery[2]	Posture dependent, increased pain in lumbar ext.[2]	Wide-based gait[6] Thigh pain with 30 seconds of lumbar extension[6]	**Educate** **Correction of movement impairment**
	LE numbness or tingling[3]	Decreased muscle stretch reflexes[4]	**Exercise/stretching** Muscle stretching/ strengthening[1]
	LE muscle cramping No pain when seated[6]	Decrease LE strength, specifically ext. hallucis longus[3]	Aerobic training: stationary bike, harnessed treadmill walking, aquatic therapy[2,5]
		Decreased lumbar ext; decreased lumbar lordosis[2]	MMT/ROM, Reflex tests[2]
		Pain relieved with flexion[3]	LE myotome/dermatome testing[2,4]
		Decreased LE sensation (dermatomal pattern)[2]	Neural Tension Test (SLR)[4]
		Diminished pedal pulse[3]	Quadrant Test[4]
		Neurogenic/vascular claudication with ambulation[3]	Two-Stage Treadmill Test[2] Lasegue Test[4]

1. Brotzman SB, Wilk KE. *Clinical Orthopaedic Rehabilitation.* 2nd ed. Philadelphia, PA: Mosby; 2003.
2. Fritz J, Erhard R, Vignovic M. A non-surgical treatment approach for patients with lumbar stenosis. *Phys Ther.* 1997;77(9): 962–973.
3. Iverson MD, Katz JN. Examination findings and self-reported walking capacity in patients with lumbar spinal stenosis. *Phys Ther.* 2001;81(7):1296–1306.
4. Lyle MA, et al. Relationship of physical examination findings and self-reported symptom severity and physical function impairments in patients with degenerative lumbar conditions. *Phys Ther.* 2005;85(2):120–133.
5. Saunders HD, Saunders RR. *Evaluation, Treatment, and Prevention of Musculoskeletal Disorders.* vol. 1: Spine. 4th ed. Chaska, MN: The Saunders Group; 2004.
6. Katz JN, et al. Degenerative lumbar spinal stenosis: Diagnostic value of the history and physical examination. *Arthritis Rheum.* 1995;38(9):1236–1241.

Ruling out Stenosis

Findings	Sensitivity
Age > 65 years[1,2,3]	77%
Pain below buttocks[1,2]	88%
Leg symptoms worse with walking, better with sitting[1,2]	81%
Best posture for symptoms is sitting[1,2]	89%
Worst posture for symptoms is walking or standing[1,2]	89%
Severe lower extremity pain[3]	65%
Symptoms worsen when walking[3]	71%
Numbness[3]	63%

✪ The above findings, when absent, are useful for ruling out stenosis.

1. Katz JN, et al. Degenerative lumbar spinal stenosis: Diagnostic value of the history and physical examination. *Arthritis Rheum.* 1995;38(9):1236–1241.
2. Fritz JM, Erhard RE, Delitto A, Welch WC, Nowakowski PE. Preliminary results of the use of a two-stage treadmill test as a clinical diagnostic tool in the differential diagnosis of lumbar spinal stenosis. *J Spinal Disord.* 1997;10(5):410–416.
3. Deyo RA, Jarvik JG. Diagnostic evaluation of low back pain with emphasis on imaging. *Ann Intern Med.* 2002;137:586–597.

Spondylosis (DDD/DJD, Osteochondrosis, Spinal Arthritis)

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
Usually people over 40 y/o, but can start as early as 20[3], especially in those who work with or carry heavy loads often[5] Prevalence of (+) imaging finding 0–86% but not necessarily predictive of low back pain.[1]	Low back pain,[4] especially with carrying heavy loads or repetitive twisting[5] Lumbar stiffness[4] Possible sciatic pain[5] Feeling of "catching" or "clunking" in lumbar spine with forward flex/ext[4]	**Lumbar rotation-extension** **Lumbar extension** **Lumbar rotation** **Lumbar rotation-flexion** Segmental hypo or hypermobility[2] Reversed lumbopelvic rhythm[4] Radiating pain with SLR if disc herniation[2] Increased LBP with lifting/carrying heavy loads or extreme forward bending.[5]	**Pain control** **Correction of movement impairment** **Stabilization** **Mobilization** **Exercise** Muscle length/strength **Educate** Extension Quadrant Segmental Mobility Test[4] Lumbar/LE ROM/MMT Shear Stability Test[4] Active/Passive Mobility Test[4] SLR[2] Anterior Spring Test[4]

1. Battie ML, et al. Lumbar disc degeneration: Epidemiology and genetic influence. *Spine.* 2004;29(23):2679–2690.
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3. Rothschild BM. *Lumbar Spondylosis.* eMedicine; WebMD. www.emedicine.com.
4. Saunders HD, Saunders RR. *Evaluation, Treatment, and Prevention of Musculoskeletal Disorders.* vol. 1: Spine. 4th ed. Chaska, MN: The Saunders Group; 2004.
5. Seidler A, et al. The role of cumulative physical work load in lumbar spine disease: Risk factors for lumbar osteochondrosis and spondylosis associated with chronic complaints. *Occup. Environ Med.* 2001;58;735–746.

Ruling out Degenerative Changes in the Spine

⦸ Extension Quadrant Test

1. Patient stands with equal dispersion of weight on both legs.
2. Patient is instructed to lean back, rotate, and side-flex toward one side.
3. Movement is a combined motion of extension, rotation, and side flexion.
4. Movement is repeated on the opposite side.
5. (+) test is identified by reproduction of the patient's concordant pain.

Reliability	Sensitivity	Specificity	+LR	–LR
NT	**70**	NT	NA	NA

FIGURE 11-40 Quadrant

FIGURE 11-41 Quadrant Overpressure

Ankylosing spondylitis

Prevalence	Symptoms	DSM/Signs	TBC/Special Tests
Rare in North America, in Germany 1%[3] 2nd or 3rd decade[5,6] Male > females[6] 2–3x greater in males[6]	**1st symptoms in late adolescence or early adulthood**[6] Initially it is a dull pain that is insidious in onset[6] **Pain is felt in the deep buttock and/or in the lumbar regions and is accompanied by morning stiffness in the same area that lasts for a few hours**[3] Pain intermittent, may last for weeks to months[5] It improves with activity and returns with inactivity[5] Pain usually worst at night Bone tenderness may be primary complaint[5] Arthritis in the hip and shoulders, often early in the course of the disease[5] Asymmetric arthritis of lower limbs at the stage of the disease Neck pain and stiffness is characteristic of advanced disease Fatigue[4]	**Lumbar hypomobility** Loss of spinal mobility with restriction in flexion, extension of the lumbar spine, and expansion of the chest[1,4,6] Muscle spasms Pain in SI joint with direct pressure or movement Inflammation in peripheral joints[3,6] Mild stiffness to total fused spine[4] Decreased lumbar lordosis[3,5] Atrophy of gluteus muscles Increased thoracic kyphosis[3,5] Cervical spine hyperextension[3]	**Pain control** **Exercise** Promote spinal extension Prone lying Passive and active spinal extension **Mobilization** **Education** **Measurement of chest wall expansion**[2] Schober Test[2] Decreased lumbar lordosis[2] Direct tenderness over sacroiliac joint[2] L3–S1 midline pressure[2] Lumbar spine pressure[2] SASSS[1]

1. Averns HL, et al. Radiological outcome in ankylosing spondylitis: Use of the stroke ankylosing spondylitis spine score (ASSS). *Br J Rheumatol*. 1996;35:373–376.
2. Cleland J. *Orthopaedic Clinical Examination: An Evidence-Based Approach for Physical Therapists*. Carlstadt, NJ: Learning Systems. 2005;195.
3. Dougados M. Ankylosing spondylitis. *Orphanet*. Nov 2001.
4. Ince G, et al. Effects of a multimodal exercise program for people with ankylosing spondylitis. *Phys Ther*. 2006;86:7.
5. Saunders HD, Saunders RS. *Evaluation, Treatment, and Prevention of Musculoskeletal Disorders*. vol. 1. 4th ed. Chaska, MN: The Saunders Group. 2004; 124.
6. Sieper J, et al. Ankylosing spondylitis: an overview. *Ann Rheum Dis*. 2002;61:8–18.

Screening out Ankylosing Spondylitis Through the History *(Gran)*

Symptoms	Sensitivity	Specificity	+LR	–LR
Pain not relieved by lying down	**80**	49	1.57	**0.41**
Back pain at night	71	53	1.51	0.55
Morning stiffness > 30 minutes	64	59	1.56	0.68
Pain or stiffness relieved by exercise	74	43	1.3	0.6
Age of onset ≤ 40 years	**1.0**	0.07	1.07	**0**

Gran JT. An epidemiological survey of the signs and symptoms of ankylosing spondylitis. *Clin Rheumatol*. 1985;4:161–169.

✪ The symptoms above tend to indicate an atypical pain presentation that would perhaps indicate systemic disease and referral for assistance with the management of the disease.

Screening out/Ruling in Ankylosing Spondylitis

Chest Expansion

1. Use tape measure at nipple line.
2. Ask patient to take a deep breath.
3. (+) test is a change of < 2.5 cm.

Reliability	Sensitivity	Specificity	+LR	–LR
NT	**91**	**99**	**91**	**0.09**

Gran JT. An epidemiological survey of the signs and symptoms of ankylosing spondylitis. *Clin Rheumatol.* 1985;4:161–169.

FIGURE 11-42 Chest Expansion