

Chapter 19



Herniated Lumbar Disc

INTRODUCTION

S. Josh Bell, MD, Stephanie Niño, PT, DPT, FAAOMPT, OCS, and Cheryl Kathleen Obregon, PT, DPT, FAAOMPT

Epidemiology

Age

- All ages can be affected.
- Predominance of patients between ages 30 to 50.
- Trials, such as SPORT trial, have mean enrollment of ages between 40 and 43.

Gender

- Predominance of males
- Males twice as likely to have than females

Sport

- Any sport can cause a disc herniation
- Increased risk with improper technique
- Contact sports
- Repetitive twisting of the back

Position

- Can occur in any position
- Bending and twisting with load cause higher load to disc
- Lifting mechanics, especially with load in front of body away from center axis

Pathophysiology

Intrinsic Factors

- Previous disc herniation
- Male gender
 - 2:1 dominance
 - Ages 30 to 50
- Congenital spinal abnormalities

Extrinsic Factors

- Poor mechanics
- Improper technique
 - Lifting
 - Sport-specific
- Smoking
- Sedentary lifestyle

Traumatic Factors

- High levels of force (traumatic collision sports, such as football)
- Repetitive motions
- Loading of the back (twisting with load)
- Improper technique

Classic Pathological Findings

- Numbness in a dermatomal distribution
 - Dermatomal patterns in the lumbar spine
 - L2—Anterior thigh, medial thigh and groin
 - L3—Anterior thigh and medial knee/calf
 - L4—Anterior knee and medial calf/foot
 - L5—Anterior leg and dorsum foot
 - S1—Posterior leg and lateral/sole foot
- Unilateral weakness
- Leg pain is greater than back pain

Clinical Presentation

History

- Leg pain is greater than back pain
 - Greater back pain indicates the possibility of a lumbar sprain/strain
- Weakness or numbness
 - Specific to muscle groups/nerve distributions
- Low back tightness/spasm



FIGURE 19-1. Dermatomal pattern of a patient with right L5 radiculopathy (hash marks represent dermatomal pattern of decreased sensation).



FIGURE 19-2. Knee reflex testing.

Physical Examination

Abnormal Findings

- Straight leg raise
 - When lifting the straight leg from a supine position pain radiates according to the nerve distribution of the involved nerve
- Numbness in a dermatomal distribution ([Figure 19-1](#))
 - L3—Medial knee
 - L4—Medial leg and medial foot/ankle
 - L5—Anterior leg and anterior foot/ankle
 - S1—Lateral foot/sole of foot
- Loss of relevant reflex ([Figure 19-2](#))
 - L3—Knee reflex
 - L4—Knee reflex
 - S1—Achilles reflex

Pertinent Normal Findings

- Normal bowel and bladder function
- Predominance of leg pain and less back pain
 - To differentiate pathology from nerve root compression and lower back pain
- No evidence of hip pathology
 - Normal motion
 - No pain in groin with resisted hip flexion
 - No pain with log roll maneuver of the leg

Imaging

- Radiographs of lumbar spine
 - AP/LAT
 - Possible flexion/extension (to rule out instability)
- MRI of lumbar spine ([Figure 19-3A,B](#))
 - Evaluate for compression of nerve roots
 - Should correlate to dermatomal pattern on physical examination
- Potential radiograph of hip to rule out hip pathology

Differential Diagnosis

- Infection
 - Fever may be present
- Tumor
 - Weight loss unexplained
 - Pain at night/rest
- Fracture
 - Significant trauma should be evaluated with radiographs of the spine
- Musculoskeletal back pain (without disc herniation)
 - Lumbar sprain/strain
 - No radiation to legs
- Hip pathology
 - Evaluate with range of motion
 - Evaluate with provocative testing
 - Resisted straight leg raise
 - Muscular strength
 - Log roll
 - Potentially evaluate with radiographs
- Cauda equina syndrome
 - Compression of multiple nerve roots from a large or central disc herniation
 - Present with abnormal bowel or bladder function (retention or loss of control)
- Saddle anesthesia (loss of sensation in the groin area)
- Loss of sensation to bilateral lower extremities

Treatment

Nonoperative Management

- Medication (antiinflammatory: NSAIDs vs. oral steroids or pain medication)
- Stretching and early active rehabilitation
- Workplace and activity restrictions
- Physical therapy
- Epidural steroid injection (ESI)

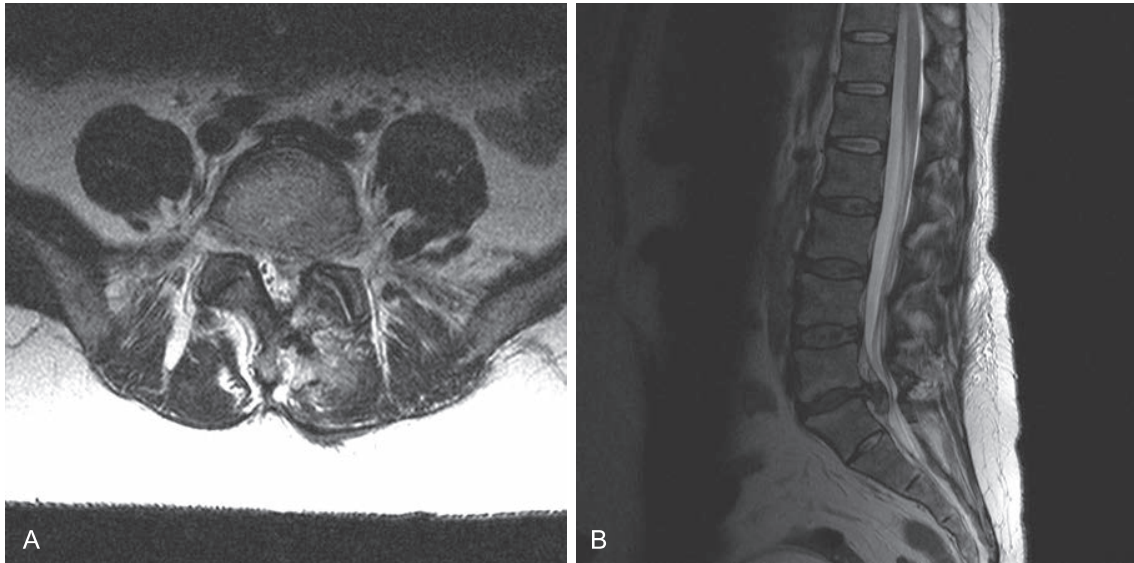


FIGURE 19-3. **A**, Axial MR image of S1 lumbar disc herniation. **B**, Sagittal MR image of S1 lumbar disc herniation.

Guidelines for Choosing Among Nonoperative Treatments

- No evidence of cauda equina syndrome
- Symptoms managed with medication and activity restrictions
- No progressive weakness or neurological loss

Surgical Indications

- Absolute:
 - Progressive motor and sensory loss
 - Cauda equina syndrome
- Relative:
 - Progressive or persistent symptoms after 6 weeks of nonsurgical care
 - Significant loss of motor strength (e.g., quadriceps)

Aspects of History, Demographics, or Exam Findings that Affect Choice of Treatment

- Progressive neurologic findings affect the decision to proceed to surgery
- Significant weakness in quadriceps or other major motor group
- If patient has persistent or worsening pain that is not relieved with nonoperative treatment

Aspects of Clinical Decision Making When Surgery is Indicated

- Progressive loss of motor function
- Failure of appropriate trial of 6 weeks to 3 months of nonoperative treatment
- Progressive pain not responsive to treatment.

Evidence

Buttermann GR: Treatment of lumbar disc herniation: Epidural steroid injection compared with discectomy. A prospective,

randomized study. *J Bone Joint Surg Am* 86:670–679, 2004.

This prospective randomized study of patients with lumbar disc herniation who received discectomy vs. epidural steroid injection. There were 50 patients in each group and a significant amount of crossover between the groups. Patients in the discectomy group had better outcomes. (Level I evidence).

Osterman H, Seitsalo S, Karpinnen J, et al: Effectiveness of microdiscectomy for lumbar disc herniation: A randomized controlled trial with 2 years of follow-up. *Spine* 31:2409–2414, 2006.

This prospective randomized study of patients with lumbar disc herniation who received discectomy vs. isometric physical therapy. There were 28 patients in each group with no statistical difference between groups. (Level I evidence).

Peul WC, van Houwelingen HC, van den Hout WB, et al: Surgery versus prolonged conservative treatment for sciatica. *N Engl J Med* 356:2245–2256, 2007.

A randomized prospective study of patients with surgical and nonsurgical treatment for lumbar disc herniation. This study showed improved outcomes in the surgical group early with no statistical difference at 1 year. (Level I evidence).

Ostelo RW, de Vet HC, Waddell G, et al: Rehabilitation following first-time lumbar disc surgery: A Systematic review within the framework of the Cochrane collaboration. *Spine* 28:209–218, 2003.

This systematic review of randomized controlled trials evaluated the protocol for postoperative rehabilitation after first-time lumbar surgery. No evidence for restriction of activities immediately after surgery was found and strong evidence for intensive exercise. (Level I evidence).

Ostelo RW, Costa LO, Maher CG, et al: Rehabilitation after lumbar disc surgery: An update Cochrane review. *Spine* 34:1839–1848, 2009.

This systematic review of randomized controlled trials evaluated postoperative protocol after lumbar surgery. Exercise

programs after surgery seem to lead to faster decrease in pain postoperatively. (Level I evidence).

Weber H: Lumbar disc herniation: A controlled, prospective study with ten years of observation. *Spine* 8:131–140, 1983.

This prospective study of patients with surgical and nonsurgical treatment for lumbar disc herniation showed improved outcomes in the surgical group at 1 year and no statistical difference at 4- and 10-year follow up. (Level II evidence).

Weinstein JN, Tosteson TD, Lurie JD, et al: Surgical vs. nonoperative treatment for lumbar disk herniation: The Spine Patient Outcomes Research Trial (SPORT), A randomized trial. *JAMA* 296:2441–2450, 2006.

This prospective, randomized study of operative and nonoperative treatment for lumbar disk herniation found better outcomes in surgical patients but the primary differences in the study were not statistically significant. There were large crossovers in the study confounding some conclusions. (Level I evidence).

Multiple-Choice Questions

QUESTION 1. A patient has a disc herniation causing decreased sensation to the area of the right medial malleolus and a decreased knee reflex on the right side. The most likely nerve root effected by this herniation is:

- A. Right L2
- B. Left S1
- C. Right L4
- D. Left L4

QUESTION 2. Based on demographics, the most likely patient to get a symptomatic lumbar disc herniation is:

- A. 20-year-old female
- B. 40-year-old male
- C. 65-year-old female
- D. 10-year-old male

QUESTION 3. Signs of cauda equina syndrome may include all of the following except:

- A. Shortness of breath
- B. Loss of normal bowel or bladder function/control
- C. Saddle anesthesia
- D. Weakness

QUESTION 4. Risk factors for lumbar disc herniation include the following except:

- A. Smoking
- B. Previous lumbar disc herniation
- C. Male
- D. Physically fit

QUESTION 5. Appropriate nonoperative treatment for lumbar disc herniation includes the following except:

- A. Physical therapy
- B. Medication management
- C. Work/activity restrictions
- D. Trigger point injections

Answer Key

QUESTION 1. Correct answer: **C** (see [Pathophysiology](#))

QUESTION 2. Correct answer: **B** (see [Pathophysiology](#))

QUESTION 3. Correct answer: **A** (see [Treatment](#))

QUESTION 4. Correct answer: **D** (see [Pathophysiology](#))

QUESTION 5. Correct answer: **D** (see [Treatment](#))

NONOPERATIVE REHABILITATION OF HERNIATED LUMBAR DISC

S. Josh Bell, MD, Stephanie Niño, PT, OCS, FAAOMPT, and Cheryl Kathleen Obregon, PT, DPT, FAAOMPT

GUIDING PRINCIPLES OF NONOPERATIVE REHABILITATION

- Pain control
- Pain free mobilization of the spine
- Lower extremity and core strengthening
- Patient specific progression of activities, modalities

Phase I (Weeks 0 to 2, Postinjury)

Goals

- Pain control, decrease of inflammation
- Mobilization, unloading as necessary
- Education

Protection

- Protect with walker as needed
- Use of lumbar support, such as lumbosacral orthosis (LSO), as necessary

Management of Pain and Swelling

- Pharmacologic treatment
 - NSAIDs
 - Oral steroid
 - Pain medication
- Ice or cryotherapy
- Avoidance of painful spinal motions (rest)
- Taping and therapeutic modalities (electrical stimulation)
- Education on log rolling, proper bed mobility, sit to stand transition, hip-hinging exercise for sit to stand and squatting

Techniques for Progressive Increase in Range of Motion

Manual Therapy Techniques

- Manipulation of thoracolumbar (T/L) junction for lower extremity pain modulation
- Side-lying manual distraction
- Grade I, II mobilization (pain control)
- Neural mobilizations
- Correction of standing lateral shift, if present (Figure 19-4)
- Exercises
 - Pelvic neutral and transverse abdominal bracing, progression with LE movement with brace (start



FIGURE 19-4. Correction of lateral shift; pain-free manual correction (by therapist) of pelvis to correct left lateral shift in this patient.

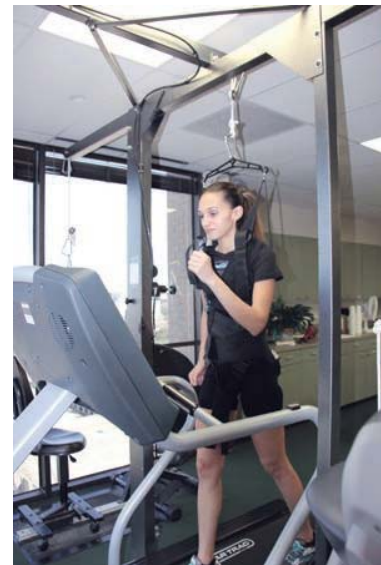


FIGURE 19-5. Body weight support walking on treadmill.

- with 5 min then progress to 15 min total time with LE movements)
- If patient has an extension bias, begin with prone lying (start 5 min base time on patient’s symptoms decreasing)
- Body weight support unloaded walking on treadmill (Figure 19-5)
- Supine mechanical traction or inversion table for symptom relief (start with 25% of body weight for 20 to 30 min intermittent holds)
- Lumbar spine pain-free ROM
- Unloaded squats (using functional gym) (i.e. Total Gym)

Soft Tissue Techniques

- Paraspinals myofascial release (MFR)
- Soft tissue mobilization (STM) to paraspinals (Figure 19-6)
- Nerve gliding (patient directed) (Figure 19-7)



FIGURE 19-6. Soft tissue paraspinal mobilization (STPM).



FIGURE 19-7. Patient-directed sciatic nerve gliding.

Stretching and Flexibility Techniques for the Musculotendinous Unit

- Stretching to limit of pain allowable
- Gentle hamstring and/or hip flexor stretching with protected spine position, being cautious of radicular symptoms

Other Therapeutic Exercises

- Encourage functional walking to tolerance
- Lower extremity strengthening to pain tolerance
- Education on wearing and removing LSO brace (as needed)
- Avoid sitting greater than 20 minutes

TIMELINE 19-1: Rehabilitation of Herniated Lumbar Disc

PHASE I (weeks 0 to 2)	PHASE II (weeks 2 to -6)
<ul style="list-style-type: none"> • Rest • PT modalities • Functional unloading • Stretching/ROM to tolerance • Manipulation of T/L junction • Myofascial release (MFR) paraspinals • Soft tissue mobilization (STM) neural tissue 	<ul style="list-style-type: none"> • Retrain protective movement patterns • PT modalities • Functional unloading • Mechanical traction • Paraspinal MFR • Soft tissue mobilization (STM) functional movement patterns • Supine hamstring, hip flexor, piriformis stretches • Progression to quadruped exercise • Hip strengthening exercises • Body mechanics training and education • Pelvic neutral stability ball with progressing to LE movement • Supine and prone lumbar stabilization exercises • Walking program, swimming • Body weight squats and lunges • ADLs retraining

Activation of Primary Muscles Involved

- Lower extremity strength exercises are encouraged, as tolerated by pain level
- Proper activation of transverse abdominal, external obliques, multifidus, and gluteals

Milestones for Progression to the Next Phase

- Oswestry disability index (ODI), between 20% and 40%
- Able to sit and stand with spinal neutral mechanics
- Pain-free transitional movements (i.e., sit to stand, supine to sit)
- No lateral shift or acute lumbar kyphosis can be present (correct spinal position)

Phase II (weeks 2 to 6, Postinjury, variable progression dependent on herniation and patient factors)

Protection

- Retrain protective movement patterns (i.e., using lumbar roll with sitting, avoiding truck flexion with squatting and sit to stand)
- Wean from LSO brace (if used)

Management of Pain and Swelling

- Use of modalities (heat, electrical stimulation, taping)
- Decrease use of walking aids



FIGURE 19-8. Side-lying manual mobilization of lumbar facet joints (gapping).

- Pharmacological treatment
 - NSAIDs
 - Decrease use of narcotics

Techniques for Progressive Increase in Range of Motion

Manual Therapy Techniques

- Mobilization and manipulation of thoracic spine, lumbar spine (opening, closing, and gapping techniques) (Figure 19-8)
- Mobilization of SI joint (supine, side lying, prone techniques), hips to correct hypomobility, and for pain modulation

- Muscle energy techniques (METs) for muscular recruitment or inhibition
- Side-lying lumbar distraction

Soft Tissue Techniques

- Paraspinals myofascial release (MFR), soft tissue mobilization (STM) surrounding neural tissue
- STM with movement to restore functional movement patterns

Stretching and Flexibility Techniques for the Musculotendinous Unit

- Supine hamstring, hip flexor
- Figure four piriformis stretches
- Repeat Phase I with progressing to sitting, standing, and quadruped exercise
- Hip/back dissociation exercise (using biofeedback for proper spine alignment while moving at the hips) (Figure 19-9)

Other Therapeutic Exercises

- Hip strengthening exercises
- Continue functional unloading on body weight support treadmill
- Body mechanics training and education

Activation of Primary Muscles Involved

- Lower extremity strength exercises are encouraged, as tolerated by pain level
- Proper activation of transverse abdominus, external obliques, multifidus, and gluteals

TIMELINE 19-1: Rehabilitation of Herniated Lumbar Disc (Continued)

PHASE III (weeks 6 to 12)	Phase IV (weeks 10 to 18)	Phase V (weeks 18 to 52)
<ul style="list-style-type: none"> • Proper protective spine mechanics • PT modalities as needed • Mobilization and manipulation of thoracic spine, lumbar spine, SI joints • Side-lying lumbar distraction • Paraspinal MFR • STM surrounding neural tissue • Supine hamstring, hip flexor, piriformis stretches • Use of resistance with LE strengthening exercise • Increase resistance of long lever challenge on dynamic spine control • Abdominal exercise (plank) • SLS static and dynamic activities • Use of unstable surfaces • Use of resistance bands with UE and LE 	<ul style="list-style-type: none"> • PT modalities as needed • Mobilization and manipulation of thoracic spine, lumbar spine, SI joints • Side-lying lumbar distraction • Paraspinal MFR • STM surrounding neural tissue • Supine hamstring, hip flexor, piriformis stretches • Use of resistance with LE strengthening exercise • Increase resistance of long lever challenge on dynamic spine control • Abdominal exercise (plank) • SLS static and dynamic activities • Use of unstable surfaces • Use of resistance bands with UE and LE • Unloading jumping on reformer progressing to squat jumps, broad jumps 	<ul style="list-style-type: none"> • PT modalities as needed • Mobilization and manipulation of thoracic spine, lumbar spine, SI joints • Side-lying lumbar distraction • Paraspinal MFR • STM surrounding neural tissue • Supine hamstring, hip flexor, piriformis stretches • Use of resistance with LE strengthening exercise • Increase resistance of long lever challenge on dynamic spine control • Abdominal exercise (plank) • SLS static and dynamic activities • Use of unstable surfaces • Use of resistance bands with UE and LE • Unloading jumping on reformer progressing to squat jumps, broad jumps • Progressive resistive exercises (PRE) Lumbar and core • Hip/LE PRE • Upper extremity PRE • Sports-specific drills with protective pivoting • Carioca drills • Slide board • Plyometrics • Agility ladder



FIGURE 19-9. Hip/back dissociation using a stick to give biofeedback for proper spine alignment to allow hip to hinge in normal pattern and allow for proper spine mechanics.

Sensorimotor Exercises

- Balance on unstable surfaces (rocker board, foam with neutral spine)
- Single leg balance (SLB) with resistive bands or pulleys four-way directions (**Figure 19-10A,B**)

Open and Closed Kinetic Chain Exercises

- Pelvic neutral using blood pressure cuff for biofeedback, advancing with lower extremity movements
- Quadruped neutral (**Figure 19-11**)
- Pelvic neutral on the floor with mini squats progressing to upper extremity movements with resistive bands

Techniques to Increase Muscle Strength, Power, and Endurance

- Mini squat in pelvic neutral
- Total or Vigor Gym in pelvic neutral
- Standing lat pulldown with pelvic neutral

Neuromuscular Dynamic Stability Exercises

- Refer to OKC and CKC exercise

Functional Exercises

- Hip hinging series: sit, stand, squat, and stagger squat (keeping spine in position and movement comes from hinging at the hips as opposed to motion through spine)
- Proper log rolling for bed mobility
- Gait training
- Education on getting on/off floor

Milestones for Progression to the Next Phase

- Minimal daily symptoms
- Reduce ODI score <20%
- Able to perform ADLs

Phase III (weeks 6 to 12, Postinjury)

The majority of patients treated in a nonoperative treatment protocol will be advanced to return to sport after this phase. If they require additional treatment/cannot progress, they may require further evaluation and consideration for other treatment modalities (i.e., epidural steroid injection, surgery).

Protection

- Proper protective spine mechanics for high functional activities, return to work, and sport



FIGURE 19-10. A, B, Single leg balance with resistive bands.



FIGURE 19-11. Quadrupedal neutral position.

Management of Pain and Swelling

- NSAIDs as needed
- Ice or cryotherapy prn
- E-stim/TENS, as necessary

Techniques for Progressive Increase in Range of Motion

Manual Therapy Techniques

- Mobilization and manipulation of thoracic spine, lumbar spine, SI joint, hips to correct hypomobility and for pain modulation
- Side-lying lumbar distraction
- Muscle energy techniques (METs) for muscular recruitment or inhibition

Soft Tissue Techniques

- Neural tissue mobilization
- Paraspinal MFR
- STM functional movement patterns

Stretching and Flexibility Techniques for the Musculotendinous Unit

- Supine hamstring, hip flexor and piriformis stretches

Other Therapeutic Exercises

- Standing upper extremity exercises with cable with pelvic neutral (Figure 19-12)
- Total Gym
- Treadmill

Activation of Primary Muscles Involved

- Use of resistance bands of upper and lower extremities
- Use of unstable surfaces
- Advance of abdominal exercise (plank, etc.) (Figure 19-13)
- Focus on transverse abdominals, external obliques, latissimus dorsi, gluteus maximus, gluteus medius, hamstrings, multifidus, psoas, quadratus lumborum



FIGURE 19-12. Pelvic neutral (feedback by therapist) standing upper extremity cable exercises.

Sensorimotor Exercises

- Sitting stability ball
- Advance to standing on unstable disc
- Single leg stance (SLS) static and dynamic activities

Open and Closed Kinetic Chain Exercises

- Prone pelvic neutral with blood pressure cuff with lower and upper extremity progression
- Dynamic movements using a stick for biofeedback on neutral spine
- Use of bands and cables in varies directions/resistance in functional hip hinge position

Techniques to Increase Muscle Strength, Power, and Endurance

- Advance abdominal exercise
 - Plank
 - Lateral plank
 - Resisted proprioceptive neuromuscular facilitation (PNF)

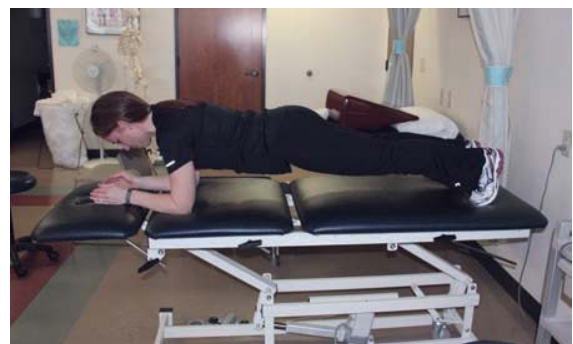


FIGURE 19-13. Plank.

- Emphasis on the following muscle groups: gluteals, abdominals, deep back extensors

Neuromuscular Dynamic Stability Exercises

- BOSU ball
- Single leg stance dynamic and static activities
- Improving body sense awareness in cutting, pivoting, and agility work

Plyometrics

- Unloading jumping on reformer to progressing to squat jumps, broad jumps, SL hops

Functional Exercises

- Education and technique for proper spine mechanics
- Increased resistance of long lever challenge on dynamic spine control
- Hip hinging with upper extremity weighted challenge
- Use of resistive bands in functional positions (i.e., lunge)
- Overhead squatting

Sport-Specific Exercises

- Squat jumps, single leg hips
- Agility ladder
- Resisted golf swings

Milestones for Progression to Advanced Sport-Specific Training and Conditioning

- Able to demonstrate neutral spine in all functional positions (using observation and monitoring patients symptoms)
- Pain free and progressive improvement with standing balance activities (measure by patient pain report and time on single leg stance)
- LE strength returned to within 10% of preinjury level (or 10% of expected strength at normal) (measured with manual muscle testing of all myotomes)
- Able to demonstrate proper form in sports-specific skills

Criteria for Abandoning Nonoperative Treatment and Proceeding to Surgery or More Intensive Intervention

- Continued pain on activities
- Inability to advance to sport specific drills
- Continued setbacks with rehabilitation caused by pain, weakness or failure to progress
- Progressive neurological decline
- Persistent or worsening pain

Tips and Guidelines for Transitioning to Performance Enhancement

- Proper body mechanics observed and trained
- Proper nutrition and hydration during training

- Advance per progression to prevent a setback or recurrence of symptoms

Performance Enhancement And Beyond Rehabilitation: Training/Trainer and Optimization of Athletic Performance

- Progression of core strength including abdominals and paraspinals are key to injury prevention in the future (i.e., plants, side plants, bridging, lat pulldown, hip hinging with cable resistance)
- Proper technique (sports-specific) can be the keys to progress and continued improved performance

Specific Criteria for Return to Sports Participation: Tests and Measurements

- Pain-free activities
- Core strength and LE strength within 10% of preinjury or “normal” level (measured by manual muscle testing)
- Single leg balance equal side to side (measured by time)
- Any functional tests?

Evidence

Danielson JM, Johnsen R, Kibsgaard SK, et al: Early aggressive exercise for postoperative rehabilitation after discectomy. *Spine* 25:1015–1020, 2000.

This is a randomized controlled trial comparing a training group and a mild exercise group postoperatively. Vigorous medical exercise started 4 weeks after surgery reduced disability and pain after surgery. (Level I evidence).

McGregor AH, Dore CJ, Morris TP, et al: Function after spinal treatment, exercise, and rehabilitation (FASTER). *Spine* 36:1711–1720, 2011.

This multicenter, factorial, randomized controlled trial on the postoperative management of spinal surgery patients. Found no difference at 12 months ODI for usual care versus rehabilitation versus rehabilitation with educational booklet and booklet only. (Level I evidence).

Ostelo RW, Costa LO, Maher CG, et al: Rehabilitation after lumbar disc surgery: An update Cochrane review. *Spine* 34:1839–1848, 2009.

This systematic review of randomized, controlled trials evaluated postoperative protocol after lumbar surgery. Exercise programs after surgery seem to lead to faster decrease in pain postoperatively. (Level I evidence).

Ostelo RW, de Vet HC, Waddell G, et al: Rehabilitation following first-time lumbar disc surgery: A systematic review within the framework of the Cochrane collaboration. *Spine* 28:209–218, 2003.

This systematic review of randomized controlled trials evaluated the protocol for postoperative rehabilitation after first-time lumbar surgery. No evidence for restriction of activities immediately after surgery was found and strong evidence for intensive exercise. (Level I evidence).

Weber H: Lumbar disc herniation: A controlled, prospective study with ten years of observation. *Spine* 8:131–140, 1983.

This prospective study of patients with surgical and nonsurgical treatment for lumbar disc herniation showed improved

outcomes in the surgical group at 1 year and no statistical difference at 4- and 10-year follow up. (Level II evidence).

Weinstein JN, Tosteson TD, Lurie JD, et al: Surgical versus nonoperative treatment for lumbar disk herniation: The spine patient outcomes research trial (SPORT), A randomized trial. *JAMA* 296:2441–2450, 2006.

This prospective, randomized study of operative and nonoperative treatment for lumbar disk herniation found better outcomes in surgical patients, but the primary differences in the study were not statistically significant. There were large crossovers in the study confounding some conclusions. (Level I evidence).

Multiple-Choice Questions

QUESTION 1. Plyometric training should start in what phase of rehabilitation after lumbar disc injury?

- A. Phase I (1 to 2 weeks)
- B. Phase II (3 to 6 weeks)
- C. Phase III (6 to 18 weeks)
- D. Any time

QUESTION 2. A key to future injury prevention after lumbar herniation:

- A. Lower extremity strength
- B. Upper extremity strength
- C. Proper technique in sport
- D. Level of disc herniation

QUESTION 3. A sign that indicates the possible need for more medical intervention for lumbar disc herniation includes:

- A. Increasing pain
- B. Inability to progress in rehabilitation protocol
- C. Progressive neurological signs and symptoms
- D. All of the above

QUESTION 4. Goals for successful nonoperative treatment of lumbar disc herniation include all of the following except:

- A. Running endurance
- B. Core and lower extremity strength
- C. Mobilization of the spine
- D. Pain control

QUESTION 5. Manipulation of the thoracolumbar spine is an example of:

- A. An exercise in rehabilitation
- B. A manual therapy technique
- C. A soft tissue technique
- D. A strengthening technique

Answer Key

QUESTION 1. Correct answer: **D** (See [Phase III](#))

QUESTION 2. Correct answer: **C** (See [Phase III](#))

QUESTION 3. Correct answer: **D** (See [Phase III](#))

QUESTION 4. Correct answer: **A** (See [Phase I](#))

QUESTION 5. Correct answer: **B** (See [Phase I](#))

POSTOPERATIVE REHABILITATION AFTER LUMBAR DISC HERNIATION SURGERY

S. Josh Bell, MD, Stephanie Niño, PT, OCS, FAAOMPT, and Cheryl Kathleen Obregon, PT, DPT, FAAOMPT

Indications for Surgical Treatment

- Progressive neurological symptoms
- Correlation of symptoms with MRI imaging
- Symptoms that persist after reasonable nonoperative management

Brief Summary of Surgical Treatment

Major Surgical Steps

- General anesthesia prone position, abdomen free fluoroscopy positioned ([Figure 19-14](#))

- Techniques vary from open to microdiscectomy with positioning of tubes for access and instrument passing ([Figure 19-15](#))
- Place needle localization under lateral fluoroscopy to confirm level ([Figure 19-16](#))
- Dissect subperiosteal down spinous process to the lamina on the affected side ([Figure 19-17](#))
- Protect the facet joint capsule
- Place lamina spreader between spinous processes
- Expose ligamentum flavum and incise
- Use minimal resection of lamina (based on level of disc) ([Figure 19-18](#))
- Gently protect dura
- Remove disc fragments ([Figure 19-19](#))



FIGURE 19-14. Patient in prone position with fluoroscopy positioned for lumbar discectomy. (From Angevine PD, Gigante PR, McCormick PC: *Patient positioning for spinal surgery*. In: Winn HR: *Youmans Neurological Surgery*, ed 4. Philadelphia: Saunders (Elsevier), 2011, pp. 447–452.)

- Ensure no remnant fragments are present and that nerve root is free (Figure 19-20)
- No postoperative anticoagulation
- Early mobilization

Factors that May Affect Rehabilitation

Anesthetic

- Local long-acting anesthetics may improve early pain control

Surgical

- Multilevel disc herniation require longer early phases to allow for additional surgical trauma

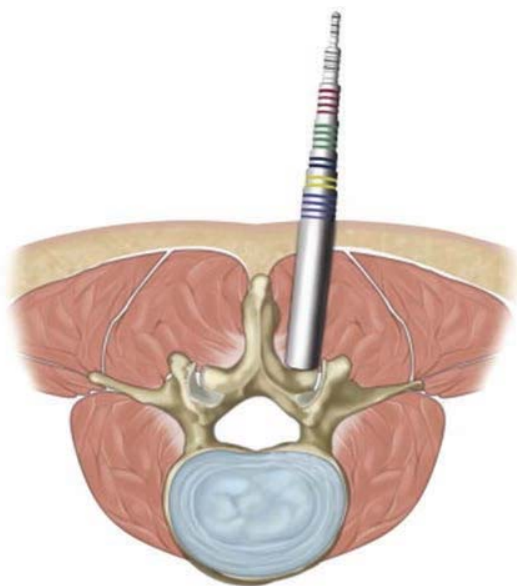


FIGURE 19-15. Use of microdiscectomy dilating tubes to minimize incision. (From Lee P, Wong AP, Ganju A: *Surgical Anatomy and Techniques to the Spine*. In *Surgical anatomy and operative techniques of lumbar stenosis*. Philadelphia: Saunders (Elsevier), 2013, Ch 43.)

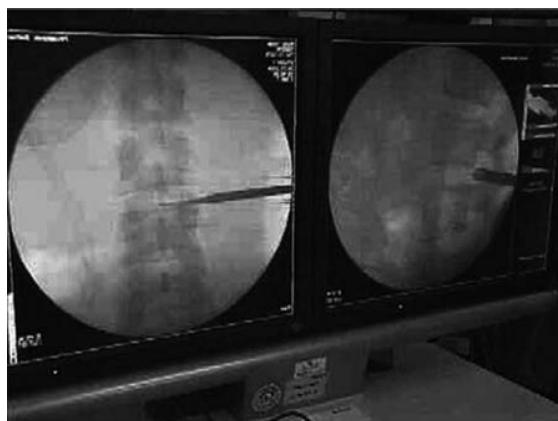


FIGURE 19-16. Intraoperatively fluoroscopically confirmed level for surgical discectomy. (From Leu HF: *Posterior foraminal lumbar decompression*. In: Kim DH, Kim Y-C, Kim K-H editors: *Minimally Invasive Percutaneous Spinal Techniques*. Philadelphia: Saunders (Elsevier), 2011, pp 360–366.)

Before Surgery: Overview of Goals, Milestones, and Guidelines¹

GUIDING PRINCIPLES OF POSTOPERATIVE REHABILITATION

- Understand the level of disc herniation treated (nerves and levels affected)
- Understand the importance of core muscle groups to support the rehabilitation
- Understand the importance of pain control for advance of therapy
- Proper selection of manual therapy intervention applied at the appropriate phase of healing
- Recognize the importance of reintegration of proper techniques to prevent future injury

Phase I: Immediate Postoperative Period (days 0 to 14)

CLINICAL PEARLS

- Pain control to get the patient to have confidence in the postoperative period is of paramount importance.
- Early mobility with proper pain management to build and restore patient's confidence towards pain-free mobility and progression.

Goals

- Pain control
- Early mobility

¹Prehabilitation, if appropriate, is described in the Nonoperative Rehabilitation section of this chapter. For a timeline for postoperative rehabilitation, refer to the Nonoperative Rehabilitation part.

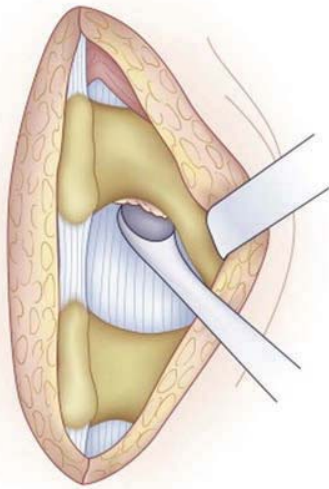


FIGURE 19-17. Dissection down spinous process to expose lamina. (From Bono CM, Schoenfeld A, Garfin SR: *Lumbar disc herniations*. In: Herkowitz HN, Garfin SR, Eismont FJ, et al, editors: *Rothman-Simeone The Spine*, ed 6. Philadelphia: Saunders (Elsevier), 2011, pp 887–914.)

- Support of weight bearing (walking aids, back brace as needed)
- Edema control (medication, ice, and protection from injury)

Protection

- Use of walker for unloading as necessary postoperatively
- Possible use of supportive lumbar brace (LSO)

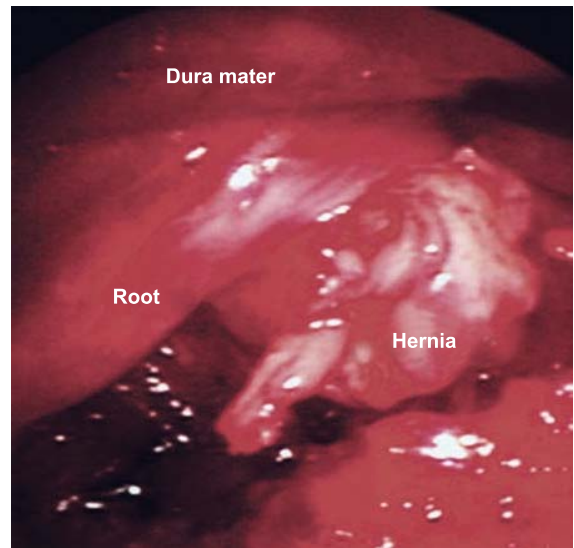


FIGURE 19-19. Herniated material removed with protection of nerve root. (From Blamoutier A: *Surgical discectomy for lumbar disc herniation: Surgical techniques*. *Orthop Traumatol Surg Res* 99:S187–96, 2013)

Management of Pain and Swelling

- In immediate postoperative period, patient will have local anesthetic long-acting for localized pain relief
- Oral pain management with medication
- TENS unit to control pain
- Ice therapy to reduce inflammation and pain
- Patient education regarding avoidance of painful motions
- PT modalities

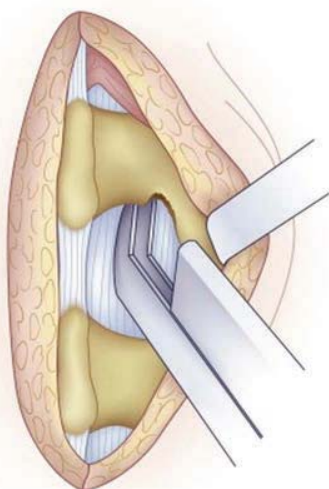


FIGURE 19-18. Minimal resection of lamina to expose herniated disc beneath. (From Bono CM, Schoenfeld A, Garfin SR: *Lumbar disc herniations*. In: Herkowitz HN, Garfin SR, Eismont FJ, et al, editors: *Rothman-Simeone The Spine*, ed 6. Philadelphia: Saunders (Elsevier), 2011, pp 887–914.)

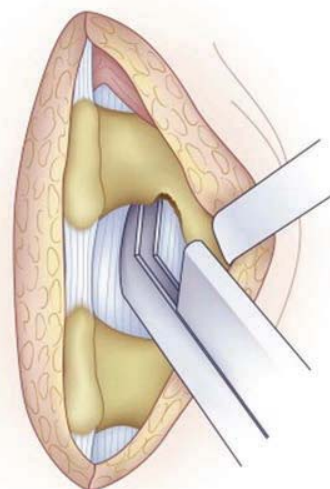


FIGURE 19-20. Ensure area free of disc material and nerve root is not impinged. (From Bono CM, Schoenfeld A, Garfin SR: *Lumbar disc herniations*. In: Herkowitz HN, Garfin SR, Eismont FJ, et al, editors: *Rothman-Simeone The Spine*, ed 6. Philadelphia: Saunders (Elsevier), 2011, pp 887–914.)

Techniques for Progressive Increase in Range of Motion

Manual Therapy Techniques

- Limited in first several weeks secondary to incision (gentle soft tissue techniques for early treatment)

Stretching and Flexibility Techniques for the Musculotendinous Unit

- Lumbar spine pain-free ROM
- Functional unloading (unloading the spine/soft tissue to eliminate pain in functional activities, i.e., walking/transitional movements, can use functional unloader—weight supported walking)
- Education of log rolling, proper bed mobility, sit-to-stand transitions

Other Therapeutic Exercises

- Walking low intensity level for cardiovascular fitness
- Body-weight support treadmill for walking with additional offloading (Figure 19-21) (Parameters are 65% of body weight ambulating 0.1 to 0.5 mph up to 40 to 50 minutes)

Activation of Primary Muscles Involved in Injury Area or Surgical Structures

- Unloaded squatting using Total Gym

Open and Closed Kinetic Chain Exercises

- Walking program
- Body weight support walking on treadmill if available

Functional Exercises

- ADLs training
- Sit-to-stand transitions
- Log rolling
- Don/doff LSO brace if used



FIGURE 19-21. Body weight support treadmill walking.

Milestones for Progression to the Next Phase

- Healing of the surgical incision
- Pain control to allow sitting and standing
- ODI (Oswestry disability index 20% to 40%)

Phase II: (weeks 2 to 6, Postoperative)

CLINICAL PEARLS

- Closely monitor the athlete's progression as it will vary
- Pay attention to movement patterns and guarding in the patient's movements
- Slow progress early with attention to any adjustments as necessary for any adverse neurological symptoms

Goals

- Protect surgical wound
- Increase core strength
- Improve mobility
- Improve flexibility

Protection

- Discontinue ambulatory aids as tolerated
- Retrain protective movement patterns

Management of Pain and Swelling

- PT modalities (heat, electrical stimulation, taping—Kinesio tape for pain reduction/muscle spasm relief)
- Oral pain medication
- Ice or cryotherapy as necessary to decrease inflammation and swelling

Techniques for Progressive Increase in Range of Motion

- Stretching/flexibility techniques for the musculotendinous unit
- Supine hamstring, hip flexor, piriformis stretches, gluteal stretch (Figures 19-22, 19-23)

Manual Therapy Techniques

- Mobilization and manipulation of thoracic spine, lumbar spine (opening, closing and gapping techniques) (Figure 19-24)
- SI joint (supine, side-lying, and prone techniques), hips to correct hypomobility, and for pain modulation
- Muscle energy techniques (METs) for muscular recruitment or inhibition
- Side-lying lumbar distraction

Soft Tissue Techniques

- Paraspinal myofascial release (MFR)
- Soft tissue manipulation (STM) surrounding neural tissue



FIGURE 19-22. Piriformis figure-of-4 stretch.



FIGURE 19-23. Single knee to chest.

- STM functional movement patterns
- Incisional scar massage

Other Therapeutic Exercises

- Body weight support walking on treadmill (unload 65% of total body weight at 0.1 to 0.5 mph on treadmill for up to 40 to 50 minutes)
- Repeat Phase I with progressing to sitting, standing, and quadruped exercise

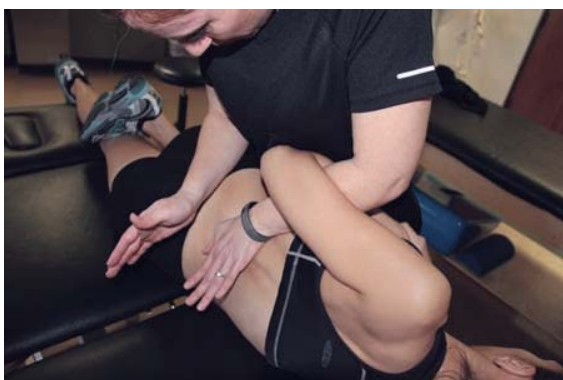


FIGURE 19-24. Side-lying manual lumbar mobilization (gapping).



FIGURE 19-25. Pelvic neutral position with progressive lower extremity mobility challenge (bent knee fallout).

Activation of Primary Muscles Involved in Injury Area or Surgical Structures

- Lower extremity strength exercises are encouraged as tolerated by pain level, proper activation of transverse abdominal, external obliques, multifidus, and gluteals (Figures 19-25 to 19-26). (Begin with 5 minutes at 10 seconds hold for pelvic neutral or abdominal bracing. Then progress to lower extremity movement with neutral spine for 3 to 5 minutes each leg. Total stabilization time is 10 to 15 minutes. All movement should not be painful and repetitious until proper mechanics/muscle activation is done with ease.)
- Hip/back dissociation exercise (biofeedback on spine to allow hips and back to function independently (Figure 19-27) (2 to 3 minutes total: hip hinge exercise)
- Hip strengthening/neuromuscular recruitment exercises (10 seconds hold x 10 reps; progress to 2 to 3 sets)
- Supine hamstring (Figure 19-28), hip flexor, piriformis stretches (1 minutes hold, 3 to 5 reps)

Sensorimotor Exercises

- Pelvic neutral on stability ball with progressing to LE movement (reps to fatigue: when a patient can no longer maintain neutral spine)



FIGURE 19-26. Pelvic neutral position with progressive lower extremity mobility challenge(marching).



FIGURE 19-27. Hip/back dissociation with biofeedback (with stick) on spine to allow for proper alignment and motion through the hip (hinging at the hip) while keeping a pelvic neutral position of the spine.

- Sitting on stability ball, static and dynamic movements on unstable surface (reps to fatigue)
- Balance on unstable surfaces (rocker board, foam with neutral spine)
 - Single leg balance (SLB) with resistive bands or pulleys four-way directions (Figure 19-29) (begin with 10 reps in each direction if patient is able to maintain form, progress to up to 20 reps)

Open and Closed Kinetic Chain Exercises

- Lunges (2 to 3 sets, 10 to 15 reps)
- Body weight squats (unloading as necessary) (5 minutes)
- Pelvic neutral using blood pressure cuff for biofeedback, advancing with lower extremity movements (begin with 5 minutes and progress to 15 minutes total time)
 - Quadruped neutral (Figure 19-30)
 - Pelvic neutral on the floor with mini squats progressing to upper extremity movements with resistive bands (3 sets to fatigue)



FIGURE 19-28. Supine hamstring stretch.



FIGURE 19-29. Single leg balance with lower extremity resistance bands.

Techniques to Increase Muscle Strength, Power, and Endurance

- Mini squat with pelvic neutral (3 sets to fatigue)
- Total Gym or Vigor Gym in pelvic neutral (5 to 10 minutes)
- Standing lat pulldown with pelvic neutral (10 to 15 reps, 2 to 3 sets)

Neuromuscular Dynamic Stability Exercises

- Refer to OCK and CKC exercise

Functional Exercises

- Proper sitting mechanics, sit-to-stand transitions, squatting, lifting, getting on/off floor, ADLs retraining
- Hip hinging series: sit, stand, squat, and stagger squat
 - Proper log rolling for bed mobility
 - Gait training
 - Education on getting on/off floor



FIGURE 19-30. Quadruped neutral position.

Milestones for Progression to the Next Phase

- Minimal daily symptoms
- Reduce ODI score <20%
- Perform ADLs

Phase III: (weeks 6 to 10, Postoperative)

CLINICAL PEARLS

- Progress of activities with a focus on core strengthening
- Advanced based on ability to perform activities with proper mechanics and technique
- Continue with lifting precautions and protection from injury as any setback or return or neurological symptoms should be avoided.

Goals

- Pain-free transitions
- Demonstrate proper body mechanics with exercises
- Walk 1 mile without pain (trying to approximate up to 20 minutes of loaded activity)

Protection

- Proper protective spine mechanics for high functional activities, return to work, and sport

Management of Pain and Swelling

- NSAIDs as needed

Techniques for Progressive Increase in Range of Motion

Manual Therapy Techniques

- Mobilization and manipulation of thoracic spine, lumbar spine, SI joint, hips to correct hypomobility and for pain modulation
- Side-lying lumbar distraction
- Muscle energy techniques (METs) for muscular recruitment or inhibition

Soft Tissue Techniques

- Neural tissue mobilization
- Paraspinal MFR
- STM functional movement patterns

Stretching and Flexibility Techniques for the Musculotendinous Unit

- Supine hamstring, hip flexor, and piriformis stretches



FIGURE 19-31. Standing cable exercises of upper extremities with pelvic neutral position.

Other Therapeutic Exercises

- Standing cable exercises of the upper extremities with pelvic neutral (Figure 19-31)
- Total Gym
- Body weight support treadmill with progression to regular treadmill

Activation of Primary Muscles Involved in Injury Area or Surgical Structures

- Use of resistance bands of upper and lower extremities
- Use of unstable surfaces
- Advance of abdominal exercise (plank, etc.)
- Focus on transverse abdominals, external obliques, latissimus dorsi, gluteus maximus, gluteus medius, hamstrings, multifidus, psoas, quadratus lumborum

Sensorimotor Exercises

- Sitting on stability ball
- Advance to standing on unstable disc
- Single leg stance (SLS) static and dynamic activities

Open and Closed Kinetic Chain Exercises

- Prone pelvic neutral with blood pressure cuff with lower and upper extremity progression
- Dynamic movements using a stick for biofeedback on neutral spine
- Use of bands and cables in varies directions/resistance in functional hip hinge position

Techniques to Increase Muscle Strength, Power, and Endurance

- Advance abdominal exercise
 - Plank
 - Lateral plank
 - Resisted proprioceptive neuromuscular facilitation (PNF)
- Emphasis on the following muscle groups: gluteals, abdominals, deep back extensors

Neuromuscular Dynamic Stability Exercises

- BOSU ball
 - Single leg stance dynamic and static activities
 - Improving body sense awareness in cutting, pivoting, and agility work

Functional Exercises

- Education and technique for proper spine mechanics
 - Increased resistance of long lever challenge on dynamic spine control
 - Hip hinging with upper extremity weighted challenge
 - Use of resistive bands in functional positions, i.e. lunge
 - Overhead squatting (use of bar overhead during squat maneuver; no weight)

Milestones for Progression to the Next Phase

- Complete resolution of pain
- Able to demonstrate neutral spine in all functional positions (both subjective feedback and also qualitative from the therapist observing the motions and positions)

Phase IV: (weeks 10 to 14, Postoperative)

CLINICAL PEARLS

- Use core strengthening exercises as a foundation for total fitness.
- Use exercises focusing on sport specific routine is important at this stage of rehabilitation.
- Ensure proper technique throughout the exercises is important to reinforce spine mechanics and build the foundation for future return to sports.

Goals

- Fluid motion in normal spine activities
- Elimination of abnormal spinal mechanics
- Walking program progression (greater than 1 mile)
- Light lifting program
- ADLs without pain

Protection

- Reinforce proper spine mechanics throughout all activities

Techniques for Progressive Increase in Range of Motion

Manual Therapy Techniques

- Muscle energy techniques (METs) for muscular recruitment or inhibition (any setbacks with small resurgence of symptoms may require treatment)

Stretching and Flexibility Techniques for the Musculotendinous Unit

- Supine hamstring, hip flexor, and piriformis stretches

Other Therapeutic Exercises

- Total Gym workout
- Swimming
- Treadmill
- Elliptical

Activation of Primary Muscles Involved in Injury Area or Surgical Structures

- Use of resistance bands of upper and lower extremities
- Use of unstable surfaces
- Advance of abdominal exercise (plank, etc.)
- Focus on transverse abdominals, external obliques, latissimus dorsi, gluteus maximus, gluteus medius, hamstrings, multifidus, psoas, quadratus lumborum

Sensorimotor Exercises

- Single leg stance (SLS) dynamic activities
- Unstable disc

Open and Closed Kinetic Chain Exercises

- Use of bands and cables in varies directions/resistance in functional hip hinge position (therapist to assist to ensure hip is the hinge for motion allowing for stable spine in exercises) (Figure 19-32)

Techniques to Increase Muscle Strength, Power, and Endurance

- Advance abdominal exercise
 - Plank
 - Lateral plank
 - Resisted proprioceptive neuromuscular facilitation (PNF)



FIGURE 19-32. Therapist providing feedback to keep proper hip position during standing upper extremity cable exercises.

- Emphasis on the following muscle groups: gluteals, abdominals, deep back extensors
- Treadmill and swimming for cardiovascular fitness

Neuromuscular Dynamic Stability Exercises

- BOSU ball
 - Single leg stance dynamic and static activities
 - Improving body sense awareness in cutting, pivoting, and agility work

Plyometrics

- Squat jumps, broad jumps, single leg hops

Functional Exercises

- Education and technique for proper spine mechanics
 - Increased resistance (using upper extremity cables) of long lever challenge on dynamic spine control
 - Hip hinging with upper extremity weighted challenge
- Use of resistive bands in functional positions, i.e., lunge
- Overhead squatting

Sport-Specific Exercises

- Squat jumps, single leg hips
 - Agility ladder
 - Resisted golf swings
- Carioca

Milestones for Progression to the Next Phase

- Proper spinal mechanics (both subjective feedback and qualitative assessment from the therapist observing all positions)
- Complete resolution of pain
- Able to demonstrate neutral spine in all functional positions, using both subjective feedback from the patient and qualitative assessment from the therapist observing the positions

Phase V: (weeks 14 to 24, Postoperative)

CLINICAL PEARLS

- Progress at this point can focus towards sport-specific type of exercises.
- It is important that as progress improves with cardiovascular fitness and strength to ensure proper spine mechanics to prevent further injury.
- Therapist to evaluate overall body mechanics to correct deficiency in kinetic chain.

Goals

- Improve cardiovascular fitness
- Incorporate sport-specific protocols
- Encourage proper spine mechanics throughout kinetic chain (from foot to head)

Protection

- Continue to monitor for proper form during activities

Management of Pain and Swelling

- NSAIDs as needed

Techniques for Progressive Increase in Range of Motion

Manual Therapy Techniques

- Muscle energy techniques (METs) for muscular recruitment or inhibition (as necessary)

Stretching and Flexibility Techniques for the Musculotendinous Unit

- Supine hamstring, hip flexor and piriformis stretches
- Stretching of gastroc-soleus complex

Other Therapeutic Exercises

- Standing cable upper extremity exercises with pelvic neutral
- Total Gym
- Swimming
- Treadmill or elliptical

Activation of Primary Muscles Involved in Injury Area or Surgical Structures

- Use of resistance bands of upper and lower extremities
- Use of unstable surfaces
- Advance of abdominal exercise (plank, etc.)
- Focus on transverse abdominals, external obliques, latissimus dorsi, gluteus maximus, gluteus medius, hamstrings, multifidus, psoas, quadratus lumborum

Sensorimotor Exercises

- Standing on unstable disc
- Single leg stance (SLS) static and dynamic activities
- BOSU ball

Open and Closed Kinetic Chain Exercises

- Use of bands and cables in variable directions/resistance in functional hip hinge position

Techniques to Increase Muscle Strength, Power, and Endurance

- Plank
- Lateral plank
- Resisted proprioceptive neuromuscular facilitation (PNF)
- Progress from previous phases to include hip flexors, quads, gastroc soleus, hip abductors and external obliques

Neuromuscular Dynamic Stability Exercises

- Single leg stance dynamic and static activities
- Improving body sense awareness in cutting, pivoting, and agility work
- Rocker-board activities
- Single leg stance (SLS) with lower body resistance bands

Plyometrics

- Squat jumps, broad jumps, single leg hops

Functional Exercises

- Education and technique for proper spine mechanics
- Increased resistance of long lever challenge on dynamic spine control
- Hip hinging with upper extremity weighted challenge
- Use of resistive bands in functional positions, i.e., lunge
- Overhead squatting

Sport-Specific Exercises

- Squat jumps, single leg hips
- Agility ladder
- Resisted golf swings

Milestones for Progression to the Next Phase

- Pain-free activities
- Core strength and LE strength within 10% of preinjury or “normal” level
- Single leg balance equal side to side

Phase VI: (weeks 24 to 52, Postoperative)**CLINICAL PEARLS**

Transition to sport should emphasize proper technique and spinal mechanics with restoration of sport activity. Proper spinal mechanics should be emphasized over performance until the ability to maintain those mechanics with endurance are achieved.

Goals

- Progress to normal activities and sport
- Regain normal sport velocity
- Establish endurance for sport and core body strength (depends on specific sport technique to be able to determine return to play)

Techniques for Progressive Increase in Range of Motion

- Manual therapy techniques not applicable, except as necessary as per previous phases
- Stretching of paraspinals, piriformis, hip flexors

Other Therapeutic Exercises

- Progression to cardiovascular endurance
- Progression of UE and LE resistance exercises with focus on proper form and endurance

Activation of Primary Muscles Involved in Injury Area or Surgical Structures

- Focus on transverse abdominals, external obliques, latissimus dorsi, gluteus maximus, hip abductors, hamstrings and lower extremity strengthening

Sensorimotor Exercises

- Stability ball
- Rocker board
- Single leg stance dynamic activities

Open and Closed Kinetic Chain Exercises

- Use of bands and cables in various directions/resistance in functional hip hinge position

Techniques to Increase Muscle Strength, Power, and Endurance

- Cardiovascular fitness to include treadmill, swimming
- Plank exercises
- Resisted PNF

Neuromuscular Dynamic Stability Exercises

- Agility work with cutting and pivoting/weight transfer
- Single leg stance dynamic and static activities

Plyometrics

- Lunges multidirectional
- Squat jumps
- Single leg jumps

Functional Exercises

- Increased resistance of long lever challenge on dynamic spine control
- Hip hinging with upper extremity weighted challenge
- Observation and correction of spine mechanics during exercise

Sport-Specific Exercises

- Agility ladder
- Carioca
- Pivot drills
- Resisted swinging (golf)

Milestones for Progression to the Next Phase

- Proper technique to and through fatigue
- Return to 10% of estimated or previous strength (manual muscle testing from therapist or isokinetic testing)
- LE strength within 10% of each other (manual muscle testing from physical therapist or isokinetic testing)

Criteria for Return to Sport**General**

- Within 10% of normal or previous (preinjury) core strength (How measured?)
- Proper mechanics to and through fatigue
- Pain-free mobility with activity and throughout agility drills
- Demonstration of sport skills with proper mechanics and pain free

Sport-Specific

- Golf
 - Pain-free proper mechanics of swing

- With attention to hip turn, spine position, and shoulder turn
- Football/contact sports
 - Ensure pain-free noncontact full speed prior to return
 - Gradual return to full contact (protected contact (player initiated) prior to open full contact)
 - Monitor closely during practice to ensure that athlete is progressing with proper mechanics/technique

After Return to Sport

Continuing Fitness or Rehabilitation Exercises

- Proper spine mechanics throughout activity (observed)
- Core strengthening exercises: plank, lateral plank
- Lower extremity strength and conditioning

Exercises and Other Techniques for Prevention of Recurrent Injury

- Lower extremity flexibility important for injury prevention
- Proper technique in sport
- Core (lumbar and abdominal) strength and endurance

Evidence

Danielson JM, Johnsen R, Kibsgaard SK, et al: Early aggressive exercise for postoperative rehabilitation after discectomy. *Spine* 25:1015–1020, 2000.

This is a randomized controlled trial comparing a training group and a mild exercise group postoperatively. Vigorous medical exercise started 4 weeks after surgery reduced disability and pain after surgery. (Level I evidence).

McGregor AH, Dore CJ, Morris TP, et al: Function after spinal treatment, exercise, and rehabilitation (FASTER). *Spine* 36:1711–1720, 2011.

This multicenter, factorial, randomized controlled trial on the postoperative management of spinal surgery patients. Found no difference at 12 months ODI for usual care versus rehabilitation versus rehabilitation with educational booklet and booklet only. (Level I evidence).

Ostelo RW, Costa LO, Maher CG, et al: Rehabilitation after lumbar disc surgery: An update Cochrane review. *Spine* 34:1839–1848, 2009.

This systematic review of randomized controlled trials evaluated postoperative protocol after lumbar surgery. Exercise programs after surgery seem to lead to faster decrease in pain postoperatively. (Level I evidence).

Ostelo RW, de Vet HC, Waddell G, et al: Rehabilitation following first-time lumbar disc surgery; A systematic review within the framework of the Cochrane collaboration. *Spine* 28:209–218, 2003.

This systematic review of randomized controlled trials evaluated the protocol for postoperative rehabilitation after first time lumbar surgery. No evidence for restriction of activities immediately after surgery was found and strong evidence for intensive exercise. (Level I evidence).

Weber H: Lumbar disc herniation: A controlled, prospective study with ten years of observation. *Spine* 8:131–140, 1983.

This prospective study of patients with surgical and nonsurgical treatment for lumbar disc herniation showed improved

outcomes in the surgical group at 1 year and no statistical difference at 4- and 10-year follow up. (Level 2 evidence).

Weinstein JN, Tosteson TD, Lurie JD, et al: Surgical versus nonoperative treatment for lumbar disk herniation: The spine patient outcomes research trial (SPORT)—A randomized trial. *JAMA* 296:2441–2450, 2006.

This prospective, randomized study of operative and nonoperative treatment for lumbar disk herniation found better outcomes in surgical patients, but the primary differences in the study were not statistically significant. There were large crossovers in the study confounding some conclusions. (Level I evidence).

Multiple-Choice Questions

QUESTION 1. An important aspect of the surgical technique includes all of the following except:

- Broad exposure of disc removing lamina for visualization
- Protection of the dura
- Fluoroscopic confirmation of level
- Removal of disc fragments

QUESTION 2. Pain control in Phase I for the patient who had surgical treatment for lumbar disc herniation should include:

- Narcotic medication
- Sleep
- Repeated injection
- Meditation

QUESTION 3. Squat jumps should first be incorporated into the postop protocol after surgical treatment for lumbar disc herniation in phase:

- Phase I
- Phase II
- Phase III
- Phase IV

QUESTION 4. Which milestone is important to advance to phase IV?

- Discontinuation of narcotic pain medication
- Complete resolution of pain
- Return to within 10% of preinjury strength
- The ability to do a plank exercise

QUESTION 5. Which of the following are essential for prevention of injury?

- Proper spinal mechanics during exercise and sport
- Return of core strengthening
- Appropriate lower extremity strength and flexibility
- All of the above

Answer Key

QUESTION 1. Correct answer: **A** (see Surgical Technique)

QUESTION 2. Correct answer: **A** (see [Phase I](#))

QUESTION 3. Correct answer: **C** (see [Phase III](#))

QUESTION 4. Correct answer: **B** (see [Phase III](#))

QUESTION 5. Correct answer: **D** (see [Phase VI](#))

BEYOND BASIC REHABILITATION: RETURN TO GOLF AFTER LUMBAR DISC HERNIATION

S. Josh Bell, MD, Stephanie Niño, PT, OCS, FAAOMPT, and Cheryl Obregon, PT, DPT, FAAOMPT

Introduction

ASPECTS OF GOLF THAT REQUIRE SPECIAL ATTENTION IN REHABILITATION

- Ensure adequate mobility throughout the kinetic chain (shoulders, hips, thoracic spine, etc.) to reduce load on lumbar spine.
- Hip strength including rotation and abductors.
- Proper spine mechanics throughout the swing.
- Lumbar disc herniation and lumbar strains are very common in golf.
- Surgery is relatively uncommon for golfers when compared to the number of injuries for this condition.
- Lumbar pain after strain, disc herniation, or other injury is very common in the athletic and occasional athletic population.
- Because golf requires trunk rotation to generate the golf swing, these injuries are very problematic for this sport. Appropriate treatment requires evaluation and treatment of the entire kinetic chain.

Advanced Rehabilitation Program

Week 0 to 12

- Follow protocols for postoperative rehabilitation of lumbar disc herniation (see timeline in the Nonoperative Rehabilitation part of this chapter).

Week 12 to 18

- Stretching/flexibility program (all static holds for 1 minute, 3 reps):
 - Half-kneeling hip flexor stretch
 - Child pose (heel to buttocks) to stretch paraspinals
 - Supine hamstring stretches ([Figure 19-33](#))
 - Supine piriformis figure-of-4 stretch ([Figure 19-34](#))
 - Seated torso rotation
 - Seated torso rotation with club ([Figure 19-35](#))
- Strengthening program to include: (10 to 15 reps, 2 to 3 sets)
 - External obliques and transverse abdominals:
 - PNF Standing diagonal, upper extremity with resistive bands or cables ([Figure 19-36](#))

- Seated resisted torso rotation with golf club
- Resistive shoulder flies and reverse flies ([Figure 19-37](#))
- Standard and side planks (begin with 30 seconds, progress to 1 minute)
- Bird dog (quadruped position with opposite arm and leg off the ground)



FIGURE 19-33. Supine hamstring stretch.



FIGURE 19-34. Piriformis figure-of-4 stretch.



FIGURE 19-35. Seated torso rotation with club.



FIGURE 19-37. Resistive reverse flies, standing.

- Hip abductors:
 - Standing hip abduction with resistive bands
 - Lateral squat stepping with resistive tubing
- Periscapular: (low weight, 3 to 5 minutes)
 - Postural exercise with cervical neutral and scapular retraction (Figure 19-38)
 - Unilateral resisted scapular retraction
- Balance exercise to include:
 - Squats on foam (10 reps, 2 sets)
 - Single-leg stance with and without foam (goal of 1 minute)

Week 18 to 24

- Stretching program to include (all static holds for 1 minute, 3 reps):

- Half-kneeling hip flexor stretch
- Child pose (heel to buttocks) to stretch paraspinals
- Supine hamstring stretches
- Supine piriformis figure-of-4 stretch
- Seated torso rotation
- Seated torso rotation with club
- Strengthening program to include: (10 to 15 reps, 2 to 3 sets)
 - External obliques and transverse abdominals:
 - Seated resisted torso rotation with golf club (Figure 19-39)
 - Resistive shoulder flies and reverse flies on foam
 - Side planks with resisted able pulling
 - Bird dog on foam rolls
- Hip abductors/rotators:
 - Standing hip rotation on stool with resistance (Figure 19-40)
 - Sideboard in hip hinge position with stick



FIGURE 19-36. Standing diagonal pulley upper extremity resistance with proper spine mechanics.

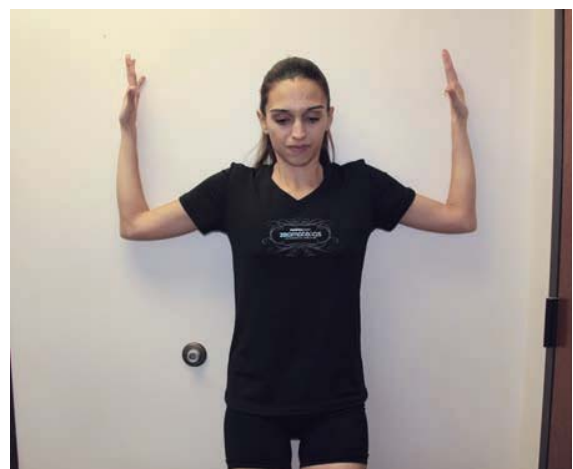


FIGURE 19-38. Postural exercise with neutral cervical alignment and scapular retraction.



FIGURE 19-39. Seated resisted torso rotation with club.

- Periscapular:
 - Resisted backswings
 - Resisted downswings
 - Resisted through-swings
- Balance exercise to include:
 - Standing on rocker board with golf swing (until patient fatigues)
 - Single-leg stance with resistance bands (Figure 19-41) (start with 10 reps each direction)

Sports Performance Testing

General History

- Previous injury history
- Length of time symptoms have been present

Subjective Questionnaires

- Oswestry disability index (ODI)
- Visual analog scale (VAS)



FIGURE 19-40. Standing hip rotation on stool with resistance.



FIGURE 19-41. Single-leg stance exercise with resistance bands.

Medical History

- Other chronic medical conditions
- Previous medical treatment

Sports Injury History

- How has this injury affected performance?
- How long have you trained/performed with this injury?

Surgical History

- Any previous surgery involving the present problem
- Other orthopedic or neurological treatment
- Previous injection history and response to injection

Chronic Conditions/Medication

- Current medications?
- Currently on narcotic medications?
- Do current activities require any medication for function?

Specific Tests

- ODI is used throughout the rehabilitation to assess progress to therapy and ability to advance to the next phase of rehabilitation
- Strength testing (side to side comparison) using manual muscle testing or isokinetic testing
- Single leg activities are used to advance the athlete, such as the Y excursion test
 - Static/dynamic postural assessments
 - Observation of technique during rehabilitation activities to ensure proper form
 - Use of pain-free swings: has athlete progressed back to full swings without pain?

Specific Criteria for Progression to the Next Stage to Determine Readiness for Golf

- Progression and mastery of core and lower extremity strengthening
- Reduction in measured ODI
- Improved performance on stability exercises (e.g., rocker board)

Specific Criteria for Release to Unsupervised Complete Participation in Golf

- Pain-free full swing with proper spine mechanics

Recommended Ongoing Exercises

- Core strengthening including abdominal, lumbar extension, and lower body strengthening should be continued indefinitely.
- Stability and balance exercises, rocker board, and balance ball should be continued.
- Lower extremity and spinal flexibility should be continued indefinitely.

Evidence

Danielson JM, Johnsen R, Kibsgaard SK, et al: Early aggressive exercise for postoperative rehabilitation after discectomy. *Spine* 25:1015–1020, 2000.

This is a randomized controlled trial comparing a training group and a mild exercise group postoperatively. Vigorous medical exercise started 4 weeks after surgery reduced disability and pain after surgery. (Level I evidence).

McGregor AH, Dore CJ, Morris TP, et al: Function after spinal treatment, exercise, and rehabilitation (FASTER). *Spine* 36:1711–1720, 2011.

This multicenter, factorial, randomized controlled trial on the postoperative management of spinal surgery patients. Found no difference at 12 months ODI for usual care versus rehabilitation versus rehabilitation with educational booklet and booklet only. (Level I evidence).

Ostelo RW, Costa LO, Maher CG, et al: Rehabilitation after lumbar disc surgery: An update Cochrane review. *Spine* 34:1839–1848, 2009.

This systematic review of randomized controlled trials evaluated postoperative protocol after lumbar surgery. Exercise programs after surgery seem to lead to faster decrease in pain postoperatively. (Level I evidence).

Ostelo RW, de Vet HC, Waddell G, et al: Rehabilitation following first-time lumbar disc surgery; a systematic review within the framework of the Cochrane collaboration. *Spine* 28:209–218, 2003.

This systematic review of randomized controlled trials evaluated the protocol for postoperative rehabilitation after first

time lumbar surgery. No evidence for restriction of activities immediately after surgery was found and strong evidence for intensive exercise. (Level I evidence).

Weber H: Lumbar disc herniation: A controlled, prospective study with ten years of observation. *Spine* 8:131–140, 1983.

This prospective study of patients with surgical and nonsurgical treatment for lumbar disc herniation showed improved outcomes in the surgical group at 1 year and no statistical difference at 4- and 10-year follow-up. (Level II evidence).

Weinstein JN, Tosteson TD, Lurie JD, et al: Surgical versus nonoperative treatment for lumbar disk herniation: The spine patient outcomes research trial (SPORT), A randomized trial. *JAMA* 296:2441–2450, 2006.

This prospective, randomized study of operative and nonoperative treatment for lumbar disk herniation found better outcomes in surgical patients but the primary differences in the study were not statistically significant. There were large crossovers in the study confounding some conclusions. (Level I evidence).

Multiple-Choice Questions

QUESTION 1. Specific considerations for return to sport for golf activities after lumbar disc herniations include all of these, except:

- Ensure adequate mobility throughout the kinetic chain (shoulders, hips, thoracic spine, etc.) to reduce load on lumbar spine
- Hip strength including rotation and abductors
- Proper spine mechanics throughout the swing
- Adequate wrist/grip strength for the swing

QUESTION 2. Sport-specific exercises after lumbar disc herniation begin at what interval after surgery?

- 8 weeks
- 4 weeks
- 12 weeks
- 16 weeks

QUESTION 3. Criteria to return the golfer to full sports activities without supervision include:

- Pain-free full golf swing with proper spine mechanics
- Single-leg jump equivalent on both sides
- Discontinuation of pain medication
- Upper body strength returned to preinjury level

QUESTION 4. Sport-specific exercises/rehabilitation protocols can start as early as ___ weeks after surgery/injury.

- 2 weeks
- 18 weeks
- 4 weeks
- 12 weeks

QUESTION 5. The proper interval for static stretches in the progress back to sport is:

- A. 3 minute stretch for 2 repetitions
- B. 30 second stretch for 5 repetitions
- C. 1 minute stretch for 3 repetitions
- D. 30 second stretch for 3 repetitions

Answer Key

QUESTION 1. Correct answer: **D** (see [Introduction](#))

QUESTION 2. Correct answer: **C** (see [Advanced Rehabilitation](#))

QUESTION 3. Correct answer: **A** (see [Specific Tests](#))

QUESTION 4. Correct answer: **D** (see [Introduction](#))

QUESTION 5. Correct answer: **C** (see [Introduction](#))