

Review Article

# Nursing review section of Surgical Neurology International: Part 1 lumbar disc disease

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Received: 19 April 17    Accepted: 19 April 17    Published: 11 December 17

## Abstract

**Background:** Patients with lumbar disc disease may present with low back pain, pain that radiates down to the lower extremity (radiculopathy), and leg pain that increases with ambulation (neurogenic claudication). Patients may first undergo diagnostic studies (magnetic resonance imaging, computed tomographic examinations) to determine whether there is any significant nerve root or thecal sac compression.

**Methods:** Increasingly, patients with low back pain with/without radiculopathy are being screened by nurses rather than by neurologists or neurosurgeons/orthopedists. Recognition of the basic neurological symptoms and signs of lumbar disc disease is critical to manage and triage these patients.

**Results:** The neurological examination includes evaluation of the straight leg raising test (SLR/Lasegue Maneuver) and assessment of: motor function [grade 0 (no motion) to grade 5 (normal motion)], reflexes [Patellar and Achilles levels graded 0 (absent) to grade 4+ (clonus)], sensory loss (pin prick, light touch, position, and vibration), and cerebellar function (tandem gait, heel-shin, and finger-nose-finger testing). Learning to read MR and CT studies for disc herniations is critical. Nonsurgical discs include those that are minimally protruding or bulging. Alternatively, surgical disc herniations when correlated with significant neurological findings are extruded (ruptured through the annulus) or sequestered (migrated beyond the disc space following rupture).

**Conclusions:** Familiarity with symptoms, neurological signs, and radiographic presentations for patients with lumbar disc disease is critical for nurses. Here, we review the important factors nurses should know to better recognize, triage, and treat patients with lumbar disc disease.

**Key Words:** Bulging; extruded, far lateral disc, foraminal, laminectomy, laminotomy, lumbar discs, nonsurgical, nursing, sequestered, surgical

Access this article online

Website:

[www.surgicalneurologyint.com](http://www.surgicalneurologyint.com)

DOI:

10.4103/sni.sni\_151\_17

Quick Response Code:



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**How to cite this article:** Epstein NE, Hollingsworth RD. Nursing review section of Surgical Neurology International: Part 1 lumbar disc disease. Surg Neurol Int 2017;8:301. <http://surgicalneurologyint.com/Nursing-review-section-of-Surgical-Neurology-International:-Part-1-lumbar-disc-disease/>

## INTRODUCTION

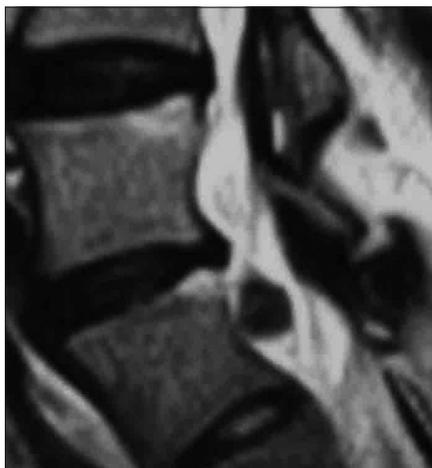
Nurses are increasingly seeing patients with low back pain and potential lumbar disc herniations in the office or in hospital settings. They need to learn how to perform a neurological examination and correlate symptoms (complaints) with neurological findings (signs). Familiarity with the various radiographic studies, including X-rays, magnetic resonance images (MRI), and computed tomographic studies (CT), is critical if nurses want to actively contribute to the care of these patients [Figures 1-10].

## SYMPTOMS OF LUMBAR DISC HERNIATIONS

Symptoms are defined by patients' complaints. These typically include pain, numbness/burning, tingling, and



**Figure 1:** Illustration of the location of lumbar discs. This illustration (Joseph A. Epstein M.D./Copyright Nancy E. Epstein M.D.) shows the different locations of lumbar discs; they may be located inside the spinal canal (centrally or laterally) or as shown (blue), outside the spinal canal [e.g. proximal or distal foraminaly (at the beginning or end of the foramen) and far laterally (beyond the facet joint)]



**Figure 3:** Parasagittal (off to the side) T2-weighted. MRI showing sequestered discs below L4-L5 interspace. This parasagittal T2-weighted MRI (CSF spinal fluid turns white/hyperintense) shows a sequestered fragment of disc that has migrated inferior to the L4-L5 disc space

weakness in a specific nerve root distribution down one or both legs (radiculopathy). If the compression involves multiple nerves, then the deficit may be multifocal; this is often defined as cauda equina compromise.

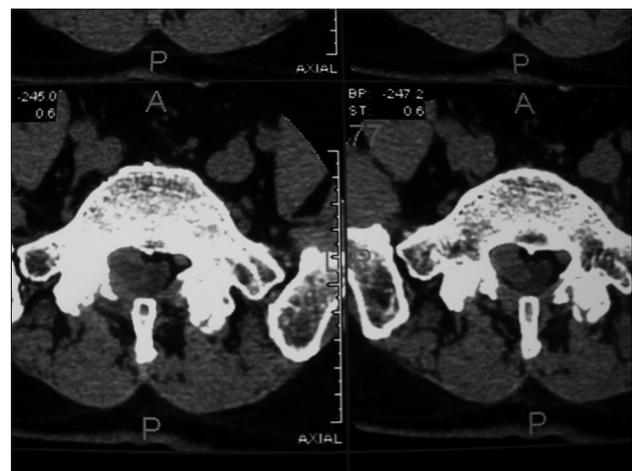
## NEUROLOGICAL SIGNS (EXAMINATION) FOR A LUMBAR DISC HERNIATIONS

### How to perform a neurological exam for a lumbar disc herniation

First, perform a straight leg raising (SLR) test (e.g., with the patient seated, the leg is elevated to 90 degrees). This stretches/tethers the nerve over a disc herniation, and produces pain at a certain height. For example, severe pain



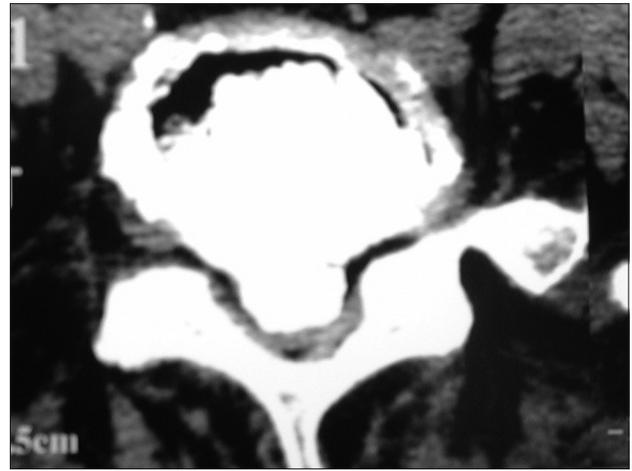
**Figure 2:** Axial MR of right L5-S1 lumbar disc (extruded). This axial T2 weighted MR image (T2 means the spinal fluid is white/hyperintense) demonstrated a right-sided L5-S1 disc herniation compressing the S1 nerve root. Note the additional marked anterolateral compression of the dura/theal sac containing the cauda equina



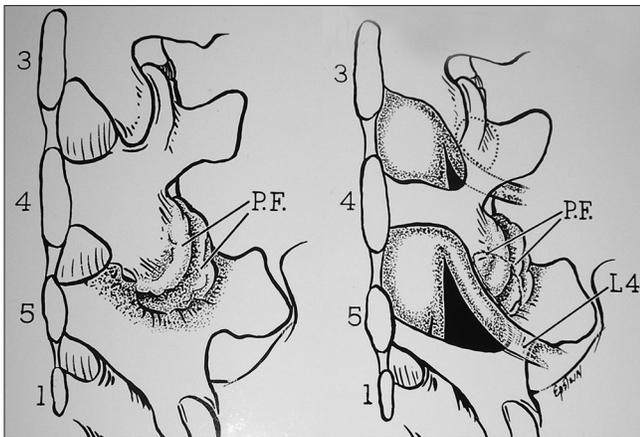
**Figure 4:** Axial noncontrast CT scan showing a massive extruded/sequestered L5-S1 disc with right-sided inferior migration opposite S1. This axial noncontrast CT scan demonstrates a massive right-sided extruded/sequestered disc at the L5-S1 level with marked right-sided inferior migration opposite to the S1 pedicle. Note severe compromise of the thecal sac and obliteration of the S1 nerve root



**Figure 5:** Noncontrast CT scan of the left lateral/foraminal/far lateral disc at the L3-L4 level. This noncontrast CT scan demonstrates a left-sided lateral/foraminal/far lateral disc herniation resulting in some anterolateral compression of the dural sac, along with marked obliteration of the superiorly exiting L3 nerve root as well as compression of the inferior L4 nerve root. Here, the patient may require a full facetectomy [Figure 11]

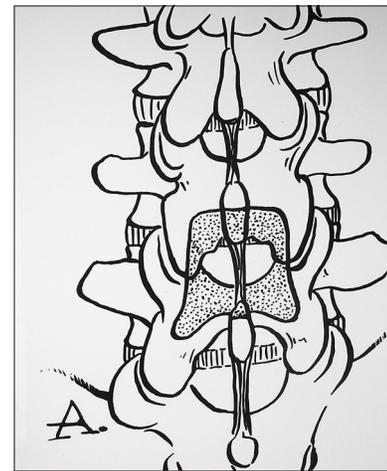


**Figure 6:** Noncontrast axial CT scan of massive central calcified disc/limbus fracture filling the spinal canal contributing to cauda equina compression. The axial noncontrast CT demonstrated calcification/ossification of a massive central disc herniation filling the spinal canal at the L4-L5 level. This is also called a limbus fracture. This patient presented with a cauda equina syndrome (paralysis) and required removal of this disc through a coronal hemilaminectomy [Figures 8 and 9] from both sides



**Figure 7:** Right-sided lateral foraminal stenosis requiring L4-L5 laminotomy. In this case (Image: Joseph A. Epstein M.D./Copyright Nancy E. Epstein M.D.), the patient had right-sided compression (unilateral) at the L4-L5 level of the L4 and L5 roots. Note the compression extended laterally/foraminally requiring partial removal of the lower part of L4 and upper part of L5 (laminotomy) with partial right L4-L5 facetectomy (removal of the facet) to decompress the L4 and L5 roots and thecal sac

would correlate with a positive SLR test at 10–20 degrees, moderate at 30–50 degrees, mild at 60–80 degrees, and negative at 90 degrees. Next, the motor examination is assessed using a 6-point scale; 0 (no function/paralysis) to 5 (normal). The motor exam includes (with the patient seated) the assessment of iliopsoas function (elevate the knee), quadriceps strength (straighten the leg out), dorsiflexion (pull the foot and toes up), and plantar flexion (push the foot down – give me 90 miles an hour). The reflexes are assessed on a 5-point scale: 0 (absent) to 4+ (clonus); in addition, the Babinski response (stimulating the bottom of the foot) may

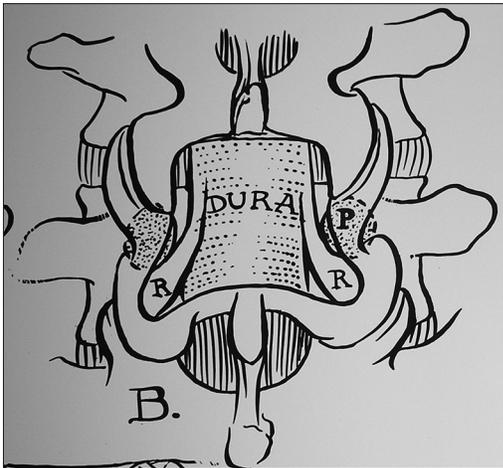


**Figure 8:** Illustration before removal of the L4-lamina above and L5 lamina below to perform a coronal hemilaminectomy. This illustration (Joseph A. Epstein M.D./Copyright Nancy E. Epstein M.D.) shows how much of the bone that will have to be removed to perform a coronal hemilaminectomy at the L4-L5 level. This involves removing half of the lamina above (L4) and half of the lamina below the L4-L5 disc space level

indicate cord compression. The cerebellar exam includes evaluation of tandem gait [walking on a straight line with one foot in front of the other (test for inebriation)] and heel-shin (placing one foot over the knee and sliding it down the shin without wavering).

### Magnetic resonance scans of lumbar disc herniations

MR scans best demonstrate soft tissue (e.g., similar to the chocolate side of an M&M) [Figures 2 and 3]. They reflect the water content of the tissues, and thereby show



**Figure 9: Coronal hemilaminectomy L4-L5 level (removal of half of L4 and half of L5 laminae).** In this illustration (Joseph A. Epstein M.D./Copyright Nancy E. Epstein M.D.), half of the lower part of the L4 lamina and half of the upper part of the L5 laminae have been removed. This constitutes a coronal or partial laminectomy of both the L4 and L5 levels, potentially allowing access to a central disc herniation at that level. Note adequate visualization of both L5 roots (on either side) and the central thecal sac (nerve tissue in the middle)

you the nerves but only show you the water in the bone. Typically, MR scans are the studies first performed to demonstrate lumbar disc herniations because they do not involve radiation and are noninvasive tests.

### Computed tomographic scans

CT images best show the bone (e.g., the hard candy shell of the M&M). They clearly demonstrate in a positive image the actual location of the bone itself, as well as other calcified/ossified tissues [Figures 4-6].

## TYPES OF DISCS

### Bulging and protruding discs (nonsurgical lesions)

Nonsurgical degenerative changes of lumbar discs are frequently found on MR scans of the lumbar spine. These findings increase in frequency with age. Neither bulging or protruding discs significantly compress nerve tissue.

### Extruded and sequestered lumbar discs

Disc herniations that go through the annulus of the disc (the surrounding capsule of the disc) may be surgical lesions. Extruded discs are defined as those that have ruptured through the annulus, but the fragment(s), are still in continuity with the disc space itself. On the other hand, the sequestered disc has not only ruptured through the annulus, but the fragments have migrated away from the capsule, extending above, below, or to the side of the disc level.

### Abnormal neurological exam that may correlate with a lumbar disc herniation

Neurological signs of significant surgical lumbar disc herniations may include a positive femoral stretch



**Figure 10: Left-sided laminotomy at L4-L5 and right-sided hemilaminectomies at the L3-L4, L4-L5, and L5-S1 levels.** This illustration (Joseph A. Epstein M.D./Copyright Nancy E. Epstein M.D.) demonstrates on the left a laminotomy at the L4-L5 level (removal of half of the lamina of L4 above and half of L5 below). On the right side, the lower part of L3 (laminotomy) and all the L4 and L5 laminae (hemilaminectomies) have been removed to decompress the L3-4, L4-L5, and L5-S1 levels

test (L2-L4) or SLR signs. These findings must then be correlated with other neurological deficits.

### L1-L2 and L2-L3 discs (proximal lumbar disc herniations)

At the L1-L2 level, if the disc is off to one side, the patient may be unable to lift the knee (while seated; weakness of the iliopsoas), straighten the knee (quadriceps) with an absent knee jerk (Patellar response), and can have numbness in the thigh (L1, L2, L3 distributions). When the disc fills the spinal canal at this level, the patient may present with paralysis (cauda equina syndrome), that may also include sphincter (bowel/bladder) dysfunction (incontinence).

### L3-L4 discs

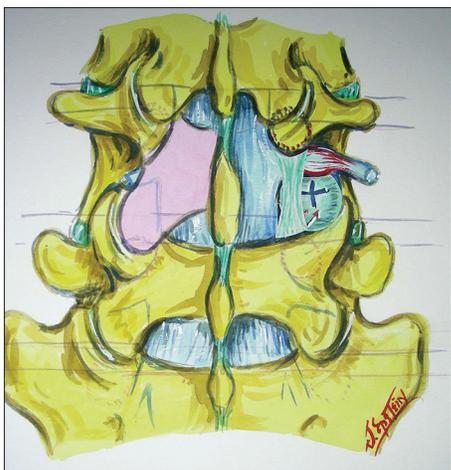
A patient with a unilateral L3-L4 disc may demonstrate weakness on elevating the thigh (iliopsoas) and straightening out the leg (quadriceps), a loss of the knee reflex (Patellar response), and decreased pin appreciation in the L3-L4 distributions (anterior thigh; inside/medial calf). If this is on both sides and fills the canal, the patient may be paralyzed, and may exhibit a cauda equina syndrome with sphincter dysfunction.

### L4-L5 discs

Unilateral disc herniations at the L4-L5 level may present as a foot drop – weakness of the extensor hallucis longus and dorsiflexors (L5 distribution) accompanied by a loss or decrease of the ankle reflex (Achilles response), as well as decrease in pin appreciation in the L5 distribution (outside of the calf and over the top of the foot).

### L5-S1 discs

Disc herniations at the L5-S1 level on one side typically compress the S1 nerve root. Patients may demonstrate



**Figure 11: Unilateral inferior facetectomy vs. full facet removal during laminectomy.** This figure (Joseph A. Epstein M.D./ Copyright Nancy E. Epstein M.D.) illustrates a laminectomy at the L4 level (both sides). The left inferior articular facet (L4 lower facet on the left) has been removed, but the superior articular facet (connected to the L5 lamina) is still intact. On the right, the entire L4-L5 facet has been removed to allow excision of a far lateral free disc fragment (seen way off to the side)

an inability to walk on the toes on that side indicating plantar flexor weakness, a loss of the ankle reflex (Achilles response), and decreased pin appreciation on the lateral aspect of the foot.

## LUMBAR DECOMPRESSIVE PROCEDURES

There are different types of lumbar decompressive operations available for lumbar spine surgery [Figures 7-10].

### Coronal hemilaminectomy

A laminectomy involves removal of the bone on both sides to decompress an entire level. This may include removal of a portion of the lamina above and below the disc space to be decompressed. For example, if the disc is bilateral (both sides) at the L4-L5 level, a coronal hemilaminotomy (removal of half lower part of the lamina L4 above and half of the L5 lamina below) would be performed [Figures 8 and 9].

### Laminotomy

However, one can also just remove part of the lamina above and below one disc space to address a one-sided disc herniation. This is called a laminotomy. For example, if there is a disc herniation at the L4-L5 level on just one side, then the lower part of the L4 hemilamina above and the upper portion of the L5 hemilamina below would be removed [Figure 7]. This can be repeated at any level (e.g., in the illustration in Figure 7 involving the L5-S1 level).

### Laminotomy on one side and multilevel hemilaminectomy on the other side

In some cases, patients may warrant a laminotomy (partial removal of the lamina above/below) at one interspace on one side (right side Figure 10), whereas there may be multilevel stenosis requiring removal of the hemilaminae (half of the laminae) on the other side (left side of Figure 10).

### Laminectomy with different degrees of facet removal to address foraminal and far lateral discs

In cases where a patient has a lumbar disc herniation extending laterally, foraminally, or far laterally (way off to the side), more extensive facet resection (removal) may have to accompany the laminectomy. As illustrated in Figure 10, when the disc is located underneath the facet joint (foraminally), one may be able to access the disc by removing the inferior articular facet (seen on the left side of the diagram). However, if the disc is found far laterally, beyond the facet joint, full facet removal may be warranted (on the right side of Figure 10).

## CONCLUSION

This is just a short introduction for nurses who want to become more familiar with the symptoms, signs, radiographic (X-ray, MR, CT) findings, and surgical procedures available for treating lumbar disc herniations.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.