DISC HERNIATION

Disc Herniation

What is a disc herniation? A disc herniation is the term given to a region of the disc (usually the posterior region) that abruptly juts outward--often compressing the delicate adjacent neural structures.

Disc herniations cannot be seen on x-ray; instead, so magnetic resonance imaging (MRI) must be ordered in order to properly visualize the disc. CAT scan can also be utilized; however, it is better at seeing bone than disc.

With regard to herniations size, ironically, the bigger the herniation the better. That is because – for reasons not completely understood – these bigger herniations respond much better to surgical decompression. This phenomenon has been well researched by Carragee and will be discussed more below. With regard to pain, however, the size of the herniation has nothing to do with it. That is, very small herniations can be just as painful (if not more painful) than giant herniations.

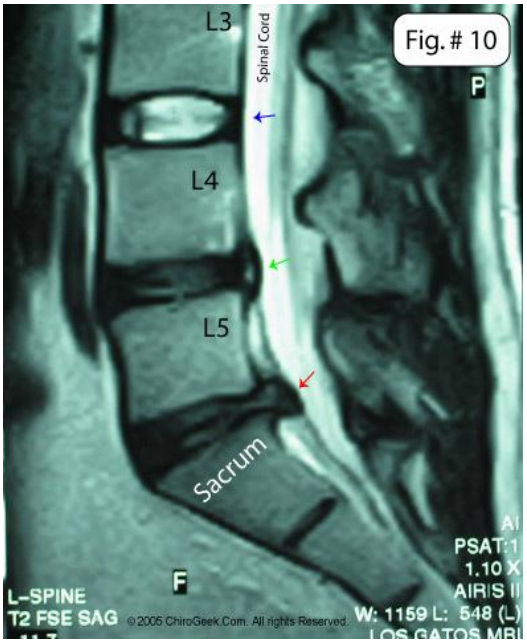


Figure # 10*: This is a sagittal (from the side view) T2 weighted MRI lumbar image, demonstrates two types of disc herniation: the L5/S1 disc has suffered a 9mm disc extrusion (red arrow) that is not contained by the PLL. The L4/5 disc has suffered a smaller 4mm disc protrusion (green arrow) that is contained by the PLL (a remnant HIZ sign is also seen here). The L3/4 (blue arrow) is completely normal and has no disc material projecting posteriorly into the epidural space. Also note that the L3/4 disc is white in color, which indicates it is non-degenerated (i.e., full of water and healthy proteoglycan). The two herniated discs (L4/5 & L5/S1) are "black" on this MRI image, which indicates disc desiccation (lack of water and proteoglycan) and is termed "degenerative disc disease" (DDD); this is usually a precursor to disc herniation for it weakens the annulus that contains the pressurized and irritative nuclear material.*

In other words, a disc herniation occurs when the Jell-O like center of the intervertebral disc (nucleus pulposus) tears its way through the back outer portion of the disc (annulus fibrosus) and invades the space (anterior epidural space) where the delicate nerve structures live (thecal sac and nerve roots). And the presences of this nuclear material (which is filled with biochemical irritants called cytokines) in the anterior epidural space may severely irritate these neural structures, which in turn may cause severe back and/or leg pain. It is still being debated as to whether the cause of disc-herniation-induced sciatica is secondary to compression or secondary to chemical irritation of the nerve roots. Many authors believe it is a combination of both.

The Confusion of Disc Herniation and Sciatica:

Modern research as demonstrated that the relationship between disc herniation and its often-time associated sciatica are a far more complex and bewildering than previously realized. For example, since the invention of MRI, we have learned that some patients have disc herniation on MRI, yet have no pain at! And, visa versa: some patients have terrible back and leg pain yet have no disc herniation or visible disc defect on MRI! Even more confusing is the fact that some patients who completely recover from the back pain and sciatic, still have the same disc herniation appearance on follow-up MRI!

The Contained Disc Herniation:

Another strange irony is the fact that smaller and innocent looking disc herniations are the most difficult to treat and respond less favorably to decompressive surgery (discectomy) and conservative care, when compared to the larger and more advanced disc extrusions and sequestrations.

So how do we treat such a small contained herniation? Derby says, unfortunately, that we have yet to discover a good cure and interbody fusion (which empirically has a horrible reputation) is the alternative. However, we have a technology called Nucleoplasty, as well as other minimally invasive nuclear decompression devices, which are trying to bridge the gap between fusion and discectomy. Unfortunately, the evidence is not quite there and even the leading researchers can't agree on the efficacy of these percutaneous Nucleotomys .

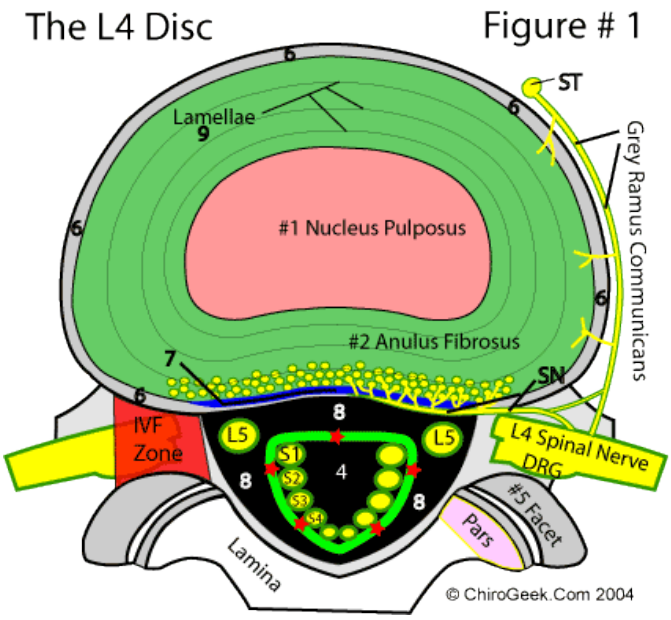
And to further cloud the water, we now know that sciatica (a horrible burning lower limb pain associated with disc herniation) is not always causes by the direct compressive pressure from a herniated disc. That is, it can be caused from nuclear material "leaking" from the back of the disc onto the adjacent nerve roots, i.e., chemical radiculopathy and/or from chemical and pressure irritation of the posterior intradiscal nerve fiber, i.e., the sinuvertebral nerves, which is called discogenic sciatica.

THE TUTORIAL: THE BIRTH OF A DISC HERNIATION

Let's begin our tutorial with a quick review of the normal disc, and then proceed through each type of herniation.

The Normal Disc:

Figure #1*: The 'nucleus pulposus' (pink #1), which is a water-rich gel-like mass of proteoglycan material, has the duty to support the tremendous 'Axial-Load' (weight) of the body. This nucleus is 'corralled' by the stronger 'Annulus fibrosus' (green #2). The annulus is made out of concentric rings of a cartilage-like material called '**lamellae**' (#9). It is this specially arranged collagen that gives the annulus the tremendous strength needed to hold that nucleus in place. (The nucleus pulposus, because of the tremendous axial load upon it, is constantly trying to escape from the confines of the center of the disc. If it does manage to escape (tear) through the PLL (#7), the appearance on MRI is called a disc extrusion)*

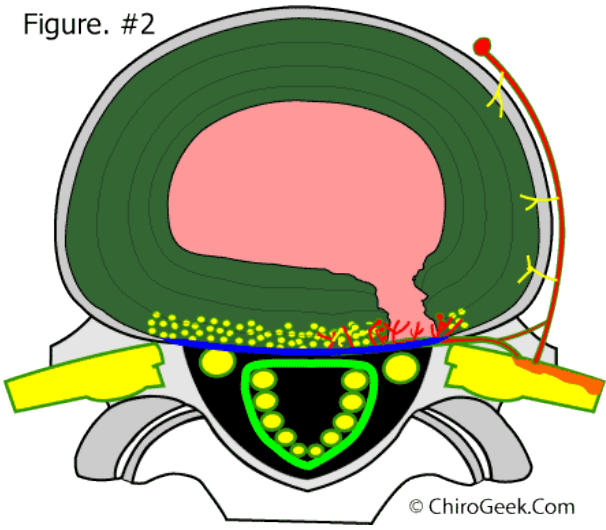


The "posterior longitudinal ligament shields the delicate posterior neural structures and acts as a last line of defense against the potentially irritating nucleus pulposus. Note the posterior disc is 'concave' in shape, as outlined by the PLL. The 'posterior neural structures', which are very sensitive to pressure and chemical irritation, include the following: **'**Spinal Nerve Roots**'** (L4, L5, S1), **'**Dura Mater or the Thecal Sac ' (red star), and the 'Dorsal Root Ganglion**'** (DRG). And finally we have the sinuvertebral nerve (# SN); the Sinuvertebral nerve connects to the outer 1/3 of the annulus fibrosus. These tiny nerve ending have the ability to carry PAIN messages to the brain and are thought to be one of the causes of discogenic pain. The epidural space (#8) also contains the traversing nerve roots (L5) that are often the favorite target of the compressive disc herniation.

THE DISC BULGE: first step to disc herniation

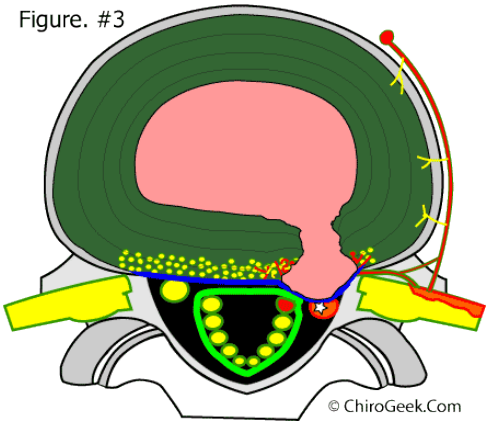
In order for a disc to herniate, its structural components must first 'weaken'. This weakening occurs as a result of disc degeneration. Disc degeneration occurs naturally, to some degree, in all disc, but in some people the process become especially severe and damaging. The 'bottom-line' of the degeneration process is that the annulus becomes dried and brittle, hence allowing for the development of disc bulging and full thickness posterior annular tearing, or internal disc disruption.

Figure #2 *demonstrates the 'pre-cursor' to a disc herniation. This type of disc lesion - that bulges into the anterior epidural space without any area of focal-ness or out-pouching - would be called a "disc bulge" on MRI (only because the MRI can NOT show the condition within the disc), although in reality it is a "grade 3 radial annular tear" (you would need CT discography to identify the tear) that has disrupted the posterior annulus and allowed irritating nucleus pulposus material to enter into the outer fibers of the disc. Again, this in of itself (IDD) may cause severe and disabling pain in some unfortunate people; however, the subject of Internal Disc Disruption is not the focus of this page. Also note that the PLL, although bulged, continues to be intact and has not ruptured. As well shall see later, the PLL is the 'key' to differentiating between a disc protrusion and a disc extrusion. Finally, note that the Sinuvertebral nerves are irritated (red) and are sending pain signals on to the brain through the sympathetic nervous system.*



Disc protrusion: Posterior longitudinal Ligament is still intact

Figure #3 *demonstrates a 4 millimeter disc protrusion and represents a worsening of our disc bulge. The posterior of the disc is 'focally' or 'eccentrically' pushing backwards into the anterior epidural space and has contacted, and even somewhat compressed, the traversing nerve root (white star) and right front corner of the thecal sac. Note that the PLL (blue) still has NOT been disrupted and is still "containing" the near-herniated nuclear material.*



Although disc protrusions are seen in about 30% of the normal non-symptomatic population, nerve root compression is not, and if much more indicative of a 'problem. This patient may well be suffering right sided radicular pain (sciatica) and/or lower back pain as a result of compression/irritation of the traversing nerve root and/or irritation of the sinuvertebral nerves in the posterior of the disc.

Disc extrusion: the posterior longitudinal ligament has ruptured

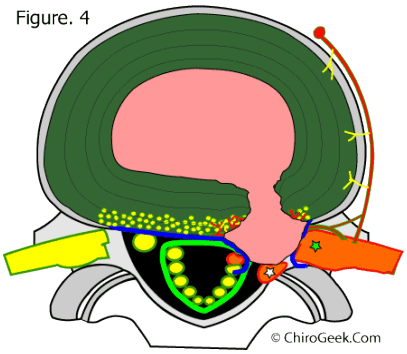


Figure #4 demonstrates a more serious progression of our pathologically degenerated disc: an 8 milimeter disc extrusion (non-contained herniation) is now present. The PLL (blue) has finally been defeated and has completely ruptured, hence allowing for further migration of the nucleus pulposus into the anterior epidural space. Note the marked displacement of the transversing nerve root (white star) and the exiting nerve root (green star) which has now turned completely red with inflammation and venous congestion. The disc extrusion is NOT typically seen in the asymptomatic person and is often an indication for surgical decompression.