Limitations And Pitfalls Of Medical Imaging Of The Low Back

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"Members of the jury, a picture is truly worth a thousand words and I have objective proof that my client suffered a significant back injury in the car accident. I have the equivalent of an anatomical drawing of my client's spine that shows a large herniated disk in his low back. This image was created by a computer-enhanced machine called an MRI and provides proof of the devastating injury my client sustained. In fact, I will show you this medical image during the trial and you will be able to visualize this painful abnormality for yourself."

THIS TYPE OF OPENING STATEMENT could become common in view of the medical advances in diagnostic imaging that help identify anatomical abnormalities in the low back.[1] But, is it really this simple? Does the MRI scan actually "prove" that a specific injury caused the disk herniation or even if this abnormality is causing pain? This article will ex-

plore the anatomical construction of the low back, the various types of imaging modalities used in diagnosing problems to this anatomical area, and the limitations of those tests.

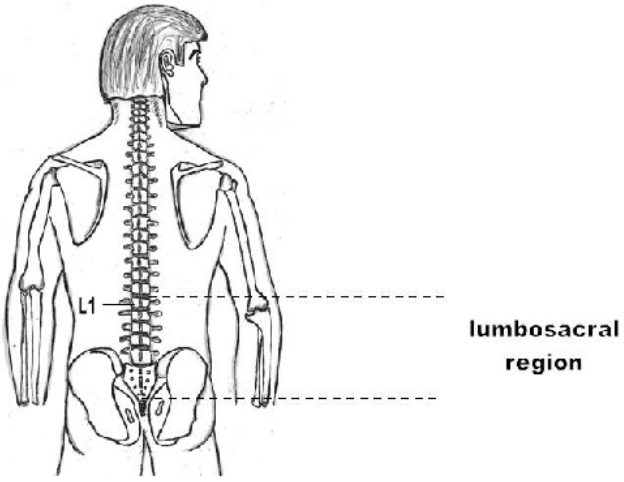
ANATOMY OF THE BACK • Since an imaging study reveals anatomy, it is useful to look at how the low back is constructed. The low back, known as the lumbar or lumbosacral region of the spine, is the termination point of the spine with attachment to the pelvis.

Bones

The bones of the low back consist of five lumbar vertebrae and a fused bone known as the sacrum. Bones themselves, however, are not pain sensitive; it is the membrane covering these structures, the richly innervated periosteum, that causes pain from bone trauma, such as a fracture, or a nontraumatic cause, such as cancer.

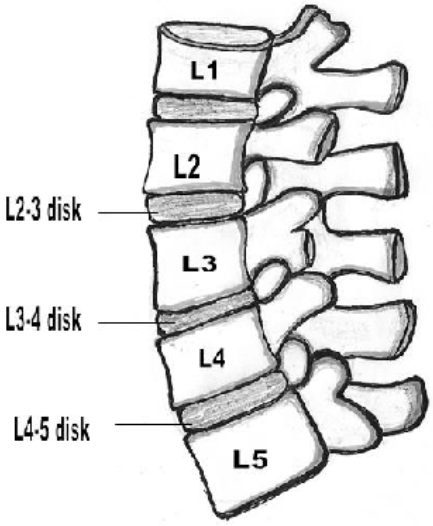
The five lumbar vertebrae are stacked on top of each other like napkin rings and are labeled L1 to L5 consecutively; the L1 vertebra is the highest and located at the level of the navel.

Illustration 1



The location of the lumbosacral region in the body

Illustration 2

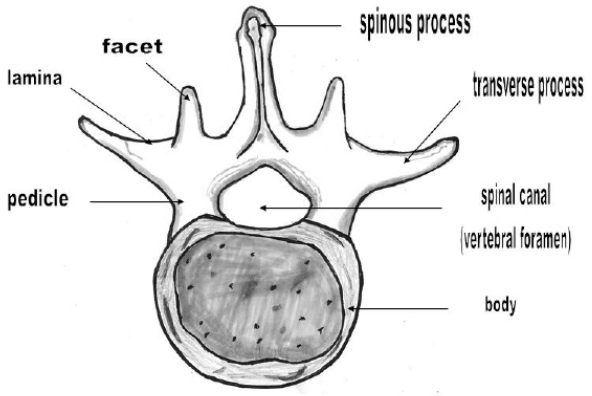


The lumbar vertebrae with intervertebral disks

Its major components are bones, joints, ligaments, disks, muscles, and nerve roots. Unfortunately, any of these structures can be a pain generator, a fact that contributes to the difficulty in diagnosing the cause of a person's low back pain.

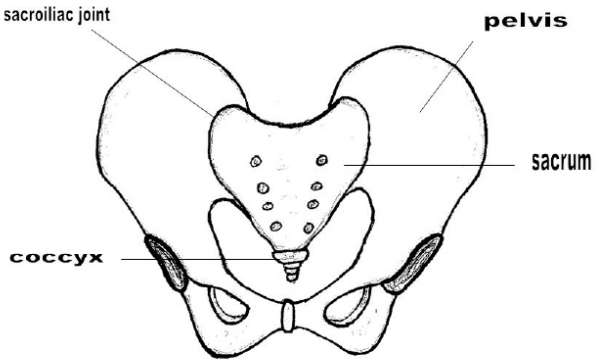
In addition to their role in supporting the weight of the upper body, vertebrae allow the low back to move, provide for muscle attachment to the spine, and protect the nerve roots that extend from the spinal cord through openings in the spine on their journey down into the legs.

Illustration 3



A lumbar vertebra – top view

Illustration 4



The sacrum and pelvis viewed from the front

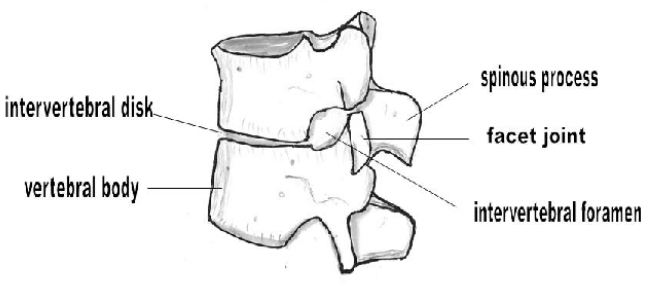
Each vertebra has two parts: a massive body that supports the downward weight, and a more delicate arch that extends posteriorly (toward the back) from the vertebral body. The arch forms an opening, called the spinal canal or vertebral foramen, which contains and protects the nerve roots coursing downward from the spinal cord. The arch, attached to the vertebral body by paired pedicles, extends outward to the sides as the transverse processes which serves as the attachment for muscles, and completes the structure as the lamina. The vertebral arch terminates as the spinous process which is felt as the bony bumps underneath the skin of the back. Two sets of vertebral joints, the facets, interconnect each vertebra with the one above and below and allow a person to bend forward and back or side to side.

The other bony structure of the low back, the sacrum, is actually a series of fused vertebrae that appears like an upside-down triangle when viewed from the front. In turn, the fifth lumbar vertebra (L5) sits on top of the sacrum. The termination point of the low back is the coccyx, or tailbone, attached to the end of the sacrum. The role of the sacrum is to connect the spine to the pelvis via the sacroiliac joint (SI joint), located on each side of the sacrum.

Joints

Joints such as the elbow and knee allow body parts to bend and turn. In the low back, the facets and sacroiliac joints provide that mobility and are supplied by sensory nerve fibers that generate pain signals. The two paired facet joints are the way that each vertebra interconnects with the vertebrae above and below it thereby providing for movement.

Illustration 5



Two lumbar vertebrae – side view

Facets are the cause of low back pain in 10-20 percent of patients. Swenson, *Differential Diagnosis: A*

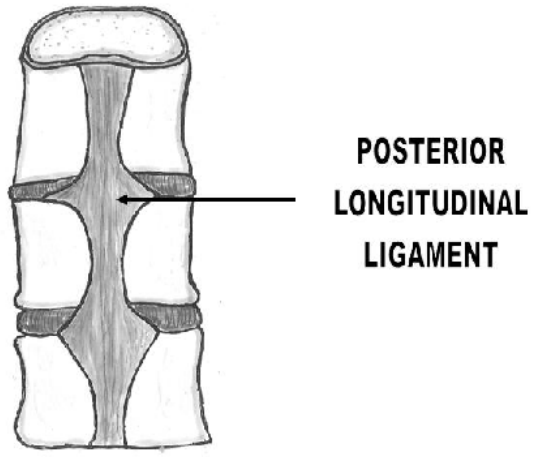
Reasonable Clinical Approach, 17 Neurologic Clinics 43 (1999); 17: 43-63, WB Saunders, Philadelphia.

The sacroiliac (SI) joint, connecting the sacrum to the pelvis, is not as mobile as the facets, allowing for only small movements and accounts for 13-30 percent of low back pain. Schwarzer, Aprill & Bogduk, *The sacroiliac joint in chronic low back pain,* 20 Spine 31 (1995).

Ligaments

Ligaments connect one bone to another and consist of fibrous bands of tissue. In the low back, they keep the vertebrae in place, providing stability to the spine. Like cables, some strap-like ligaments extend up and down the length of the spine, called longitudinal ligaments. These structures are located in the front and back of the spine and are known as the anterior longitudinal ligament and posterior longitudinal ligament respectively.

Illustration 6

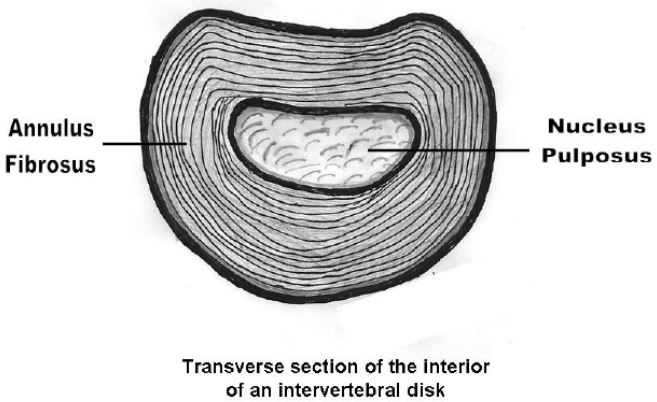


The spine also has a series of short ligaments, the ligamentum flavum, that connect the lamina of the individual vertebrae together. While ligaments are supplied by nerve fibers, it is unclear as to how much they contribute to the symptom of low back pain. Czerniecki and Goldstein, *General Considerations Of Pain In The Low Back, Hips, And Lower Extremities,* inn Bonica's Management of Pain, ch. 75 (John Loeser, ed., Lippincott & Wilkins, 3d ed. 2001).

Disks

The intervertebral disks are probably the most misunderstood component of the low back. Placed between each vertebra, they serve as cushions for the spine, acting as shock absorbers for the micro-traumas of daily life. Disks also allow the vertebrae to slide against one another providing for a small degree of mobility. Like a jelly donut, a disk consists of an inner gelatinous core named the nucleus pulposus and an outer firmer layer termed the annulus fibrosis.

Illustration 7



Transverse section of the interior of an intervertebral disk

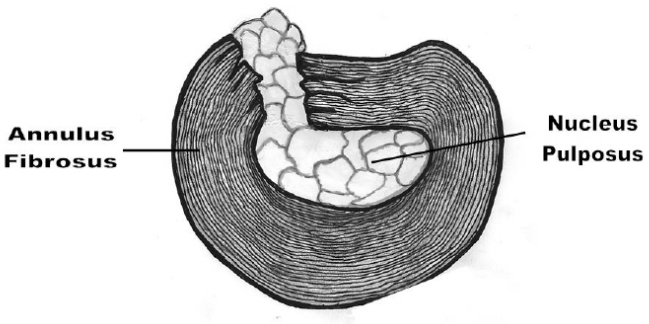
The nucleus pulposus is 90 percent water by volume during a person's younger years with elements of connective tissue accounting for the remaining

10 percent. Encasing the nucleus pulposus is the tough outer annulus fibrosis which consists of criss-crossing fibers resembling a steel-belted radial tire.

Disks are usually designated according to the vertebrae above and below them. Thus, the L3-4 disc is located between the third and fourth lumbar vertebrae.

In a disk herniation (also known as a slipped disk), the gelatinous core oozes through a tear or defect in the annulus, just as that which occurs when a grape is squeezed so that the inner pulp extrudes through the skin of the grape. Disks almost always herniate posteriorly in the middle (central or midline disk) or to the left or right sides (lateral disk) and may trap the exiting nerve root.

Illustration 8



Herniation of the nucleus pulposus through a tear in the annulus fibrosus

When this type of entrapment happens, surgery (discectomy) may be needed to remove the extruded nucleus pulposus thereby decompressing the nerve root. However, "the term herniated disk does not imply any knowledge of etiology, relation to symptoms, prognosis or need for treatment." Modic, Ross, *Lumbar degenerative disk disease,* 245 Radiology 43 (2007).

Nerve Roots

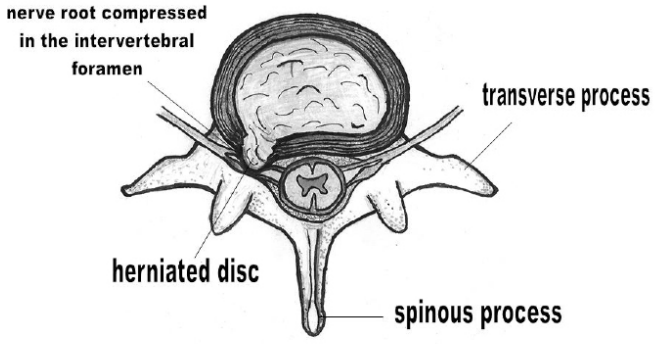
The lower portion of the spinal cord ends around the L1 or L2 levels and is termed the conus medullaris. Extending from the spinal cord are paired sensory and motor nerve roots course downward individually, protected within the vertebral spinal canal, on their journey to the legs. To some ancient anatomist, this bundle of nerve roots in the low back resembled a horse's tail, so it became known as the cauda equina.

Sensory nerves relay information such as pain, temperature, and touch from the legs upward toward the spinal cord on its way to the brain. On the other hand, motor nerves carry signals outward from the spinal cord to the muscles of the legs, causing the muscles to contract and the legs to move.

In the low back, the nerve roots exit from the spine through openings, the intervertebral foramina, formed by the stacked vertebrae above and below the disc. When this opening becomes too narrow due to bony overgrowth, the exiting nerve roots may become compressed, requiring surgery to relieve the pressure on the nerve roots. This procedure is known as a foraminotomy.

After exiting the spine in the low back, the nerve roots extend down the leg in a specific pattern providing sensory and motor function to that portion of the lower limb. By knowing this pattern, physicians often can diagnose which nerve roots are affected. For example, a herniated L5-S1 disk that is pressing on the S1 nerve root often causes shooting pain from the back, down the back of the thigh, calf and into the outside of the foot. This pattern of pain is called sciatica and is often accompanied by numbness and tingling in the lower extremity. These sensory changes follow a dermatomal pattern; that is, each sensory nerve root follows a specific pattern into the extremity. By knowing the sensory pattern that the nerve root follows, a dermatome, the physician can determine which nerve root is affected, thereby identifying which level of the lumbar spine is involved.

Illustration 9



Herniated disk compressing the nerve roots existing through the intervertebral foramen

This drawing should be corrected to saw "… compressing the left nerve root" and remove "exiting through the intervertebral foramen.

If the motor nerve roots are also affected, the individual will experience weakness in specific muscle groups supplied by that nerve root. A myotome refers to a group of muscles supplied by a single nerve root. In an S1 compression, for example, the calf muscles may be weakened causing difficulty when pushing down with the foot such as in attempting to stand on the toes. Reflex testing may also reveal an abnormality, such as a diminished ankle reflex which is reflective of an S1 nerve root compression. Likewise, a diminished patella tendon reflex is indicative of a problem with the L4 nerve root.

Muscle

Muscles can be a source of pain and the muscles of the back are important pain generators for low back pain. Swenson., supra; Travell & Simons, *Myofascial Pain and Dysfunction,* The Trigger Point Manual, ch. 2 (Williams and Wilkins 1983).

Back muscles vary in length and size and are found in multiple layers. In addition, muscles in the buttock can cause back pain and sometimes mimic a nerve root compression problem.

Muscle pain can be acute, such as a spasm from a back sprain, or chronic, resulting from myofascial trigger points. The latter are localized or focal regions of muscle that remain tight and knotted from an acute or repetitive injury causing persistent localized pain as well as radiating symptoms down the leg, mimicking a nerve root problem. *Id.*

The Normal Aging Spine

As we age, just like wrinkles and gray hair, changes occur within the spine, Most of the time, these changes are asymptomatic; that is, they do not cause pain. When radiologists report these changes on diagnostic images, they usually use the term "degenerative." Unfortunately, this term creates a mental image to the patients of their back falling apart and disintegrating; the descriptor "normal aging" would be a better choice. Thompson & Carr, *Content analysis of practitioner-requested lumbar spine x-ray reports,* 80 Brit. J. Radiology 866 (2007).

Aging changes in the low back can be seen as early as the third decade of life. Swenson, supra. Aging changes which occur in bony structures include bone loss (osteoporosis) and bone spurs (osteophytes). The disks age by loss of water content, turning the gelatinous core into a tougher crab meat-like texture. Disks narrow in height and can develop fissures or tears in the annulous fibrosus. Thus, a tear is simply a description and not meant to imply a traumatic cause. Modic, Ross, *Lumbar degenerative disk disease,* Radiology 2007; 245:34-61.

These degenerative disk changes are not painful of themselves with a very high prevalence seen in the pain-free population. Modic & Ross, supra. Ligaments become lax and even calcify; muscles lose their bulk.

IMAGING PROCEDURES • Diagnostic modalities of the low back are used by the courts to determine the validity of a compensation claim and most physicians rely upon the radiology reports to assist in making a diagnosis and to develop a treat-

ment plan. It is important to remember, however, that while the image may be objective, the report, or the interpretation of that study is subjective.

Most reports are generated by a radiologist who reviews the images and decides on what the studies show — are they normal or abnormal and why. These conclusions are found in the impressions section of the report. What is not so well known is that imaging interpretation can vary between radiologists (interobserver variability) as well as by the same radiologist on different days (intraobserver variability) as much as 20-30 percent of the time. Alpert & Hillman, *Quality and variability in diagnostic radiology*,1 J. Am. Coll Radiology 127 (2004); Jaffee, *Why an image?* 19 Investigative Radiology 248 (1984); Deyo, McNiesh & Cone, *Observer variability in the interpretation of lumbar spine radiographs*, 28 Arthritis & Rheumatism 1066 (1985); Wiesel, Tsourmas, Feffer et al., *A study of computer-assisted tomography; The incidence of positive CAT scans in an asymptomatic group of patients*, 9 Spine 549 (1984).

The following is an overview of some of more common imaging modalities available to physicians in diagnosing the cause of low back pain.

Lumbar X-Rays

X-rays are a form of electromagnetic radiation that penetrates an object based upon the density of that object. More dense body parts cast an image resembling a shadow by blocking the x-ray beam; x-rays go through less dense tissues and are not seen on the screen. Thus, bone and calcium deposits are evident on lumbar x-rays, but less dense structures, such as nerves, disks, and muscle are not imaged. Consequently, bone pathology, including a fracture or subluxation, can be diagnosed with this imaging modality, but the test cannot visualize a herniated disk.

It is common for physicians to order x-rays at the time of the initial evaluation of the patient with low back pain. However, routine plain x-rays of the low back in patients with acute lumbar pain may be of limited clinical utility since 75 percent of such studies provide no useful information. Goddard & Gholkar, *Diagnostic and therapeutic radiology of the spine: an overview*, 14 Imaging 355 (2002).

On the other hand, plain radiographs are important in the evaluation of failed back syndrome, i.e. persistent back pain despite surgery. Onesti, *Failed back syndrome*, 10 Neurologist 259 (2004).

Myelogram

A myelogram is a form of x-ray in which x-ray contrast dye is injected into the fluid space around the cauda equina and spinal cord and x-rays are taken of that segment of the spine. This technique allows for the visualization of the nerves to the lower back and spinal cord by outlining them with dye. In turn, a herniated disk or spinal cord pathology can be inferred if there is a distortion of the dye but the disks and nerves are not directly viewed.

Currently, myelograms are performed infrequently and are limited to those situations in which the test is combined with a CT scan when other imaging techniques are inconclusive.

Discograms

Discography is a controversial procedure designed to identify pain arising from a specific intervertebral disk. In this two-part test, a contrast agent is injected into the nucleus pulposus, the gelatinous interior of the disk. An x-ray or CT scan is then done to determine if an abnormality exists such as a rip in the outer edge of the disc. The controversy stems from the second part of the procedure in which the patient is asked if the injection reproduces that person's back pain. If the answer is yes, the patient is described as having concordant pain and the offending disk is thereby identified.

The procedure is unique in that it is the only method of identifying pain originating from a specific intervertebral disk. Carragee, Tanner, Khurana, et al., However the rates of false-positive results in selected patients without low back symptoms

raises questions as to the usefulness of discography, 25 Spine 1373 (2000). In addition, the discogram is an invasive procedure whose complications including disk infection, abscess formation, acute disk herniation, and blood vessel injection. Smuck, Yoon & Colwell, *Intravascular injection of contrast during lumbar discography: A previously unreported complication,* 9 Pain Med 1030 (2008).

The medical literature reveals a wide variation in the sensitivity, specificity and positive predictive value of the procedure. Swenson, supra.; Silber, Anderson, Vaccaro, et al., *Pre-operative discography: appropriate indications and clinical interpretation,* U. Pa. Orthopedic J. 79 (2001). This variability is due to several factors including proper execution of the technique itself, the nature of the disks, and symptom interpretation. Wichman, *Discography: over 50 years of controversy,* 106 Wisc. Med J. 27 (2007). For example, lumbar discograms were performed on patients but without a history of low back discomfort. Nevertheless, the authors reported that 70 percent of the asymptomatic patients tested had a significant pain response from the injection. Carragee, Tanner, Khurana, et al., *The rates of false-positive lumbar discography in selected patients without low back symptoms are documented,* 25 Spine 1373 (2000). Proponents of discography advocate the use of the procedure in preparation for surgery, pointing out that it is helpful to identify which disk requires surgery. Peh, *Provocative discography: current status,* 1 Biomed Imaging & Intervention J. e2 (2005).

This controversy has led one investigator to conclude that discography should be done with high selectivity and be limited to situations in which "the degree of symptoms dictate surgical consideration, when there is a high index of suspicion for disc origin of pain, and when other imaging procedures have been equivocal or negative." Swenson, Differential Diagnosis: A reasonable clinical approach, *Neurologic Clinics, Lower Back Pain,* Edited by Scott Haldeman, supra. Others, however, have concluded that the discogram does not provide any useful information in the diagnosis and treatment of low back pain. Wichman, *Discography: over 50 years of controversy,* Wisc Med J, supra.; Bogduk & Karasek, *Precision diagnosis and treatment of back and neck pain,* 11 Continuum 94 (2005); Cohen, Larkin, Barna, et al., *Lumbar discography: A comprehensive review of outcome studies, diagnostic accuracy and principles,*30 Regional Anesthesia & Pain Med. 163 (2005).

CT Scans

Computerized tomography (CT) involves multiple x-ray "slices" through the body (tomography) which are then fed into a computer for analysis. These slices are made in the axial plane, i.e. horizontal cuts from head to toe.

The test is performed while the patient lies on a movable table within a large opening in the scanner much like a donut with a hole in the center. An x-ray tube then circles around the body at a 360 degree angle taking hundreds of images through the same plane. These images are fed into a computer that reconstructs this information as a slice through the interior of the body. The patient table is then advanced a short distance and another "slice" is taken and so on.

Because minute differences in density are detected by this method, CT scanning can image highly dense structures such as bone as well as low density tissues such as disks and nerves. By taking multiple "cuts," CT scans effectively slice through the body at different levels. To use a loaf of bread as an example, an x-ray is only able to image through one plane such as the top, bottom or side of the loaf. The CT scan, however, can cut the bread into slices and allow the viewer to see from the crust into the interior of the loaf.

Further, advances in computer software allow physicians to construct a three dimensional image of the body region. CT scanning can also be combined with a myelogram or discogram to enhance imaging of the spine.

MRI Scans

Magnetic resonance imaging (MRI) is an extraordinary imaging advancement that goes beyond CT scanning. An MRI does not use x-rays but rather an interaction of a powerful magnetic field and radio waves.

The protons in the nuclei of the hydrogen atoms of the body act as tiny magnets. When stimulated by a powerful magnetic field generated by the MRI scanner, about one half of the protons line up in the direction of the magnetic field and the balance do so in the opposite direction. When these excited nuclei are exposed to radio waves, they change direction resulting in the emission of signals that are detected, analyzed and displayed as an image of the body. Like CT scanning, two and three dimensional slices of the body provide exquisite views of the body's interior. Unlike CT scanning, MRI images can be made through any plane of the body and reveal more detail for soft tissues.

A major limitation in the use of MRI is the inability to scan patients with electronic devices such as a pacemaker or spinal cord stimulator as well as the presence of ferrous metallic fragments such as a bullet, shrapnel or metallic particles in the eye prevalent in those who work or are exposed to metal.

IMAGING NOT FITTING THE CLINICAL PICTURE: A LITIGATION DISCONNECT

● Medical imaging of the low back becomes problematic when the radiological pictures do not fit the clinical picture. This is especially important when the claimant is seeking compensation based upon an abnormal test result. This imaging-pain disconnect occurs through a wide spectrum including those situations of abnormal imaging with no pain to normal images with low back pain.

Abnormal Images And No Back Pain

The work of physicians and lawyers would be easy if one could point to an abnormality on an x-ray or scan and unequivocally state that the pathology is the cause of the pain. The problem is that frequently radiographic abnormalities occur without concomitant back pain. No imaging procedure is immune to this conundrum. Simply put, many imaging abnormalities are the result of the asymptomatic aging processes discussed earlier in this article.

For example, a study involving x-rays of the low back of 1,172 healthy young adults without low back pain discovered significant abnormalities in 58 percent of those imaged. Korber & Bloch, *The "normal" spine,* Med. J. Austl. 70 (1984). Similarly, a study of military parachute instructors who experienced tremendous vertical forces on their spine revealed no correlation between the severity of radiographic changes and either the prevalence or severity of low back pain. Bar-Dayan, Weisbort, Bar-Dayan, et al., *Degenerative disease in lumbar spine of military parachuting instructors,*149 J. Royal Army Med. Corps 260 (2003).

As for myelograms, 24 percent of lumbar myelograms from individuals with no back pain had significant abnormalities such as herniated disks. Hitselberger & Witten, *Abnormal myelograms in asymptomatic patients*, J. Neurosurgery 204 (1968). Even CT scans are not immune from these statistics. For instance, 24 percent of a study population who had no low back pain was found to have significant abnormalities of the lumbar spine. Wiesel, Tsourmas, Feffer, et al., *A study of computer-assisted tomography, the incidence of positive CAT scans in an asymptomatic group of patients,* supra.

MRI scans provide exquisite detail of the inside of the body, and as expected, a greater incidence of abnormalities. A number of studies involving lumbar MRI scans of subjects without low back pain are reported in the medical literature. For example, a study of asymptomatic subjects published in the New England Journal of Medicine revealed that 52 percent of the subjects had a lumbar disk bulge of at least one level, 27 percent had a disk protru-

sion and one percent had a disk extrusion. Jensen, Brant-Zawadszki, Obuchowski, et al., *Magnetic resonance imaging of the lumbar spine in people without back pain,* 331 New Eng. J. Med. 69 (1994).

Another study of asymptomatic subjects revealed that an astounding 76 percent incidence of disk herniations. Boos, Rieder, Schade, et al., *The diagnostic accuracy of magnetic resonance imaging, work perception, and psychosocial factors in identifying symptomatic disc herniations,* 20 Spine 2613 (1995). A different study of subjects without a history of back or leg pain revealed that a third of the subjects had substantial abnormalities. Boden, Davis, Dina, et al., *Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects,* 72 J. Bone & Joint Surg, 403 (1990). A study of women between 16 and 80 years of age without low back pain demonstrated degenerative disk disease in over a third of those between 21 and 40 years of age. Powell, Wilson, Szypryt, et al., *Prevalence of lumbar disc degeneration observed by magnetic resonance in symptomless women,* 2 Lancet 1366 (1986). By age 70, 80 percent of the subjects were found to have significant disk abnormalities. Another study of asymptomatic adolescent tennis players demonstrated that only 15 percent of these athletes had normal lumbar MRI scans. Alyas, Turner & Connell, *MRI findings in the lumbar spines of asymptomatic, adolescent, elite tennis players,* 41 Brit. J. Sports Med. 836 (2007).

As for discograms, researchers examined the lumbar spine of healthy, asymptomatic people and found that the test was abnormal 17 percent of the time in this population. Walsh, et al., *Lumbar Discography in Normal Subjects: A Controlled Prospective Study,* 72 Journal of Bone and Joint Surgery 1081 (1990).

Thus, the medical literature demonstrates that no matter which imaging technique is used, significant pathology occurs in the low back region of individuals without a current or past history of low back pain. Therefore, the question is "what separates individuals with dramatic morphologic findings who have no symptoms from individuals with identical alterations who do?" Modic & Ross, supra. An abnormality found on an imaging study should not be considered diagnostic "unless it conforms to the clinical syndrome." Frymoyer, *Back pain and sciatica,* 318 New Eng. J. Med. 291 (1988). That is, an abnormality found on imaging must correspond to the clinical presentation and findings to be medically relevant.

Back Pain And Normal Imaging

Conversely, a person may have back pain due to pain-generating problems with no abnormal findings on the imaging studies. Muscular causes, such as myofascial trigger points, are typically without x-ray changes unless there is so much muscle spasm that the curvature of the spine is affected. Travell & Simons, supra. The joints of the back — facets and SI — can appear normal but can be the source of pain with the diagnosis established by nerve blocks to the suspected joints. Czerniecki, Goldstein, *General considerations of pain in the low back, hips, and lower extremities,* Bonica's Management of Pain, 3rd ed John Loeser, editor, supra; Czerniecki & Goldstein, supra.

Psychosocial And Compensation Factors

Unfortunately, significant complaints of pain with disability and without an identifiable or minimal cause occur due to a preponderance of psychosocial issues. Any discussion of low back pain must, therefore, include a consideration of psychological and social issues surrounding this problem. These factors are yet another reason why it can be difficult to make a direct connection between an imaging abnormality with a patient's complaints of pain and why "a purely anatomic pathologic approach to diagnosis is not adequate to characterize the patient who has low back pain." Swenson, supra.

Litigation and compensation issues are yet additional factors that contribute to low back pain and disability. For example, in a surgical outcome

study of patients with low back pain, it was shown that workers' compensation and litigation issues are strongly associated with poor surgical outcomes. Vaccaro, Ring, Scuderi, et al., *Predictors of outcome in patients with chronic back pain and low-grade spondylolisthesis,* 22 Spine 2030 (1997). In fact, the majority of patients with failed back syndrome — poor clinical outcomes following low back surgery — are involved with lawsuits, claiming total disability from any form of work. Onesti, *Failed back syndrome,* Neurologist, supra.

Needless to say, compensation acts as a "powerful disincentive and barrier to recovery because of factors such as secondary gain." Vaccaro, et al., supra.

USING IMAGING IN LOW BACK PAIN LITIGATION • Despite these stumbling blocks, medical imaging does have a role in a claims setting when appropriately utilized and correlated with the plaintiff's clinical picture and medical records.

Clinical Correlation

Not even the highly sophisticated MRI can determine what caused a herniated lumbar disk that is so graphically revealed by this imaging study. However, when that scan matches the clinical setting, it provides powerful support for a case.

Reviewing a claimant's past medical records and imaging studies can be a treasure trove for counsel. If a pre-accident imaging study shows pathologic changes, counsel for the claimant should readily concede this finding but argue that the abnormality was quiescent until the injury. To determine the accuracy of this argument, however, the past medical records may be reviewed for evidence of prior back problems and symptoms. The family doctor — or primary care provider — is usually the first person a patient visits for a medical problem and one of the best records to obtain. Prior complaints of back pain should appear in these records and the file should also contain reports from orthopedic surgeons, neurologists, chiropractors, physical therapists and imaging studies. Other important documents to secure include health insurance and pharmacy records. Insurance records should be examined because they provide a list of diagnostic codes and names of treating physicians. Pharmacy records set forth medications prescribed and the name of the physician who ordered the drug. By reviewing this information, the defense may quickly ascertain if a pre-existing back problem exited which the claimant has failed to disclose.

It should also be standard practice for an attorney involved in low back litigation to determine if there was any imaging of the back prior to the injury. If yes, the pre and post incident images should be compared side-by-side by a radiologist looking for changes. Obviously, the lack of an appreciable difference between these two studies renders any abnormality meaningless as it pertains to the claim. Still, any changes in the pre and post accident studies may have no trauma-related significance but may merely reflect progressive, expected age-related changes such as spur formation or desiccation (diminished water content) of the disks. If the post-accident scan, however, shows significant changes in pathology, such as nerve compression that fits the clinical picture and was not on the pre-accident study, then the scan supports the case.

CONCLUSION • The limitations and pitfalls of medical imaging in low back pain cases are many and stem from the subjective nature of the reading of the images by the radiologist, the inherent limitations of the particular imaging procedure, the normal aging process, the imaging of those changes in the asymptomatic population, causes of back pain without a radiological correlate, and the powerful psycho-socioeconomic influences at work in a compensation setting.

Insurance adjusters and defense counsel should not be intimidated by a positive test result on a radiological study. This finding is merely one piece

of evidence that must be correlated with the patient's clinical picture. Because of the significant percentage of asymptomatic individuals with abnormal radiological findings, an abnormal x-ray or scan does not always provide objective verification of a claim. On the other hand, positive imaging studies that correlate with the claimant's clinical course may provide powerful support for the injury claim. Ultimately, it is not an imaging result but rather the physician who identifies the cause of a patient's back pain in the context of the clinical history, physical findings, and imaging studies.

PRACTICE CHECKLIST FOR
Limitations And Pitfalls Of Medical Imaging Of The Low Back

- The low back is the termination point of the spine with attachment to the pelvis, an area known as the lumbosacral region. Its major components are bones, joints, ligaments, disks, muscles, and nerve roots.

- The bones of the low back consist of five lumbar vertebrae and a fused bone known as the sacrum:

__ Bones are not pain sensitive; it is the membrane covering these structures, the periosteum, that causes pain from bone trauma.

- Joints allow the body to bend and turn. In the low back, the facets and sacroiliac joints provide that mobility.

- Ligaments connect one bone to another and consist of fibrous bands of tissue. In the low back, they keep the vertebrae in place, providing stability to the spine:

__ Like cables, some strap-like ligaments extend up and down the length of the spine and are called longitudinal ligaments;

__ The spine also has a series of short ligaments, the ligamentum flavum, that connect the lamina of the individual vertebrae together.

__ The intervertebral disks are located between each vertebra and they serve as cushions for the spine, acting as shock absorbers for the micro-traumas of daily life:

__ A disk consists of an inner gelatinous core named the nucleus pulposus and an outer firmer layer termed the annulus fibrosis;

__ In a disk herniation, the gelatinous core oozes through a tear or defect in the annulus.

- Paired sensory and motor nerve roots extend from the spinal cord and hang down individually on their downward journey to the legs:

__ Sensory nerves relay information such as pain, temperature and touch from the legs upward toward the spinal cord on its way to the brain. Motor nerves carry signals outward from the spinal cord to the muscles of the legs, causing the muscles to contract and the legs to move.

Back muscles vary in length and size and are found in multiple layers.

- Diagnostic modalities of the low back are used determine the validity of a compensation claim and most physicians rely upon the reports to make a diagnosis and to develop a treatment plan:

__ X-rays are a form of electromagnetic radiation that penetrates an object based upon the density of that object. They show bone abnormalities but not soft tissue such as muscle, nerves and disks;

__ A myelogram is a form of x-ray in which x-ray contrast dye is injected into the fluid space around the cauda equine;

__ Discography is a two-part test. A contrast agent is injected into the nucleus pulposus and an x-ray or CT scan is done to determine if an abnormality exists such as a rip in the outer edge of the disc. The patient is then asked if the injection reproduces that person's back pain;

__ Computerized tomography (CT) involves multiple x-ray "slices" through the body (tomography) which are then fed into a computer for analysis;

- __ An MRI uses a powerful magnetic field and radio waves to make images of the structures of the body. The MRI is the best imaging procedure to show disks and nerves.

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