Spinal Pathology in the Asymptomatic Person
Importance of Diagnostic Imaging
Literature Timeline

1968

Abnormal myelograms occur in asymptomatic people.

Hitselberger WE, Witten RM. Abnormal myelograms in asymptomatic patients. J Neurosurgery. 1968;28:204-206.

1984

"In order to study the type and number of CAT scan abnormalities of the lumbar spine that occur in asymptomatic people, 52 studies from a control population with no history of back trouble were mixed randomly with six scans from patients with surgically proven spinal disease, and all were interpreted by three neuroradiologists in a blinded fashion. […] Spinal disease was identified in an average of 19.5% (23.8%, 22.7%, and 12.5%) of the under 40-year-olds, and it was a herniated nucleus pulposus in every instance. In the over 40-year-old age group, there was an average of 50% (29.2%, 81.5%, and 48.1%) abnormal findings, with diagnoses of herniated disc, facet degeneration, and stenosis occurring most frequently."

Wiesel SW, et al. A Study of Computer-Assisted Tomography: I. The Incidence of Positive CAT Scans in an Asymptomatic Group of Patients. *Spine.* 1984;9(6):549-551.

1986

It was found that by age 60-65, 95% of the men and 70% of the woman had at least one degenerative change on their roentgenograms…It is important to realize that although roentgenographic abnormalities represent structural changes in the spine, they do not necessarily cause symptoms.

Gore DR, et al. Roentgenographic findings of the cervical spine in asymptomatic people. Spine. 1986;11(6):521-4.

1989

The results suggest that lumbosacral disk bulges or herniations are common in women of childbearing age, whether pregnant or not, contrary to an earlier report, pregnant women do not have an increased prevalence of disk abnormalities.

Weinreb JC, et al. Prevalence of lumbosacral intervertebral disk abnormalities on MR images in pregnant and symptomatic women. Radiology. 1989;170(1 Pt 1):125-8.

1990

**LBP: low back pain

Promotes use of discograms (procedure advanced since 1968) ". . . in conjunction with standardized methods for assessment of pain, lumbar discography is a highly reliable and specific diagnostic test. This study did not address the validity or sensitivity or provide guidelines for choosing patients for discography. Certainly, discography is not the best diagnostic test for all patients who have low-back pain."

This is an evaluation of discography to confirm positive disc findings found on MRI, patient pain reports, and physical examination. The study involved 7 patients with LBP and 10 patients without LBP where MRI performed and then discogram injections performed. Abnormal discogram findings were found in both symptomatic and asymptomatic patients. The authors explained a positive finding on discogram in an asymptomatic patient to mean that there was pain associated with the injection itself.

Walsh TR, Weinstein JN, Spratt KF, et al. Lumbar Discography in Normal Subjects. A Controlled Prospective Study. *The Journal of Bone and Joint Surgery, Incorporated.* 1990;72-A(7):1081-1088.

"We performed magnetic resonance imaging on sixty-seven individuals who had never had low-back pain, sciatica, or neurogenic claudication. […] About one-third of the subjects were found to have a substantial abnormality. Of those who were less than sixty years old, 20 per cent had a herniated nucleus pulposus and one had spinal stenosis. In the group that was sixty years old or older, the findings were abnormal on about 57 per cent of the scans: 36 per cent of the subjects had a herniated nucleus pulposus and 21 per cent had spinal stenosis. There was degeneration or bulging of a disc at least one lumbar level in 35 per cent of the subjects between twenty and thirty-nine years old and in all but one of the sixty to eighty-year-old subjects. […] We concluded that abnormalities on magnetic resonance images must be strictly correlated with age and any clinical signs and symptoms before operative treatment is contemplated."

Boden SD, et al. Abnormal Magnetic-Resonance Scans of the Lumbar Spine in Asymptomatic Subjects: A Prospective Investigation. *The Journal of Bone and Joint Surgery.* 1990;72-A(3):403-408.

The overall lifetime prevalence of back pain remains at 60-90% level, with an annual incidence of 5%. The incidence of disabling LBP has increased 168% in the United States between 1971 to 1986. [….] the long-term effects of surgery are not very encouraging. The only blinded controlled study of surgery demonstrated benefits of surgery in the first year. However, after 4 and 10 years, patients who had surgery were no better than those who had not. […] Nachemson went so far as to state that only 20% of patients with acute back pain can be given a precise pathoanatomic diagnosis. In patients with chronic back pain, this breakdown in a relationship between symptomatology and demonstratable pathology becomes even more dramatic. These facts require of the classical pathology model. In the first, pathology can exist without symptoms. In the second, symptoms can occur without obvious pathology. The article goes on to discuss factors that influences back pain including psychosocial issues.

Haldeman S. Presidential Address, North American Spine Society: Failure of the Pathology Model to Predict Back Pain. Spine. 1990;15(7):718-724.

This article discusses the signal intensity change with age and concomitant with decreases in water and glycosaminoglycans and increases in collagen. Such changes represent normal age related degeneration of the disk.

Modic MT and Herfkens RJ. Intervertebral disk: normal age-related changes in MR signal intensity. Radiology. 1990;177:332-333.

1991

We performed magnetic resonance imaging of the lumbar spine on 66 asymptomatic subjects and found that 12 (18%) had either a disc protrusion or herniation. An additional 26 (39%) had a bulge that was associated with degenerative disc disease. We also found examples of spinal stenosis, narrowed nerve root canals, osteophytes, and vertebral body involvement with multiple myeloma. Degenerative disc disease is a common finding in asymptomatic adults that increases in frequency with age. It occurs more frequently in men and usually involves more than one level. The most common location is L5-S1.

Greenberg JO, et al. Magnetic resonance imaging of the lumbar spine in asymptomatic adults. Cooperative study- American Society of Neuroimaging. J Neuroimaging. 1991;1(1):2-7.

1994

"We used the following standardized terms to classify the five intervertebral disks in the lumbosacral spine: normal, bulge […], protrusion […], and extrusion […].
Thirty-six percent of the 98 asymptomatic subjects had normal disks at all levels. With the results of the two readings averaged, 52 percent of the subjects had a bulge at at least one level, 27 percent had a protrusion, and 1 percent had an extrusion. Thirty-eight percent had an abnormality of more than one intervertebral disk. The prevalence of bulges, but not of protrusions, increased with age. […]
On MRI examination of the lumbar spine, many people without back pain have disk bulges or protrusions but not extrusions. […] The discovery by MRI of bulges or protrusions in people with low back pain may frequently be coincidental."

Jensen MC, et al. Magnetic Resonance Imaging of the Lumbar Spine in People Without Back Pain. *N Engl J Med.* 1994;331(2):69-73.

1995

"Study design: A prospective cross-sectional analytic study.
Objectives: To assess in patients with chronic low back pain whether the presence or absence of pain originating from the lumbar zygapophysial joints correlates with changes seen on computed tomography. […]
Sixty-three patients with low back pain lasting longer than 3 months underwent computed tomography and blocks of zygapophysial joints at L5-S1, L4-L5, and L3-L4. […] Using the results of a repeat assignment with two radiologists there was no statistically significant different in the joint scores between those with and those without pain originating from the zygapophysial joint. […]

Computed tomography has no place in diagnosis of lumbar zygapophysial joint pain."

Schwarzer AC, et al. The Ability of Computed Tomography to Identify a Painful Zygapophysial Joint in Patients With Chronic Low Back Pain. *Spine.* 1995;20(8):907-912.

"Individuals with minor disc herniations (i.e., protrusion, contained discs) are at a very high risk that their magnetic resonance images are not a casual explanation of pain because a high rate of asymptomatic subjects (63%) had comparable morphologic findings. The only highly significant difference between the study group and control group regarding morphologic findings was the criteria of a nerve root compromise. Work perception and psychosocial factors were helpful in discriminating between symptomatic and asymptomatic disc herniations."

Boos N, et al. The Diagnostic Accuracy of Magnetic Resonance Imaging, Work Perception, and Psychosocial Factors in Identifying Symptomatic Disc Herniations. *Spine.* 1995;20(24):2613-2625.

1997

Conclusion: There is no firm evidence for the presence or absence of a casual relationship between radiographic findings and nonspecific low back pain.

Van Tulder MW, et al. Spinal radiographic findings and nonspecific low back pain. A systematic review of observational studies. Spine. 1997;22(4):427-34.

1998

**MR: magnetic resonance

"To evaluate the prevalence and radiologic findings of annular tear (especially of contrast material enhancement), bulging disk, and disk herniation on T2-weighted and gadolinium-enhanced T1-weighted magnetic resonance (MR) images in people without low back pain (LBP) or sciatica.
[…] The prevalence of bulging disk and focal disk protrusion was 81% (29 volunteers) and 33% (12 volunteers), respectively. There were no extrusions. Twenty-eight annular tears were found in 20 patients (56%); 27 tears (96%) also showed contrast enhancement.
[…] Annular tears and focal disk protrusions on MR images, with or without contrast enhancement, are frequently found in an asymptomatic population. Extruded disk herniation, displacement of nerve root, and interruption of annuloligamentous complex are unusual findings in an asymptomatic population and can be more closely related to patients with LBP or sciatica."

Stadnik TW, et al. Annular Tears and Disk Herniation: Prevalence and Contrast Enhancement on MR Images in the Absence of Low Back Pain or Sciatica. *Radiology.* 1998;206:49-55.

The frequency of all degenerative findings increased linearly with age. Disc degeneration was the most common observation. We found significant differences in frequency between genders for posterior disc protrusion and foraminal stenosis. Compression of the spinal cord was observed in 7.6% of [asymptomatic] subjects.

Matsumotot M, et al. MRI of intervertebral discs in asymptomatic subjects. J Bone Joint Surg Br. 1998;80(1):19-24.

**MR: magnetic resonance

Purpose of this study was to identify MR abnormalities of lumbar spine with in asymptomatic patients to determine MR findings that are predictive of LBP in symptomatic patients.

"RESULTS: Disk bulging or disk protrusion was found in 42 (14%) and 48 (16%) of the intervertebral spaces in 37 (62%) and 40 (67%) subjects, respectively. High-signal-intensity zones were found commonly (in 23 [7.7%] and 25 [8.3%] of the intervertebral spaces in 19 (32%) and 20 (33%) subjects, respectively). Disk extrusions were less common (in 11 [3.7%] and 11 [3.7%] of the intervertebral spaces in 11 (18%) and 11 (18%) subjects, respectively). […] CONCLUSION: In patients younger than 50 years, disk extrusion and sequestration, nerve root compression, end plate abnormalities, and osteoarthritis of the facet joints are rare and, therefore, may be predictive of low back pain in symptomatic patients."

Weishaupt D, Zanetti M, Hodler J, and Boos N. MR Imaging of the Lumbar Spine: Prevalence of Intervertebral Disk Extrusion and Sequestration, Nerve Root Compression, End Plate Abnormalities, and Osteoarthritis of the Facet Joints in Asymptomatic Volunteers. *Radiology*. 1998;209:661-666.

2000

"Study Design. A cross-sectional study comparing the relationship of symptoms with anatomic impairment visible on lumbar magnetic resonance imaging in 408 symptomatic subjects. Objective. To determine how various anatomic impairments, including the magnitude and location of nerve compression visible on lumbar magnetic resonance imaging, are associated with patient reports of pain, weakness, and dysesthesia."

"The presence of disc extrusion and/or ipsilateral, severe nerve compression at one or multiple sites is strongly associated with distal leg pain. Mild to moderate nerve compression, disc degeneration or bulging, and central spinal stenosis are not significantly associated with specific pain patterns. Although segmental distributions of pain can be determined reliably from pain drawings, this finding alone is of little use in predicting lumbar impairment. The self-report of lower extremity weakness or dysesthesia is not significantly related to any specific lumber impairments."

Beattie PF, et al. Associations Between Patient Report of Symptoms and Anatomic Impairment Visible on Lumbar Magnetic Resonance Imaging. *Spine.* 2000;25(7):819-828.

"Physical job characteristics and psychological aspects of work were more powerful than magnetic resonance imaging-identified disc abnormalities in predicting the need for low back pain-related medical consultation and the resultant work incapacity. However, the conclusions are still preliminary, and replication of the findings in larger and more representative study samples is needed."

Boos N, et al. Natural History of Individuals With Asymptomatic Disc Abnormalities in Magnetic Resonance Imaging: Predictors of Low Back Pain–Related Medical Consultation and Work Incapacity. *Spine.* 2000;25(12):1484-1492.

"The presence of a high-intensity zone does not reliably indicate the presence of symptomatic internal disc disruption. Although higher in symptomatic patients, the prevalence of a high-intensity zone in asymptomatic individuals with degenerative disc disease (25%) is too high for meaningful clinical use. When injected during discography, the same percentage of asymptomatic and symptomatic discs with a high-intensity zone were shown to be painful."

Carragee EJ, et al. Lumbar High-Intensity Zone and Discography in Subjects Without Low Back Problems. *Spine.* 2000;25(23):2987-2992.

This article addresses the lack of universal nomenclature standardization with respect to the definition of a disk herniation.

Millette P. Classification, diagnostic imaging and imaging characterization of a lumber disc. Radiol Clin North Am. 2000;38(6):1267-92.

2001

"Objective: To determine the prevalence of magnetic resonance imaging (MRI) findings in the lumbar spine among persons without current low back pain or sciatica and to examine which findings are related to age or previous back symptoms.
[…] Of 148 subjects, 69 (46%) had never experienced low back pain. There were 123 subjects (83%) with moderate to severe desiccation of one or more discs, 95 (64%) with one or more bulging discs, and 83 (56%) with loss of disc height. Forty-eight subjects (32%) had at least one disc protrusion and 9 (6%) had one or more disc extrusions.
[…] Many MR imaging findings have a high prevalence in subjects without low back pain. These findings are therefore of limited diagnostic use. The less common findings of moderate or severe central stenosis, root compression, and extrusions are likely to be diagnostically and clinically relevant."

Jarvik JJ, et al. The Longitudinal Assessment of Imaging and Disability of the Back (LAIDBack) Study: Baseline Data. *Spine.* 2001;26(10):1158-1166.

The findings of the current study suggest limited diagnostic value of computer tomography in sacroiliac joint disease because of low sensitivity and specificity.

Elgafy H, et al. Computer tomography findings in patients with sacroiliac pain. Clin Orthop Relat Res. 2001;382:112-8.

2002

"Annular tears of lumbar intervertebral disks are found in both symptomatic and asymptomatic persons; therefore, it is difficult to determine whether these findings indicate acute abnormality. Our purpose was to determine whether the MR imaging findings of tears (ie, hyperintensity and contrast enhancement) of the annulus fibrosus persist or resolve over time. […]
Hyperintensity on T2-weighted MR images and enhancement of annular tears could not be used to determine the tears' acuity over the range of follow-up provided in this study."

Munter FM, et al. Serial MR Imaging of Annular Tears in Lumbar Intervertebral Disks. *Am J Neuroradiol.* 2002;23:1105-1109.

2003

"Study Design: Retrospective monozygotic twin cohort study.
Objectives: Our goal was to investigate the associations between different spinal MRI findings and current, past year, and lifetime low back pain after adjusting for occupational physical loading, smoking, genetics, and early family influences. […]
Other MRI findings did not explain the various symptom histories. […]
These findings raise new questions about the underlying mechanisms of LBP. The sensitivities of the only significant MRI parameters, disc height narrowing and annular tears, are poor, and these findings alone are of limited clinical importance."

Videman T, et al. Associations Between Back Pain History and Lumbar MRI Findings. *Spine.* 2003;28(6):582-588.

2004

**LBP: low back pain

"Studies have shown that 60% of patients suffering from LBP recover in 1 week, 90% in 6 weeks, 95% in 12 weeks, and only 1.2% remain disabled by the end of 1 year."

"Even if a pain generator is suspected, it is not clear how this can be reliably related to reported pain perception, impairment, and disability in the face of complex social, emotional, and neuropsychologic cofounders."

Narcotic habituation (opioid use), depression, and social disincentives are known to magnify reports of LBP.

"When the expedited work-up fails to turn up a catastrophic condition, the clinician should be reluctant to assume minor degenerative findings adequately explain the 'illness.' The physician should assess the patient carefully for psychologic or social factors that might be contributing to a hyperbolic expression of LBP."

The physical exam especially in the presence of "red flags by history" should include the following:

1. Palpation of muscular structures and spinous processes in low back.
2. Neurologic exam: sensory, motor, and reflex testing of lower extremities.
    a. Straight Leg Test to 60 degrees.
    b. Cross Straight Leg Test (25% sensitive and 90% specific)
    c. Bilateral Hip Exam
    d. Waddell testing/signs of nonorganic cause(s) of LBP
3. "Finally, during the history and physical examination, the clinician should observe carefully the effect of the patient and the context of the LBP illness as presented by the patient. Remarkably, the objective finding of serious emotional distress is seen more commonly in subjects without serious underlying pathology. That is, patients with serious spinal pathology such as chronic vertebral osteomyelitis or unstable spondylolisthesis have been shown to have less emotional distress despite severe pain that subjects with nonspecific LBP illness."

Regarding diagnostic imaging studies for LBP, those studies have a high rate of asymptomatic abnormalities and degenerative changes are expected. "The patient should understand clearly that the usual degenerative changes are expected but that is not what you are looking for." It can be misleading to the patient that the degenerative changes shown on a diagnostic test are the cause of LBP. "This misperception is almost impossible to rectify after the fact and can be avoided easily by carefully explaining beforehand what serious pathology one is looking for." MRI is more effective than plain radiography films. MRI has essentially replaced CT scanning, though CT scans are effective to image bony detail in patients who cannot do MRI because, for example, they have implanted metal or suffer with claustrophobia.

"One may realize that chronic LBP illness may not stem from a mechanical spinal disorder alone. In fact, the mechanical pathology may be just a portion of the problem with amplification by neuropsychologic, social, and psychologic issues. Chronic disabling LBP commonly is confounded by chronic pain, emotional troubles, poor job satisfaction, alcohol and narcotic abuse, and compensation issues, just to identify a few. It would follow that expecting to identify a single cause for this symptom complex is impractical and any single test may not be a reasonable approach. Furthermore, surgical correction of the mechanical portion of LBP, even if correctly identified, then can be expected only to relieve a portion of the patient's symptoms as long as the confounding issues continue to be significant or have become lifelong adaptive mechanisms."

Carragee E, MD; Hannibal, M, MD. Diagnostic Evaluation of Low Back Pain. *Orthop Clin. N. Am.* 2004;35:7–16.

Conclusion: Painful disc injections are poor independent predictors of subsequent LBP episodes in subjects initially without active lower back complaints. Annular disruption is a weak predictor of future LBP problems. Psychological distress and preexisting chronic pain processes are stronger predictors of LBP outcomes.

Carragee EJ, et al. Prospective controlled study of the development of lower back pain in previously asymptomatic subjects undergoing experimental discography. Spine. 2004;29(10):1112-7.

2005

Conclusion: Most degenerative disc "abnormalities" were moderately associated with LBP. The strongest associations were noted for Modic changes and anterolisthesis. Further studies are needed to define clinical relevance."

Kjaer P, et al. Magnetic Resonance Imaging and Low Back Pain in Adults: A Diagnostic Imaging Study of 40-Year-Old Men and Women. *Spine.* 2005;30(10):1173-1180.

The development of serious LBP disability in a cohort of subjects with both structural and psychosocial risk factors was strongly predicted by baseline psychosocial variables. Structural variables on both MRI and discography testing at baseline had only weak associations with bask pain episodes and no association with disability or future medical care.

Carragee EJ, et al. Discographic, MRI, and psychosocial determinants of low back pain disability and remission: a prospective study in subjects with benign persistent back pain. The Spine J. 2005(5):24-35.

Conclusion: Depression is an important predictor of new LBP, with MRI findings likely less important. New imaging findings have a low incidence; disc extrusions and nerve root contact may be the most important of these findings.

Jarvik JG, et al. Three-year incidence of low back pain in an initially asymptomatic cohort: Clinical and imaging risk factors. Spine. 2005;30(13):1541-8.

Conclusion: In typical patients with LBP or radiculopathy, MR imaging does not appear to have a measurable value in terms of planning conservative care. Patient knowledge of imaging findings does not alter outcome and is associated with a lesser sense of well-being.

Modic MT, et al. Acute low back pain and radiculopathy: MR imaging findings and their prognostic role and effect on outcome. Radiology. 2005;237(2):597-604.

Our findings suggest that the MRI abnormalities examined are not major predictors in outcome in patients with LBP. They give no support to the use of MRI findings as a way refining case definition for LBP in epidemiological research.

McNee P, et al. Predictors of long-term pain and disability in patients with low back pain investigated by magnetic resonance imaging: A longitudinal study. BMC Musculoskeletal Disorders. 2011;12:234 doi: 10.1186/1471-2474-12-234.

2006

"Minor trauma does not appear to increase the risk of serious LBP episodes or disability. The vast majority of incident-adverse LBP events may be predicted not by structural findings or minor trauma but by a small set of demographic and behavioral variables."

Carragee E, et al. Does Minor Trauma Cause Serious Low Back Illness? *Spine.* 2006;31(25):2942-2949.

Conclusion: Findings on MR imaging within 12 weeks of serious LBP inception are highly unlikely to represent any new structural change. Most new changes (loss of disc signal, facet

arthrosis, and endplate changes) represent progressive age changes not associated with acute events. Primary radicular syndromes may have new root compression findings associated with root irritation.

Carragee E, et al. Are first-time episodes of serious LBP associated with new MRI findings? Spine J. 2006;6(6):624-35.

"Objective: To describe magnetic resonance imaging (MRI) findings in the lumbar spine in asymptomatic elite adolescent tennis players, to serve as the baseline for a future prospective longitudinal cohort study.
[…]
Conclusions: Abnormalities were frequent, predominately in the lower lumbar spine, almost exclusively at L4/5 and L5/S1 levels. Pars injuries and facet joint arthroses were relatively common."

Alyas F, et al. MRI findings in the lumbar spine of asymptomatic, adolescent, elite tennis players. *Br J Sports Med.* 2007;41:836-841.

Recommendation #2: Clinicians should not routinely obtain imaging or other diagnostic tests in patients with non-specific low back pain.

Chou R, et al. Diagnosis and treatment of low back pain: a joint clinical guideline from the American College of Physicians and American Pain Society. Ann Int Med. 2007;147:478-491.

"To evaluate the association between lumbar spine facet joint osteoarthritis (FJ OA) identified by multidetector computed tomography (CT) and low back pain (LBP) in the community-based Framingham Heart Study.
[…] This study was an ancillary project to the Framingham Heart Study. A sample of 3529 participants of the Framingham Heart Study aged 40 to 80 underwent multidetector CT imaging to assess aortic calcification.
[…] There is a high prevalence of FJ OA in the community. Prevalence of FJ OA increases with age with the highest prevalence at the L4-L5 spinal level. At low spinal levels women have a higher prevalence of lumbar FJ OA than men. In the present study, we failed to find an association between FJ OA, identified by multidetector CT, at any spinal level and LBP in a community-based study population."

Kalichman L, et al. Facet joint osteoarthritis and low back pain in the community-based population. *Spine.* 2008;33(23):2560-2565.

Conclusion: Patient knowledge of imaging findings do not alter outcome and are associated with a lesser sense of well-being.

Ash LM, et al. Effects of diagnostic information, per se, on patient outcomes in acute radiculopathy and low back pain. AJNR Am J Neuroradiol. 2008;29(6):1098-103.

"Objectives: To determine prevalence rates of spondylolysis, isthmic and degenerative spondylolisthesis in an unselected adult community-based population; and to evaluate the association of spondylolysis, isthmic and degenerative spondylolisthesis with low back pain (LBP).
[…]
Conclusions: Based on CT imaging of an unselected community-based population, the prevalence of lumbar spondylolysis is 11.5%, nearly twice the prevalence of previous plain radiograph-based studies. This study did not reveal a significant association between the observation of spondylolysis on CT and the occurrence of LBP, suggesting that the condition does not appear to represent a major cause of LBP in the general population."

Kalichman L, et al. Spondylolysis and spondylolisthesis: prevalence and association with low back pain in the adult community-based population. *Spine.* 2009;34(2):199-205.

Results: The prevalence of disc degeneration was 7% in L1-2, 12% in L2-3, 15.5% in L3-4, 49.5% in L4-5, and 53% in L5-S1 A herniated disc was observed at the corresponding level in 0.5, 3.5, 6.5, 25, and 35.0% of cases respectfully. Spondylolisthesis was observed in < 3% of this population…Episode of low back pain, smoking status, body mass index, and hours standing did not affect the prevalence of disc degeneration.

Conclusion: Hours spent sitting significantly increased the prevalence of disc herniation, but episode of low back pain, smoking status, obesity, and sitting hours were not significant risk factors.

Kanayama M, et al. Cross-sectional magnetic resonance imaging study of lumbar disc degeneration in 200 healthy individuals. J Neurosurg Spine. 2009;11(4):501-7.

Conclusion: The most helpful components for predicting persistent disabling low back pain were maladaptive coping behaviors, nonorganic signs, functional impairment, general health status, and presence of psychiatric comorbidities.

Chou R and Shekelle P. Will this patient develop persistent disabling low back pain? JAMA;2010;303(13):1295-1302.

Cases that had early MRI were more likely to have worse outcomes. Results suggest that iatrogenic effects of early MRI are worse disability and increased medical costs and surgery, unrelated to severity.

Webster BS and Cifuentes M. Relationship of early magnetic resonance imaging for work-related low back pain with disability and medical utilization outcomes. J Occup Environ Med. 2010;52(9):900-907.

"Prevalence of lumbar spondylolisthesis was 31%."

"Spondylolisthesis may be more common among older men than previously recognized."

Denard PJ, et al. Lumbar Spondylosis Among Elderly Men: Prevalence, Correlates, and Progression. *Spine.* 2010;35(10):1072-1078.

"To determine the prevalence of spondylolysis in a selected population and evaluate the association of spondylolysis with low back pain (LBP). Spondylolysis is widespread in the general population but the prevalence of spondylolysis and its relationship with LBP in the Korean population is controversial. […]
The prevalence of spondylolysis was not associated with the presence of LBP and age in adulthood."

Ko SB, and Lee SW. Prevalence of Spondylosis and Its Relationship with Low Back Pain in Selected Population. *Clinics of Orthopedic Surgery.* 2011;3:34-38.

Conclusion: In Southern European subjects, vertebral endplate changes are not associated with chronic low back pain.

Kovacs FM, et al. Vertebral endplate changes are not associated with chronic low back pain among Southern European subjects: a case control study. AJNR Am J Neuroradol. 2012;33(8):1519-24.

Many lumbar spine imaging tests are obtained in patients who have no clinical symptoms or risk factors suggesting a serious underlying condition, yet evidence shows that routine imaging is not associated with benefits, exposes patients to unnecessary harms, and increase costs. This article reviews current trends and practice patterns in lumbar spine imaging, direct and downstream costs, benefits and harms, current recommendations, and potential strategies for reducing imaging overuse.

Chou R, Deyo RA, Jarvik JG. Appropriate use of lumbar imaging for evaluation of low back pain. Radiol Clin North Am. 2012;50(4):569-85.

Physicians that bill for the performance of MRI procedures, rather than referring patients outside of their practice, appear to change practice patterns such that they use more MRI for their patients with low back pain. The increase use of MRI use leads to an increase in surgery.

Shrelbati JB and Baker LC. The relationship between low back magnetic resonance imaging, surgery, and spending: Impact of physician self-referral status. Helath Serv Res. 2011;46(5):1362-1381.

Conclusion: Degenerative findings in both the lumbar and cervical spine, suggesting tandem disc degeneration, was common in asymptomatic subjects. These results provide normative data for evaluating patients with degenerative lumbar and cervical disc diseases.

Matsumoto M, et al. Tandem age-related lumbar and cervical intervertebral disc changes in asymptomatic subjects. Eur Spine J. 2013;22:708-13.

Conclusion: MRI performed at 1-year follow-up in patients who had been treated for sciatica and lumbar disk herniation did not distinguish between those with a favorable outcome and those with an unfavorable outcome.

El Barzouhi A, et al. Magnetic resonance imaging in follow-up assessment of sciatica. NEJM. 2013;368(11):999-1007.

2014

"It is questionable whether an annular tear (AT) is a predictor for accelerated degeneration of the intervertebral discs. The aim of the present study was to answer this question via a matched case-control study design that reliably eliminates potential confounders. […]

Discs with a Pfirrmann grade >2 with an AT, defined by a hyperintense signal intensity on MRI, are not prone to accelerated degeneration if compared to discs without an AT. Therefore, the presence of an AT per se does not predict accelerated disc degeneration."

Farshad-Amacker NA, et al. Is an annular tear a predictor for accelerated disc degeneration? *Eur Spine J.* 2014;23:1825-1829.

"Background context: The epidemiology, the fracture pattern, and the clinical relevance of prevalent vertebral fractures in old men are debated wherefore we set out to clarify these issues. […] Conclusions: A prevalent vertebral fracture is common in old men but has low clinical relevance. There does not seem to be a specific fracture pattern that predisposes for back pain."

Kherad M, et al. There is low clinical relevance of a prevalent vertebral fracture in old men – the MrOs Sweden study. *The Spine Journal.* 2014;15(2):281-289.

2015

"Degenerative changes are commonly found in spine imaging but often occur in pain-free individuals as well as those with back pain. We sought to estimate the prevalence, by age, of common degenerative spine conditions by performing a systematic review studying the prevalence of spine degeneration on imaging in asymptomatic individuals.

[…] Thirty-three articles reporting imaging findings for 3110 asymptomatic individuals met our study inclusion criteria. The prevalence of disk degeneration in asymptomatic individuals increased from 37% of 20-year-old individuals to 96% of 80-year-old individuals. Disk bulge prevalence increased from 30% of those 20 years of age to 84% of those 80 years of age. Disk protrusion prevalence increased from 29% of those 20 years of age to 43% of those 80 years of age. The prevalence of annular fissure increased from 19% of those 20 years of age to 29% of those 80 years of age. […]

Imaging findings of spine degeneration are present in high proportions of asymptomatic individuals, increasing with age. Many imaging-based degenerative features are likely part of normal aging and unassociated with pain. These imaging findings must be interpreted in the context of the patient's clinical condition."

Brinjikji W, et al. Systematic Literature Review of Imaging Features of Spinal Degeneration in Asymptomatic Populations. *AJNR Am Neuroradiol.* 2015;36:811-816.

2016

Lumbar Spine MR imaging was generally overused in Eastern China. Professional training and clinical guidelines are needed to facilitate evidence-based back pain practice in China.

Yu L, et al. The Use of Lumbar Spine Magnetic Resonance Imaging in Eastern China: Appropriateness and Related Factors. PLoS ONE 11(1):e0146369.doi:10.1371/journal.pone.0146369. Published January 5th, 2016.

"We found that 31% of LS MRIs were inappropriate in a healthcare system largely absent of financial and other incentives for ordering. The problem of inappropriate ordering of LS MRI is concentrated in a small number of providers; any provider-facing interventions to reduce inappropriate order should therefore be targeted, rather than aimed at all providers who order LS MRI."

Gidwani R, et al. Inappropriate Ordering of Lumbar Spine Magnetic Resonance Imaging: Are Providers Choosing Wisely? *Am J Manag Care.* 2016;22(2):e68-e76.

Conclusion: MRI assessment of the presence of nerve root compression and extrusion of a herniated disc at baseline was associated with less leg pain during 1-year follow-up, irrespective of a surgical or conservative treatment. MRI findings seem not to be helpful in determining which patients might fare better with early surgery compared with a strategy of prolonged conservative care.

El Barzouhi A, et al. Prognostic value of magnetic resonance imaging findings in patients with sciatica. J Neurosurg Spine. 2016;24(6):978-85.

2018

"A high number of the world's premier athletes demonstrated moderate to severe spine disease on MRI during the 2016 Summer Olympics, including moderate/severe degenerative disc changes with varying degrees of disc bulges and herniations."

Wasserman MS, et al. Evaluation of spine MRIs in athletes participating in the Rio de Janeiro 2016 Summer Olympic Games. *BMJ Open Sport Exerc Med.* 2018;4(1): e000335.

2019

Modic changes were not found to negatively associated with long-term pain, disability, or sick leave. Rather, the study found that low back pain with Modic changes had less disability and sick leave at long-term follow-up.

Udby PU, Bendix T, Ohrt-Nissen S, et al. Modic changes are not associated with long-term pain and disability. Spine. 2019;44(17):1186-1192.