Appropriate Use of Diagnostic Imaging in Low Back Pain: A Reminder That Unnecessary Imaging May Do as Much Harm as Good

Low back pain (LBP) is common and costly. Approximately one quarter of adults in the United States have reported having LBP lasting at least 1 whole day in the past 3 months, and 2% of all physician office visits are for low back complaints. In 2005, total healthcare expenditures in the United States for LBP were estimated at $85.9 billion. LBP is the most frequent disorder managed by physical therapists, accounting for 50% of all patients seeking outpatient physical therapy care. In the US, physical therapists are increasingly either the point of clinical entry or the main clinical contact for patients with low back complaints. Physical therapists have most extensively occupied this role in the US Army, where, since the early 1970s, they have served as nonphysician healthcare providers or physician extenders, when performing primary care (ie, evaluation and treatment for patients with neuromusculoskeletal conditions such as LBP). US Army physical therapists are credentialed to refer patients to radiology for diagnostic imaging tests (radiographs, magnetic resonance imaging [MRI], computed tomography [CT] scans, and bone scans). The implementation of these neuromusculoskeletal management programs has further expanded into other healthcare systems. This evolving role of physical therapists in the management of LBP is consistent with the American Physical Therapy Association’s Vision 2020 statement, which calls for “consumers to have direct access to physical therapists in all environments for patient/client management, prevention, and wellness services, including status as practitioners of choice in patients’/clients’ health networks holding all privileges of autonomous practice.” Finally, a projected shortage of primary care physicians for adults is looming. It is, therefore, probable that physical therapists will be the point of entry for increasing numbers of individuals with low back disorders. As such, it is imperative that physical therapists have a keen understanding of the appropriate and 

Clinical Commentary

TIMOTHY W. FLYNN, PT, PhD • BRITT SMITH, PT, DPT • ROGER CHOU, MD

SYNOPSIS: The rate of lumbar spine magnetic resonance imaging in the United States is growing at an alarming rate, despite evidence that it is not accompanied by improved patient outcomes. Overutilization of lumbar imaging in individuals with low back pain correlates with, and likely contributes to, a 2- to 3-fold increase in surgical rates over the last 10 years. Furthermore, a patient’s knowledge of imaging abnormalities can actually decrease self-perception of health and may lead to fear-avoidance and catastrophizing behaviors that may predispose people to chronicity. The purpose of this clinical commentary is as follows: (1) to describe an outline of the appropriate use, as defined in recent guidelines, of diagnostic imaging in patients with low back pain; (2) to describe how inappropriate use of lumbar spine imaging can increase the risk of patient harm and contributes to the recent large increases in healthcare costs; (3) to provide physical therapists with clear guidelines to educate patients on both appropriate imaging and information to dampen the potential negative effects of imaging on patients’ perceptions and health; and (4) to present an example of a successful clinical pathway that has reduced imaging and improved outcomes.


KEY WORDS: lumbar spine, MRI, magnetic resonance imaging, overutilization, screening, prognosis

• Distinguished Professor, Rocky Mountain University of Health Professions, Provo, UT. • Physical Therapist, SOAR Physical Therapy, Grand Junction, CO. • Associate Professor, Oregon Health & Science University, Portland, OR. Address correspondence to Dr Timothy W. Flynn, Rocky Mountain University of Health Professions, 561 East 1860 South, Provo, UT 84606, E-mail: tim@colpts.com
APPROPRIATE USE OF DIAGNOSTIC IMAGING IN PATIENTS WITH LBP

In 2007, the American College of Physicians and the American Pain Society published a joint clinical practice guideline on the diagnosis and management of LBP. The guideline provides updated evidence on appropriate diagnostic imaging in patients with LBP. The 3 key recommendations regarding diagnostic imaging are the following:

1. Clinicians should not routinely obtain imaging or other diagnostic tests in patients with nonspecific low back pain (grade: strong recommendation, moderate-quality evidence).

2. Clinicians should perform diagnostic imaging and testing for patients with low back pain when severe or progressive neurologic deficits are present or when serious underlying conditions are suspected on the basis of history and physical examination (grade: strong recommendation, moderate-quality evidence).

3. Clinicians should evaluate patients with persistent low back pain and signs or symptoms of radiculopathy or spinal stenosis with magnetic resonance imaging (preferred) or computed tomography, only if they are potential candidates for surgery or epidural steroid injection (for suspected radiculopathy) (grade: strong recommendation, moderate-quality evidence).

The evidence supporting these recommendations includes a number of randomized clinical trials. Recently, a meta-analysis of 6 randomized trials of patients (n = 1804) with primarily acute or subacute LBP was conducted. The patients in these trials had no clinical or historical features that suggested a serious underlying condition. The meta-analysis indicated that there was no difference in outcomes for pain, function, quality of life, or overall patient-rated improvement between those who were provided usual care without routine lumbar imaging (radiography, MRI, or CT) versus those provided with usual care and the addition of lumbar imaging. In fact, for short-term outcomes, trends slightly favored usual care without routine imaging. Furthermore, routine imaging was not associated with psychological benefits, despite some clinicians’ perceptions that it might help alleviate patient fear and worry about back pain. Importantly, in 4 trials (n = 399) included in the meta-analysis that performed imaging in all patients or followed patients for at least 6 months, no serious underlying conditions were found. This further evidence that imaging may not be necessary in the absence of suggestive clinical or historical features.

The vast majority of patients with LBP do not need diagnostic imaging, and an even smaller percentage require advanced imaging, such as MRI. The results of the history and physical examination should determine if imaging is needed. Consistent with the ongoing work on subgrouping and staging patients with LBP, the first step is to determine whether the patient is appropriate for physical therapy-only management or whether further diagnostic workup is warranted. The key component in this step is identifying red flags or clinical features that represent serious underlying pathology. TABLE provides the American College of Physicians/American Pain Society evidence-based guidelines for ordering imaging when key historical or physical examination features are present.

In a primary care setting, the prevalence rate of LBP due to cancer is approximately 0.7%, that of compression fracture 4%, and spinal infection 0.01%. Estimates for prevalence of ankylosing spondylitis for patients seen in primary care range from 0.3% to 5%. Routine screening of risk factors for cancer and infection should be considered standard of care in LBP management in physical therapist practice. In a large, prospective study from a primary care setting, a history of cancer (positive likelihood ratio, 14.7), unexplained weight loss (positive likelihood ratio, 2.7), failure to improve after 1 month (positive likelihood ratio, 3.0), and age older than 50 years (positive likelihood ratio, 2.7) were each associated with a higher likelihood for cancer.

In patients with a history of cancer (not including nonmelanoma skin cancer) the posttest probability of cancer presenting with back pain increases from approximately 0.7% to 9%. This means that nearly 1 in 10 of these patients would have a metastatic cancer and thus the physical therapist should recommend immediate imaging in this subgroup of patients. Conversely, in patients with any 1 of the other 3 risk factors (unexplained weight loss, age over 50, failure to improve after 1 month) the likelihood of cancer only increases to approximately 1.2%. In this instance, a more pragmatic approach involving close monitoring and an expectation of symptom improvement during rehabilitation is warranted. If little to no improvement is noted, further...
TABLE

SCREENING FOR RED FLAGS

<table>
<thead>
<tr>
<th>Possible Cause/Key Features on Physical Examination History</th>
<th>Imaging</th>
<th>Additional Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer, history of cancer with new onset of LBP</td>
<td>MRI</td>
<td>None</td>
</tr>
<tr>
<td>Unexplained weight loss, failure to improve after 1 mo, age over 50 y</td>
<td>Lumbosacral plain radiography</td>
<td>ESR</td>
</tr>
<tr>
<td>Multiple risk factors present</td>
<td>Plain radiography or MRI</td>
<td>None</td>
</tr>
<tr>
<td>Vertebral infection</td>
<td>MRI</td>
<td>ESR and/or CRP</td>
</tr>
<tr>
<td>Fever, intravenous drug use, recent infection</td>
<td>MRI</td>
<td>None</td>
</tr>
<tr>
<td>Cauda equina syndrome</td>
<td>MRI</td>
<td>None</td>
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<tr>
<td>Urinary retention, motor deficits at multiple levels, fecal incontinence, saddle anesthesia</td>
<td>MRI</td>
<td>None</td>
</tr>
<tr>
<td>Vertebral compression fracture</td>
<td>MRI</td>
<td>None</td>
</tr>
<tr>
<td>History of osteoporosis, use of corticosteroids, older age</td>
<td>Lumbosacral plain radiography</td>
<td>None</td>
</tr>
<tr>
<td>Ankylosing spondylitis</td>
<td>MRI</td>
<td>Consider EMG/NCV</td>
</tr>
</tbody>
</table>

Abbreviations: CRP, C-reactive protein; EMG/NCV, electromyography/nerve conduction velocity; ESR, erythrocyte sedimentation rate; HLA-B27, human leukocyte antigen B27; LBP, low back pain; MRI, magnetic resonance imaging. Adapted with permission from Chou R, et al. 

Diagnostic imaging in individuals with LBP should only be used if the results of the image lead to a clinical decision that results in improved patient outcomes. This statement appears both logical and obvious; however, data suggest that in the current US healthcare system this is clearly not the guiding principle. A recent study in the *Journal of the American College of Radiology* found that 26% of medical images ordered were inappropriate, and the authors cited “MR for acute back pain without conservative therapy” as a criterion for identifying inappropriate utilization. The study found a 53% inappropriate referral rate for CT and 35% inappropriate referral rate for MRI.

MRI may, in fact, facilitate the “medicalization” of LBP, due to its visually exquisite depiction of pathoanatomy. In fact, it is questionable whether the term pathoanatomy or abnormality appropriately describes what could be considered nonpathological or normal, age-related or degenerative changes. For example, among asymptomatic persons 60 years
or older, 36% had a herniated disc, 21% had spinal stenosis, and over 90% had a degenerated or bulging disc. Carragee et al performed MRIs at baseline (no symptoms of LBP) and then a repeat MRI if a patient developed an episode of LBP. The sample included 200 patients followed for 5 years. In the patients that went on to develop clinically serious LBP during the subsequent 5 years, 84% had unchanged or improved lumbar imaging abnormalities findings after symptoms developed. Furthermore, at baseline (no LBP), there was a high incidence of what in most studies would appear to be potentially serious pathology: nearly 50% had either disc protrusion or extrusion, nearly 30% had annular fissures, and there was potential root irritation in 22%. Thus over 90% of individuals had imaging findings without any significant low back symptoms, indicating that the association between such findings and symptoms is tenuous. Jarvik et al, in a 3-year follow-up of a cohort of patients that had no LBP at baseline at the Veteran’s Administration Hospital, reported that only 2 MRI findings, canal stenosis and nerve root contact, predicted future episodes of LBP. In fact, a history of depression was more predictive than either of these 2 MRI findings. To date, there is no evidence that selecting therapeutic interventions based on the presence of common imaging findings in persons with nonradicular LBP improves outcomes. Therefore, a decision to order imaging requires clinicians to equally consider the potential harm that may occur as a result of excessive imaging.

The potential harm associated with overimaging of lumbar spine in patients with LBP includes radiation exposure (lumbar radiographs and CT), exposure to iodinated contrast (CT), increased risk of surgery (MRI), and labeling when patients are told they have an abnormality (lumbar radiographs and MRI). In 2007, 2.2 million lumbar CT scans were performed in the US. Based on the radiation exposure patients received, these CT scans were projected to cause 1200 additional future cancers. It is generally believed that at least a third of these scans were not medically necessary. Though much less of a concern, gadolinium-based MR contrast agents carry some risk. Generally, these agents remain very safe. However, it is recommended that gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease.

Lumbar spine radiographs provide an estimated radiation dose equivalent to six months of background radiation (radiation associated with normal daily living). While the risk is considered very low, it does incur a 1 in 100 000 to 1 in 10 000 risk of fatal cancer. The average radiation exposure from lumbar radiography is 75 times higher than that of a chest radiograph, which is particularly concerning in young women, given the difficulty in effectively shielding the gonads. It is estimated that female gonadal radiation from lumbar radiography is equivalent to a daily chest radiograph for several years.

Large variability in lumbar spine surgical rates is now well established. Though direct causality cannot be estab-
lished, there is a strong association between rates of advanced spine imaging and rates of surgery. FIGURE 1A displays the increasing utilization of lumbar MRI in the Medicare population from 1994 to 2004, and FIGURE 1B displays the increased utilization of spinal fusion in this same population from 1988 to 2001. In Medicare beneficiaries, the rates of spine MRI utilization accounted for 22% of the variability in overall spine surgery rates, which was more than twice the variability accounted for by differences in patient characteristics. Furthermore, the use of MRI versus a lumbar radiograph early in the course of an episode of LBP resulted in a 3-fold increase in surgical rates, with no improvements in outcomes in the subsequent year. Unnecessary lumbar spine surgery is costly and has significant side effects, including death. Life-threatening complications are particularly common in older adults, ranging from 2.3% among patients having decompression alone to 5.6% among those having complex fusions. Furthermore, in the adult population, the likelihood of multiple spinal surgeries is considerable. Martin et al reported that patients who had surgery between 1990 and 1993 had a 19% cumulative incidence of reoperation during the subsequent 11 years.

In addition to the potentially harmful effects of radiation and the risks associated with spinal surgery, there is evidence that telling patients that they have an “imaging abnormality” has negative effects related to labeling. For example, Ash and colleagues performed MRIs on 246 patients with acute LBP or sciatica and subsequently randomized them to receive the results of the image or not. At 1 year, both groups had similar clinical outcomes; however, self-rated general health improved significantly more in the group that remained blind to the results of their MRI.

PLACING IMAGING RESULTS IN THE APPROPRIATE CONTEXT: PATIENT EDUCATION

Imaging can lead to additional tests, follow-up, and referrals, and may result in an invasive procedure of limited or questionable benefit. Furthermore, it can be very difficult to counteract negative consequences following an imaging finding of purported pathology, such as a herniated or degenerated disc. A patient will typically focus on this as the source of the problem. Therefore, the therapist needs to provide clear information to reverse the potentially negative effects that knowledge of imaging abnormalities may have on perceptions of health. However, it goes beyond just imparting information. The physical therapist must frequently change the patient’s beliefs that their LBP will not improve unless the image improves. We should reiterate to the patient that the image of a disc lesion of some sort represents a “picture” of a single moment in time and that we have no compelling evidence that this indicates or indict them to a prolonged course of impairment/disability. They require frequent reassurance that there is no serious damage or disease and that the overall prognosis is good—for example, a consistent positive message informing the patient that, regardless of the imaging findings, the vast majority of low back pain resolves fairly quickly, the risk of chronic LBP is very low, and, therefore, the odds for recovery are good. It is particularly important to identify individuals with high fear-avoidance beliefs regarding the effects of activity and work on their LBP, in order to institute an aggressive program to break the cycle of inactivity, disuse, and increased disability.

In these individuals, specific programs that focus on correcting mistaken beliefs about the negative effects of activity or exercise on the back and engage them in active physical therapy are warranted. In addition, a psychosocial education program can have a positive effect on LBP beliefs in a primary prevention setting.

It may be helpful during the education process to provide patients with examples of pathology in imaging that is not associated with pain and disability. Contrast the radiographs in FIGURE 2 and MR images in FIGURE 3 from a 62-year-old male who had bilateral hip replacements in 2002, with FIGURE 4, which are MRI images from a 32-year-old male with chronic LBP. The images from the 62-year-old...
male demonstrate significant lumbar degenerative changes associated with intermittent symptoms, which he managed with exercise, yoga, and occasional physical therapy. He had an episode of LBP in the summer of 2010, which he recalled as sharp LBP after canoeing and hiking for 2 weeks. He was able to “work through” his pain with ibuprofen and stretching during his trek. The patient subsequently had a full recovery from this exacerbation after 9 sessions of physical therapy (Oswestry Low Back Pain Disability Questionnaire score, 46% at worst and 6% at discharge). He was contacted 6 months after his initial visit and noted that he had recently completed a 2-week back-packing hike of the United States Continental Divide and had no current LBP.

The 32-year-old automobile parts store manager had a history of chronic LBP. He was off-work for disability and presented in September 2009 with severe LBP. In FIGURE 4 are MRIs from 2009 that were interpreted as relatively “unremarkable,” with degenerative disc disease at L4-5 and L5-S1, and mild disc protrusion at L4-5. His central canal is sufficient at all levels. He was not deemed a surgical candidate, and was referred to physical therapy. The patient attended a total of 24 sessions of physical therapy over a 9-month period that focused on core strengthening and conditioning. His Oswestry improved from 84% to 36% at the time of discharge. Interestingly, this patient had low Fear-Avoidance Belief Questionnaire (FABQ) physical activity (10 of 24) and work scale (9 of 42) scores. He returned to work at a new job managing automobile parts with a new company in February 2010, with continued moderate levels of LBP and disability. Clearly, this patient’s MRI results are not reflective of serious pathology; yet he continued to have LBP, whereas the 62-year-old male in our first example had the proverbial “spine of an 85-year-old” and enjoyed a robust physical lifestyle.

The use of such examples may help patients to understand that imaging findings do not determine the extent of pain or limitations, and that the focus should be on maximizing function. Ultimately, recovery and relief of pain depend on getting the patient active again and restoring normal function.52 Educating patients on the facts about the use and limitations of lumbar spine imaging is imperative.

Wennberg argues that the shift to shared decision making and “preferencesensitive care,” away from paternalistic, “delegated” decision making and “supply-sensitive care,” will actually reduce utilization rates of services (eg, surgery and imaging), if we educate the patients about the facts.52 Evidence supporting this assertion includes a clinical trial, in which patients with LBP who were candidates for elective spine surgery were randomized to either read a brochure and watch a video with actual patients describing their preferences and their decisions on whether to have surgery or not, versus a control group who received only the brochure.17 The written booklet contained anatomic illustrations of the lumbar spine, a discussion of surgical and nonsurgical treatments for herniated disks and spinal stenosis, a general description of expected outcomes, and a short self-test on material in the booklet.
The video program included animated graphics of spinal anatomy, a discussion of problems that cause back pain, and a discussion of ambiguities in diagnosis. Outcome probabilities for surgical and nonsurgical care at 1, 4, and 10 years were presented, along with interviews from real patients who had experienced either good or bad outcomes of surgical or nonsurgical care. The patients who watched the video scored higher on a knowledge test for decision-making information and the cohort of patients with a herniated disc who watched the video were less likely to choose surgery than patients who received only the brochure (32% versus 47%). The 1-year outcomes for the patients in either group who decided against surgery were the same as the patients who had surgery, thus the surgery rates were reduced without adverse outcomes. Wennberg suggests that a central impediment to developing shared decision making is a reimbursement system that rewards physicians for performing an operation but does not reward the physician for taking the time to learn what patients want. In high-volume disorders, LBP in particular, changing the system of healthcare delivery is crucial to implementing patient-preference-driven, shared decision making and reducing overutilization of imaging resources. A system that places physical therapists as first providers for back pain has the potential to improve outcomes and reduce overutilization of finite and expensive resources, while providing both evidence-based and preference-sensitive healthcare.

**POTENTIAL PATHWAYS TO LOWER IMAGING: THE VIRGINIA MASON EXAMPLE**

When used appropriately, diagnostic imaging in the early to middle stages of an individual presenting with LBP should be an infrequent occurrence. Multiple publications have called for an evidence-based approach when considering imaging in patients with LBP. However, implementing this evidence into action has proven to be daunting, as rates of imaging continue to increase. A recent systematic review evaluated the effect of distributing educational materials to clinicians on rates of appropriate LBP imaging. The majority of the included studies observed no significant improvement in rates of appropriate imaging, and it is currently unclear whether educational materials are effective or not for changing LBP imaging behavior.

An exception is the experience of the Virginia Mason Medical Center in Seattle, WA in changing the care pathway for individuals presenting with LBP. In the summer of 2004, the insurance company Aetna gave Virginia Mason notice that their specialty practices cost up to twice as much as other top local practices for the same care. This resulted in Virginia Mason studying the care process for LBP and noting a lack of standardized, evidence-based procedures. Though Virginia Mason physicians were salaried and had no direct financial incentive to run excess tests, many had gotten into the habit of ordering an MRI. The proposed solution was to change the pathway and implement an evidence-based protocol with physical therapy upfront (FIGURE 5). The result was that, within a year, the number of individuals with LBP who received an MRI decreased from 15% to 10%. In addition, the cost of an episode of care was reduced from the $2100–$2200 to the $900–$1000 range, and the early initiation of physical therapy reduced the need for staff at the Virginia Mason’s chronic pain center, as fewer patients with LBP went on to that level of care. The new model resulted in only 6% of patients losing time from work, though further research should also report on additional patient-centered outcomes of this model of care. The challenges to implementing this example are significant, as there are many stakeholders in the LBP industry. The success of the program is based on the basic assumption that in the vast majority of patients with improving function, imaging is neither required nor appropriate. However, in the current healthcare climate, the implementation of this model requires collaboration among purchasers, health plans, and providers operating in an integrated delivery system, with all parties having access to detailed cost data, along with incentives structured so that more efficient providers retain some...
CONCLUSION

When used appropriately, diagnostic imaging is an important component of patient care in individuals with low back complaints. The inappropriate use of lumbar spine imaging can increase the risk of patient harm and contributes to the recent large increases in healthcare costs. Physical therapists have an important role in educating the patient consumer and medical colleagues on appropriate imaging and the integration of the imaging findings in the overall context of patient’s function and disability. Future research should continue to explore clinical pathways that can reduce inappropriate imaging, decrease costs, and improve patient outcomes.

REFERENCES


