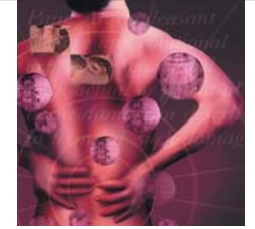


Diagnostic imaging for back pain



BACKGROUND X-rays and computerised tomography (CT) scans for back pain are often ordered to exclude pathology, to make a positive diagnosis and/or as a response to patient expectations.

OBJECTIVE This article reviews the evidence about the accuracy of diagnostic imaging to allow rational ordering without compromising patient satisfaction.

DISCUSSION X-rays make no difference to outcomes for back pain and related disability. For the exclusion of serious causes of back pain, the accuracy of X-rays and CT scans is limited. Most positive findings on radiological investigations, particularly degenerative findings, have little or no association with back pain. A history that includes the key features of serious causes will detect all patients requiring imaging. Care is required in explaining results of radiological investigations to patients to reassure about the absence of serious causes and to put incidental findings into perspective.

In Australia, X-rays and computerised tomography (CT) scans of the lumbosacral spine account for 3.4% and 0.8% respectively of all radiological investigations ordered by general practitioners.¹ These investigations carry a cost to Medicare and the patient, and a potentially harmful radiation dose to the gonads and other structures, placing the onus on the GP to balance their potential risks against the benefits. The perceived benefits include diagnosis of the cause of pain and the exclusion of serious pathology (so called 'red flag conditions') and greater patient satisfaction. Patients often expect X-rays based on misconceptions about the benefits they offer.² However, when checked against the available evidence, these benefits appear to be limited.

The decision to order radiological investigations for back pain, as for any medical problem, should be guided by primary considerations such as:

- will the investigation influence the outcome
- what is the probability that significant findings will be present given the clinical features, and
- will the investigation detect the cause of the problem?

Secondary, but nonetheless important considerations include patient reassurance about the absence of serious disease, medicolegal and compensation factors, and the costs and risks of the investigation.

This article aims to provide the reader with the relevant evidence to allow rational ordering of diagnostic imaging for back pain without compromising the ability to detect serious pathology or to reduce patient satisfaction. In this article, the term 'back pain' includes both low back pain and upper back pain. As the literature on upper back pain is quite limited, some of the recommendations for the investigation of low back pain



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Table 1. Sensitivity (100% minus false negative %) and specificity (100% minus false positive %) of plain films in the evaluation of some pathological causes of back pain⁷

Condition	Sensitivity	Specificity
Malignancy	70%	90%
Osteomyelitis	80–90%	70–90%
Spondylitis	50%	90%

have been applied to the entire back when relevant literature on upper back pain was lacking.

Will this investigation influence the outcome?

A pragmatic approach to investigation focusses on the outcomes from ordering imaging versus delaying ordering, or not ordering imaging at all. The consequences of delayed ordering of imaging has been calculated for ordering X-rays on all patients with low back pain at the first visit compared with restricting X-rays to those who have not improved at 4–8 weeks.³ This showed a theoretical benefit of ordering X-rays of an average reduction of 0.04 days of suffering per patient at 10 times the cost and a tenfold greater radiation exposure. The risk and cost of the earlier diagnosis of the small percentage of occult serious disease therefore seems unwarranted.

The outcomes of not ordering X-rays have been tested in two controlled trials on low back pain. The first of these, for pain of duration over 6 weeks, showed the patients assigned to having an X-ray were significantly more likely to have pain, disability and medical attention at 3 months than the control patients assigned to no X-ray.⁴ These differences were no longer significant at 9 months. Despite no benefit in outcomes, more than 80% overall said they would choose to have an X-ray. Patient satisfaction was greater in the X-ray group. The second trial, on acute low back pain in United Kingdom family health services, showed that those assigned to having an X-ray had no benefits in pain, disability or physical functioning, but had a small advantage in mental health.⁵

Ability of imaging to exclude 'red flag' conditions

The current evidence suggests that X-rays and CT scans have limited ability to exclude serious causes of back pain, ie. 'red flag conditions'. *Table 1* details the

accuracy of plain films in the evaluation of some pathological causes of back pain. It can be seen that plain films are reasonably sensitive and specific in the detection of malignancy. However, they may miss pathology in the early stages of malignancy as they require 50–75% of focal bone loss in cancellous bone to be visible on the lateral view and even more loss to be visible on the anteroposterior (AP) view.⁶

A single AP film of the pelvis showing inflammatory changes in the sacroiliac joints has a 50% sensitivity for spondyloarthropathy.⁷ Where changes are equivocal, the addition of angled posterior and oblique films increase this figure to 80%, comparable to the sensitivity of CT scanning.⁸

The relationship of pain to radiological changes

It is important to remember that imaging does not show pain – imaging shows anatomy. Precise diagnosis of anatomical sources of back pain requires injection studies such as provocation discography and blockade of the nerve supply to facet joints.⁹ The notion that radiological abnormalities in anatomy can be invoked as the cause of back pain has been challenged by several studies.^{10–13}

The most common of these abnormalities are the degenerative changes including spondylosis/osteophytes,¹⁰ spondylolysis (pars fractures and defects),¹⁴ disc calcification, facet joint arthrosis and subluxation,¹¹ degenerative listhesis, and comprehensive radiological degenerative indices.¹¹ Their incidence is similar in patients with back pain and in asymptomatic controls.^{10,11} Although the findings of degeneration increase with age,^{12,13} pain does not increase proportionally.¹¹ The peak incidence of backache is in the middle years of life.¹¹

Several other commonly reported radiological abnormalities are generally felt to be of questionable clinical significance. These include single disc space narrowing,^{15,16} 'lumbarisation' and 'sacralisation', Schmorl nodes, mild to moderate scoliosis, and spina bifida occulta.⁷ Scheuermann kyphosis has been linked to an increased incidence of back pain and a decreased prevalence of leg pain.¹⁷

In contrast, a relationship has been found between back pain and the radiological findings of compression fractures.^{18,19} There is a weak association between pain and spondylolisthesis in women,²⁰ but not in men.¹⁴ There is also a weak association between pain and multiple disc degeneration in the lumbar spine,¹⁶ but

Table 2. Spinal diseases linked to back pain: prevalence in a primary care population,^{3,24-26} key historical features and their respective positive likelihood ratios, ie. their likelihood, given the presence of the feature(s)²⁴

Spinal disease	Primary care prevalence	Key historical feature	Positive likelihood ratio
Compression fracture	4% ²⁴	Patient aged 70+ years	5.5
		Trauma	2.0
		Corticosteroid use	12.0
Cancer	0.66% (lumbar spine) ²⁵ 0.63% (thoracic spine) ²⁵	Patient aged 50+ years	2.7
		Previous history of cancer	15.5
		Failure to improve within a month of therapy	3.1
		Unexplained weight loss (4.5 kg in 6 months)	2.5
		No relief with bed rest	>1.7
		Duration of pain >1 month	2.6
		Age 50+ years, cancer history, unexplained weight loss, failure of conservative therapy	2.5
Ankylosing spondylitis	0.3% ²⁶	Out of bed at night because of pain	3.1
		Pain not relieved supine	1.6
		Pain duration 3+ months	1.6
		Back pain at night	1.5
		Morning stiffness, 0.5 hours or more	1.6
Spinal osteomyelitis	0.01% ³	Intravenous drug abuse, urinary tract infection or skin infection	NA

not the thoracic spine.²¹ The association with the lumbar spine weakens with age as the prevalence of degenerative changes increases.²²

There is a stronger association between chronic low back pain and fissures in the posterior annulus of the disc demonstrated on magnetic resonance imaging (MRI). As an indicator of the source of pain, these fissures have a positive likelihood ratio as high as 6.5.²³

Probability of radiological findings in back pain

The primary care prevalence of spinal diseases with radiological findings linked to low back pain is shown in *Table 2*. These range from 4% with compression fractures to less than 0.01% for spinal infections.^{3,24-26} Clinical red flag indicators which screen out those with very low likelihood of these conditions should be pursued before radiological investigation is contemplated. Considering the 'positive likelihood ratio' aids in the interpretation of results. For instance, a positive likelihood ratio of 12 for compression fracture and corticosteroid, indicates that a patient with X-ray signs of a

fracture is 12 times as likely to actually have a compression fracture if they have been taking corticosteroids.

Criteria for the use diagnostic imaging X-rays

The key historical features listed in *Table 2*, plus compensation status, have been applied to low back pain in American primary care as criteria for ordering plain films.²⁷ When used in this way, they have a sensitivity of 100% and a specificity of 28% in detecting red flag conditions. However, 58% of patients fulfilled the criteria, possibly more than the proportion chosen by responsible doctors using intuitive criteria.

Based on other studies showing poor sensitivities and specificities of some of these criteria, Bogduk⁹ has shortened this criteria list without loss of security to the following:

- history of cancer
- significant trauma
- unexplained weight loss (4.5 kg in <6 months)
- temperature >37.8°C
- risk factors for infection

- neurological deficit
- minor trauma in patients
 - over 50 years of age
 - known to have osteoporosis
 - taking corticosteroids, and
- no improvement over 1 month.

This list is most useful as a prompt for history taking in general practice, as patients who have none of these features can be reassured that the chance of any serious condition is remote. In the absence of any published recommendations for the thoracic spine, this list may be used for upper back pain.

Back pain attributed to a work injury is not, in itself, an indication for imaging at the first visit. Workcover guidelines recommend the delayed use of plain films at 4–6 weeks in back pain without radiculopathy.²⁸ If there are clinical features of a spondyloarthropathy (Table 2), early investigation is still not indicated until 3 months after the onset of pain in keeping with the diagnostic criteria.²⁹ Pelvic films with AP, angled posterior and oblique views should be the initial radiological investigation here.⁷

Although the criteria in Table 2 were developed principally for acute low back pain, with the exception of failure to improve after 1 month, they act as prompts for screening of red flag conditions in chronic back pain. The screening test of choice here is an MRI scan as it has a higher sensitivity and specificity for detecting red flag conditions than either X-rays or CT scans, and can detect potentially painful fissures in the posterior annulus of the disc. However, the lack of a Medicare rebate for general practice patients makes this expensive investigation inaccessible to most.

CT scanning

Computerised tomography scanning has virtually no role in the assessment of uncomplicated back pain and only a very limited role in the assessment of low back pain with sciatica. As the natural history of sciatica treated conservatively is generally favourable, CT scanning should be limited to patients with neurological symptoms and signs that are worsening or failing to resolve. Caution is required in the interpretation of the findings from CT scans as there is a high prevalence of herniated lumbar discs in asymptomatic individuals. This has been measured at 19.5% in those under 40 years of age and 26.9% in those over 40 year of age.³⁰ In the thoracic spine, the evaluation of disc disease is limited by the poor ability of CT to define thecal sac or nerve root compression.³¹ Magnetic resonance imaging is the preferred investigation. Computerised tomography scanning does

have a role in the assessment of back pain following trauma. Here it is superior to X-rays at defining bony and soft tissues abnormalities.³²

Dealing with patients

Armed with the evidence in this article, the GP should be in a strong position to deal with the pressure from patients to order imaging. Discussion of the limited ability of imaging to exclude serious causes of pain and to positively diagnose the cause of the pain may address some misconceptions about the usefulness of imaging. It has been shown that a brief educational intervention (see *Patient education* page 403 this issue) can reduce the proportion who believe X-rays are necessary from 73 to 44%, without affecting patient satisfaction or missing any serious diagnoses.²

When explaining the results of imaging to patients, great care should be taken in placing significance on positive findings. Unless there is a good correlation between the clinical features and the radiological findings, and there is good research evidence linking the findings to pain, they should be not be used to provide a diagnostic label. It is helpful to explain at the point of ordering a radiological investigation that its prime purpose is to exclude serious causes of back pain and that the ability of the investigation to provide a diagnosis is quite limited.

Particular care should be taken not to alarm patients by placing significance on degenerative changes. As these changes are irreversible and progressive, they may carry the connotation that the pain will never resolve, therefore placing a psychological barrier in the way of recovery. It is interesting to speculate if this was a reason for the increased prevalence of pain and disability with X-rays in the study mentioned earlier in this article.⁴

Summary of important points

- Imaging does not show pain – imaging shows anatomy.
- Radiological investigations for back pain have limited utility in excluding serious causes.
- A good history is the best tool for exclusion of serious causes of back pain.
- Radiological investigations make no difference to back pain and related disability.
- Most positive findings of radiological investigations, particularly degenerative findings, have little or no association with back pain.

Conflict of interest: none.

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