Role of Medical Imaging on Outcomes of Mechanical Low Back Pain Patients

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Abstract

Purpose: The objective of this study was to determine the impact of diagnostic imaging on outcomes of a cohort of mechanical low back pain patients. Methods: The cohort was incident cases reporting for treatment at physiotherapy clinics across Canada. Patients were less than 90 days post injury, assessed between January 1, 1999 and December 31, 2001. Those with previous back surgery and those not working at the time of assessment were excluded. Patients were categorized into one of two groups based on their imaging history: Imaging Group - those who received at least one diagnostic test (CT/MRI, x-ray) before treatment initiation (n=317), Non-Imaging Group – an equal size random sample of those within the cohort who did not receive any pre-treatment imaging (n=317). Results: There were no statistically significant differences in baseline characteristics between groups. There were no statistically significant differences in number of treatment days, change in Visual Analogue Scale pain rating, or change in function from assessment to discharge between groups. Conclusions: Diagnostic imaging did not lead to improved outcomes for this cohort of acute and subacute mechanical low back pain patients.

Introduction

As a society, we consume tremendous resources to diagnose and treat painful spinal disorders[1] even though low back pain is usually a benign and self-limiting condition.[2] The popularity of imaging studies remains high but most patients recover within a few weeks without the need for these investigations.[3,4]

Of the main imaging techniques used in low back pain (plain radiograph, CT, MRI), there is no evidence of their diagnostic accuracy and limited conclusions regarding their effectiveness.[5] Most positive findings on radiological investigations, particularly degenerative findings, have little or no association with back pain. The accuracy of both X-ray and CT are limited and research has shown that they make no difference to back pain outcomes and related disability.[6]

MRI of the lumbar spine produces exquisitely sensitive depictions of pathoanatomy.[7] But even early access to MRI has questionable value. In a trial where spine patients were randomly assigned to receive either rapid MRI or radiograph, the two imaging procedures resulted in nearly identical outcomes for primary care patients.[8] The use of advanced imaging technology has yet to help delineate the anatomical and pathological structures that actually cause pain[9] because abnormal findings do not always indicate symptoms.[2,6,10,-14] These findings question the discriminative power to differentiate between symptomatic and asymptomatic individuals[2] based on our current criteria for low back pain diagnosis.

Jarvik and Deyo[15] reviewed the evidence for imaging spine patients in primary care settings. From their MEDLINE search, they concluded that therapy not including imaging is the most appropriate course for adults younger than 50 years with no signs or symptoms of systemic disease. Clinicians need to be cognizant of red flags that point to the more serious conditions that require further investigation and reserve diagnostic imaging for serious cases.[3] This minority of cases includes patients with suspected cauda equina syndrome, infection, tumour or fracture. However, imaging studies should be interpreted stringently[6] to avoid unnecessary patient labelling and potentially inappropriate treatment[7] because the risk of misdiagnosis is high.[16]

Inappropriate utilization of diagnostic imaging can lead to further "medicalization" of low back pain.[7] Overutilization is not cost-effective, does not appear to affect overall treatment[17] and can increase the likelihood of iatrogenic complications.[1] The diagnostic assessment of low back pain should predominantly be based on history and clinical examination since imaging has minimal influence on diagnostic or therapeutic decisions.[18,19]

Despite the abundant research, some radiologists and clinicians still fail to recognize the poor correlation between imaging findings and significant, treatable disease. Ten years after the Agency for Health Care Policy and Research (AHCPR)[20] produced guidelines on this topic, imaging is still overused.[18] There is still need for evidence-based guidelines and emphasis on the limited role of imaging in low back pain treatment.[18]

The objective of this study was to determine the impact of diagnostic imaging on outcomes of a cohort of mechanical low back pain patients. The research question was: In patients presenting for active rehabilitation, did pre-treatment diagnostic imaging studies help lead to significantly better outcomes?

Materials and Methods

This study involved a retrospective review of incident cases that participated in back pain rehabilitation between January 1, 1999 and December 31, 2001. The cohort was less than 90 days post injury and attended treatment at any one of 43 rehabilitation clinics across Canada.

The clinics are secondary care rehabilitation facilities that focus on pain control and recovery of movement in acute, sub-acute and chronic ambulatory populations. Treatment involved a range of protocols that were based on active, exercise-based rehabilitation for mechanical spinal pain of musculoskeletal origin.[21] The number of treatment hours per day, the number of days in each stage, and the total treatment time were adapted to the individual needs of patients.

Mechanical back pain was the working diagnosis of all patients in the cohort. This diagnosis implies pain arising from the structures of the spine that responds to movement and position; mechanical pain is unrelated to infection, chemical irritation or tumour.

The rare back pain patients with suspected systemic disease and cases sustaining trauma sufficient to produce severe bony injury or major neurological sequelae were not involved since they are not patient types typically referred to such treatment. Minors, surgical candidates, those with previous back surgery, chronic patients and those not working at the time of assessment were excluded; this resulted in a sample size of 2,565.

Patients were referred to treatment via general practice and family physicians. All imaging studies were done at the discretion of the referring physicians. All imaging studies were conducted prior to, reporting for and initiation of treatment. The clinics did not order or request any imaging studies. Physiotherapy treatment was conducted independent of the imaging studies, and was based on aggravating and relieving movements/positions, not pathology. Registered physiotherapists with specialized training performed standardized assessments (physical examination and history). The high inter-tester reliability of the assessment procedures has been described elsewhere.[22]

Assessment and patient self-report were used to obtain baseline and outcome information. Patients participated in a clinical interview, completed a baseline questionnaire on how pain has affected physical function, and provided sociodemographic information.

At discharge, the questionnaire was completed again to determine any changes or improvements. All information from the two questionnaires and spinal assessment were entered into a computer program and then electronically transferred and stored in a central clinical database. Prior to analysis, patient data were anonymized, with the exception of patient identification number, using methods designed to protect the confidentiality of all patients under study. No patient was contacted.

For statistical analysis, clinical and outcome variable data for this study were accessed from this clinical database. The database was designed for research purposes and contains clinical details desirable for epidemiological research.[23] All analyses were conducted with SPSS for Windows release 11.0.1, November 15, 2001. The University of Toronto Research Ethics Board approved this study.

Patients were categorized into one of two groups based on their imaging history. Of the 2565 cases, 317 received at least one of the diagnostic tests studied (CT, MRI, x-ray) prior to treatment (Imaging Group). For sample size considerations, all patients with at least one of the tests under consideration were categorized into the Imaging Group. The Non-Imaging Group consisted of an equal size random sample drawn from all remaining cases (n=2,248) that did not receive any pre-treatment imaging.

Primary outcomes assessed were: 1) total number of treatment days, 2) change in Visual Analogue Scale (VAS) pain rating from assessment to discharge, and 3) change in perceived function from initial assessment to discharge, based on change in questionnaire scores. The questionnaire responses were analyzed as a single variable, the total score for 18 patient self-report items based on a previously published instrument, the Low Back Outcome Score;[24] the higher the score, the greater the patient's perceived level of function.[25] Secondary outcome measures were: 1) change in medication usage from assessment to discharge, 2) subjective global rating at discharge (pain is: gone, decreased, same, increased), 3) perceived ability to control pain.

Results

Of the 317 patients with imaging studies, 250 (79%) had plain film x-rays alone; 33 had CT/MRI alone. An additional 34 had x-ray and CT/MRI. The result is that 90% (284) of the sample received plain film x-rays.

The mean age of the cohort was 39.4 years (SD=10.1, range=18-64), with 66.4% males. The mean symptom duration was 30.7 days (SD=24.3, range=1-89). Constant pain was reported by 63% and 65% reported at least occasional medication use for their back pain. Work injuries were the cause of pain for 55.1% of the cohort, 5.1% were sports injuries, 8.4% motor vehicle accident, 20% could not identify a cause, and 11.4% were injuries in the home or others.

Table 1 reveals that there were no statistically significant differences in baseline characteristics except lagtime; the Imaging Group took an average of 5 more days to report for treatment after injury (t=-2.9, p=0.003).

Logistic regression analysis was used to model the relationship between the binary response variable (imaging performed yes/no) and the outcome measures. Univariate logistic regression analysis was used to identify any significant associations between each independent variable and the dichotomous outcome. An alpha level of 0.05 (two sided) was used as the criterion for statistical significance.

Table 2 reveals that there were no statistically significant differences in change in visual analogue scale pain rating from assessment to discharge between groups (odds ratio=1.03). The Imaging Group was in treatment for 2 additional days, on average (odds ratio=1.01), and had an increase in function of almost 2 points as measured by questionnaire score (odds ratio=1.02). Analysis by individual imaging tests did not change the magnitude of the effect of any of the findings.

Table 1
Baseline demographics and clinical findings for mechanical back pain patients with and without pre-treatment imaging studies

		Non Imaging Group (n=317)	Imaging Group (n=317)	SSD
Age – mean (SD)		38.6 (10.4)	40.1 (9.8)	NS
VAS – mean (SD)		5.3 (2.1)	5.4 (2.1)	NS
Medication Use (%)	Never	10.1	13.3	NS
	1-2 / day	29.5	26.7	NS
	Occasional	47.6	43.9	NS
	Several	12.8	16.1	NS
Sex	% female	36.9	30.3	NS
Q Score – mean (SD)		43.4 (8.4)	41.9 (8.7)	NS
Lagtime – mean (SD)		27.9 (23.6)	33.6 (24.7)	*
Constancy – mean (SD)		67.4	61.2	NS

SD – standard deviation SSD – statistically significant difference NS – not significant * $p<0.05$

Table 2
Primary outcomes for mechanical back pain patients with and without pre-treatment imaging studies

Primary Outcomes		Non Imaging Group (n=317)	Imaging Group (n=317)	Odds Ratio	95% CI	SSD
Change in VAS	mean (SD)	2.3 (2.9)	2.6 (2.7)	1.03	0.92 – 1.12	NS
Number of Treatment days	mean (SD)	12.7 (14.1)	14.7 (14.8)	1.01	0.999 – 1.02	NS
Change in Function (QS)	mean (SD)	15.0 (11.7)	16.9 (10.6)	1.02	0.99 – 1.04	NS

VAS – visual analogue scale SD – standard deviation SSD – statistically significant difference NS – not significant QS – questionnaire score

Table 3
Secondary outcomes measures for mechanical back pain patients with and without pre-treatment imaging studies

Secondary Outcomes		Non Imaging Group (n=317)	Imaging Group (n=317)	X^2	SSD
Medication Use (%)				2.32	NS
	Never	53.2	60.1		
	1-2 / day	5.1	6.3		
	Occasional	39.2	31.6		
	Several	2.5	1.9		
Subjective symptom rating				2.08	NS
	Gone	47.2	49.7		
	Decreased	46.2	45.4		
	Same	5.5	4.9		
	Increased	1.0	0		
Pain control				0.53	NS
	No control	5.1	5.7		
	Can abolish	33.3	28.4		
	Can reduce	61.6	65.9		

X^2 – Chi Square Contingency Coefficient SSD – statistically significant difference NS – not significant

Chi square analysis revealed that there were no statistically significant differences in change in medication use, global pain rating, or pain control ability post treatment between groups (Table 3).

Discussion

In this study of patients reporting for treatment with mechanical back pain, imaging performed prior to rehabilitation did not contribute to improved function, reduced pain or fewer treatment days. The clinical and statistical differences in outcomes, between those with and without pre-treatment imaging, were negligible.

Of the 317 patients who received imaging, 90% obtained plain x-rays in isolation or in tandem with another test. Thus, for this cohort, plain x-ray was a popular choice, but the results add further confirmation that imaging offers little benefit.

Similar findings have been cited previously. Kerry et al.[26] stated that referral for lumbar spine radiography at first presentation of low back pain in primary care is not associated with improved physical functioning, reduced pain or disability. Lumbar spine radiography in primary care patients with symptom duration of at least 6 weeks is associated with an increase in the general practice workload, but not with improved functioning, decreased pain or better overall health status.[27] Consensus-based guidelines recommend that lumbar spine x-rays not be used routinely.[20,26] In support of the guidelines, the presence of imaging does not add benefit to patients' outcomes.

Indications for or appropriateness of imaging tests were not evaluated; assessing primary care physician decisions was not an objective of this study. Physicians ordered tests based on clinical judgement or other rational. Physicians often believe imaging is a necessary part of primary care because of medical-legal ramifications or patient pressure. Medical-legal concerns can be allayed by physician awareness of indications of non benign conditions that require further investigation. Kendrick et al.[27] revealed that patients receiving x-rays were more satisfied with their care, but remained worried and not reassured that their low back pain was caused by innocuous conditions. Assertive patients need to hear from their doctors that lumbar spine imaging has limited use in diagnosing the cause of acute low back pain[26] and has no important role in predicting the prognosis or determining the procedures involved in conservative treatment of chronic low back pain.[13,28]

In rare cases, a physician's examination may lead a doctor to suspect causes of injury like severe trauma or suspicion of serious disease. Only in these rare cases are imaging scans important to patient diagnosis and a valuable and valid investigation. The decision to obtain imaging studies must be based on whether the studies will influence patient management.[29] Any demonstrated structural abnormalities should be interpreted only in the light of the clinical findings.[2,10,30] Care is required in explaining results of radiological investigations to prevent patients from becoming alarmed and to put incidental findings into perspective.[6] Although technologically advanced scans are excellent tools to study morphology, findings must be related to data from clinical examinations to provide meaningful judgments.[9] Thus, the detailed pictures produced by sophisticated imaging scans and the lack of pathoanatomic information on plain x-rays have actually increased the importance of the clinical evaluation.[14]

If serious disease is suspected and confirmed, they are not candidates for physiotherapy. At the secondary care level, clinicians in this study provided additional screening; they were specifically trained to recognize serious disease during the initial assessment. Such patients were referred on to appropriate treatment and therefore did not enter into our treatment streams; thus, all patients in the cohort had mechanical low back pain.

Imaging as a primary method to identify serious disease or as a method to screen certain cases from conservative care referral only contributes to the overutilization problem. Physiotherapy referral can and should be made without the need for imaging. Unless serious disease is suspected, a physician's thorough clinical exam is sufficient to make appropriate referrals. The clinical evaluation remains of paramount importance despite great advancements in imaging technology. As Vucetic et al.[31] state, most of the relevant information can be obtained by listening to the patient.

Limitations of this study include the potential for several biases.[32] Since secondary care caseloads are dependent on physician referral, there may be centripetal bias; physicians do not refer all of their back pain patients to this clinic system, so only certain mechanical pain patients may gravitate towards this type of treatment. Similarly, since treatment was an active rehabilitation program, physicians may have decided that this form of management was not appropriate for those who were minimally restricted or profoundly disabled; thereby, creating a referral filter bias.

Since this sample represents only those who attended a rehabilitation program, those who had imaging tests and pursued other treatment options were not available for tracking. This issue of individual treatment options plagues many musculoskeletal research studies involving secondary care, because there are always multiple treatment choices. Recent evidence from a pilot project involving rehabilitation providers[33] suggests that patient pain severity and functional status measures for this clinic system are similar to six other non-related physiotherapy facilities in Ontario. This finding suggests that the present sample is representative of patient types that physicians refer to physiotherapy.

In this case, treatment choice is mainly an issue of generalizability of findings. The results of this study do not allow for conclusions on all back pain patients; the results are most generalizable to acute and subacute, mechanical low back pain patients referred to active rehabilitation. The inclusion/exclusion criteria may suggest that this is a relatively narrow set of patients, but this is clearly not the case when considering the thousands of acute patients presenting in physicians' offices every year that are candidates for secondary care.

The patient recruitment methods may have introduced another source of referral filter bias. Imaging is routinely and justifiably utilized for most surgical candidates. One fortunate feature of our health care system however, is that it unintentionally forces an extended waiting period for almost all elective surgical candidates. Only in rare circumstances are back pain patients sent directly from primary care to the operating room. Most patients are referred for conservative care while waiting for a surgical decision. Thus, this sample, in all likelihood, includes the outcomes of both non-operative and potential operative patients.

Study strengths include the standardization of treatment and data collection. Because of the extensive steps taken to ensure a standardized protocol for all patients, there was little variation in actual treatment, thereby reducing the possibility of confounding by treatment regimen. Using clinics that are fully integrated, with the same centrally coordinated data collection tools and philosophy of treatment, reduces the potential for unexpected treatment aberrations and inadequate data accumulation. Working patients were chosen to help reduce any secondary gain issues that could influence outcomes. An inception cohort was utilized to help eliminate any confounding factors that are often present in chronic pain populations.

In conclusion, after ruling out serious disease via clinical examination, back pain patients appropriate for physiotherapy referral will not likely benefit from diagnostic imaging. Those with pre-treatment imaging tests (CT, MRI, x-ray) had no statistically significant differences in outcomes compared to a group without any imaging studies. Diagnostic imaging did not lead to improved outcomes for this cohort of acute and subacute mechanical back pain patients.

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