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Self reported health status and magnetic resonance imaging findings in patients with low back pain

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Abstract The authors present a prospective study of quality of life (SF-36) and MRI findings in patients with low back pain (LBP). Disc herniation and nerve root compression contribute to LBP and poor quality of life. However, significant proportions of asymptomatic subjects have disc herniation and neural compromise. Little is known about the influence of disc abnormalities and neural compression on quality of life in symptomatic patients. The purpose of this study was to assess the relationship between the extent of disc abnormality, neural impingement and quality of life. A total of 317 consecutive patients with LBP referred for MRI completed an SF-36 health status questionnaire immediately before imaging and again 6 months later. Patients were grouped according to the most extensive disc abnormality and any neural compromise reported at MRI. The relationship between symptoms, radiological signs and SF-36 scores was assessed. Eighty percent (255/317) and 65% (205/317) of patients completed the initial and 6-month SF-36, respectively. Thirty-six percent of patients (115/317) had one or more herniated discs and 44% (140/317) had neural impingement. There was little relationship between the extent of disc

abnormality and quality of life. Patients with radiological evidence of neural impingement reported better general health ($P < 0.01$). SF-36 scores improved at 6 months in four dimensions, but general health deteriorated ($P < 0.01$). Patients with neural impingement had improved pain scores at 6 months ($P < 0.05$). The study results showed that the pain and dysfunction caused by disc herniation and neural compromise are not sufficiently distinct from other causes of back pain to be distinguished by the SF-36. Whilst neural compromise may be the best radiological feature distinguishing patients who may benefit from intervention, it cannot predict quality of life deficits in the diffuse group of patients with LBP.

Key words MRI · Lumbar spine · Quality of life · Low back pain · SF-36

Introduction

Low back pain (LBP) clearly influences a patient's perception of health status. Recent studies assessing health-related quality of life measurements in people with LBP reveal severe impairment across the spectrum of physical and emotional health [11, 20]. The precise relationship between disc lesions, perceived pain and disability is less clear [15, 19, 23]. A herniated disc is thought to cause sciatic pain through direct compression of surrounding neural structures [22]; however, disc material may also cause an inflammatory response in the nerve root that results in pain [10, 18]. The exact aetiology of sciatic pain remains uncertain.

With the advent of accurate non-invasive imaging techniques such as CT and MRI, researchers have been able to investigate the relationship between disc abnormalities, neurological involvement and pain. In general the results have highlighted the complex and multicausal nature of LBP. For instance, in asymptomatic subjects, annular bulges have been found in as many as 52% [14] and disc herniations in 20–36% [2, 14]. Evidence of nerve root or thecal compromise is a more specific radiological finding, which has been shown to differentiate between asymptomatic and symptomatic groups with disc prolapses [3]. However, not all patients with LBP and sciatica have nerve root compromise on radiological examination [3]. Thus, clinicians attempt to relate radiological findings to clinical signs and symptoms, particularly pain distribution, before deciding on management. Despite this, patients may undergo unnecessary surgical interventions on discs which, although abnormal, are not the reason for their symptoms. There is widespread variation in surgical management for low back pain [25]. Although surgery is very effective in selected patients [1, 27], symptoms may improve without it [4, 23] and surgery still fails to relieve symptoms in others [7, 9]. One reason for this could be inappropriate patient selection [16]. The potential morbidity and costs [7] of both conservative and surgical management make the clarification of management in these patients essential.

This study explores the relationship between clinical symptoms, MRI-demonstrated disc abnormalities and perceptions of health in symptomatic patients attending for MRI of the spine. Little is known about the relationship between disc prolapse and the patient's perception of health in a population with LBP.

Material and methods

Patient selection

As part of a wider study, data were collected on consecutive patients attending three hospitals for MRI of the lumbar spine. The data collection period lasted for approximately 3 months in two large centres and for 5 months in a smaller centre. Inclusion criteria

Table 1 MRI sequences used at the three centres^a

	Centre A	Centre B	Centre C
Field strength T	0.5 & 1.5	0.5	0.5 & 1.0
Slice thickness (mm)	4	4	5
Interslice gap (mm)	0.5–1	1	1
Sagittal T1-W			
TR (ms)	600	600	360
TE (ms)	17	12	14
Sagittal T2-W			
TR (ms)	3500	2927	4000
TE (ms)	85	130	100
Axial T1-W			
TR (ms)	600	591	420
TE (ms)	17	20	9

^aThese were the basic sequences employed, sometimes altered slightly to increase coverage. Other sequences and enhancement were used at the discretion of the radiologist

for the study were low back pain and/or sciatica. Exclusion criteria were: suspected neoplasia, infection, fracture, previous lumbar surgery, failure to complete imaging and age less than 16. Eligible patients were subclassified into three pain groups according to the information provided by the referring clinician: (1) patients with LBP and sciatica, (2) patients with LBP and non-specific radiating pain in the lower limbs and (3) patients with LBP only. Additional data were collected on patient age and sex.

Classification of disc pathology

The MRI protocols varied slightly between centres according to machine specification and the preferences of radiologists (see Table 1). However, as a common minimum, T1- and T2-weighted sagittal and appropriate T1-weighted axial images were obtained in all patients.

The MRI report dictated by the radiologist was used to classify disc abnormalities for each patient. Each lumbar disc was classified into one of four categories: (1) normal, (2) degenerate disc only, (3) annular disc bulge, (4) herniated disc. At each level it was also noted whether disc changes were associated with any nerve root or thecal impingement. Thus, at all five lumbar disc levels a patient could fall into one of eight categories, ranging from normal disc with no neural impingement to herniated disc with neural impingement. For ease of analysis, each patient was then classified into one of four overall classifications denoting the most extensive disc abnormality: normal discs at all levels, degenerate disc at one or more levels, annular bulge at one or more levels or herniated disc at one or more levels. Other non-disc abnormalities such as spondylolisthesis and bony canal stenosis were also recorded. The lead author (W. H.) performed the classification process on all patients, whilst a 10% random sample was independently classified by a second author (A.K.D.) to assess inter-rater reliability.

Measurement of patient-health-related quality of life

The UK version of SF-36 [13, 26] was used to assess patient quality of life. This questionnaire is designed to measure eight aspects of quality of life: physical function, role limitations due to physical problems, bodily pain, general health perceptions, energy and

vitality, social function, role limitations due to emotional problems and mental health. Each dimension is scored from 0 (worst health) to 100 (best health). It is a generic questionnaire, for which population norms are available [13], and it has been particularly well validated in similar groups of patients with low back pain [11] and sciatica [20]. For direct comparison with radiological findings, patients were invited to complete the SF-36 on the day of their imaging appointment. All patients who completed the initial SF-36 were sent a follow-up questionnaire and prepaid envelope by post, 6 months after imaging. If no response was received within 21 days, a second follow-up questionnaire was sent. These 6-month quality of life data are purely descriptive. This study did not aim to explain changes in health status and therefore information on patient management is not presented.

Statistical analysis

Inter-rater reliability was assessed using the kappa statistic [5]. Relationships between clinical pain symptoms and MRI findings were analysed using the chi-squared (χ^2) statistic. Baseline SF-36 scores were compared with published population norms for SF-36 scores [13]. Differences in mean SF-36 scores between patients grouped into the four disc categories were analysed using one-way analysis of variance (ANOVA). Any differences between each pair of disc categories were investigated using a post-hoc Scheffé test [24]. All SF-36 scores were transformed to age- and sex-standardised scores for statistical comparisons [11]. The initial hypothesis was that patients with more extensive disc abnormalities would report worse quality of life. Unpaired *t*-tests were used to analyse differences in health between patients with and without evidence

of neural impingement. Changes in patient health over the 6-month follow-up period were assessed using paired *t*-tests. All analyses were performed using the statistical package SPSS for Windows version 6.0.

Results

Patient characteristics

A total of 317 eligible patients were referred to three MRI units during the study period. Patient characteristics are described in Table 2. Overall, the mean age of patients was 47.5 years (range 16–84); 165 patients (52%) were female. In 117 referrals (36.9%) sciatic pain was mentioned by the clinician on the referral form, whilst some pain radiating from the lower back was mentioned in 122 patients (38.5%). The remaining 78 patients (24.6%) were referred with LBP as their major symptom. There were no statistically significant demographic differences between the three referral categories (Table 2).

Radiological findings

There was complete agreement on the overall disc classification of the 32 MRI reports (10%) rated independently by two of the authors (Kappa = 1). There was also good agreement on whether there was neural impingement present in these 32 patients (Kappa = 0.87). Disagreement occurred in two patients where the extent of possible neural impingement was minor.

The majority of disc herniations (89%) and annular bulges (61%) imaged occurred at the L5-S1 and L4-L5 disc levels (Table 3). Degenerative disc changes were common throughout the lumbar spine. Overall, 47 patients (14.8%) had normal lumbar discs, 49 (15.5%) had degenerative discs at one or more levels only, 106 (33.4%) had one or more annular bulges, and the remaining 115 patients (36.3%) had disc herniation demonstrated in at least one disc (Table 4). Impingement on the nerve roots or thecal sac was significantly related to the disc abnormality ($P < 0.01$). Neural structures were reported to be compromised in 77% of patients with herniated discs,

Table 2 Patient characteristics (LBP low back pain)

	Total Group (<i>n</i> = 317)	LBP only (<i>n</i> = 78)	LBP (radiating) (<i>n</i> = 122)	LBP (+sciatica) (<i>n</i> = 117)	<i>P</i> -value for group differences
Mean age (SD)	47.5 (14)	48.1 (15)	48.0 (15)	46.4 (13)	NS*
% Female	52	45	58	50	NS**

* ANOVA; ** Chi-squared

Table 3 Prevalence of disc abnormality by disc level (*n* = 317)

	L1/L2	L2/L3	L3/L4	L4/L5	L5/S1
Herniated disc	4	1	11	57	73
Annular bulge	12	26	61	90	64

Table 4 Overall prevalence of disc abnormalities: association with nerve root (NR)/thecal impingement and patient demographics

^aNeural impingement caused by bony canal stenosis (*n* = 9), spondylolisthesis (*n* = 2), osteophyte (*n* = 2) and epidural lipomatosis (*n* = 1)
^bNeural impingement increased by spondylolisthesis (*n* = 7), bony canal stenosis (*n* = 13) and cyst (*n* = 1)

	Normal discs throughout	Degenerative disc(s) only	Annular bulge(s)	Herniated disc(s)	<i>P</i> -value for group differences (χ^2 unless stated)
No. of patients	47	49	106	115	
No. with NR or thecal impingement (%)	4 ^a /47 (9)	10 ^a /49 (20)	37 ^b /106 (35)	89/115 (77)	$P < 0.01$
Mean age	39.8	52.7	49.6	46.4	$P < 0.01$ (one-way ANOVA)
% Female	68	52	59	43	$P < 0.05$

Table 5 Relationship between symptoms on referral and MRI findings

	LBP only (<i>n</i> = 78)	LBP radiating (<i>n</i> = 122)	LBP +sciatica (<i>n</i> = 117)	<i>P</i> -value for group differences (χ^2 statistic)
Normal discs (%)	10/78 (13)	22/122 (18)	15/117 (13)	NS
Degenerative disc(s) (%)	15/78 (19)	27/122 (22)	7/117 (6)	<i>P</i> < 0.01
Annular bulge(s) (%)	31/78 (40)	42/122 (34)	33/117 (28)	NS
Herniated disc(s) (%)	22/78 (28)	31/122 (25)	62/117 (53)	<i>P</i> < 0.01
Nerve root/theal impingement(s) (%)	29/78 (37)	47/122 (39)	64/117 (55)	<i>P</i> < 0.05

whilst this figure fell to 35% and 20% in patients with disc bulges and degeneration respectively (Table 4). Neural compression was often due to a combination of disc material and bony degenerative changes. A patient with normal discs, degenerative discs or minor annular bulge might have associated stenosis, spondylolisthesis or hypertrophy of the adjacent facet joints (Table 4). Patients

Fig. 1 Mean (SE) SF-36 scale scores before $\square$ and 6 months after $\blacksquare$ imaging (*n* = 161 minimum), and population norms (×). British population norm for 45–49 year old (Jenkinson (1993)). Patients are in significantly worse health than population norms on all dimensions before and after imaging; all *P* < 0.01

with normal discs had a mean age of 39.8 years and tended to be younger than patients with disc lesions (mean age 48.8; *P* < 0.01). Herniated discs were more common in men (*P* < 0.05).

The likelihood of disc abnormalities being demonstrated by MRI was significantly related to the symptoms reported by clinicians at referral (Table 5). Sixty-two of the 117 patients (53%) referred with LBP and sciatica were shown to have disc herniations by MRI, compared with only 31/122 (25%) and 22/78 (28%), respectively, of patients referred with some radiating pain and LBP only (*P* < 0.01). The proportion of patients with annular bulge(s) but no disc herniation was not significantly related to the clinical symptoms at referral. Fifteen of the 117 patients (13%) referred with sciatica showed no signs of disc abnormalities. Reported nerve root or thecal impingement were significantly more common amongst patients referred with sciatica than in the other two referral groups (Table 5), but almost half of patients referred with sciatica had no nerve root impingement reported at MRI.

Patient health status

On the day of imaging, 255/317 patients (80%) completed the SF-36 quality of life questionnaire. Six months later, 205 of the 255 patients (80%; 65% overall) returned the follow up SF-36. Before imaging, patients had SF-36 scores indicative of significantly poorer quality of life than the age- and sex-standardised general population (Fig. 1). Very little association was seen between SF-36 scores and the presence or absence of disc lesions or neural compression shown by MRI (Table 6). Patients with herniated discs had the worst physical role limitations, particularly when compared to patients with degen-

Table 6 MRI findings and pre-imaging mean SF-36 scores (0 = worst health, 100 = best health)^a

	Normal discs (<i>n</i> = 36)	Degenerative disc(s) (<i>n</i> = 33)	Annular bulge(s) (<i>n</i> = 77)	Herniated disc(s) (<i>n</i> = 74)	<i>P</i> -value (one-way ANOVA)	No impingement (<i>n</i> = 133)	Impingement (<i>n</i> = 89)	<i>P</i> -value (unpaired <i>t</i> -test)
Physical function	46.4	47.1	45.3	43.1	NS	45.0	45.1	NS
Role (physical)	29.2	34.8	28.0	17.2	<i>P</i> < 0.05 ^b	26.7	23.7	NS
Bodily pain	33.6	37.3	36.5	27.3	<i>P</i> < 0.05 ^c	34.0	31.4	NS
General health	51.7	56.4	53.3	60.9	<i>P</i> < 0.05 ^c	52.1	61.6	<i>P</i> < 0.01
Energy vitality	40.6	41.3	40.7	44.5	NS	40.4	44.4	NS
Social function	56.8	60.4	60.8	51.5	NS	57.8	55.6	NS
Role (emotional)	63.0	58.1	62.6	54.1	NS	58.6	59.8	NS
Mental health	58.3	64.3	66.0	62.6	NS	62.6	64.5	NS

^a*n* represents the minimum number of patients in each group completing each SF-36 dimension

^bReported health is worse in the herniated disc(s) group than in the degenerative disc(s) group (Scheffé test; *P* < 0.05)

^cNo two individual group means are significantly different

Table 7 Neural compromise and patient recovery (mean difference between baseline and 6-month SF-36 scores)^a

	No nerve root/thecal impingement (<i>n</i> = 93)	Nerve root/thecal impingement (<i>n</i> = 68)	<i>P</i> -value (unpaired <i>t</i> -test)
Physical function	4.2	5.3	NS
Role (physical)	10.6	18.1	NS
Bodily pain	7.2	14.4	<i>P</i> < 0.05
General health	-3.1	-4.5	NS
Energy vitality	1.0	5.5	NS
Social function	3.4	10.9	NS
Role (emotional)	1.0	11.3	NS
Mental health	1.5	4.0	NS

^a*n* represents the minimum number of patients completing each dimension in each group

erative discs only (*P* < 0.05). The same trend is seen in the bodily pain dimension, but no two individual groups were significantly different. Conversely, the general health of patients with normal lumbar discs was worse than that of patients with herniated discs. Despite the fact that patients with findings of neural impingement were older than other patients (50.4 years vs 45.1 years), they still reported a significantly better general health score (*P* < 0.01). Six months later, patients' health had improved (Fig. 1) in most dimensions, significantly so in four dimensions – physical function, role limitations (physical), bodily pain, social function (*P* < 0.01 in all four cases). However, patients' perceptions of their general health had fallen significantly (*P* < 0.01). The presence of neural impingement at imaging was associated with an improvement in reported bodily pain at 6 months (Table 7). Despite the improvement in SF-36 scores 6 months after MRI, patients clearly still had poor quality of life as measured by all eight dimensions at this stage (Fig. 1).

Discussion

Methodological issues

There are a number of methodological issues to be considered before our results can be satisfactorily interpreted. Our study group ranged from patients whose sciatic pain was clearly suspected to be caused by one particular disc, through to patients whose LBP had no localising symptoms. In order to come to more specific conclusions, we subclassified referrals according to their pain symptoms. The classification of patients into three categories (LBP with sciatica, LBP with radiating pain and LBP only) relied on the referring clinician accurately recording the symptoms. If clinicians under- or over-recorded symptoms on the referral slip, then the distinction between groups would become blurred. Despite these possibilities, the significant relationship that we found between patients referred with Sciatica and MRI-proven neural impingement provides support for the validity of our classifications.

Our use of the MRI report to classify disc abnormality may also have led to some under-reporting. In a busy clinical situation, some small (presumably insignificant) disc lesions may go unreported, especially as radiologists are concerned about over-reporting. This would caution against comparing our results on the prevalence of disc abnormalities with studies where radiologists have independently reviewed images with the sole aim of recording any abnormality, however trivial. The use of the MRI report also restricted us in our classification of disc abnormalities. We had to use the terms commonly used by the various radiologists. Nevertheless, if there were a relationship between the extent of disc disease and patient quality of life, this should still be revealed in our results. One might have expected a patient with five normal lumbar discs to have better quality of life than a patient with a large disc herniation severely compromising the nerve

root; in fact we found the opposite. In order to confirm our findings in an experimental setting, a further study of the following design would be useful: a few clinicians would refer patients with independently verified clinical symptoms to MRI, the MRI findings at each disc level would then be classified into strictly defined disc abnormalities by two or three independent radiologists without knowledge of the patient's symptoms; symptoms and MRI findings could then be related with quality of life scores. Our use of standard referral information and MRI reports in this present study makes our results more pragmatic. Our results reflect the relationships between clinical symptoms, MRI findings and quality of life which are actually observed in clinical practice.

Finally the use of a generic rather than disease-specific health questionnaire will have influenced our findings. The SF-36 is well validated in this patient group [20], and our results have confirmed it is able to distinguish LBP patients from the general population and that it is sensitive to changes in health status over time. As the SF-36 measures quality of life over the 4 weeks leading up to its completion, it provides a good snapshot of recent health.

Interpretation of results

Quality of life in these patients was severely impaired compared with the normal population, but the presence and extent of a disc lesion was not strongly associated with decreasing quality of life. There was some evidence of a trend towards worse bodily pain and physical role limitations in patients with disc herniations shown at MRI, but these patients also reported better perceptions of general health. Forty-seven patients (15% overall) had normal lumbar discs demonstrated by MRI. The chronic back pain and poor quality of life in these 47 patients is clearly not related to their lumbar discs.

Impingement of neural structures was not present in the majority of these symptomatic patients. In 177 patients (56%), MRI did not demonstrate neural compression as a possible cause for the patients' symptoms. The presence of neural impingement was not associated with any further reduction in quality of life. In fact, perceptions of general health were better in patients with neural impingement. One possible explanation for this is that patients with neural impingement seen at MRI were more likely to be suffering from symptoms that had not yet become chronic and therefore had not affected their outlook on their previously good general health. Neural impingement may be the most important radiological finding distinguishing asymptomatic from symptomatic disc prolapses [3]. However, it appears to have little ability to predict quality of life within a group of patients with LBP.

Poor relationships between radiological findings and quality of life are not uncommon. It is clear that not all radiological lesions are related to pain or dysfunction and

vice versa [12, 21]. The situation seems particularly complex in LBP. Cook et al. [6] have previously shown weak correlation between the number and severity of vertebral fractures and quality of life in symptomatic osteoporotic patients. The most likely explanation for the lack of association shown in our study is that many pathogenic factors are responsible for pain and dysfunction in this group. The influence of disc morphology and neural compression on quality of life is not sufficiently distinct in order to demarcate patients with nerve root compression from patients with LBP due to other causes. For instance, Yu and colleagues [28, 29] have demonstrated that annular bulges and degenerative discs are often accompanied by radial tears of the annulus fibrosis, suggesting that nerve root pain may arise from exposure to the disc contents without mechanical compression.

Clinical information about the individual patient's pain was more informative than quality of life scores in predicting which patients would have disc abnormalities and neural impingement demonstrated by MRI. However, in patients referred with sciatica, neural impingement was seen in only 55% (64/117). In part, these findings can be explained by the time delay between onset of symptoms, outpatient clinic appointment and MRI. A patient initially reporting sciatica may have significant resolution of the disc prolapse before undergoing MRI. A further 13% (15/115) of patients referred with sciatic pain were reported to have completely normal lumbar discs. In these patients, it may be that sciatica was either over-reported or confused with referred pain on the MRI request form.

The improvement in quality of life for the group as a whole over the 6-month period was encouraging, but the deterioration in patients' perceptions of their general health suggests that patients are less optimistic about their long-term prognosis. Many patients may be disappointed that MRI did not demonstrate any definite cause for their LBP. Equally, the small proportion of patients with disc herniations who were scheduled for surgery were likely to be still waiting for surgery at the time of the second questionnaire. The average wait from MRI to theatre was approximately 48 weeks in one of the neurosurgical centres. Studies with longer follow-ups suggest that these patients can expect further improvement [1, 27]. Patients with neural impingement reported improved pain scores at 6 months, which is likely to reflect the natural regression of disc herniation and sciatic pain known to occur in this group [4].

This series has shown considerable difficulty in relating symptoms and quality of life measures to MRI findings in the range of patients who are routinely referred for MRI of the lumbar spine. They ranged from patients with clear mechanical causes for their sciatic pain, through to those whose pain and quality of life impairment were associated with a normal MR examination. Obviously, if clinical symptoms were perfectly correlated with radiological findings, there would be no diagnostic reason to

perform the MRI; it is precisely in such situations of uncertainty that imaging technologies can make the most diagnostic impact [17]. MR images of the lumbar spine, when carefully analysed alongside the clinical findings, are of proven value in assisting a clinician's diagnosis and management plans [8]; they may also contribute to improvement in health. However, a better understanding of the pathogenesis of low back pain and the effectiveness of interventions in selected patient groups would aid management decisions.

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