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Improvement in Pain after Lumbar Spine Surgery: the Role of Preoperative Expectations of Pain Relief

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Abstract

Objectives—Improvement in pain is a major expectation of patients undergoing lumbar spine surgery.

Methods—Among 422 patients, the goal of this prospective study was to measure 2-year postoperative pain and to determine whether this outcome varied according to patient and clinical characteristics, including amount of pain relief expected preoperatively. Before surgery patients completed valid questionnaires that addressed clinical characteristics and expectations for pain improvement. Two years after surgery patients reported how much pain improvement they actually received.

Results—The mean age was 56 years old and 55% were men. Two years after surgery 11% of patients reported no improvement in pain, 28% reported a little to moderate improvement, 44% reported a lot of improvement, and 17% reported complete improvement. In multivariable analysis, patients reported less pain improvement if, before surgery, they expected greater pain improvement (OR 1.4), had a positive screen for depression (OR 1.7), were having revision surgery (OR 1.6), had surgery at L4 or L5 (OR 2.5), had a degenerative diagnosis (OR 1.6), and if, after surgery, they had another surgery (OR 2.8) and greater back (OR 1.3) and leg (OR 1.1) pain (all variables $p \leq .05$).

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Conclusions—Pain is not uncommon after lumbar surgery and is associated with a network of clinical, surgical, and psychological variables. This study provides evidence that patients' expectations about pain are an independent variable in this network. Because expectations are potentially modifiable this study supports addressing pain-related expectations with patients before surgery through discussions with surgeons and through formal preoperative patient education.

Keywords

Lumbar surgery; expected pain relief; actual pain relief; expectations; prospective

Introduction

Low back pain is a highly prevalent and costly medical condition among US adults, with increasing prevalence noted in older adults.[1] Causes of low back pain are diverse and include vertebral compression fractures, degenerative joint disease, spinal stenosis, as well as various mechanical disorders. Hallmarks of low back pain are physical and psychological suffering, functional impairment, and disability. Multiple possible therapies exist to include pharmacologic, rehabilitative, and interventional (for example epidural injections) approaches. Patients whose back pain progresses despite these interventions are often referred for possible lumbar spine surgery.[2]

Various outcomes have been considered to gauge success after lumbar surgery; however, long-term pain relief remains the main goal for most patients. Often the intensity of pre- and postoperative pain are compared using numerical rating scales, such as 0 (no pain) to 10 (worst pain).[3,4] While this comparison provides valuable information, it fails to capture salient aspects of the pain experience such as perceived disability due to pain.[5] Also, the amount of change in pain measured with numerical rating scales is a calculated number and proposed thresholds for what number constitutes important change are not applicable to all patients.[6–8] Thus, there is a need to identify different methods to measure change in pain and to capture the broader spectrum of the pain experience.

One possible method to assess postoperative change in pain is by asking patients about the amount of global improvement in pain they received as a result of surgery. This global assessment is a more comprehensive outcome because it captures both the intensity of pain and the affective components of pain. For spine surgery, assessing pain improvement is particularly relevant because pain after surgery is common and often permanent, and identifying what variables are associated with long-term postoperative pain depends on how pain is defined.[9]

The challenge of measuring pain after lumbar surgery is further complicated by the fact that patients undergoing surgery are highly diverse with respect to clinical features, diagnosis, and severity of disease, with some patients seeking surgery after exhausting all other therapies while others seek surgery far earlier in their course. Thus, the decision to undergo elective lumbar surgery is largely based on patients' perspectives and expectations of outcome.

We previously reported on the development and testing of a survey to measure patients' preoperative expectations of lumbar spine surgery.[10,11] The survey asks patients about amount of improvement expected for symptoms, function and psychological well-being. One item specifically asks patients about expected improvement in pain. A postoperative version of the survey also exists and is used to query patients about how much improvement was actually received for each expectation. The postoperative item about pain asks patients to rate the amount of improvement in pain received from a global perspective.

Using data generated in a large prospective cohort of lumbar spine surgery patients, the goal of this study was to measure the amount of pain improvement two years after surgery according to the global pain question and to determine whether this outcome varied according to patient and clinical characteristics, including the amount of pain relief expected before surgery. This study is unique, to the best of our knowledge, in that it also examined the preoperative expectation of pain relief as a predictor of long-term actual pain relief.

Methods

This study was approved by the Institutional Review Board at the Hospital for Special Surgery and all patients provided written informed consent. Patients included in this analysis were part of a large multi-phase study to develop and test a survey to measure patients' preoperative expectations of lumbar spine surgery and then to ascertain fulfillment of these expectations two years after surgery (described previously).[10–13] The 20-item survey was derived from qualitative interviews with patients, was confirmed by an expert panel of spine surgeons, and is able to distinguish between patients with different diagnoses; thus the survey has content and construct validity. The survey also is internally consistent, and is reliable based on repeat measurement of individual items and the overall score. Factor analysis revealed four factors that explained 67% of the variance (personal daily care, physical function, psychosocial issues, and skeletal improvement). In addition, when used postoperatively to ascertain fulfillment of expectations the survey is associated with global and spine-specific measures of outcome.[12,13] Details about enrollment and the survey pertinent to the current analysis are described briefly below.

Assembling the sample

Patients were eligible for this study if they were ≥ 18 years old, spoke English, did not have cognitive deficits, and were scheduled for lumbar spine surgery by one of five participating spine surgeons at the Hospital for Special Surgery in New York City.

Preoperative assessment

Patients were enrolled several days before surgery and were asked about their expectations of surgery during an in-person interview. One item of the survey specifically asks patients how much improvement they expect with regard to pain relief with response options of "complete improvement, back to normal", "not complete improvement but a lot of improvement", "a moderate amount of improvement", or "a little improvement." Patients also rated intensity of back and leg pain on a numerical rating scale ranging from 0 (no pain) to 10 (most pain) and completed the following questionnaires: the modified Oswestry

Disability Index which measures disability due to low back pain in 10 areas with an overall score ranging from 0–100% (higher is more disability); the Geriatric Depression Scale which measures psychological depressive symptoms with an overall score ranging from 0–30 (≥ 11 is a positive screen for depression); and the Spielberg State Anxiety Inventory with scores ranging from 20–80 (population norms are available for comparison).[14–16] Pre- and intraoperative clinical information was obtained from surgeons and medical records. These included history of previous spine surgery, current spine diagnosis, and number of vertebral levels involved.

Postoperative assessment

Approximately two years after surgery patients received a telephone follow-up to ascertain outcomes. They were asked a global question about how much improvement in pain they received with response options of “complete improvement, back to normal”, “not back to normal, but a lot of improvement”, “a moderate amount of improvement”, “a little improvement” or “no improvement”. Patients also were asked to rate the intensity of current back and leg pain according to the 0 to 10 numerical rating scale. They were also asked about any spine-related events since surgery, such as repeat surgery. Follow-up medical records also were reviewed for any spine-related complications.

Data analysis

The primary outcome was the amount of pain improvement received measured with the global question at two years. Multivariable analysis was carried out with ordered logistic regression which is applicable when the dependent variable has several response options that are ordered or ranked (i.e. five levels of amount of pain improvement received). We used the proportional odds model which sequentially collapses ordinal levels and assumes the odds ratio is constant across all possible collapses of the levels of the response variable. We used the score test of proportional odds assumption to confirm the odds ratios were constant in all our logistic regression models.

Independent covariates were selected if they were associated in bivariate analysis with $p \leq .05$. Independent covariates included amount of pain improvement expected preoperatively, depressive and anxiety symptoms, prior and subsequent back surgery, spine diagnosis, vertebral levels involved, use of opioids, and pain-related disability measured with the Oswestry Disability Index. Change in pain intensity also was an independent covariate and was calculated as the difference in pre- to postoperative numerical pain rating. Two current definitions for a clinically important change in pain intensity also were calculated, i.e. a change of ≥ 2 points for back pain with no worsening of leg pain, and a change of ≥ 30% for back pain with no worsening of leg pain.[3–5,17] The secondary outcome was the proportion of patients whose expectation for pain improvement was fulfilled defined as concordance between the amount of pain improvement expected and the amount of pain improvement received. Variables associated with fulfillment of this expectation were assessed with multivariable analysis. Additional multivariable analyses were done with postoperative back and leg pain as dependent variables and the same independent covariates. All multivariable analyses also controlled for surgeon.

Results

In total, 757 patients were screened; 47 patients were not enrolled because they were not eligible due to language and diagnosis, 100 refused mostly because they had no time or were not interested in research, 47 were not approached due to study personnel scheduling, and 538 were enrolled. Of these, 488 patients expected pain relief preoperatively and comprised the possible sample for this report. We attempted to contact these 488 patients for a follow-up assessment from May 2012 to August 2014; of these 66 did not participate for the following reasons: 33 refused mostly because they had no time, 9 were not eligible mostly because they were deceased or did not have surgery, 4 did not rate back pain postoperatively and therefore were not included, and 20 were lost to follow-up. The remaining 422 patients (87% of those who comprised the possible sample) completed the follow-up a mean of 2.2 years later (range 1.9–3.1) and were included in this analysis. Compared to the 422 participants, the 66 who did not participate were younger (56 vs 51 years old, p=.02) and had worse Oswestry Disability Index scores (56 vs 61, p=.008); there were no differences based on gender, diagnosis, and preoperative back or leg pain.

The mean age of the participants was 56 years old, 55% were men, 60% were college graduates, 36% were working full time, and 18% were work disabled due to their spine (Table 1). Most patients had a diagnosis of a degenerative condition including spinal stenosis (27%), degenerative disc disease (15%) and degenerative spondylolisthesis (13%) and most (79%) had symptoms for more than 6 months. According to surgeons' reports, 21% were having revision surgery, 38% had surgery for 1 level, 32% had surgery for 2 levels, 30% had surgery for 3 or more levels, 90% had surgery for either L4 or L5, and 38% had either lateral or interbody spine fusion. The mean Oswestry Disability Index score was typical for patients undergoing spine surgery, however 38% had a positive screen for depression and 60% had anxiety symptoms greater than population norms for age and sex. Nearly half were currently taking opioids and 76% had had epidural injections for back pain; overall 91% had had some type of conservative treatment for back pain. With respect to the expectation about pain, most patients preoperatively expected a lot (44%) or complete (45%) improvement (Table 2). The preoperative median back pain was 7 and the median leg pain for the worse leg was 6.

During the two-year follow-up, 6% had a complication, such as a spine infection or fracture, and 15% had a subsequent spine surgery.

For the main outcome, i.e. response to the global question about postoperative improvement in pain at 2 years, 11% reported no improvement, 28% reported a little to moderate improvement, 44% reported a lot of improvement, and 17% reported complete improvement (Table 2). Multiple variables were associated with the amount of pain improvement received in bivariate analyses (Table 3). These included a spectrum of diverse clinical characteristics, such as vertebral level, revision and subsequent surgery, and psychological characteristics. In addition, greater preoperative expectations for pain improvement was associated with less subsequent actual pain improvement. These covariates were independent of each other with correlation coefficients <.20 for most bivariate comparisons. In multivariable analysis, patients were more likely to have less improvement in pain at two years (i.e. the dependent

variables) if, before surgery, they expected greater pain improvement, had symptoms longer, had a positive screen for depression, were having revision surgery, had surgery at L4 or L5, and had a degenerative diagnosis. They also had less improvement in pain if they had had a subsequent surgery and had greater back and leg pain intensity at the two-year follow-up (i.e. 41% and 55% did not meet the 2-point and 30% thresholds for a clinically important change in pain intensity).

For the secondary analysis regarding fulfillment of the pain expectation, 35% of patients had their expectation fulfilled as expected, 8% had their expectation surpassed, and 57% did not have their expectation fulfilled. The proportions of patients who had their expectation fulfilled were 23% for those who expected complete improvement, 60% for those who expected a lot, 60% for those who expected moderate, and 71% for those who expected a little improvement. The variables associated with an unfulfilled expectation in multivariable analysis were greater preoperative expectations (OR 6.0; CI 3.9, 9.2; p<.0001), a positive screen for depression (OR 1.9; CI 1.2, 3.1; p=.01), surgery at L4 or L5 (OR 3.6; CI 1.6, 8.5; p=.003), subsequent surgery (OR 3.6; CI 1.8, 7.5; p =.0005), and less decrease in back (OR 1.3; CI 1.2, 1.4; p<.0001) and leg (OR 1.1; CI 1.0, 1.1; p=.02) pain according to the numerical scale.

In additional analyses, there were associations between amount of pain improvement and change in postoperative back (r=−.45, p<.0001) and leg (r=−.24, p<.0001) pain; the mild to moderate magnitude of the associations demonstrates that these outcomes measured somewhat different phenomena (such as the composite pain experience and the intensity of postoperative pain, respectively). In multivariable analysis, more postoperative back pain was associated with greater expectation for pain relief (OR 1.7, 1.3, 2.2; p<.0001), more preoperative back pain (OR 1.1, 1.1, 1.2, p=.0002), taking opioids (OR 1.7; 1.2, 2.4; p=.007); having revision surgery (OR 1.8; 1.2, 2.8; p=.009), and subsequent spine surgery (OR 2.0; 1.2, 3.3; p=.005). In multivariable analysis, more postoperative leg pain was associated with greater expectation for pain relief (OR 1.6, 1.2, 2.1; p=.0006) and more preoperative leg pain (OR 1.1, 1.0, 1.2; p=.003).

Discussion

Our study showed that pain after lumbar surgery is common with only 17% of patients reporting complete improvement in pain at two years. Our prospective design and large sample size permitted us to identify diverse clinical, surgical and psychological variables that were independently associated with a global measure of improvement in pain. Our study is unique in demonstrating that preoperative expectations of pain relief are independently associated with postoperative improvement in pain.

The topic of patients' expectations of postoperative pain has been assessed for the short-term recovery period for multiple surgeries, including complex procedures such as coronary artery bypass graft surgery and minor ambulatory procedures.[18–21] Some evaluations reported less short-term postoperative pain in patients who preoperatively expected better pain experiences; however, this was not consistently found, especially regarding the affective aspect, versus the intensity, of pain.[18,19] The topic of long-term postoperative pain has not

been studied comprehensively with respect to psychological characteristics, such as expectations, and the nature of pain.

Our findings also illustrate the particular complexity of assessing postoperative back pain. Although pain may occur after other orthopedic procedures, postoperative lumbar pain is particularly challenging because it may be due to various causes, such as natural age-related changes in disc height and vertebral alignment, progression of the underlying spine disease that prompted surgery in the first place, technically failed surgery, multiple concurrent spine diagnoses, and subsequent adaptation (and possible maladaptation) to the surgery by adjacent discs, vertebrae and muscles.[22] Thus to understand the etiology of postoperative pain it may be necessary to distinguished among new, persistent, or recurrent pain. In the future the use of novel surgical implants will further complicate our ability to interpret pain after lumbar surgery because these devices may alter the recovery process and may influence indications for possible additional interventions.

Many prior studies have addressed postoperative lumbar pain using numerical rating scales with various thresholds to define clinically important changes.[6–8] Variables found to be associated with more pain after surgery include greater preoperative pain, psychological variables, degenerative diagnoses, and revision surgery.[6–8,23,24] Our study confirms the importance of these variables, and provides evidence for the importance of other explanatory variables, such as longer duration of symptoms and involvement of lower vertebral levels. Our use of a global measure for improvement in pain may have contributed to our ability to quantify the contributions of these latter variables which are clinically suspected to be associated with postoperative pain.

Previous studies also showed that patients have high expectations of lumbar spine surgery regardless of the severity of their condition and dysfunction [9,25–29] and our findings are similar to those that reported a high proportion of patients expecting no pain after surgery.[26,27,29,30] Only several studies, however, specifically addressed fulfillment of expectations for pain. For example, one study preoperatively asked patients about expectations for pain and function and then postoperatively asked whether each of these expectations was met or not met; comparisons between pre- and postoperative responses, however, were not made.[30] Our study is similar to two studies that preoperatively asked patients what change in pain was expected and postoperatively asked patients a parallel question about what change occurred.[25,28] In the first study 60% of patients had their expectation for pain fulfilled at 12 months.[25] Our proportion is less than this and may reflect our longer follow-up time and subsequent progression of disease or the development of new conditions. In the second study, approximately 65% of patients reported their expectations for pain were “probably” or “definitely” fulfilled; however, this study had a short follow-up of 12 weeks.[28]

How expectations impact subsequent pain after spine surgery is not readily apparent. Although high expectations can be motivating, they also may predispose to poor outcomes if they are too unrealistic.[9] For example, inappropriately high expectations may contribute to postoperative pain if patients become discouraged with recuperation time, abandon rehabilitation, and ignore recommended lifestyle changes that could, if adopted, minimize

progression of the underlying spine condition. Expectations that are too low also may contribute to postoperative pain if patients lack the necessary motivation to participate in rehabilitation and are unwilling to make lifestyle changes and to follow postoperative precautions to protect their spine.[9]

This study is limited in that it was conducted at a tertiary care spine center and may not be generalizable to patients in other settings. We also did not delineate whether the nature of postoperative pain was the same or different compared to preoperative pain, and whether it was persistent or new. We also did not have systematically acquired postoperative clinical data or surgeons' ratings of outcome.

Back pain is common two years after lumbar spine surgery with most patients having less improvement in pain than they expected preoperatively. Measuring global improvement in pain demonstrates that postoperative back pain is a complex phenomenon due to a network of clinical, surgical, and psychological variables that are independent of pain intensity. Our study provides evidence that patients' preoperative expectations of pain relief are part of this network. In addition, because expectations are potentially modifiable this study supports addressing pain-related expectations with patients before surgery through discussions with surgeons and through formal preoperative patient education.

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Table 1

Demographic and clinical characteristics for entire sample and according to amount of pain relief expected (N=422)

		According to amount of pain relief expected			
Characteristic	**Entire sample (N=422)**	**Complete (n=190)**	**A lot (n=185)**	**Moderate (n=40)**	**A little (n=7)**
Age, years (mean±SD)	56±15	56±15	56±15	56±14	50±17
Men	55%	59%	49%	63%	71%
Employed full time	36%	42%	32%	35%	0% *
Workman compensation	10%	7%	10%	26%	29% †
Non-work related accident	18%	19%	17%	15%	14%
Lawsuit pending	4%	3%	4%	3%	14%
Depressive symptoms, score [a] (mean±SD)	10±7	9±7	10±8	11±7	14±9
positive screen for depression	38%	33%	41%	48%	57% *
Anxiety symptoms, score [b] (mean±SD)	40±12	39±12	41±13	42 ±10	43±13
more anxiety than population norms	60%	54%	63%	73%	57% *
Major medical comorbidity	29%	25%	35%	18%	43%
Diagnosis					
acute herniated disc	22%	27%	19%	10%	14%
degenerative disease [c]	78%	73%	81%	90%	86% ¶
Symptoms > 6 months	79%	77%	80%	85%	86%
Disability due to back pain, score [d] (mean±SD)	56%± 14%	56%±15%	56%±13%	57%±17%	60%±12%
Revision surgery	21%	15%	23%	30%	57% †
Narcotics	44%	40%	45%	53%	86% *
Epidural corticosteroids	76%	73%	76%	83%	86%
Vertebral levels involved					
L1	11%	7%	16%	10%	14%
L2	25%	20%	30%	33%	14%
L3	42%	42%	42%	50%	29%
L4	73%	75%	70%	78%	57%
L5	61%	60%	62%	65%	43%
Spine fusion (lateral or interbody)	38%	34%	44%	43%	29%

Characteristic	Entire sample (N=422)	According to amount of pain relief expected			
		Complete (n=190)	A lot (n=185)	Moderate (n=40)	A little (n=7)
Required subsequent surgery within 2 years	15%	12%	16%	25%	43%¶

[a] based on Geriatric Depression Scale, possible range 0–30, higher is more depressive symptoms, ≥ 11 is positive screen for depression

[b] based on Spielberg State Anxiety Inventory, possible score 20 – 80, higher is more anxiety

[c] spondylolisthesis, stenosis, disc disease

[d] based on Oswestry Disablity Index, possible range 0–100%, higher is more disability

* p ≤ .05;

¶ p ≤ .01;

† p ≤ .001

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Table 2

Pain improvement and pain intensity (N = 422)

Amount of pain improvement [a], number of patients (%)	Pre-operative	Post-operative	Pre- to postoperative difference
none	-	47 (11%)	-
a little	7 (2%)	52 (12%)	-
moderate amount	40 (9%)	67 (16%)	-
a lot	185 (44%)	187 (44%)	-
complete	190 (45%)	69 (17%)	-
Pain intensity [b], mean (95% CI)			
back	6.1 (5.8, 6.4)	2.9 (2.6, 3.2)	3.2 (2.8, 3.6)
leg	5.2 (4.9, 5.5)	1.7 (1.4, 2.0)	3.5 (3.1, 3.9)
Changed by minimum clinically important difference, %			
based on threshold points [c]	-	-	248 (59%)
based on threshold percent [d]	-	-	190 (45%)

[a] improvement expected (preoperative) and improvement received (postoperative)

[b] numerical rating 0 (none) to 10 (worst)

[c] back pain decrease by ≥ 2 points, no increase in points for leg pain

[d] back pain decrease by 30%, no increase in percent for leg pain

Table 3

Bivariate and multivariable associations between less pain improvement received postoperatively and demographic and clinical variables (N = 422)

	Bivariate		Multivariable	
Variables	**OR (95% CI)**	**p**	**OR (95% CI)**	**p**
Expected greater pain improvement	1.9 (1.5, 2.4)	<.0001	1.4 (1.1, 1.9)	.001
Symptoms for > 6 months	1.8 (1.2, 2.9)	.006	1.6 (1.0, 2.5)	.06
Not working full time	1.6 (1.1, 2.2)	.02	-	-
Treated with epidural injections	1.5 (1.0, 2.3)	.04	-	-
Taking opioids	1.2 (0.8, 1.7)	.32	-	-
Worse disability due to pain [a]	1.0 (1.0, 1.0)	.11	-	-
Positive screen for depression [b]	2.1 (1.4, 3.0)	<.0001	1.7 (1.2, 2.5)	.005
More anxiety than population norms [c]	1.5 (1.1, 2.2)	.02	-	-
Revision surgery	2.3 (1.5, 3.6)	.0001	1.6 (1.0, 2.6)	.04
Surgery for more vertebral levels	1.3 (1.1, 1.5)	.0003	-	-
Surgery for L4 or L5	1.9 (1.0, 3.5)	.04	2.5 (1.3, 4.7)	.004
Surgery for degenerative diagnosis	2.1 (1.4, 3.2)	.001	1.6 (1.0, 2.6)	.05
Subsequent surgery within 2 years	4.1 (2.5, 6.7)	<.0001	2.8 (1.7, 4.7)	<.0001
Increase in intensity of back pain at 2 years [d]	1.3 (1.2, 1.3)	<.0001	1.3 (1.2, 1.3)	<.0001
Increase in intensity of leg pain at 2 years [d]	1.1 (1.1, 1.2)	<.0001	1.1 (1.0, 1.1)	.004

[a] based on Oswestry Disability Index

[b] based on Geriatric Depression Scale

[c] based on Spielberg State Anxiety Inventory

[d] based on pre- to postoperative change, numeric rating scale, 0 (no pain) to 10 (worst pain)

multivariable analysis controlled for surgeon