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The relationship between pain and depressive symptoms after lumbar spine surgery

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Abstract

Although depressive symptoms are common among those living with back pain, there is limited information on the relationship between postsurgical pain reduction and changes in depressive symptoms. The objective of this prospective cohort study was to examine the change in pain and depressive symptoms and to characterize the relationship between pain and depressive symptoms after lumbar spine surgery. We assessed 260 individuals undergoing lumbar spine surgery preoperatively and postoperatively (3 and 6 months) using a pain intensity numeric rating scale and the Patient Health Questionnaire depression scale. The relationship between change in pain (a 2-point decrease or 30% reduction from the preoperative level) and depressive symptoms was examined using standard regression methods. Preoperatively, the mean pain intensity was 5.2 (SD 2.4) points, and the mean depressive symptom score was 5.03 (SD 2.44) points. At 3 months, individuals who experienced a reduction in pain (63%) were no more likely to experience a reduction in depressive symptoms (odds ratio 1.07, 95% confidence interval [CI] .58 to 1.98) than individuals who experienced no change from preoperative pain (34%). However, at 6 months, individuals who experienced a reduction in pain (63%) were nearly twice as likely to experience a reduction in depressive symptoms (odds ratio 1.93, 95% CI 1.15 to 3.25) as those who experienced no change or an increase in pain (31%). We found that most individuals experienced clinically important reductions in pain after surgery. We concluded that those whose pain level was reduced at 6 months were more likely to experience a reduction in depressive symptoms.

Keywords

Back pain; Depression; Lumbar spine; Pain intensity; Spine surgery

1. Introduction

Spine surgery is one of the most common inpatient procedures in the United States, and the frequency of surgical spine procedures has risen dramatically during the past 2 decades

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[10,11]. Pain is a frequent complaint of individuals with degenerative conditions of the lumbar spine, and resolution of this pain is one objective of surgical intervention [24]. Pain is associated with an emotional response marked by anxiety [5,38] and depression [18,40].

Depressive symptoms are common among individuals seeking surgical care of degenerative conditions of the lumbar spine [4,6]. These depressive symptoms can interfere with an individual's ability to take part in normal work and/or recreational activities [29]. This interference leads to reduced productivity and social participation, which in turn leads to a diminished quality of life [35,36]. There have been very limited studies investigating the relationship between pain and depression after spine surgery. One retrospective study examining the impact of revision arthrodesis in the treatment of symptomatic pseudarthrosis found a significant improvement in visual analog scale back pain scores at 2 years that was not associated with improvement in mental health or depression ratings, suggesting that, in this diagnostic group, mental health symptoms associated with pseudarthrosis-associated back pain may be more refractory to revision surgery [1].

The interrelatedness of pain and depression are difficult to untangle in studies because many investigations are cross-sectional, prospective over short periods, or inclusive of individuals who are already experiencing persistent pain [18]. Negative emotions, such as anxiety and depression, increase the risk for postoperative pain [7] and new-onset chronic pain [3]. The persistence of pain over time also contributes to the exacerbation of depression that is, in part, related to the severity of pain [12]. Data on the longitudinal relationship between pain and depression after surgery can provide key information on the temporal and directional relationship between these 2 experiences. Data on this relationship can also provide a guide to identifying those at risk for continued depressive symptoms that undermine function and quality of life after surgery.

As part of larger prospective cohort studies, the current analysis sought to examine the longitudinal relationship between back pain and depressive symptoms in a sample of patients with degenerative conditions of the lumbar spine. The objective of this prospective cohort study was to examine the change in pain and depressive symptoms and to characterize the relationship between pain and depressive symptoms after lumbar spine surgery. We hypothesized that individuals who experience a clinically signifi-cant reduction in pain from preoperative levels would be more likely to experience a reduction in depressive symptoms than individuals who do not experience a clinically significant reduction in pain.

2. Methods

Our Institutional Review Board approved this study. All research-related events occurred in a private research room to ensure confidentiality.

2.1. Study population

Individuals in the current analysis were participants from 2 prospective cohort studies conducted to assess the influence of patient activation on health behavior and recovery after lumbar spine surgery. The current sample included a natural history cohort that has been

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previously described [42,43] and the control group for a currently active intervention trial to improve rehabilitation participation after spine surgery.

Individuals presenting to our spine center from August 2005 through August 2011 for surgical treatment (i.e., lumbar decompression and, in the case of lumbar spondylolisthesis, arthrodesis) for degenerative conditions of the lumbar spine were considered for inclusion in the current analysis. To be included, patients had to be >18 years old, English-speaking, and capable of providing informed consent (as determined by a Mini-Mental Status Examination score of >18 of 30 points [41]). Excluded were individuals with previous spine surgery because they have a markedly different clinical recovery course than those having primary surgery [15]. Of the 578 patients presenting for treatment of degenerative conditions of the lumbar spine, 312 (54.0%) were eligible. Of those, 260 (83.3%) agreed to participate.

2.2. Participant assessments

Individuals were assessed at 3 time points: the preoperative clinical visit and the 3- and 6-month postoperative clinical visits. The assessment instruments are described.

2.2.1. Demographic and social information—A questionnaire elicited information concerning demographic (age, sex, and race/ethnicity) and social (education and household income) characteristics. The 260 patients were predominantly non-Hispanic white (89%) and female (58%), with a diagnosis of lumbar stenosis (78%); the mean age was 58 (SD 15) years (Table 1).

2.2.2. Health—Measures of current pain intensity and depressive symptoms were obtained.

2.2.2.1. Intensity of current pain.: The intensity of current back pain was assessed using a numeric rating scale [13], with respondents reporting pain intensity on an 11-point scale (0 [no pain] to 10 [severe pain]). This numeric rating scale has proven reliable (Pearson $r > .80$) and valid (highly correlated with the visual analog scale) in young and old adults [8,19]. The numeric rating scale has been shown to be free of the response error associated with other pain intensity scales when measuring pain among individuals ≥65 years old [20,23]. To define a clinically meaningful improvement in pain intensity after surgical intervention, we used a threshold reduction of 2 points or 30% from preoperative assessment [16].

2.2.2.2. Depressive symptoms.: Depressive symptoms were measured with the Patient Health Questionnaire 9-item (PHQ-9) depression scale [44]. The PHQ-9, a brief screening tool designed to identify the presence of depressive symptoms, was developed using the diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders [2]. The original validation study and 2 diagnostic meta-analyses of multiple studies comparing the PHQ-9 with a criterion standard psychiatric interview have established good sensitivity (range, 77% to 88%) and specificity (range, 88% to 94%) for the PHQ-9 [31]. A PHQ-9 score of ≥10 points is indicative of clinical depression [30].

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2.3. Statistical analyses

To examine the relationship between pain and depression, we classified each individual with regard to change in pain intensity after surgical intervention depending on whether a clinically significant reduction in pain (defined as a reduction of 30% or 2 points from preoperative pain intensity) was achieved. We then compared those who had experienced clinically significant reduction in pain vs all others with respect to changes in depressive symptoms (PHQ-9). Individuals were characterized using continuous and dichotomous methods. Continuous characterization was achieved by using the change in score between preoperative and postoperative assessments as the dependent measure. Dichotomous characterization was achieved by using an indicator for improvement. Patients in whom the PHQ-9 score decreased from preoperative to postoperative were deemed to have improved. Cases in which the PHQ-9 score remained stable or increased from preoperative to postoperative were deemed not to have improved.

The relationship between reduction in pain intensity and change in depressive symptoms was then modeled using repeated-measures regression equations: linear regression for continuous characterization and logistic regression for dichotomous categorization. In the continuous characterization, we estimated the mean change in the dependent variable among those with clinically important reduction in pain intensity. In the dichotomous characterization, we estimated the odds of experiencing an improvement in depressive symptoms among those with a clinically important reduction in pain intensity. Time since surgery (in months) was included as a covariate to account for temporal changes in the dependent variables. Other patient characteristics, such as age and sex, were included as potential confounders. Regression diagnostics concerning collinearity and residual analysis were conducted to assess the fit of a final model [47]. All analyses were performed with SAS statistical software, version 9.2 (SAS Institute, Inc., Cary, NC, USA). The level of significance was set at .05.

3. Results

3.1. Pain intensity

At the preoperative visit, the mean pain intensity was 5.2 (SD 2.4) points, indicating moderate pain [37] (Table 2). By 3 months after surgery, mean pain intensity had decreased to 3.3 (SD 2.1) points: 8 (3.1%) experienced increased pain intensity rating, 88 (33.8%) experienced no change in pain intensity rating, and 164 (63.1%) experienced a clinically meaningful reduction in pain intensity. Similar improvements were seen by 6 months after surgery, with mean pain intensity having decreased to 3.0 (SD 1.8) points: 16 (6.2%) experienced increased pain intensity, 80 (30.8%) experienced no change in pain intensity, and 164 (63.1%) experienced a clinically meaningful reduction in pain intensity.

3.2. Depressive symptoms

At the preoperative visit, the mean depression score was 5.0 (SD 2.7). At the preoperative visit, the mean depressive symptom score (PHQ-9) was 5.03 (SD 2.44) points, with 15 (5.8%) individuals meeting the criterion for depression. By 3 months after surgery, the mean depressive symptom score had decreased to 2.0 (SD 1.9) points. Approximately three-

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fourths (205, 78.9%) of the participants experienced a reduction in depressive symptoms; the remainder (55, 21.1%) experienced no change or worsening of depressive symptoms. At that time, no individuals met the criterion for depression. By 6 months after surgery, the mean depressive symptom score was 3.5 (SD 1.8) points. More than half (106, 63.9%) of the participants experienced a reduction in depressive symptoms; the remainder (94, 36.1%) experienced no change or worsening of depressive symptoms. One (0.4%) individual met the criterion for depression.

3.3. Relationship between pain intensity and depressive symptoms

At the preoperative visit, there was a significant positive bivariate correlation between pain intensity and depressive symptoms ($P = .689$), representing a strong relationship.

At 3 months after surgery, individuals who experienced a clinically meaningful reduction in pain were no more likely to experience a reduction in depressive symptoms (odds ratio 1.07, 95% confidence interval [CI] .58, 1.98) than individuals who experienced no change or increase in pain intensity.

Individuals who had achieved or maintained a clinically meaningful reduction in pain at 6 months were nearly twice as likely to experience a reduction in depressive symptoms as individuals who experienced no change or increase in pain (odds ratio 1.93, 95% CI 1.15 to 3.25). Adjusting for the influence of time since surgery, sex, and age >65 years, the relationship between a clinically meaningful reduction in pain at 6 months and reduction in depressive symptoms persisted (Table 3). These individuals achieved, on average, an adjusted reduction in depressive symptoms of 1.83 (SD .29) points more than those who experienced no change or increase in pain.

4. Discussion

Results of this prospective cohort study showed that changes in pain intensity after surgery were associated with a reduction in depressive symptoms 6 months after surgery for patients with degenerative conditions of the lumbar spine. The relationship between reduction in pain intensity and reduction in depressive symptoms at 6 months was similar to that found in a study of 500 primary care patients with persistent back, hip, or knee pain [32]. In that study, Kroenke et al. [32] showed that change in pain was a strong predictor of change in depression severity at 12 months. Those investigators reported that a reduction in severity of depressive symptoms was an equally strong predictor of subsequent pain severity. Their study adds to the evidence for a bidirectional relationship between pain and depression.

Unlike the bidirectional analysis of Kroenke et al. [32], our analysis focused on the impact of pain improvement on depressive symptoms. This focus arises from the population under study—those undergoing spine surgery. We were interested in determining whether improvements in pain, often a result of spine surgery, are associated with improvements in depressive symptoms. The inability of our study to show a relationship between changes in pain and depressive symptoms at 3 months may be related to the persistence of pain during the period of healing after surgery. The studies cited earlier have examined postoperative pain and depressive symptoms at 6 months [25,32]. Postsurgical pain is a prevalent

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complication after any surgery, with incidence ranging from 10% to 50% [28]. Although most individuals did report a clinically meaningful reduction in intensity of back pain after surgery at 3 months, there may have been nonspecific pain associated with the surgery. Sources of this pain include skin incision, healing muscle tissue with reactive spasm, and nerve root inflammation [33]. There is the potential for undertreatment of pain during the immediate postoperative period because of concerns for respiratory complications [9]. It has been estimated that postoperative pain is inadequately treated in up to one-half of patients [26,45]. Subsequent examination of the relationship between pain intensity and depression should include an assessment of postsurgical pain.

Alternately, the inability to show a relationship between changes in pain intensity and depressive symptoms at 3 months may reflect the time it takes for improvements in pain to be translated into increased activity leading to greater social reinforcement and thus improved mood. According to Lewinsohn et al. [34], depression can result from a stressor that disrupts normal behavior patterns, leading to a low rate of positive reinforcement and thus negative mood. Applying the theory to these data, it would be predicted that individuals experiencing pain because of their spinal condition would avoid normal work and recreational activities that provide pleasure or other positive reinforcement. The absence of this positive reinforcement would lead to an increase in depressive symptoms. Because the healing process after lumbar spine surgery takes time, there may be a lag between the reduction in low back pain and the resumption of normal work and recreational activities. This lag would be reflected in the delay in improvement in depressive symptoms.

Our study has several limitations. First, we could not establish whether pain intensity at the preoperative visit was related to onset or severity of depressive symptoms at that time. Second, the relationship between changes in pain intensity after surgery and changes in depressive symptoms may be biased by confounding variables of which we were not aware. Third, most of our participants were not experiencing severe depressive symptoms or would have screened positive for depression based on their PHQ-9 scores. The association between reduced pain and improvement in depressive symptoms may be understated in the current study due to a floor effect of reported depressive symptoms. Further, these findings may not be identical in a population where there is a higher prevalence of depression or a greater burden of depressive symptoms. Fourth, most of our study population was white (89.2%), a fact that may limit the extension of these findings to populations with a different racial composition. Fifth, unlike the analysis reported in Kroenke et al. [31], our analysis examined the concomitant reduction in depressive symptoms among those who experienced a clinically meaningful reduction in pain intensity. Sixth, given that individuals with somatic complaints may have elevated scores on generic measures of depression, the number of persons classified as depressed in this study may be elevated because of the impact of pain-related symptoms on the scale score. Finally, we did not measure the level of activity of the participants. Measurement of activity would have allowed us to investigate whether changes in pain-related activity affected the relationship between pain changes and depression, as suggested by Lewinsohn et al. [34]. At least 1 study, a sample of persons with major extremity trauma, suggested that psychological distress does not arise from reduced activity, as was suggested by Lewinsohn et al. [34], but rather that psychological distress affects the relationship between pain and reduced function [46]. That study indicated that pain and

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psychological distress contribute to reduced function during the first year after a serious injury; however, as recovery proceeds, the role of psychological distress in determining function increases and the contribution of pain to decreased functioning fades [46].

Our study methodology has several strengths. First, we were able to measure all variables prospectively. This study design enhances the probability that risk factors are nondifferential and estimates of association are attenuated. Second, we assessed whether the associations would remain when the analyses were adjusted by other patient characteristics, such as sex, which is important, given the literature on potential sex differences in pain physiology and clinical outcomes [17,22].

This study has potentially important clinical implications. We have shown that pain and depression are related in individuals undergoing spine surgery for degenerative conditions of the lumbar spine. Effective pain management after surgery is related to a reduction in the burden of depressive symptoms. It is plausible that this effective management would lead to a reduction in the need for depression treatment in those who show improvements in pain. For individuals whose pain does not improve after surgery, there is an increased risk for continued depression that may require evaluation and management. Our study suggests taking a staged approach to the management of depression in this population: (1) patients should be carefully followed after surgery and the level of pain relief should be documented, and (2) patients whose pain does not improve should be carefully assessed for depressive symptoms and appropriate treatment should be provided. There are a number of instruments that may be used to routinely assess depression in persons with pain, in addition to the PHQ-9 [8,14,21,39]. Identification of patients with depression is warranted because effective treatments are well established [27]. Further, reduction in depressive symptomatology is associated with a reduction in pain severity and interference [5].

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References

[1]. Adogwa O, Parker SL, Shau D, Mendelhall SK, Cheng J, Aaronson O, Devin CJ, McGirt MJ. Long-term outcomes of revision fusion for lumbar pseudarthrosis: clinical article. J Neurosurg Spine 2011;15:393–8. [PubMed: 21699473]

[2]. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. Washington, DC: American Psychiatric Association; 1994.

[3]. Ashburn MA, Fine PG. Persistent pain following trauma. Mil Med 1989;154:86–9. [PubMed: 2494587]

[4]. Atkinson JH, Slater MA, Patterson TL, Grant I, Garfin SR. Prevalence, onset, and risk of psychiatric disorders in men with chronic low back pain: a controlled study. PAIN® 1991;45:111–21. [PubMed: 1831555]

[5]. Bair MJ, Wu J, Damush TM, Sutherland JM, Kroenke K. Association of depression and anxiety alone and in combination with chronic musculoskeletal pain in primary care patients. Psychosom Med 2008;70:890–7. [PubMed: 18799425]

[6]. Block AR, Gatchel RJ, Deardorff WW, Guyer RD. The mind-body interface: establishing surgical prognosis In: Block AR, Gatchel RJ, Deardorff WW, Guyer RD, editors. The psychology of spine surgery. Washington, DC: American Psychological Association; 2003 p. 101–14.

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

[7]. Brander V, Gondek S, Martin E, Stulberg SD. Pain and depression influence outcome 5 years after knee replacement surgery. Clin Orthop Relat Res 2007;464:21–6. [PubMed: 17603386]

[8]. Breivik EK, Bjornsson GA, Skovlund E. A comparison of pain rating scales by sampling from clinical trial data. Clin J Pain 2000;16:22–8. [PubMed: 10741815]

[9]. Cullen ML, Staren ED, El-Ganzouri A, Logas WG, Ivankovich AD, Economou SG. Continuous epidural infusion for analgesia after major abdominal operations: a randomized, prospective, double-blind study. Surgery 1985;98:718–28. [PubMed: 3901375]

[10]. Davis H Increasing rates of cervical and lumbar spine surgery in the United States, 1979–1990. Spine (Phila Pa 1976) 1994;19:1117–23. [PubMed: 8059266]

[11]. Deyo RA, Gray DT, Kreuter W, Mirza S, Martin BI. United States trends in lumbar fusion surgery for degenerative conditions. Spine (Phila Pa 1976) 2005;30:1441–5. [PubMed: 15959375]

[12]. Dickens C, McGowan L, Clark-Carter D, Creed F. Depression in rheumatoid arthritis: a systematic review of the literature with meta-analysis. Psychosom Med 2002;64:52–60. [PubMed: 11818586]

[13]. Downie WW, Leathman PA, Rhind VM, Wright V, Branco JA, Anderson JA. Studies with pain rating scales. Ann Rheum Dis 1978;37:378–81. [PubMed: 686873]

[14]. Dworkin RH, Turk DC, Farrar JT, Haythornthwaite JA, Jensen MP, Katz NP, Kerns RD, Stucki G, Allen RR, Bellamy N, Carr DB, Chandler J, Cowan P, Dionne R, Galer BS, Hertz S, Jadad AR, Kramer LD, Manning DC, Martin S, McCormick CG, McDermott MP, McGrath P, Quessy S, Rappaport BA, Robbins W, Robinson JP, Rothman M, Royal MA, Simon L, Stauffer JW, Stein W, Tollett J, Wernicke J, Witter J. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. PAIN® 2005;113:9–19. [PubMed: 15621359]

[15]. Eichholz KM, Ryken TC. Complications of revision spinal surgery. Neurosurg Focus 2003;15:E1–4.

[16]. Farrar JT, Young JP, Jr, LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. PAIN® 2001;94:149–58. [PubMed: 11690728]

[17]. Fillingim RB, King CD, Ribeiro-Dasilva MC, Rahim-Williams B, Riley JL, 3rd. Sex, gender, and pain: a review of recent clinical and experimental findings. J Pain 2009;10:447–85. [PubMed: 19411059]

[18]. Fishbain DA, Cutler R, Rosomoff HL, Rosomoff RS. Chronic pain-associated depression: antecedent or consequence of chronic pain? A review. Clin J Pain 1997;13:116–37. [PubMed: 9186019]

[19]. Flaherty SA. Pain measurement tools for clinical practice and research. AANA J 1996;64:133–40. [PubMed: 9095685]

[20]. Gagliese L, Weizblit N, Ellis W, Chan VWS. The measurement of postoperative pain: a comparison of intensity scales in younger and older surgical patients. PAIN® 2005;117:412–20. [PubMed: 16153776]

[21]. Geisser ME, Roth RS, Robinson ME. Assessing depression among persons with chronic pain using the Center for Epidemiological Studies-Depression Scale and the Beck Depression Inventory: a comparative analysis. Clin J PAIN® 1997;13:163–70. [PubMed: 9186024]

[22]. Grenspan JD, Craft RM, LeResche L, Arendt-Nielsen L, Berkley KJ, Fillingim RB, Gold MS, Holdcroft A, Lautenbacher S, Mayer EA, Mogil JS, Murphy AZ, Traub RJ. Studying sex and gender differences in pain and analgesia: a consensus report. PAIN® 2007;132:S26–45. [PubMed: 17964077]

[23]. Herr KA, Spratt K, Mobily PR, Richardson G. Pain intensity assessment in older adults: use of experimental pain to compare psychometric properties and usability of selected pain scales with younger adults. Clin J Pain 2004;20:207–19. [PubMed: 15218405]

[24]. Hilibrand AS, Rand N. Degenerative lumbar stenosis: diagnosis and management. J Am Acad Orthop Surg 1999;7:239–49. [PubMed: 10434078]

[25]. Hurwitz EL, Morgenstern H, Yu F. Cross-sectional and longitudinal associations of low-back pain and related disability with psychological distress among patients enrolled in the UCLA Low-Back Pain Study. J Clin Epidemiol 2003;56:463–71. [PubMed: 12812821]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

[26]. Ibrahim AW, Farag H, Naguib M. Epidural morphine for pain relief after lumbar laminectomy. Spine (Phila Pa 1976) 1986;11:1024–6. [PubMed: 3554553]

[27]. IsHak WW, Ha K, Kapitanski N, Bagot K, Fathy H, Swanson B, Vilhauer J, Balayan K, Bolotaulo NI, Rapaport MH. The impact of psychotherapy, pharmacotherapy, and their combination on quality of life in depression. Harv Rev Psychiatry 2011;19:277–89. [PubMed: 22098324]

[28]. Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. Lancet 2006;367:1618–25. [PubMed: 16698416]

[29]. Kerns RD, Haythornthwaite JA. Depression among chronic pain patients: cognitive-behavioral analysis and effect on rehabilitation outcome. J Consult Clin Psychol 1988;56:870–6. [PubMed: 3204197]

[30]. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med 2001;16:606–13. [PubMed: 11556941]

[31]. Kroenke K, Spitzer RL, Williams JBW, Lowe B. The Patient Health Questionnaire Somatic, Anxiety, and Depressive Symptom Scales: a systematic review. Gen Hosp Psychiatry 2010;32:345–59. [PubMed: 20633738]

[32]. Kroenke K, Wu J, Bair MJ, Krebs EE, Damush TM, Tu W. Reciprocal relationship between pain and depression: a 12-month longitudinal analysis in primary care. J Pain 2011;12:964–73. [PubMed: 21680251]

[33]. Kumar RJ, Menon KV, Ranjith TC. Use of epidural analgesia for pain management after major spinal surgery. J Orthop Surg (Hong Kong) 2003;11:67–72. [PubMed: 12810975]

[34]. Lewinsohn PM, Youngren MA, Grosscup SJ. Reinforcement and depression In: Depue RA, editor. The psychobiology of the depressive disorders: implications for the effects of stress. New York: Academic Press; 1979 p. 291–316.

[35]. Lin EHB, Katon W, Von Korff M, Tang L, Williams JW, Jr, Kroenke K, Hunkeler E, Harpole L, Hegel M, Arean P, Hoffing M, Della Penna R, Langston C, Unutzer J. Investigators I. Effect of improving depression care on pain and functional outcomes among older adults with arthritis. A randomized controlled trial. JAMA 2003;290:2428–34. [PubMed: 14612479]

[36]. Lindsay PG, Wyckoff M. The depression-pain syndrome and its response to antidepressants. Psychosomatics 1981;22:576–7.

[37]. McCaffery M, Beebe A. Assessment In: Pain: clinical manual for nursing practice. St. Louis: Mosby; 1989 p. 6–33.

[38]. Munce SE, Stansfeld SA, Blackmore ER, Stewart DE. The role of depression and chronic pain conditions in absenteeism: results from a national epidemiologic survey. J Occup Environ Med 2007;49:1206–11. [PubMed: 17993924]

[39]. Poleshuck EL, Bair MJ, Damush TM, Krebs EE, Kroenke K, Giles DE. Musculoskeletal pain and measures of depression: response to comment on the article by Poleshuck et al. Gen Hosp Psychiatry 2010;32:114–5. [PubMed: 20672020]

[40]. Romano JM, Turner JA. Chronic pain and depression: does the evidence support a relationship? Psychol Bull 1985;97:18–34. [PubMed: 3983297]

[41]. Rovner BW, Folstein MF. Mini-mental state exam in clinical practice. Hosp Pract 1987;22:99, 103, 106, 110.

[42]. Skolasky RL, Mackenzie EJ, Riley LH, III, Wegener ST. Psychometric properties of the Patient Activation Measure among individuals presenting for elective lumbar spine surgery. Qual Life Res 2009;18:1357–66. [PubMed: 19916057]

[43]. Skolasky RL, Mackenzie EJ, Wegener ST, Riley LH, III. Patient activation and adherence to physical therapy in persons undergoing spine surgery. Spine (Phila Pa 1976) 2008;33:E784–91. [PubMed: 18827683]

[44]. Spitzer RL, Williams JBW, Kroenke K, Linzer M, deGruy FV, III, Hahn SR, Brody D, Johnson JG. Utility of a new procedure for diagnosing mental disorders in primary care. The PRIME-MD 1000 study. JAMA 1994;272:1749–56. [PubMed: 7966923]

[45]. Sriwatanakul K, Weis OF, Alloza JL, Kelvie W, Weintraub M, Lasagna L. Analysis of narcotic analgesic usage in the treatment of postoperative pain. JAMA 1983;250:926–9. [PubMed: 6134850]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

[46]. Wegener ST, Castillo RC, Haythornthwaite J, Mackenzie EJ, Bosse MJ. Psychological distress mediates the effect of pain on function. PAIN® 2011;152:1349–57. [PubMed: 21396777]

[47]. Weisberg S Applied linear regression. New York: Wiley; 1985.

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Table 1

Demographic characteristics of the study population (n = 260).

Characteristic	No.
Mean age (y, SD)	58.0 (15.4)
Sex (%)	
Female	152 (58.5)
Male	108 (41.5)
Race (%)	
White	232 (89.2)
Nonwhite	28 (11.8)
Average CCI score (SD)	3.9 (5.2)
Marital status (%)	
Married/living with spouse	220 (84.6)
Living with partner	4 (1.5)
Separated/divorced/widowed	16 (6.2)
Never married	24 (9.3)
Household income (%)	
<$30,000	64 (24.6)
$30,000–$50,000	76 (29.2)
>$50,000	96 (36.9)
Not reported	24 (9.3)
Education (%)	
No college degree	116 (44.6)
College degree	24 (9.2)
Advanced college degree	120 (46.2)
Diagnosis (%)	
Stendosis	203 (78.0)
Stenosis with spondylolisthesis	57 (22.0)

CCI = Charlson Comorbidity Index.

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Table 2

Mean pain intensity and depressive symptoms of the study population (n = 260).

Measure	Preoperative score (points, SD)	Postoperative score (points, SD)	
		3 mo	6 mo
Mean pain intensity (NRS)	5.2 (2.4)	3.3 (2.1)	3.0 (1.9)
Mean depressive symptoms (PHQ9)	5.0 (2.7)	2.0 (1.9)	3.5 (1.8)

NRS = numeric rating scale; PHQ9 = Patient Health Questionnaire 9-item depression screen.

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Table 3

Relationship between change in pain intensity and improvement in depressive symptoms in the study population (n = 260) at 6 months.

Independent variable	Odds ratio (95% confidence interval) of depression improvement	*P* value
Pain intensity		
No improvement	1	Reference
Improvement *	2.68 (1.48–4.86)	.001
Time since surgery (mo)	1.39 (1.04–1.86)	.024
Sex		
Male	1	Reference
Female	1.15 (0.67–1.98)	.603
Age (y)		
<65	1	Reference
≥65	2.18 (1.19–4.02)	.012

* Improvement was defined as 2 points or a 30% reduction from preoperative pain intensity.