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LUMBAR SURGERY IN WORK-RELATED CHRONIC LOW BACK PAIN: CAN A CONTINUUM OF CARE ENHANCE OUTCOMES?

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Abstract

Background Context—Systematic reviews of lumbar fusion outcomes in purely workers' compensation (WC) patient populations have indicated mixed results for efficacy. Recent studies on lumbar fusions in the WC setting have reported return-to-work rates of 26–36%, re-operation rates of 22–27%, and high rates of persistent opioid use two years post-surgery. Other types of lumbar surgery in WC populations are also acknowledged to have poorer outcomes than in non-WC. The possibility of improving outcomes by employing a biopsychosocial model with a continuum of care, including post-operative functional restoration in this “at risk” population, has been suggested as a possible solution.

Purpose—To compare objective socioeconomic and patient-reported outcomes for WC patients with different lumbar surgeries followed by functional restoration, relative to matched comparison patients without surgery.

Study Design/Setting—A prospective cohort study of chronic disabling occupational lumbar spinal disorder (CDOLD) patients with WC claims treated in an interdisciplinary functional restoration program.

Patient Sample—A consecutive cohort of 564 patients with pre-rehab surgery completed an functional restoration and was divided into groups based on surgery type: lumbar fusion (F group,

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n = 331) and non-fusion lumbar spine surgery (NF group, n = 233). An unoperated comparison group was matched for length of disability (U group, n = 349).

Outcome Measures—Validated patient-reported measures of pain, disability and depression were administered PRE- and POST-rehab. Socioeconomic outcomes were collected via a structured one-year POST interview.

Methods—All patients completed an intensive, medically-supervised FRP, combining quantitatively-directed exercise progression with a multimodal disability management approach. The writing of this manuscript was supported in part by NIH Grant 1K05-MH-71892 and no conflicts of interest are noted among the authors.

Results—The F group had a longer length of disability compared to the NF and U groups (M = 31.6, 21.7, and 25.9 months, respectively, $p < .001$). There were relatively few statistically significant differences for any socioeconomically-relevant outcome among groups, with virtually identical POST-rehab return-to-work (F=81%, NF=84%, U=85%, $p = .409$). The groups differed significantly after surgery on diagnosis of major depressive disorder and opioid dependence disorder, as well as patient-reported depressive symptoms and pain intensity PRE-rehab. However, no significant differences in patient-reported outcomes were found POST-rehab. PRE-rehab opioid dependence disorder significantly predicted lower rates of work return and work retention, as well as higher rates of treatment-seeking behavior. Higher levels of PRE-rehab perceived disability and depressive symptoms were significant risk factors for poorer work return and retention outcomes.

Conclusions—Lumbar surgery in the WC system (particularly lumbar fusion) have the potential achieve positive outcomes that are comparable to CDOLD patients treated non-operatively. This study suggests that surgeons have the opportunity to improve lumbar surgery outcomes in the WC system, even for complex fusion CDOLD patients with multiple prior operations, if they control post-operative opioid dependence and prevent an excessive length of disability. Through early referral of patients (who fail to respond to usual post-operative care) to interdisciplinary rehabilitation, the surgeon determining this continuum of care may accelerate recovery and achieve socioeconomic outcomes of relevance to the patient and WC jurisdiction through the combination of surgery and post-operative rehabilitation.

Keywords

lumbar spinal fusion; chronic disabling occupational spinal disorders; deconditioning syndrome; functional restoration; return to work; outcomes; risk factors; workers' compensation; opioid dependence; depression; biopsychosocial model

INTRODUCTION

Lumbar spine surgery rates in the workers' compensation (WC) setting for chronic disabling occupational lumbar disorder (CDOLD) patients have been rising steadily, especially lumbar spine fusion procedures.^{1, 2} There has also been a debate in the scientific literature about the long-term effectiveness of spinal fusion surgery for chronic (especially discogenic) low back pain.^{3, 4} Findings, such as low work return, high re-operation rates, and highly prevalent opioid dependence have been demonstrated in different WC jurisdictions,⁵⁻⁷ and have led to

limitations on recommendations for spinal fusion in WC claims by the largest evidence-based national guidelines, resulting in a lower surgical approval rates in a growing number of state jurisdictions mandating use of these guidelines.^{8, 9} It has been suggested that similar guidelines will be incorporated into group health and Medicare settings with the expansion of national health insurance. A large population-based study of fusions within the Washington State WC setting revealed a 22% re-operation rate and a low return-to-work rate of 36%, at 2-years post-surgery.⁷ A more recent study in the Ohio WC jurisdiction showed similar results, with a 26% return to work rate and a 27% re-operation rate, as well as a opioid dependence disorder (ODD) still noted in 85% of fusion patients 2 years postoperative.⁶ Outcomes in the Utah WC jurisdiction were comparable.^{10, 11}

In contrast, a previous prospective cohort study demonstrated high rates of work status improvement (>80%) and low rates of re-operation and recurrent injury claims for both fusion and discectomy patients in a chronic lumbar WC cohort.¹² This particular study utilized a “continuum of care approach,” with administration of functional restoration *after* surgery for these patients. An important question is whether lumbar spinal surgery *combined* with subsequent interdisciplinary rehab can improve the results of surgery alone. Such a continuum of care protocol is now quite standard in the treatment of other musculoskeletal disorders of the extremities, especially the knee.^{13–16} National treatment guidelines, such as the Official Disability Guidelines (ODG), utilize a biopsychosocial “continuum of care” model, which recommends appropriate steps and limits for sufficient preoperative care and testing, surgical decision-making, postoperative rehab and, in some chronic pain cases, interdisciplinary functional restoration.⁹ Therefore, the major goal of the present study was to take an important step in further evaluating the potential efficacy of such a combined approach with a “worst case” cohort of CLBP patients with WC claims.

Recent studies have documented the importance of psychosocial factors and their impact on outcomes following lumbar surgery,^{11, 17–20} and the impact of psychosocial factors in the development and perpetuation of chronic pain and disability has been widely documented in the literature.^{21, 22} Because lumbar fusion surgery for nonspecific chronic low back pain (CLBP) is usually performed on patients already demonstrating extensive chronic pain/disability behaviors in the WC setting, the need to pay heed to a biopsychosocial model when contemplating surgery, or managing them in post-operative rehabilitation, is becoming more apparent.^{8, 23, 24} The ODG recognizes the length of disability as being one of the most critical risk factors for poor outcomes and higher costs linked to delayed recovery.^{8, 9} Even under optimum conditions, objective outcome measures declined with increasing length of disability, making this factor a primary selection criterion for determining a “worst case” WC claim cohort.

The present study evaluated several objective socioeconomic outcomes in a prospective consecutive cohort of lumbar surgical patients with WC claims, operated on after already developing CLBP disability despite extensive non-operative care (average 16–19 months from injury to index surgery). They were all referred to an interdisciplinary functional restoration program (FRP) after demonstration of persistent post-operative disability following a trial of usual postop rehab (averaging 11–18 months postop). Patients able to successfully resume occupational activities after usual post-operative physical therapy were

excluded from this study, leaving only patients demonstrating persistent pain/disability after fusion, discectomy, decompression and/or artificial disc replacement (ADR), and after failure to respond to usual postop reconditioning and interventions.

METHODS

Patients

A consecutive cohort of 3,888 patients, admitted to a functional restoration program between the years 1992 and 2003, received rehabilitation for chronic musculoskeletal disorders. All patients in this cohort had WC claims (state or federal U.S. jurisdictions), with or without attached third party claims, or non-WC disability payments (long-term disability, short-term disability, Social Security, etc.). To be eligible for this study, all patients had a claim of a lumbar injury that was recognized as *compensable* (i.e., accepted for treatment within the jurisdiction rules), with a specific injury date. There were 822 patients without compensable spinal injuries who were excluded from the study, resulting in a sample of 3,066 patients with compensable spinal injuries. Initial injury claims ranged from minor sprains to major traumatic events (falls from a height, crush injuries or explosions). Program participation criteria included: 1) four or more months elapsed since a work-related injury; 2) non-surgical care failed to improve symptoms sufficient to allow full return-to-work; 3) surgery had not produced resolution, or simply was not an option; 4) severe pain and functional limitations remained; and 5) patients had the ability to communicate in English or Spanish.

Of this sample, those who failed to complete the functional restoration program were excluded ($n = 472$) as these patients had a low rate of outcome contact and had not completed a full dose of a rehab treatment. The final cohort consisted of 2,594 program completers, divided into 3 groups as follows:

- **F group:** At least one lumbar fusion or artificial disc replacement (ADR) surgical procedure after injury claim for degenerative disease with indications including discography, instability or failed prior lumbar surgery, but excluding lumbar fractures, dislocations, tumors, infectious etiologies or spondylolisthesis ($N = 331$);
- **NF group:** At least one lumbar surgery (discectomy or decompression) after injury claim, but no lumbar fusion or ADR ($N = 233$);
- **U Group:** A mixed group of patients with no PRE-rehab spinal surgery ($N=2,021$), some of whom had PRE-rehab surgery to a non-spinal compensable body part ($N=191$). All patients in this group who had any type of non-spinal surgery were excluded. From the remaining patients ($N=1,830$), an unoperated comparison group ($N=349$) was established, matched to the F and NF groups on length of disability. The remaining non-surgical patients ($N=1,481$) were excluded from the analysis (per Figure 1 flow chart).

Both surgical groups may have had other surgeries to the same or other levels prior to the WC claim under study, or may have had a second or subsequent procedure (see Table 1). The study was granted an exemption from IRB review because all data were collected from

the standard medical records. Figure 1 demonstrates the mechanisms by which the groups were derived, in the CONSORT style.

Table 2 summarizes the demographic characteristics of the U, NF, and F groups. The U group had a lower proportion of males than the F and NF groups ($p < .001$). The NF group was more likely to have a single spinal injury (as opposed to multiple spinal injuries or a combination of spinal and extremity injuries), compared to both the F and the U groups ($p < .001$). Finally, the F group was more likely to have had multiple PRE-rehabilitation surgeries ($p < .001$), and had a longer time from surgery to rehab ($p < .001$), relative to the NF group. In claiming this is a “worst case” cohort, the authors wish to emphasize the extremely long period of time (involving partial and/or total disability) from injury to index surgery (averaging 16–19 months), in addition to 11–18 months between surgery and functional restoration admission, with the average total disability time ranging from 22–32 months for all three groups. Table 1 presents the types of spine surgery and their frequency under the WC claim being treated for the NF and F groups.

Procedure

The functional restoration program was a medically-supervised interdisciplinary program, combining a quantitatively-directed exercise progression protocol with a multimodal disability management approach. Patients admitted to the program first underwent a comprehensive physical and psychosocial evaluation, including functional and psychosocial assessment. Patients then participated in a structured exercise program, administered by physical and occupational therapists, which was guided by repeated objective physical measurements. The disability management program included: cognitive-behavioral therapy designed to promote pain coping skills; medical case management to facilitate vocational reintegration; biofeedback and relaxation training to assist stress management, and educational sessions to improve knowledge of musculoskeletal disorders and to encourage health and fitness maintenance after program discharge. The program was medically-supervised to allow for simultaneous medication management (including psychotropic medications and opioid taper), as well as limited interventional procedures (if needed). The specific program descriptions of its procedures has been published in multiple outcome studies documenting its effectiveness in providing functional improvement, often cited in national treatment guideline references.^{8, 9, 25–32} The effectiveness of functional restoration methods have also been well documented in the literature.^{33–41}

Measures

Patients completed a battery of psychosocial patient-reported outcome measures at admission to, and discharge from, the functional restoration program. In addition, the Structured Clinical Interview based on the Diagnostic and Statistical Manual of Mental Disorders (SCID) was administered by a trained clinician upon program admission, and patients were evaluated for Axis I psychiatric disorders.^{42, 43} For the purposes of this study, the major Axis I psychiatric disorders occurring with a high prevalence in a chronic pain population were reported: major depressive disorder; anxiety disorders; and substance use disorders.⁴⁴ Psychosocial patient-report measures were administered at program admission (PRE) and discharge (POST). Measures included the Beck Depression Inventory (BDI), a

measure of depressive symptoms.⁴⁵ BDI scores of 20 or greater have been found to indicate moderate to severe depressive symptoms.⁴⁶ The Million Visual Analog Scale (MVAS) was used to measure patient-perceived disability,⁴⁷ and scores of 70 or greater indicate moderate to severe disability.⁴⁸ Pain was measured with the pain intensity visual analog scale (VAS), a 10 cm line with endpoints of 0=no pain and 10=the worst possible pain. Scores on the pain VAS of 6 or greater indicate severe pain and are associated with poorer rehabilitation outcomes.^{48, 49} All patient-reported measures have been shown to be reliable and valid for use with chronic pain patients.⁵⁰

One-year POST-rehabilitation socioeconomic outcomes were collected using a structured telephone interview.^{51, 52} These one-year socioeconomic outcomes were obtained with a 94% successful contact rate for this cohort, and included:

- return-to-work (i.e., whether the patient returned to work at any point in the post-discharge year);
- work retention (whether the patient was still employed at the one-year follow-up);
- percentage seeking treatment from a new healthcare provider;
- number of visits to a new healthcare provider;
- new surgeries to original area of injury since program discharge;
- new compensable injury claims (with or without work loss);
- and workers' compensation case settlement.

These socioeconomically-relevant outcomes have been consistently reported from this program in the past, and have been shown to be reliable discriminant indicators of patients who complete the program, relative to those who refuse treatment or do not complete it.^{25, 26, 53, 54}

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Data Analyses

Statistical analyses of differences among the three groups were performed using the Chi-Square statistic for categorical variables, and one-way ANOVAs for continuous variables. All significant *p*-values reported were complemented by the reporting of the Cohen's *w* effect size for categorical variables,⁵⁵ and the partial eta-squared effect size statistic for continuous variables. The POST psychosocial patient-reported measures were evaluated using a ANCOVA procedure, with PRE-rehab scores as a covariate . For the one-year outcome variables, multivariate logistic regression analyses were used to assess possible risk factors for adverse outcomes across the entire cohort. In addition to lumbar fusion surgery, predictor variables in these regression analyses included any substantial psychosocial comorbidity and relevant demographic differences between the groups.

RESULTS

PRE- and POST-Rehabilitation Psychosocial Characteristics

Patients in the NF group had lower PRE-rehabilitation mean levels of depressive symptoms as measured by the BDI, compared to the F group (15.9 vs. 19.1, $p = .002$). In addition, patients in the NF groups were less likely to meet the diagnostic criteria for major depressive disorder compared to the F and the U groups (43.4% vs. 59% and 56.5%, respectively, $p = .002$). Patients in the F group had a significantly higher prevalence of post-injury opioid dependence disorder relative to the NF group and the U group (31.3% vs. 19.4% and 17.3%, respectively, $p < .001$). Upon completion of the program, both groups were comparable on all psychosocial measures. PRE and POST psychosocial characteristics of the cohort are summarized in Table 3.

One-Year Socioeconomic Outcomes

Table 4 summarizes the one-year POST-rehabilitation objective socioeconomic outcomes of the three groups. There were no significant differences among the groups in work-related outcomes, including both return-to-work and work retention. This finding provided contrast to much lower work status outcomes in prior WC spine surgery publications.^{6–8} In addition, there were no differences in rates of additional surgery (1.2–3.7%) or new compensable injuries. These non-significant differences among groups may hide the fact that the additional surgery rates for the surgical groups ranged from 3.3–3.7%, well below fusion re-operation rates of 22–27% in recent lumbar fusion WC claim studies. Because a minority of patients may have had a non-lumbar compensable injury associated with their lumbar claim, some of these surgeries may have been to the cervical spine or extremities, further lowering the actual re-operation rate from what is historically found in this CDOLD cohort. Recurrent WC injury claims in the year following treatment completion at 1.4–2.4% are also well below historical rates of more than 30–60% after recovery from WC injuries.^{56,57} The F group was more likely to seek treatment from a new provider after discharge from rehabilitation, relative to the U and NF groups (34.4% vs. 21.7% and 25.6% respectively, $p = .001$), with more medical visits ($p = .032$). Analysis of groups seeking healthcare from new providers following the FRP over 3 decades has identified opioid dependence disorder and opioid-seeking as the primary reason given by such patients, consistent with the higher rates of opioid dependence for the F group.^{6,58}

Risk Factors for Adverse Outcomes

Multivariate logistic regression analyses were conducted across the entire cohort of patients. The results of this analysis are shown in Table 5, with all non-significant predictors removed from the model. Patients in the F group were 1.94 times more likely to seek treatment from a new provider after rehabilitation than the U group, after controlling for gender and opioid dependence. The most robust risk factors for poorer outcomes was the presence of post-injury opioid dependence disorder, which predicted lower rates of return-to-work and work retention, as well as higher rates of treatment-seeking behavior at the one-year follow-up interview. In addition, PRE depressive symptoms on the BDI were predictive of both return-to-work and work retention, while PRE perceived disability on the MVAS predicted work retention, and female gender predicted treatment-seeking behavior.

DISCUSSION

Most previous studies of lumbar surgery in CLBP (particularly lumbar fusion) have concentrated on comparisons between the surgery and a non-operative comparison group.^{59–62} However, few studies focus on (or even include) WC claim patients. With the exception of two studies,^{41, 59} no other previous studies have looked at a population of extreme lengths of disability after WC claims receiving one or more fusions or other spinal procedure in a continuum of care (i.e., surgery followed by active rehabilitation). Under current WC national treatment guidelines, a continuum of care is contemplated, beginning with a surgical decision made only after early non-operative care has had an adequate trial.^{8, 9} When usual postop reconditioning therapy and/or injections fails to result in recovery to pre-injury function, a more intensive interdisciplinary program, such as a functional restoration program (or chronic pain management), is recommended.^{8,9} No prior study has evaluated such a continuum of care in comparison to patients treated non-operatively with similar extreme lengths of disability prior to interdisciplinary rehabilitation.

In demonstrating no statistically significant differences in most socioeconomic outcomes of relevance to the WC system, very important differences were shown between these surgical cohorts and comparisons in the spine literature of lumbar surgery in the WC system whose surgeons or other providers offered only “usual,” more limited post-operative care. Work return and retention rates in these fusion and non-fusion groups were substantially higher than the 26–36% reported 2 years post-surgery in recent studies of large WC cohorts from Washington and Ohio State jurisdictions.^{6, 7, 10} While there may have been differences in state jurisdiction rules and economies during the study period of 1992–2003, those differences cannot account for a 2–3 fold increase in the percentage returning to work and retaining work at the end of a year, particularly for this cohort demonstrating extreme periods of disability. On average, the 1-year outcomes were taken more than 2 years after the index spine surgical procedure, making this cohort study results comparable to that from other state jurisdictions.

Similar unusual findings were noted in the re-operation rates. The studies from Washington, Utah and Ohio demonstrate 22–27% re-operation rates for lumbar fusion cases.^{6, 7, 10} In this present study, prior to the opportunity to participate in interdisciplinary rehabilitation 16.7% of the non-fusion patients had a second or subsequent surgical procedure, while 39.9% of the fusion patients had a second or subsequent surgery, with 17.2% of fusion patients having 3 or more surgeries PRE-rehab. In the year following the functional restoration program, however, only 3.3% of fusion, and 3.7% of non-fusion, patients had an additional surgical procedure. In addition, for those returning to work after the rehabilitation program, an unusually low rate of new WC injury claims was found for the post-surgical patient population. In contrast to many prior studies, only 1.4% of non-fusion patients and 2.4% of fusion patients reported a new WC injury claim from their job.⁵⁷ These results are comparable to the 1.9% new injury claims among patients in the non-surgical comparison group, who were matched for duration of disability.

The increasing trend in the prescription of opioids has generated research into long-term negative effects associated with opioid use.⁶⁰ Two recent publications have documented that

the use of opioids within the WC setting, for both acute and chronic back pain, is significantly associated with increased risk for work disability at one-year.^{44, 61–63} While surgical patients from this patient population have been identified as having increased rates of post-rehabilitation healthcare utilization,⁶⁴ the increased treatment seeking by patients may be in the service of maintaining their opioid dependence.⁶³ Further support for this hypothesis comes from the fact that data on more recent 2010–11 outcomes has seen the treatment seeking from new healthcare providers decrease 60–80% into the single digits (as measured on a quarterly basis), possibly due to more effective pain medication management and patient-negotiated opioid tapering.^{58,63,65}

Selection bias is a frequent criticism of prospective cohort studies, such as the present one. For example, it is quite possible that the fusion group patients might have had the same outcomes if they entered the functional restoration program before or without surgery. In a sense, the U groups speaks to that, because the objective work and reoperation outcomes were identical for that group and the surgical groups with an equivalent length of disability. We have no way of knowing how many of the U group had similar surgical indications as the NF or F groups, which makes conclusions about cause and effect relationships difficult. What is striking is that all the groups did about the same despite an extremely long period of disability. It remains for future studies to establish a cause and effect relationship, but it is clear from this study that neither fusion or other types of lumbar surgery necessarily lead to suboptimal outcomes. It should also be noted that the elapsed time between injury and admission to rehabilitation was an indication that this is a “worst case” cohort of fusion and non-fusion CDOLD patients, who were referred *only if* they exhibited persistent disability over a significant period of time. This is demonstrated by the extreme length of disability for all groups, as well as the majority of surgical patients having an elapsed time of eleven to eighteen months between surgery and intensive rehabilitation admission. This time, was not controlled between the groups, this contributing to another potential source of bias. It is noteworthy that the development and promulgation of national treatment guidelines are predicated on a biopsychosocial continuum of care for their recommendations, with patients “dropping out” of the guideline as they recover with the least intensive treatments (that usually begin with acute non-operative care, move to surgical and postop care, and ending in pain management for only a small group who fail to recover). Although no selection bias was evident for demographic and occupational factors in terms of program completion, it should be noted that the efficacy of this rehabilitation program has been previously demonstrated by a comparison of program completers versus non-completers.^{53,54} For example, program non-completers were 10 times less likely to return to work, 7 times less likely to retain work, and 7 times more likely to have re-operations, relative to program completers. In terms of the concept of a “continuum of care,” these findings generally reflect that program dropouts have chosen to pursue disability benefits offered under state WC jurisdictions or federal benefits like Social Security Disability. By having patients identify themselves as *disability-prone* on a biopsychosocial basis through persistent pain behaviors, limited effort and non-compliance, non-completion also provides late evidence to surgeons and state administrators of the need to consider case closure rather than persistent interventions.

CONCLUSIONS

Overall, lumbar surgery, including fusion, was *not* a risk factor for adverse outcomes, including critical outcomes such as return-to-work and work retention one-year post-functional restoration program, when a continuum of care that included interdisciplinary functional restoration was offered to patients and completed. Poorer outcome rates across the cohort were more accurately predicted by several known risk factors for persistent chronic pain and disability, especially the presence of post-injury opioid dependence disorder. Controversy has existed for decades over the poorer outcomes in the WC claim setting for lumbar spine surgery, particularly fusions. The problem with most prior studies is that they rely on the surgery as a stand-alone entity, without considering other aspects of a continuum of care. This study, following a biopsychosocial model, and evidence-based recommendations of national treatment guidelines (currently specific to the WC claim setting), demonstrated that a continuum of care produced surgery outcomes that were as positive as those involving unoperated-matched patients. Once a surgical decision has been made and acted upon, it is possible for the surgeon to influence the postoperative rehabilitation process to achieve similar outcomes, rather than leaving those decisions to others. As national health insurance and Medicare/Medicaid cost-overruns grab more headlines, poor objective outcomes for ongoing disability and healthcare utilization are likely to adversely impact the spine surgeon's options. Fortunately, this manuscript suggests that a surgeon's attention to a continuum of care, that includes attention to the patient's compliance, opioid use, and cooperation with intensive rehabilitation designed to assist vocational reintegration, can dramatically impact outcomes of socioeconomic relevance, not simply patient-reported outcomes. Although the availability of quality functional restoration program remains a limiting factor on testing the hypothesis raised in this manuscript and in national guidelines, sufficient quality programs are available to further test the findings raised in this preliminary study, to provide greater evidence-based support for the continuum of care concept. In the future, such attention by surgeons may also impact national evidence-based guidelines currently restricted to WC claims, but soon likely to impact the vastly larger group health and Medicare populations falling under the supervision of federally-administered and influenced healthcare programs.

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References

1. Rajaei SS, Bae HW, Kanim LEA, Delamarter RB. Spinal fusion in the United States: Analysis of trends from 1998 to 2008. *Spine*. 2012; 37(1):67–76. [PubMed: 21311399]
2. Deyo RA. Point of view: In response to spinal fusion in the United States: Analysis of trends from 1998 to 2008. *Spine*. 2012; 37(1):77.
3. Deyo RA, Nachemson A, Mirza SK. Spinal-fusion surgery — the case for restraint. *N Eng J Med*. 2004; 350(7):722–6.
4. Errico TJ, Gatchel RJ, Schofferman J, Benzel EC, Faciszewski T, Eskay-Auerbach M, et al. A fair and balanced view of spine fusion surgery. *Spine J*. 2004; 4(5):S129–S38. [PubMed: 15374548]
5. Fisher CG, Vaccaro AR, Mulpuri K, Angevine PD, Thomas KC, Patel AA, et al. Evidence-based recommendations for spine surgery. *Spine*. 2012; 37(1):E3–E9. [PubMed: 22076643]

6. Nguyen TH, Randolph DC, Talmage J, Succop P, Travis R. Long-term outcomes of lumbar fusion among workers' compensation subjects: A historical cohort study. *Spine*. 2011; 36(4):320–3. [PubMed: 20736894]
7. Juratli SM, Franklin GM, Mirza SK, Wickizer TM, Fulton-Kehoe D. Lumbar fusion outcomes in Washington State workers' compensation. *Spine*. 2006; 31(23):2715–23. [PubMed: 17077741]
8. Hegman, KT., editor. Occupational medicine practice guidelines: Evaluation and management of common health problems and functional recovery in workers, 2008 revision. 2. Elk Grove Village, IL: American College of Occupational and Environmental Medicine; 2008.
9. Denniston, PJ.; Kennedy, CW, Jr. 2012 Official disability guidelines. San Diego, CA: Work-Loss Data Institute; 2012.
10. DeBerard MS, Masters KS, Colledge AL, Schleusener RL, Schlegel JD. Outcomes of posterolateral lumbar fusion in Utah patients receiving workers' compensation: A retrospective cohort study. *Spine*. 2001; 26(7):738–46. [PubMed: 11295891]
11. DeBerard MS, Wheeler AJ, Gundy JM, Stein DM, Colledge AL. Presurgical biopsychosocial variables predict medical, compensation, and aggregate costs of lumbar discectomy in Utah workers' compensation patients. *Spine J*. 2011; 11(5):395–401. [PubMed: 21514244]
12. Mayer TG, McMahon MJ, Gatchel RJ, Sparks B, Wright A, Pegues P. Socioeconomic outcomes of combined spine surgery and functional restoration in workers' compensation spinal disorders with matched controls. *Spine*. 1998; 23(5):598–605. [PubMed: 9530792]
13. Bergés I-M, Ottenbacher KJ, Smith PM, Smith D. Perceived pain and satisfaction with medical rehabilitation after hospital discharge. *Clin Rehabil*. 2006; 20(8):724–30. [PubMed: 16944829]
14. Paulos LE, Wnorowski DC, Beck CL. Rehabilitation following knee surgery. *Recommendations Sports Med*. 1991; 11(4):257–75.
15. Widuchowski W, Tomaszewski W, Widuchowski J, Czamara A. Current concepts in the treatment of cartilage lesions with special regard to the knee joint. *Ortop, Traumatol, Rehabil*. 2011; 13(4): 327–41. [PubMed: 21857064]
16. Yen YM, Cascio B, O'Brien L, Stalzer S, Millett PJ, Steadman JR. Treatment of osteoarthritis of the knee with microfracture and rehabilitation. *Med Sci Sports Exerc*. 2008; 40(2):200–5. [PubMed: 18202584]
17. Elfering A. Work-related outcome assessment instruments. *Eur Spine J*. 2006; 15(1):S32–S43. [PubMed: 16328225]
18. Trief PM, Ploutz-Snyder R, Fredrickson BE. Emotional health predicts pain and function after fusion: A prospective multicenter study. *Spine*. 2006; 31(7):823–30. [PubMed: 16582857]
19. Mannion AF, Elfering A. Predictors of surgical outcome and their assessment. *Eur Spine J*. 2006; 15(1):S93–S108. [PubMed: 16320033]
20. Soegaard R, Christensen FB, Lauersen I, Bünger CE. Lumbar spinal fusion patients' demands to the primary health sector: Evaluation of three rehabilitation protocols. A prospective randomized study. *Eur Spine J*. 2006; 15(5):648–56. [PubMed: 15937676]
21. Turk, DC.; Monarch, ES. Biopsychosocial perspective on chronic pain. In: Turk, DC.; Gatchel, RJ., editors. *Psychological Approaches to Pain Management: A practitioner's handbook*. 2. New York: Guilford Publications; 2002. p. 3-29.
22. Gatchel RJ. Comorbidity of chronic pain and mental health disorders: The biopsychosocial perspective. *Am Psychol*. 2004; 59:795–805. [PubMed: 15554853]
23. Block, AR.; Gatchel, RJ.; Deardorff, WW.; Guyer, RD. *The psychology of spine surgery*. Washington, DC: American Psychological Association; 2003.
24. Jordan KD, Mayer TG, Gatchel RJ. Should extended disability be an exclusion criterion for tertiary rehabilitation?: Socioeconomic outcomes of early versus late functional restoration in compensation spinal disorders. *Spine*. 1998; 23(19):2110–6. [PubMed: 9794056]
25. Mayer TG, Gatchel RJ, Kishino N, Keeley J, Capra P, Mayer H, et al. Objective assessment of spine function following industrial injury. A prospective study with comparison group and one-year follow-up. *Spine*. 1985; 10:482–93. [PubMed: 2934829]
26. Mayer TG, Gatchel RJ, Mayer H, Kishino N, Keeley J, Mooney V. A prospective two-year study of functional restoration in industrial low back injury: An objective assessment procedure. *JAMA*. 1987; 258:1763–7. [PubMed: 2957520]

27. Mayer, TG.; Gatchel, RJ. Functional restoration for spinal disorders: The sports medicine approach. Philadelphia: Lea & Febiger; 1988.
28. Howard KJ, Mayer TG, Gatchel RJ. Comparison of chronic occupational upper extremity versus lumbar disorders for differential disability-related outcomes and predictor variables. *Journal of Occupational and Environmental Medicine*. 2012; 54(8):1002–9. [PubMed: 22842915]
29. Mayer TG, Gatchel RJ, Polatin P, Evans T. Outcomes comparison of treatment for chronic disabling work-related upper-extremity disorders and spinal disorders. *J Occup Environ Med*. 1999; 41(9):761–70. [PubMed: 10491792]
30. Wright A, Mayer TG, Gatchel RJ. Outcomes of disabling cervical spine disorders in compensation injuries: A prospective comparison to tertiary rehabilitation response for chronic lumbar spinal disorders. *Spine*. 1999; 24(2):178–83. [PubMed: 9926390]
31. Chou R, Loeser JD, Owens DK, Rosenquist RW, Atlas SJ, Baisden J, et al. Interventional therapies, surgery, and interdisciplinary rehabilitation for low back pain: An evidence-based clinical practice guideline from the american pain society. *Spine*. 2009; 34(10):1066–77. [PubMed: 19363457]
32. Roche-Leboucher G, Petit-Lemanac'h A, Bontoux L, Dubus-Bausière V, Parot-Shinkel E, Fanello S, et al. Multidisciplinary intensive functional restoration versus outpatient active physiotherapy in chronic low back pain: A randomized controlled trial. *Spine*. 2011; 36(26):2235–42. [PubMed: 21415807]
33. Mayer, EK.; Mayer, TG. The interdisciplinary treatment of the patient with chronic pain. In: Rao, RD.; Smuck, M., editors. *Orthopedic knowledge update: Spine 4*. 4. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2012. p. 161-80.
34. Hazard RG, Fenwick JW, Kalisch SM, Redmond J, Reeves V, Reid S, et al. Functional restoration with behavioral support. A one-year prospective study of patients with chronic low-back pain. *Spine*. 1989; 14(2):157–61. [PubMed: 2522243]
35. Hazard RG. Spine update. Functional restoration. *Spine*. 1995; 20(21):2345–8. [PubMed: 8553125]
36. Mayer TG, Gatchel RJ, Kishino N, Keeley J, Mayer H, Capra P, et al. A prospective short-term study of chronic low back pain patients utilizing novel objective functional measurement. *Pain*. 1986; 25(1):53–68. [PubMed: 2940500]
37. Bendix AF, Bendix T, Vaegter K, Lund C, Frølund L, Holm L. Multidisciplinary intensive treatment for chronic low back pain: A randomized, prospective study. *Cleve Clin J Med*. 1996; 63(1):62–9. [PubMed: 8590519]
38. Hildebrandt J, Pfingsten M, Saur P, Jansen J. Prediction of success from a multidisciplinary treatment program for chronic low back pain. *Spine*. 1997; 22(9):990–1001. [PubMed: 9152449]
39. Jousset N, Fanello S, Bontoux L, Dubus V, Billabert C, Vielle B, et al. Effects of functional restoration versus 3 hours per week physical therapy: A randomized controlled study. *Spine*. 2004; 29(5):487–93. [PubMed: 15129059]
40. Rainville J, Kim RS, Katz JN. A review of 1985 Volvo award winner in clinical science: Objective assessment of spine function following industrial injury: A prospective study with comparison group and 1-year follow-up. *Spine*. 2007; 32(18):2031–4. [PubMed: 17700453]
41. Mayer TG, Anagnostis C, Gatchel RJ, Evans T. Impact of functional restoration after anterior cervical fusion on chronic disability in work-related neck pain. *Spine J*. 2002; 2(4):267–73. [PubMed: 14589478]
42. Williams JB, Gibbon M, First MB, Spitzer RL, Davies M, Borus J, et al. The structured clinical interview for DSM-III-R (SCID). II. Multisite test-retest reliability. *Arch Gen Psychiatry*. 1992; 49(8):630–6. [PubMed: 1637253]
43. Spitzer RL, Williams JB, Gibbon M, First MB. The structured clinical interview for DSM-III-R (SCID). I: History, rationale, and description. *Arch Gen Psychiatry*. 1992; 49(8):624–9. [PubMed: 1637252]
44. Dersh J, Gatchel RJ, Polatin PB, Mayer TG. Prevalence of psychiatric disorders in patients with chronic work-related musculoskeletal pain disability. *J Occup Environ Med*. 2002; 44(5):459–68. [PubMed: 12024691]

45. Beck AT, Ward CH, Mendelson MM, Mock JJ, Erbaugh JJ. An inventory for measuring depression. *Arch Gen Psychiatry*. 1961; 4(6):561–71. [PubMed: 13688369]
46. Kendall PC, Hollon SD, Beck AT, Hammen CL, Ingram RE. Issues and recommendations regarding use of the Beck Depression Inventory. *Cognit Ther Res*. 1987; 11(3):289–99.
47. Million R, Nilsen KH, Jayson MI, Baker RD. Evaluation of low back pain and assessment of lumbar corsets with and without back supports. *Ann Rheum Dis*. 1981; 40(5):449–54. [PubMed: 6458250]
48. Anagnostis C, Mayer TG, Gatchel RJ, Proctor TJ. The Million Visual Analog Scale: Its utility for predicting tertiary rehabilitation outcomes. *Spine*. 2003; 28(10):1051–60. [PubMed: 12768148]
49. McGeary DD, Mayer TG, Gatchel RJ. High pain ratings predict treatment failure in chronic occupational musculoskeletal disorders. *J Bone Joint Surg*. 2006; 88-A:317–325. [PubMed: 16452743]
50. Turner JA, Romano JM. Self-report screening measures for depression in chronic pain patients. *J ClinPsychol*. 1984; 40(4):909–13.
51. Mayer, TG.; Gatchel, RJ.; Prescott, M. Socioeconomic outcomes following treatment of occupational musculoskeletal disorders: Methodology and data collection. In: Bejjani, P., editor. *Occupational Musculoskeletal Medicine*. Philadelphia: Lippincott Williams & Wilkins; 2002.
52. Mayer, TG.; Prescott, M.; Gatchel, RJ. Objective outcome evaluation: Methods and evidence. In: Mayer, TG.; Gatchel, RJ., editors. *Occupational Musculoskeletal Disorders*. Philadelphia: Lippincott Williams & Wilkins; 2000.
53. Proctor TJ, Mayer TG, Theodore BR, Gatchel RJ. Failure to complete a functional restoration program for chronic musculoskeletal disorders: A prospective 1-year outcome study. *Arch Phys Med Rehabil*. 2005; 86(8):1509–15. [PubMed: 16084800]
54. Howard KJ, Mayer TG, Theodore BR, Gatchel RJ. Patients with chronic disabling occupational musculoskeletal disorder failing to complete functional restoration: Analysis of treatment-resistant personality characteristics. *Arch Phys Med Rehabil*. 2009; 90(5):778–85. [PubMed: 19406297]
55. Cohen J. A power primer. *Psychol Bull*. 1992; 112(1):155–9. [PubMed: 19565683]
56. Abenhaim L, Suissa S, Rossignol M. Risk of recurrence of occupational back pain over three year follow up. *Br J Ind Med*. 1988; 45(12):829–33. [PubMed: 2975503]
57. Garcy P, Mayer T, Gatchel RJ. Recurrent or new injury outcomes after return to work in chronic disabling spinal disorders: Tertiary prevention efficacy of functional restoration treatment. *Spine*. 1996; 21(8):952–9. [PubMed: 8726199]
58. Dersh J, Mayer TG, Gatchel RJ, Polatin PB, Theodore BR, Mayer EAK. Prescription opioid dependence is associated with poorer outcomes in disabling spinal disorders. *Spine*. 2008; 33(20):2219–27. [PubMed: 18725868]
59. Mayer TG, McMahon M, Gatchel RJ, Sparks B, Wright A, Pegues P. Socioeconomic outcomes of combined spine surgery and functional restoration in workers' compensation spinal disorders with matched controls. *Spine*. 1998; 23:589–606.
60. Luo X, Pietrobon R, Hey L. Patterns and trends in opioid use among individuals with back pain in the United States. *Spine*. 2004; 29(8):884–90. [PubMed: 15082989]
61. Franklin GM, Stover BD, Turner JA, Fulton-Kehoe D, Wickizer TM. Early opioid prescription and subsequent disability among workers with back injuries: The disability risk identification study cohort. *Spine*. 2008; 33(2):199–204. [PubMed: 18197107]
62. Webster BS, Verma SK, Gatchel RJ. Relationship between early opioid prescribing for acute occupational low back pain and disability duration, medical costs, subsequent surgery and late opioid use. *Spine*. 2007; 32(19):2127–32. [PubMed: 17762815]
63. Kidner CL, Mayer TG, Gatchel RJ. Higher opioid doses predict poorer functional outcome in patients with chronic disabling occupational musculoskeletal disorders. *J Bone Joint Surg*. 2009; 91(4):919–27. [PubMed: 19339577]
64. Proctor TJ, Mayer TG, Gatchel RJ, McGeary DD. Unremitting health-care-utilization outcomes of tertiary rehabilitation of patients with chronic musculoskeletal disorders. *J Bone Joint Surg*. 2004; 86(1):62–9. [PubMed: 14711947]

65. Mayer, E.; Cohen, H.; Mayer, T. Functional Restoration. In: Herkowitz, H.; Garfin, S.; Eismont, F.; Bell, G.; Balderston, R., editors. Rothman-Simone The Spine. 6. Philadelphia: W.B. Saunders; 2011. p. 1912-1935.

Figure 1.
Inclusion and Exclusion Criteria

Table 1

Types of surgeries for the 2 subgroups (N = 564).

Variable	NF group N = 233	F group N = 331
Type of PRE-rehab surgery [†]		
discectomy	135 (56.3%)	41 (8.4%)
micro-discectomy	57 (23.8%)	11 (2.3%)
percutaneous discectomy	5 (2.1%)	2 (0.4%)
spinal decompression	21 (8.8%)	7 (1.6%)
ADR/TDR	0	7 (1.4%)
IDET	20 (8.3%)	1 (0.2%)
fusion, unspecified	0	35 (7.2%)
fusion, anterior	0	125 (25.7%)
fusion, posterior interbody	0	59 (12.1%)
fusion, posterior lateral	0	43 (8.8%)
fusion, 360	0	95 (19.5%)
pseudarthrosis repair	0	12 (2.5%)
hardware removal	1 (0.4%)	27 (5.6%)
bone or spinal stimulator removal	1 (1.4%)	12 (2.5%)
other decompression+fusion	0	9 (1.6%)
Total surgeries	240 (100%)	486 (100%)

[†]Percentage of total number of surgeries is reported; each patient may have had more than one surgery

Note: All patients had workers' compensation (WC) lumbar injury claims. All NF patients had an index discectomy, decompression, while all F patients had an index lumbar fusion procedure following the WC claim. Other surgical procedures may have predated the WC injury (including other spinal levels) or followed the index procedure under the same claim, accounting for the surgical distribution in this table.

Table 2

Demographics for the 3 subgroups (N = 913)

Variable	Unoperated matched comparison group (U) N = 349	Non-fusion spinal surgery (NF) N = 239	Spinal fusion surgery (F) N = 325	p-value	effect size
Age					
mean (SD)	43.5 (9.9)	44.5 (9.6)	44.3 (8.7)	.404	
Gender					
n (% male)	198 (56.7%)	176 (75.5%) ^d	225 (68%) ^d	<.001	w = 0.16 ^a
Race					
n (%)				.801	
Caucasian	236 (69%)	155 (68%)	219 (67%)		
African-American	38 (11.1%)	34 (14.9%)	43 (13.1%)		
Hispanic/Latino	65 (19%)	38 (16.7%)	61 (18.7%)		
Other	3 (0.9%)	0 (0.4%)	4 (1.2%)		
Job demand					
n (%)				.072	
Sedentary-light	41 (13%)	25 (10.7%)	27 (8.2%)		
Light-medium	88 (27.9%)	48 (20.6%)	76 (23.2%)		
Medium-heavy	120 (38.1%)	91 (39.1%)	136 (41.5%)		
Heavy-very heavy	66 (21%)	69 (29.6%)	89 (27.1%)		
Length of disability (months)					
mean (SD)	25.9 (21.2)	21.7 (23.1)	31.6 (23.4) ^{d,e}	<.001	$\eta_p^2 = 0.03^a$
Time from injury to surgery (months)					
mean (SD)	N/A	19.1 (61.8)	16.3 (19.8)	.474	
Time from surgery to rehab (months)					
mean (SD)	N/A	10.8 (19.7)	17.6 (18.2) ^e	<.001	$\eta_p^2 = 0.03^a$
Injured spinal region					
n (%)				<.001	w = 0.18 ^a
Single spinal	217 (62.2%) ^e	192 (82.4%) ^d	233 (70.4%) ^{d,e}		
Multiple spinal	59 (16.9%) ^e	25 (10.7%) ^d	42 (12.7%)		

Variable	Unoperated matched comparison group (U) N = 349	Non-fusion spinal surgery (NF) N = 239	Spinal fusion surgery (F) N = 325	p-value	effect size
Spinal + extremity	73 (20.9%) ^e	16 (6.9%) ^d	56 (16.9%) ^e		
Variable	Unoperated matched comparison group (U) N = 349	Non-fusion spinal surgery (NF) N = 233	Spinal fusion surgery (F) N = 331	p-value	effect size
Number of PRE-rehab surgeries					
n (%)				< .001	w = 0.25 ^a
none	349 (100%)	0 (0%)	0 (0%)		
single	N/A	194 (83.3%)	199 (60.1%) ^e		
multiple	N/A	39 (16.7%)	132 (39.9%) ^e		
Order of fusion surgery					
n (%)					
primary surgery	N/A	N/A	222 (67.1%)		
second surgery			26 (7.9%)		
third or later surgery			11 (3.3%)		
multiple fusion surgeries			35 (10.6%)		

^a small effect size;

^b medium effect size;

^c large effect size

^d different from no surgery matched comparison group;

^e different from non-fusion surgery group

Table 3

Psychosocial testing results (N = 913).

Measure	U group N = 349	NF group N = 233	F group N = 331	p-value	effect size
Opioid dependence disorder n(%)	48 (17.3%)	38 (19.4%)	94 (31.1%) ^{d,e}	<.001	$w = 0.15^a$
Major depressive disorder n(%)	157 (56.5%)	85 (43.4%) ^d	178 (58.9%) ^e	.002	$w = 0.13^a$
Anxiety disorder n(%)	26 (9.4%)	9 (4.6%)	31 (10.3%)	.070	
Beck Depression Inventory (BDI)					
PRE-rehab	17.3 (10.8)	15.9 (9.9)	19.1 (10.7) ^e	.002	$\eta_p^2 = .014^a$
POST-rehab ^b	10.1 (7.8)	10.0 (7.8)	9.9 (7.8)	.955	
Mean (SD)					
Million Visual Analog Scale (MVAS)					
PRE-rehab	95.2 (23.7)	91.9 (25.5)	93.4 (25.4)	.306	
POST-rehab ^b	64.4 (27.7)	68.2 (27.7)	65.8 (27.7)	.292	
Mean (SD)					
Pain intensity visual analog scale					
PRE-rehab	6.8 (1.9)	6.4 (2.2)	6.5 (2.0)	.023	$\eta_p^2 = .008^a$
POST-rehab ^b	4.6 (2.1)	4.9 (2.1)	4.8 (2.1)	.201	
Mean (SD)					

^a small effect size;

^b Note: POST-rehab scores are adjusted for PRE-rehab scores;

^c different from no surgery matched comparison group;

^d different from non-fusion surgery group

Table 4

One year socioeconomic outcomes (N = 856)

Outcome	Unoperated matched comparison group (U) N = 349	Non-fusion spinal surgery (NF) N = 233	Spinal fusion surgery (F) N = 331	p	Effect size
Return to work n (%)	271 (85.2%)	177 (83.5%)	242 (81.2%)	.409	
Work retention n (%)	256 (81%)	162 (76.8%)	223 (74.8%)	.172	
New surgery n (%)	4 (1.2%)	8 (3.7%)	10 (3.3%)	.135	
New injuries n (%)	6 (1.9%)	3 (1.4%)	7 (2.4%)	.751	
Case settlement n (%)	319 (96.4%)	206 (93.2%)	292 (94.2%)	.222	
Treatment seeking from new providers n (%)	72 (21.7%)	56 (25.6%)	105 (34.4%) ^{d,e}	.001	w = 0.12 ^a
Number of visits to new providers				.032	w = 0.16 ^a
none	260 (79%)	163 (74.4%)	200 (66.2%) ^{d,e}		
1–5 visits	38 (11.6%)	30 (13.7%)	46 (15.2%)		
6–10 visits	13 (4%)	13 (5.9%)	23 (7.6%)		
more than 10 visits	18 (5.5%)	13 (5.9%)	33 (10.9%) ^{d,e}		
n (%)					

Note: Contact rate for program completers was 94%.

^a small effect size;

^b medium effect size;

^c large effect size

^d different from no surgery matched comparison group;

^e different from non-fusion surgery group

Table 5

Logistic regression analyses for predicting one-year outcomes (N = 913)

Socioeconomic outcome	Predictor variables	B (SE)	OR	95% CI
Failure to return to work	Opioid dependence	0.76 (0.22)	2.13**	[1.37, 3.31]
	PRE-rehab BDI 20	0.54 (0.21)	1.72**	[1.14, 2.60]
	PRE-rehab surgery group			
	U group [†]			
	NF group	0.11 (0.28)	1.12	[0.64, 1.95]
	F group	0.22 (0.25)	1.24	[0.77, 2.01]
Failure to retain work	Opioid dependence	0.66 (0.21)	1.94**	[1.30, 2.90]
	PRE-rehab BDI 20	0.45 (0.19)	1.57*	[1.07, 2.30]
	PRE-rehab MVAS 85	0.65 (0.24)	1.92**	[1.21, 3.07]
	PRE-rehab surgery group			
	U group [†]			
	NF group	0.33 (0.25)	1.38	[0.84, 2.28]
Treatment seeking	F group	0.34 (0.22)	1.41	[0.91, 2.18]
	Opioid dependence	0.45 (0.19)	1.56*	[1.07, 2.28]
	Gender (female)	0.60 (0.18)	1.82**	[1.29, 2.59]
	PRE-rehab surgery group			
	U group [†]			
	NF group	0.14 (0.23)	1.15	[0.73, 1.82]
	F group	0.66 (0.20)	1.94**	[1.31, 2.87]

Note: The original regression models included the following covariates: gender, job demand, length of disability, type of injury, opioid dependence disorder, major depressive disorder, PRE-rehab BDI, and PRE-rehab pain intensity. The models reported in the Table include only significant predictors of the one-year outcomes.

*
p < .05,

**
p < .01,

[†]
reference category