

Clinical Outcomes After Posterolateral Lumbar Fusion in Workers' Compensation Patients

A Case-Control Study

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Study Design. Case-control propensity matched.

Objective. To compare clinical outcomes after lumbar fusion in patients receiving workers' compensation with a case-matched control group who are not on workers' compensation.

Summary of Background Data. Previous studies have demonstrated poor outcomes in patients receiving workers' compensation after lumbar fusion. However, a case-control study where patients are matched for covariates known to affect outcomes after lumbar fusion, including baseline clinical outcome measures, has not been done.

Methods. From 783 patients who underwent posterolateral fusion with complete preoperative and 2-year postoperative outcome measures, 60 patients who were receiving workers' compensation were identified. Outcome measures included the Oswestry Disability Index (ODI), Short Form-36 (SF-36), and back and leg pain numerical rating scales. Propensity scoring technique was used to match these patients with a control group not receiving workers' compensation using sex, age, smoking status, body mass index, diagnosis, number of levels fused, preoperative ODI, SF-36 Physical Component Summary (PCS), SF-36 Mental Component Summary, and back and leg pain scores, producing 58 matched pairs.

Results. There were no significant differences between the demographics, job classification, and preoperative outcome scores in the two groups. At 2 years after operation, patients not receiving workers' compensation had a significantly greater improvement in ODI ($P = 0.009$) and SF-36 PCS ($P = 0.007$) compared with those receiving workers' compensation. Although patients not receiving workers' compensation had greater improvements in back and leg pain compared with those receiving workers' compensation, this did not reach statistical sign-

ificance ($P = 0.079$). The mean 2-year ODI, SF-36 PCS, and back pain raw scores of patients receiving workers' compensation were significantly lower than those not receiving workers' compensation. Only 19% of workers' compensation patients achieved minimum clinically important difference in terms of ODI compared with 36% of those not receiving workers' compensation ($P = 0.061$). Only 16% of workers' compensation patients achieved SF-36 PCS minimum clinically important difference compared with 40% of those not receiving workers' compensation ($P = 0.006$).

Conclusion. After controlling for covariates known to affect outcomes after lumbar fusion, patients on workers' compensation have significantly less improvement of clinical outcomes in both mean change in ODI and SF-36 PCS, as well as the number of patients achieving substantial clinical benefit. The improvement in back pain was similar between the two groups, but patients on workers' compensation remained more disabled after lumbar fusion. Differences in outcomes may be related to unidentified covariates associated with workers' compensation status.

Key words: workers' compensation, clinical outcomes, Oswestry Disability Index, SF-36, lumbar fusion. **Spine** 2010;35:1812–1817

More than one third of sedentary workers and nearly half of physical laborers report work-related low back pain.¹ The majority of these are acute episodes that resolve within 3 months of the injury.^{2–4} However, 5% to 10% develop chronic or recurrent back pain.^{5,6} Although only 16% of all workers' compensation claims were for low back pain, these claims accounted for 33% of all claim costs; of the low back pain cases, 25% accounted for 96% of the cost.⁷ Although the cost of medical care has increased, the cost of indemnity constitutes the greatest percentage of expenditure in workers' compensation cases.⁸ The influence of this financial compensation on recovery is one of the more controversial issues in the treatment of patients with low back pain.

There is substantial evidence suggesting inferior results of treatment in workers' compensation populations. Studies have shown worse outcomes in patients undergoing rehabilitation for low back pain^{9–15} and with lumbar disc surgery.^{16,17} Previous studies have also demonstrated poor outcomes in patients receiving workers' compensation after lumbar fusion.^{14,18–24} However, these studies were either retrospective case series or unmatched comparison groups; study designs that do not control for other factors known to affect clinical outcomes after lumbar fusion.

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Multiple factors have been shown to affect clinical outcomes with lumbar fusion surgery.^{14,25} Along with psychosocial factors,^{14,15,26–28} other contributing factors include smoking status,^{14,29,30} body mass index (BMI),^{31–33} and the diagnostic indication for fusion.^{34,35} To account for these factors, this study used a case-control propensity-matched study design to compare clinical outcomes after lumbar fusion in patients receiving workers' compensation with a case-matched control group with similar demographics and similar preoperative outcome scores who are not on workers' compensation.

■ Materials and Methods

In a database of 1064 patients from a single specialty spine clinic who underwent posterolateral fusion from February 2002 to November 2006, 783 (73.6%) had complete preoperative and 2-year postoperative outcome measures. Of these, 60 patients who were receiving workers' compensation before surgery were identified. The outcome measures collected during clinic visits included the Oswestry Disability Index (ODI), the Medical Outcomes Study Short Form-36 (SF-36), and numerical rating scales for back and leg pains. The propensity scoring technique^{36,37} was used to match these 60 workers' compensation patients to a control group not receiving workers' compensation. Propensity scoring is a logistic regression technique,^{36,37} which allows simultaneous matching for multiple characteristics to produce two similar comparison groups. Data collected before surgery, including sex, age, smoking status, BMI, indication for fusion, number of levels fused, preoperative ODI, preoperative SF-36 Physical Component Summary (PCS), preoperative SF-36 Mental Component Summary (MCS), and preoperative back and leg pain scores were used to match workers' compensation patients with controls, producing 58 matched pairs.

Presurgical distress^{13,25–28} and other nonorganic factors^{38,39} have been associated with poor outcomes after treatment for lumbar spine disorders. In this study, the SF-36 MCS and SF-36 PCS were included in the analysis instead of standardized measures for mental distress because these two SF-36 domains provide similar information⁴⁰ and are readily available. The MCS measures a patient's mental health, and the PCS measures the burden of the disease on the patient's quality of life.⁴¹ Aside from these psychosocial factors, physical factors, such as BMI^{31–33} and smoking status,^{14,29,30} were included in the analysis because these have also been shown to be predictive of outcomes after lumbar fusion surgery. Data on job status and classification were collected but not included in the matching because they have not been shown to correlate with outcomes.^{42,43}

Outcome Measures

Oswestry Disability Index. The ODI⁴⁴ is a self-administered survey measuring "back-specific function" on a 10-item scale, with 6 response categories each. Each item scores from 0 to 5, higher scores being worse, which is transformed into a 0 to 100 scale. The 10 items include pain intensity, personal care, lifting, walking, sitting, standing, sleeping, work, social life, and traveling. Patients with scores between 0 and 20 have minimal disability, between 21 and 40 have moderate disability, 41 and 60 have severe disability, 61 and 80 are crippled, and 81 to 100 are bed-bound or exacerbating their symptoms.

SF-36. The SF-36 is a 36-item self-administered short-form health status survey developed in the Medical Outcomes Study, which evaluates physical function, social function, limitations in role because of physical health, limitation in role because of mental health, vitality, bodily pain, and general health. Two composite scores can be calculated: a PCS score and an MCS score. Using norm-based scoring, all domains scales have a mean of 50 and a standard deviation of 10 based on the general 1998 US population. Thus, scores <50 fall below the general population mean.⁴¹

Back Pain and Leg Pain Numerical Rating Scales. The Numerical Rating Scale are two items, 1 each for back pain and leg pain, on the survey that asks: "On a scale from 0 to 10, mark your level of back (leg) pain discomfort, with 0 being none and 10 being unbearable."⁴⁵ The minimum clinically important difference (MCID) is the number of points a patient's score has to change in order for the patient to reliably detect a noticeable difference. The MCID threshold for ODI is 12.8, for SF-36 it is 4.9, for back pain it is 1.2, and for leg pain it is 1.6.⁴⁶ A newer concept, the substantial clinical benefit (SCB), has been suggested by Glassman *et al*⁴⁷ as a more realistic target value, arguing that the MCID is a floor value rather than a true goal of treatment. The SCB is the number of points a patient's score has to change in order for the patient to report being much better. The SCB threshold for ODI is 18.8, for SF-36 it is 6.2, and for back and leg pain it is 2.5.

Statistical Analysis. Student's *t* test for independent groups was used to determine any significant differences between continuous demographic variables, preoperative clinical outcomes, and change in clinical outcomes at 2 years after surgery. χ^2 was used to compare categorical demographic variables between the two groups as well as the proportion of patients achieving the MCID and SCB for the different outcome measures in each group.

As a subanalysis, the two study groups were compared with the 665 patients in the database who were not propensity-matched. One-way analysis of variance with Bonferroni *post hoc* comparison was used to determine any significant differences between continuous variables, and χ^2 was used to compare categorical variables. A second subgroup analysis, removing patients who had revision lumbar fusion surgery from the primary analysis was also done. All *P*-values were 2-sided with *P* < 0.05 considered significant. All statistical analyses were carried out using SPSS version 17.0 (SPSS Inc., Chicago, IL).

■ Results

There were no significant differences between the demographics, length of symptoms, and preoperative outcome scores in the two groups (Table 1). Although there was a greater proportion of patients working at desk jobs in the nonworkers' compensation group and a greater proportion of heavy laborers in the workers' compensation group, the difference was not statistically significant. Twenty-six (45%) patients in the nonworkers' compensation group compared with 11 (19%) in the workers' compensation group were working at baseline (*P* = 0.005). None of the patients in the control group applied for or received workers' compensation during the 2-year follow-up period. At 2 years after surgery, nonworkers' compensation patients had a significantly greater im-

Table 1. Summary of Patient Demographics and Preoperative Outcome Scores

Variable	Nonworkers' Compensation, Mean (SD)	Workers' Compensation, Mean (SD)	P
Age	47.8 (9.4)	47.9 (9.4)	0.937
BMI	29.0 (5.5)	29.7 (6.7)	0.517
M:F	34:24	32:26	0.137
Smokers (%)	24.1	22.4	0.826
Length of symptoms (mo)	52.8 (46.3)	43.0 (4.6)	0.283
Job description			
No physical labor (desk job)	12	4	
Minimal physical labor (lift ≤30 lb)	17	12	
Moderate physical labor (lift 30–50 lb)	10	13	
Heavy physical labor (lift ≥50 lb)	16	29	0.0779
On disability	3*	58	<0.001
No. levels			
1	31	32	
2	21	21	
3	6	5	0.897
Indication for fusion			
Spondylolisthesis	9	9	
Instability	4	4	
Stenosis	5	5	
Disc pathology	11	11	
Postdiscectomy instability	15	15	
Adjacent level degeneration	8	8	
Nonunion	6	6	1.000
Preoperative outcome scores			
Back pain	8.2 (1.6)	8.2 (1.6)	0.908
Leg pain	7.6 (2.2)	7.7 (1.8)	0.866
Oswestry Disability Index	58.3 (12.7)	59.3 (11.8)	0.667
SF-36 PCS	27.4 (5.5)	27.3 (5.2)	0.873
SF-36 MCS	29.9 (10.9)	30.5 (12.3)	0.801

*Disabled not because of back problem.
SD indicates standard deviation; PCS, physical component summary; MCS, mental component summary.

provement in ODI and SF-36 PCS scores compared with those receiving workers' compensation (Table 2). In both groups, 3 patients had a subsequent revision for a nonunion within the follow-up period.

MCID and SCB Threshold Analysis

Only 11 (19%) of the 58 patients receiving workers' compensation achieved MCID for ODI (ODI ≥12.8)

Table 2. Mean Change in Outcome Score

Clinical Outcome	Nonworkers' Compensation, Mean (SD)	Workers' Compensation, Mean (SD)	P*
Back pain	2.5 (2.7)	1.7 (3.1)	0.073
Leg pain	2.2 (3.0)	1.2 (2.8)	0.079
Oswestry Disability Index	13.3 (17.1)	4.9 (14.1)	0.009
SF-36 PCS	3.9 (8.9)	-1.3 (9.7)	0.007
SF-36 MCS	6.1 (11.3)	6.7 (12.6)	0.770

*P-value is from the paired t test.
SD indicates standard deviation; PCS, physical component summary; MCS, mental component summary.

Table 3. Proportion of Patients Achieving Minimum Clinically Important Difference and Substantial Clinical Benefit Thresholds for the Different Outcome Measures

	Nonworkers' Compensation	Workers' Compensation	Unmatched Cohort
Minimum clinically important difference thresholds			
ODI ≥12.8	21 (36%)	11 (19%)	342 (51%)
PCS ≥4.9	23 (40%)	9 (16%)	326 (49%)
BP ≥1	43 (74%)	31 (53%)	516 (78%)
LP ≥2	27 (47%)	16 (28%)	379 (57%)
Substantial clinical benefit thresholds			
ODI ≥18.8	19 (33%)	5 (9%)	252 (38%)
PCS ≥6.2	21 (36%)	7 (12%)	294 (44%)
BP ≥3	24 (41%)	13 (22%)	308 (46%)
LP ≥3	22 (38%)	10 (17%)	292 (44%)

ODI indicates oswestry disability index; PCS, physical component summary; BP, back pain; LP, leg pain.

compared with 21 (36%) of 58 nonworkers' compensation patients ($P = 0.061$; Table 3). Only 5 (9%) of 58 workers' compensation patients achieved SCB for ODI (ODI ≥18.8) compared with 19 (33%) of 58 of those not receiving workers' compensation ($P = 0.002$). Similarly, 9 (16%) of 58 patients receiving workers' compensation achieved MCID for SF-36 PCS (PCS ≥4.9) compared with 23 (40%) of 58 of those not receiving workers' compensation ($P = 0.006$). Only 7 (12%) of 58 patients receiving workers' compensation achieved SCB for SF-36 PCS (PCS ≥6.2) compared with 21 (36%) of 58 of those not receiving workers' compensation ($P = 0.004$).

Subgroup Analyses

Excluded Cases. There were 665 patients not selected by propensity modeling for the primary analysis. Compared with the 2 study cohorts, unmatched patients were older (57.3 ± 13.6 years, $P = 0.000$), with a greater proportion of women (63%, $P = 0.008$) and similar mean BMI (30.0 ± 7.3 , $P = 0.519$). Although this group had less smokers (15%), this was not statistically significant ($P = 0.080$). The indications for fusion were similar among the unmatched controls and the matched cohorts ($P = 0.143$). Analysis of variance with Bonferroni *post hoc* comparison showed that unmatched patients had significantly better SF-36 MCS (38.0 ± 13.7 , $P = 0.000$) and ODI scores (52.5 ± 14.0 , $P = 0.000$), but similar SF-36 PCS (27.7 ± 6.7 , $P = 0.057$) back pain scores (7.7 ± 2.0 , $P = 0.049$) and leg pain scores (7.4 ± 2.3 , $P = 0.619$) compared with the two study cohorts. At 2-years after operation, unmatched patients had greater improvements in ODI (15.0 ± 18.1 , $P = 1.000$), SF-36 PCS (5.5 ± 1.1 , $P = 0.836$), and back (2.7 ± 2.9 , $P = 1.00$) and leg (2.4 ± 3.3 , $P = 1.000$) pain compared with those not receiving workers' compensation, although this difference did not reach statistical significance. In comparison, the workers' compensation group had statistically

Table 4. Summary of Preoperative Outcome Scores and Change in Outcome Scores With Revision Patients Removed (N = 52)

Variable	Nonworkers' Compensation, Mean (SD)	Workers' Compensation, Mean (SD)	P
Preoperative outcome scores			
Back pain	8.1 (1.7)	8.2 (1.5)	0.662
Leg pain	7.5 (2.3)	7.6 (1.8)	0.850
Oswestry Disability Index	58.6 (12.7)	60.0 (11.9)	0.569
SF-36 PCS	27.6 (5.7)	27.7 (5.0)	0.941
SF-36 MCS	29.4 (10.3)	29.4 (11.8)	0.996
Change in outcome score			
Back pain	2.3 (2.5)	1.6 (2.2)	0.125
Leg pain	2.2 (3.0)	1.3 (2.4)	0.129
Oswestry Disability Index	13.5 (6.9)	6.9 (14.5)	0.034
SF-36 PCS	4.0 (8.5)	0.9 (7.5)	0.044
SF-36 MCS	6.6 (11.4)	7.4 (12.7)	0.738

SD indicates standard deviation; PCS, physical component summary; MCS, mental component summary.

smaller improvements in ODI ($P = 0.000$), SF-36 PCS ($P = 0.000$), and back ($P = 0.041$) and leg ($P = 0.026$) pain. The proportion of patients achieving MCID and SCB for all outcome measures at 2 years was also greater in the unmatched cases compared with patients not on workers' compensation, but this was not statistically significant. The workers' compensation group had a statistically smaller proportion of patients achieving MCID and SCB for ODI ($P = 0.000$), SF-36 PCS ($P = 0.000$), and back ($P = 0.002$) and leg ($P = 0.026$) pain (Table 3).

Primary Cases Only. Subgroup analysis with the patients having revision surgeries removed showed that the results are similar to the analysis carried out for the entire cohort (Table 4). At 2 years, nonworkers' compensation patients had a significantly greater improvement in ODI and SF-36 PCS scores compared with those receiving workers' compensation.

Discussion

Lumbar fusion is a widely used treatment for patients with low back pain who have been unresponsive to less-invasive nonsurgical methods. Because reported results with lumbar fusion have been highly variable,^{34,48} substantial effort has been devoted to identifying predictors of clinical outcome. Although an array of psychosocial factors have been shown to affect clinical outcome after lumbar fusion,^{14,15,17,18,26-28} the role of workers' compensation status continues to be controversial.^{9-13,16-24}

Although a randomized design can compare surgery with nonsurgical treatment for patients receiving workers' compensation, a randomized design cannot be performed to study the effect of workers' compensation on clinical outcomes. This study matched patients on workers' compensation with a control group not on workers' compensation using the propensity matching technique. This produced two comparable patient groups as far as demographics, but more importantly with similar degrees of low back disability as reflected by the ODI, sim-

ilar levels of disease burden as indicated by the SF-36 PCS, similar amounts of mental distress as revealed by the SF-36 MCS, and similar diagnostic indications for fusion.

Although the inferior outcomes associated with workers' compensation status is likely multifactorial, the results of this study highlight at least two distinct issues. First, the demographic and baseline health-related quality of life (HRQOL) profile of the patient on workers' compensation differs from the overall population of nonworkers' compensation patients. This is demonstrated by the fact that both the workers' compensation group and the propensity score-matched control group had poorer HRQOL measures compared with the unmatched patients at baseline. This finding is similar to previous studies that have shown that workers' compensation status diminishes SF-36 scores.^{49,50}

Second, our results show that patient's not on workers' compensation, despite starting out with similar baseline HRQOL measures as those on workers' compensation, may achieve improvements in clinical outcomes similar to the unmatched patients who have better baseline HRQOL measures. The mean SF-36 PCS change in both the nonworkers' compensation patients and the unmatched cases is similar to that previously reported after lumbar fusion surgery.^{34,48} Those on workers' compensation showed a mean deterioration, despite starting out with similar SF-36 PCS scores to the nonworkers' compensation patients. Both the workers' compensation and matched control groups were severely disabled based on the ODI at baseline, yet the nonworkers' compensation patients had almost a threefold greater improvement in ODI compared with those on workers' compensation. The magnitude of ODI improvement in the control group approached the values observed in the unmatched cases, as well as to those reported in the literature.^{34,48}

The mean change in back pain was not statistically significantly different between the two groups, but patients on workers' compensation remained more disabled after lumbar fusion. The proportion of nonworkers' compensation patients achieving MCID for ODI, SF-36 PCS, and back or leg pain was similar. Only half of the patients on workers' compensation who achieved MCID for back pain also achieved MCID for ODI or SF-36 PCS. This finding implies that back pain and disability are not synonymous.

There are limitations to this study. Although the HRQOL outcome measures were collected prospectively, the study design was retrospective. Also, patients were seen at a tertiary spine center, raising the possibility that patient characteristics may differ from workers' compensation patients seen in other practice settings and may have more complex spinal pathology. Intuitively, a greater percentage of revision cases in the study cohort might predispose to poorer outcomes; however, a subanalysis limited to the primary cases did not affect the results. Although evaluating patient outcomes based on the indication for fusion would have been desirable,

small numbers in the different subgroups of indications for fusion precludes a meaningful subgroup analysis. Finally, despite a large pool of fusion cases, there was a relatively small number of workers' compensation cases. This may be due to selection bias, in that surgeons may be more hesitant to perform surgery on patients receiving workers' compensation. Given the small percentage of workers' compensation patients undergoing fusion at our center, limiting surgery among these patients is unlikely to change the outcomes of the general population of patients undergoing fusion surgery.

In summary, after controlling for several covariates known to affect lumbar fusion outcome, producing matched groups with similar demographics, diagnoses, and low back disability, the patients on workers' compensation have significantly less improvement after surgery. This was reflected in both mean change in outcome score and a lower percentage of patients reaching MCID and SCB thresholds for ODI and SF-36 PCS. This holds true even when revision cases were excluded from the analysis. Surgeons should be cautious in discussing the effectiveness of lumbar fusion for patients on workers' compensation and more so in patients with poor preoperative HRQOL scores. Additional studies are needed to identify psychosocial, health system, and medical claims barriers that hamper the improvement of clinical outcomes in patients receiving workers' compensation after lumbar fusion surgery.

■ Key Points

- To compare the clinical outcomes after lumbar fusion, propensity scoring technique was used to match patients receiving workers' compensation with a control group not receiving workers' compensation using sex, age, smoking status, BMI, diagnosis, number of levels fused, preoperative ODI, SF-36 PCS, SF-36 MCS, and back and leg pain scores.
- At 2 years after operation, patients not receiving workers' compensation had a significantly greater improvement in ODI and SF-36 PCS scores compared with those receiving workers' compensation.
- A lower percentage of workers' compensation patients reached the minimum clinically important difference and substantial clinical benefit thresholds for ODI and SF-36 PCS compared with nonworkers' compensation patients.
- The mean change in back pain was not statistically significantly different between the 2 groups, but patients on workers' compensation remained more disabled after lumbar fusion.

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