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Long-Term Disability and Return to Work Among Patients Who Have a Herniated Lumbar Disc: The Effect of Disability Compensation*

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Abstract

Background: Low-back problems are one of the most frequent reasons for disability compensation claims by workers. However, the effect of Workers' Compensation status on the long-term outcome for workers with sciatica has not been studied in detail, to our knowledge. Therefore, we believe that it is important to describe the long-term outcomes for patients who have herniation of a lumbar disc and sciatica according to the Workers' Compensation status at the time of the preoperative consultation.

Methods: We conducted a prospective, observational study of patients who had sciatica and were seeking care from specialist physicians in community-based practices throughout Maine. Among 440 eligible patients, 199 were receiving Workers' Compensation at the time of entry into the study (baseline) and 241 were not. Three hundred and twenty-six patients (74 percent) completed questionnaires at the time of a four-year follow-up. The outcomes that we assessed included disability compensation and work status as well as relief from symptoms, functional status, and quality of life.

Results: Patients who were receiving Workers' Compensation at baseline were more likely to be young, male, and employed as laborers. They reported worse functional status; however, the clinical findings for these patients were similar to those for patients who were not receiving Workers' Compensation. Patients who had

been receiving Workers' Compensation at baseline were more likely to be receiving disability benefits at the time of the four-year follow-up compared with those who had not (27 percent of 133 compared with 7 percent of 189; $p < 0.001$); however, they were only slightly less likely to be working at the time of the four-year follow-up (80 percent of 133 compared with 87 percent of 190; $p = 0.09$). Operative management did not influence these comparisons, but it decreased symptoms and improved functional status. Patients who had been receiving Workers' Compensation at baseline also had significantly less relief from symptoms and improvement in quality of life than patients who had not been receiving Workers' Compensation (all $p < 0.001$). In multivariate models, Workers' Compensation status at baseline was an independent predictor of whether the patient would be receiving disability benefits after four years (odds ratio, 3.5; 95 percent confidence interval, 1.7 to 7.6) but was not an independent predictor of whether the patient would be working on a job for pay at the time of the four-year follow-up (odds ratio, 0.6; 95 percent confidence interval, 0.3 to 1.2).

Conclusions: Even after adjustment for the initial treatment of the sciatica and for other clinical factors, patients who had been receiving Workers' Compensation at baseline were more likely to be receiving disability benefits and were less likely to report relief from symptoms and improvement in quality of life at the time of the four-year follow-up than patients who had not been receiving Workers' Compensation at baseline. Nonetheless, most patients returned to work regardless of their initial disability status, and those who had been receiving Workers' Compensation at baseline were only slightly less likely to be working after four years. Whether or not they had been receiving Workers' Compensation at baseline, patients who had been managed with an operation reported greater relief from symptoms and improvement in functional status at the time of the four-year follow-up compared with patients who had been managed nonoperatively, even though the outcomes with regard to disability and work status in these two groups were comparable.

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Low-back problems are a common cause of absence from work and are one of the most frequent reasons for disability compensation claims by working individuals^{8,23}. The financial burden in terms of direct medical costs and lost productivity is immense; it was conservatively estimated at thirty-eight billion dollars in 1994¹². In working-age populations, sciatica due to a herniated lumbar disc is a common cause of low-back problems resulting in disability. To our knowledge, the effect of Workers' Compensation status on long-term outcomes, especially subsequent disability and employment status, has not been studied in detail for patients with sciatica.

Limitations of previous clinical studies of this topic include retrospective assessment of outcome, which is often reported by the treating physician rather than the patient, and a focus on global outcome measures. These global measures group together various combinations of factors, such as changes in symptoms, function, and work status and whether a second procedure was performed^{11,19}. Furthermore, longitudinal changes in work and compensation status, with the possibility of entering and leaving the workforce, have rarely been characterized⁶. Studies of the effect of workplace disability have commonly lacked details on clinical features and outcomes and have often been uncontrolled²⁸. Nonetheless, patients receiving disability compensation are widely reported to have worse outcomes from back pain^{14,16,29}.

The purpose of this study was to assess the influence of initial Workers' Compensation status on work-related outcomes from sciatica. We previously reported high rates of disability compensation after one year of follow-up among patients who had been receiving Workers' Compensation at the time of entry into the study³. In the present report, we describe the outcomes after four years of prospective follow-up of patients with sciatica who were recruited from orthopaedic, neurosurgical, and occupational medicine practices throughout Maine.

Materials and Methods

Details about the design, methods, and one-year outcomes of the study were previously published^{3,22}. In brief, the Maine Lumbar Spine Study is a prospective observational study of patients who have sciatica. The form of management was not prescribed by the study but, rather, was determined in a routine manner by the patient and the physician. Ninety-six percent (255) of 266 patients who chose operative management had open discectomies, with findings of herniation or a free disc fragment in 91 percent (238 of 261). Bed rest, back exercises, physical therapy, spinal manipulation, and narcotic analgesics were most frequently used for patients who elected nonoperative management³.

Study Population

Adult patients who had been diagnosed by their physicians as having sciatica due to a lumbar disc her-

niation were eligible for the study. Sciatica was defined as radiation of pain down the posterior aspect of the lower limb to a level distal to the knee. Exclusion criteria included a previous operation on the lumbar spine, cauda equina syndrome, developmental spinal deformity, vertebral fracture, a spinal infection or tumor, inflammatory spondylopathy, pregnancy, or a severe comorbid condition. The exclusion criteria were intended to restrict the study to patients for whom an operation would be an elective treatment option with acceptable risk. Five hundred and seven patients with sciatica were enrolled from 1990 to 1992. Enrollment was stratified according to initial disability compensation status (receiving or not receiving) and management (operative or nonoperative)²². There was deliberate oversampling of patients who were receiving Workers' Compensation to facilitate comparison with patients who were not receiving compensation. An overall sample size goal of 440 patients was based on a two-sided alpha of 0.05 and an 80 percent power, and all strata achieved at least 99 percent of the enrollment goal²².

Determination of Workers' Compensation Status at Baseline

Group Receiving Workers' Compensation

Workers' Compensation status at the time of enrollment in the study (baseline) was assessed from physician office records and the questionnaire that was initially completed by the patients. The responses of the patients and physicians with regard to the Workers' Compensation status were identical for 84.4 percent (428) of the 507 patients. For the seventy-nine patients for whom the responses differed or were missing, the final status was ascertained on the basis of a review of Maine Workers' Compensation Board records. The final compensation status differed from the patient's response for 6.9 percent (thirty-five) of the 507 patients, and it differed from the physician's response for 3.0 percent (fifteen). Workers' Compensation status could not be determined with certainty for three patients; these individuals were excluded. Overall, 199 patients were categorized as receiving Workers' Compensation at baseline.

Group Not Receiving Workers' Compensation

To create an appropriate comparison group, we restricted this analysis to patients who were not receiving Workers' Compensation at entry and were eligible to work. Specifically, we omitted sixty-four patients who reported that they were retired (thirty-one), had another disabling condition (three), were homemakers or students (sixteen), or did not report their employment status (fourteen). Excluding these sixty-four patients from the 305 patients who were not receiving Workers' Compensation at entry left 241 patients who reported that, in the four weeks before their enroll-

TABLE I
PATIENT AND JOB-RELATED CHARACTERISTICS AT THE BASELINE EVALUATION

Characteristics	Patients Receiving Workers' Comp. at Baseline*	Patients Not Receiving Workers' Comp. at Baseline*	P Value†
Patient-related			
No. of patients	199	241	
Age (mean/median) (yrs.)	38.7/37	41.2/40	0.01
Male gender	152 (76%)	147 (61%)	<0.001
Did not graduate from college	180 (90%)	136 (56%)	<0.001
Cigarette use	114 (57%)	87 (36%)	<0.001
Initially managed operatively	84 (42%)	150 (62%)	<0.001
Retained attorney	84 (42%)	12 (5%)	<0.001
Employed in previous 4 wks.	69 (35%)	193 (80%)	<0.001
Job-related‡			
No. of patients	69	191	
Type of work			<0.001
Professional or managerial	19 (28%)	92 (48%)	
Sales or service	13 (19%)	49 (26%)	
Laborer	35 (51%)	50 (26%)	
Work physically demanding§	29 (42%)	35 (18%)	<0.001
Work stressful§	14 (20%)	59 (31%)	0.12
Likes job§	51 (74%)	152 (80%)	0.40

*The data are expressed as the number of patients, with the percentage in parentheses, except as noted.

†The statistical analyses were performed with use of the Fisher exact test, except for the comparison of age, which was performed with the t test, and the comparison of type of work, which was performed with the chi-square test (two degrees of freedom).

‡These questions were asked only if the patient had reported working in the four weeks before the baseline assessment.

§The response was considered positive if the patient answered "quite a bit" or "extremely."

ment in the study, they were working or were unemployed because of low-back pain and pain in the lower limb.

Study Protocol

Eligible consenting patients were initially interviewed in person, by trained interviewers. Follow-up data were obtained by means of mailed questionnaires at three, six, twelve, twenty-four, thirty-six, and forty-eight months. Treating physicians completed a standard baseline questionnaire that included questions about history, physical and neurological findings, diagnostic procedures, and planned treatment. Baseline imaging studies (computed tomography, magnetic resonance imaging, or myelography) for 49.5 percent (251) of the original 507 patients were available for independent review³.

Baseline and Outcome Assessment

Demographic information and data regarding work history, employment status, job characteristics, previous problems related to the spine, findings of physical examination and imaging studies, symptoms, and functional status were collected at baseline. Employment status was determined with the question, "During the past four weeks, have you been employed on a job for pay?" In addition to questions that assessed disability status, patients were asked whether they had retained an attorney because of their current back problem. Sciatica was categorized according to the Quebec classifi-

cation system^{4,32}. The frequency (scored from 0 points [not at all] to 6 points [always]) of low-back pain, pain in the lower limb, weakness of the lower limb or foot, numbness of the lower limb, and pain in the lower limb after walking and the extent to which these symptoms were bothersome (scored from 0 points [not bothersome] to 6 points [extremely bothersome]) were assessed at baseline and at the follow-up intervals. An index of low-back pain ranging from 0 to 12 points was created by summing the scores for the answers to the questions on the frequency of low-back pain and the extent to which it bothered the patient. Indices of the frequency of sciatica and the extent to which it bothered the patient, each ranging from 0 to 24 points, were created by summing the answers to four questions related to the lower limb: pain in the lower limb; numbness or tingling in the lower limb, foot, or groin; weakness in the lower limb or foot; and pain in the back or lower limb while sitting²⁷. For all symptom scales, higher scores indicated more severe symptoms.

Functional status measures included the back-specific modified disability scale described by Roland and Morris^{27,30} and the generic Medical Outcomes Study Short Form thirty-six-item questionnaire (SF-36)³⁶. The scores on the modified scale described by Roland and Morris range from 0 to 23 points, reflecting a simple sum of items that are to be marked if present^{27,30}. Items include activities that are limited because of pain (for example, "I am not doing any of the jobs that I usually do around the house"). Three of the eight domains of

TABLE II
FEATURES OF THE BACK DISORDER AT THE BASELINE EVALUATION

Features	Patients Receiving Workers' Comp. at Baseline* (N = 199)	Patients Not Receiving Workers' Comp. at Baseline* (N = 241)	P Value†
History			
No previous episodes of back pain	96 (48%)	99 (41%)	0.15
Change of job due to back pain	25 (13%)	29 (12%)	0.88
Comorbid illnesses‡	42 (21%)	54 (22%)	0.82
Physical and imaging findings			
Positive straight-leg-raising test	118 (60%) of 198	152 (64%) of 238	0.37
Mean no. of abnormal physical findings§	1.2	1.3	0.31
Moderate or severe imaging findings#	62 (67%) of 92	100 (80%) of 125	0.04
Category-4 or 6 Quebec class ^{4,32}	75 (38%)	100 (43%) of 235	0.33
Symptoms			
Current episode lasting >6 mos.	75 (38%)	65 (27%) of 239	0.02
Unilateral pain in lower limb	140 (71%) of 198	197 (82%) of 239	0.004
Mean low-back-pain score (on scale of 0-12) (points)**	9.2	7.7	<0.001
Mean sciatica frequency score (on scale of 0-24) (points)**	15.5	15.3	0.72
Mean sciatica bothersome score (on scale of 0-24) (points)**	15.6	14.9	0.25
Functional status			
Mean modified score of Roland and Morris ^{27,30} (on scale of 0-23) (points)**	17.0	14.9	<0.001
Mean SF-36 score ³⁶ (on scale of 0-100) (points)††			
Physical function	31.2	43.3	<0.001
Mental health	57.6	65.9	<0.001
General health	71.4	77.1	0.002

*The data are expressed as the number of patients, with the percentage in parentheses, except as noted. Any denominator that differed from the n value is indicated. The denominators differed slightly because not all patients answered each question on the survey.

†The statistical analyses were performed with use of the Fisher exact test, except for the comparisons of the continuous variables, which were performed with the t test.

‡Any chronic pulmonary disease, heart disease, stroke, cancer, or diabetes, as reported by the patient.

§Each patient could have as many as three abnormal findings, including those unilateral strength, sensation, and reflexes.

#The imaging studies included any computerized tomography scan, magnetic resonance image, or myelogram available for independent review. A global rating, ranging from normal to severe, was assigned by a neuroradiologist who was blinded to the treatment group and clinical information.

**Higher scores indicated worse symptoms or function.

††Higher scores indicated better function.

health included in the SF-36³⁶ — physical function, general mental health, and perceptions of general health — were used in our study. Each domain is scored from 0 points (poor health) to 100 points (optimum health). While higher scores according to the SF-36 reflect better function, higher scores on the scale of Roland and Morris reflect worse function.

Disability compensation and work status were assessed at each follow-up interval, with the principal outcome being the responses at four years. Disability compensation was ascertained from the patient's response to the question, "Are you currently applying for or receiving any compensation for back problems or sciatica?" Work status was determined from the response to the question, "Since your last interview, have

you been employed on a job for pay?" Depending on the responses to these initial questions, detailed questions were asked about the kind of disability compensation that was being received or the reason why the patient was not working. When a patient was working, information was collected on whether it was his or her usual job and whether the work was full-time. Other outcome measures emphasized health-related quality of life as reported by the patient, including symptoms, functional status, and satisfaction^{3,27}. Low-back pain and pain in the lower limb were considered to be relieved if the patient reported that, within the previous week, the symptom occurred very rarely or not at all and was not bothersome (0 or 1 point on a scale of 0 to 6 points).

TABLE III
DISABILITY AND WORK STATUS AT THE TIME OF THE FOUR-YEAR FOLLOW-UP

Status at Four-Year Follow-up	Patients Receiving Workers' Comp. at Baseline* (N = 135)	Patients Not Receiving Workers' Comp. at Baseline* (N = 191)	P Value†
Receiving any type of disability comp.	36 (27%) of 133	13 (7%) of 189	<0.001
Workers' Compensation	22 (17%) of 133	4 (2%) of 189	
SSI or SSDI‡	12 (9%) of 133	4 (2%) of 189	
Private insurance	0 (0%) of 133	3 (2%) of 189	
Not reported	2 (2%) of 133	2 (1%) of 189	
Working on a job for pay	106 (80%) of 133	166 (87%) of 190	0.09
Working at usual job§	60 (67%) of 89	139 (98%) of 142	<0.001
Working full-time§	62 (70%) of 89	105 (75%) of 140	0.45
Not working on a job for pay	27 (20%) of 133	24 (13%) of 190	
Not working due to back pain	17 (13%) of 133	7 (4%) of 190	
Retired	3 (2%) of 133	9 (5%) of 190	
Other or not reported	7 (5%) of 133	8 (4%) of 190	

*The data are expressed as the number of patients with the percentage in parentheses. The denominators differed slightly from the n values because not all patients answered each question on the survey.

†The statistical analyses were performed with use of the Fisher exact test.

‡SSI = Supplemental Security Insurance, and SSDI = Social Security Disability Insurance.

§Includes patients who reported that they were working at the time of the three or four-year follow-up because not all patients were asked questions at the time of the four-year follow-up.

Analysis

Fisher's exact test for categorical variables or the t test for continuous variables was used to assess for differences among baseline and outcome variables. The Cochran-Mantel-Haenszel test or multiple linear regression was used to determine whether outcome variables differed according to the type of initial treatment. Independent predictors of disability compensation and work status at four years were examined with use of stepwise multiple logistic regression modeling. The models included initial Workers' Compensation status and treatment, either operative or nonoperative, and an interaction term for treatment and Workers' Compensation status. In addition, models examined other baseline variables that were associated with the outcome variable (at p values of 0.20 or less), including age, education, comorbid illnesses, the findings of physical examination, the duration of the current episode, the severity of pain in the back and lower limb, and back-specific and generic measures of functional status.

In addition to assessing disability and work outcomes at four years, we examined longitudinal changes in disability compensation and work status among 404 patients (92 percent) who had completed at least one follow-up survey over the four-year period. The Kaplan-Meier product-limit method was used to estimate the survival distributions for the time until the patient first reported that he or she was not receiving disability compensation and the time until the patient first returned to work²⁰. Because of the study design, these times were technically interval-censored. For example, if at the six-month follow-up interval a patient first reported that he or she had returned to work, then the actual event had

occurred between three months and six months from baseline. To accommodate the interval-censored structure of the data, accelerated failure time models, which are regression models for time-to-event data, were used to adjust for the effect of potential confounders²⁰. All statistical analyses were performed with use of a commercial software package (Statistical Analysis System; SAS Institute, Cary, North Carolina) on a UNIX workstation (Sun Microsystems, Mountain View, California).

Results

Patient Characteristics and Clinical Features at Baseline

One hundred and ninety-nine patients who were receiving Workers' Compensation and 241 patients who were not receiving it at baseline were evaluated (Table I). Patients who were receiving Workers' Compensation were generally more likely to be young, male, less educated, and smokers. They were less likely to be managed operatively than were those who were not receiving Workers' Compensation (42 compared with 62 percent; $p < 0.001$) and were more likely to have retained an attorney because of their current back problem. As expected, they were less likely to have worked in the four weeks before the baseline evaluation. Of the patients who reported recent employment, those who were receiving Workers' Compensation were more likely to be laborers who performed physically demanding work. Patients who were not receiving Workers' Compensation were more likely to be in professional or managerial positions. Stress caused by the job and satisfaction with the job were similar for patients who were receiving Workers' Compensation and those who were not.

TABLE IV
 FEATURES AT BASELINE THAT WERE INDEPENDENT PREDICTORS OF DISABILITY
 COMPENSATION STATUS AND WORK STATUS AT THE TIME OF THE FOUR-YEAR FOLLOW-UP

Baseline Features	Odds Ratio (95% Confidence Interval)	P Value
Patients receiving any disability compensation at four-year follow-up*		
Receiving Workers' Compensation	3.5 (1.7-7.6)	<0.001
Did not graduate from college	5.9 (1.9-26.0)	0.006
Current episode lasting >6 mos.	3.1 (1.6-6.1)	<0.001
Comorbid illnesses†	2.5 (1.2-5.4)	0.02
Patients working on a job for pay at four-year follow-up‡		
Receiving Workers' Compensation	0.6 (0.3-1.2)	0.13
Age, per 5-year increment	0.7 (0.6-0.8)	<0.001
SF-36 general health score ³⁶ (on a scale of 0-12), per 5-point increment	1.1 (1.0-1.2)	0.008
Low-back-pain score (on a scale of 0-12), per 2-point increment	0.8 (0.6-0.9)	0.008

*Adjusted for initial Workers' Compensation status, level of education, duration of current episode, and comorbid illnesses (c-statistic = 0.80).

†Any chronic pulmonary disease, heart disease, stroke, cancer, or diabetes, as reported by the patient.

‡Adjusted for initial Workers' Compensation status, age, SF-36 general health score³⁶, and low-back-pain score (c-statistic = 0.74).

The patients who were receiving Workers' Compensation and those who were not were similar with regard to a history of back problems and other comorbid illnesses (Table II). The physical examinations of patients in both groups revealed similar findings. Of the patients for whom advanced imaging studies were available for review, those who were receiving Workers' Compensation were less likely to have moderate or severe findings. However, the percentages of patients meeting the Quebec classification criteria consistent with definitive evidence of nerve-root irritation (category 4 or 6)^{4,32} were similar. While objective measures of the severity in the two groups were largely similar, there were significant differences in patient-reported symptoms and functional status. Patients who were receiving Workers' Compensation reported symptoms of a longer duration ($p = 0.02$) and more severe low-back pain ($p < 0.001$). The frequency of pain in the lower limb and the extent to which it bothered the patient were comparable between the two groups, but patients who were receiving Workers' Compensation were less likely to have unilateral pain in the lower limb than those who were not receiving Workers' Compensation ($p = 0.004$). Finally, back-specific and generic measures of functional status were all worse for patients who were receiving Workers' Compensation ($p \leq 0.002$).

Disability Compensation and Work Status at the Time of the Four-Year Follow-up

Disability Compensation

Four-year outcomes were known for 326 patients (74 percent): 135 (68 percent) of the 199 who initially had been receiving Workers' Compensation and 191 (79 percent) of the 241 who had not ($p = 0.009$). Twenty-seven percent (thirty-six) of the 133 patients who had been receiving Workers' Compensation at

baseline (and who answered the pertinent question on the survey) were receiving some form of disability compensation. Seventeen percent (twenty-two) were receiving Workers' Compensation, 9 percent (twelve) were receiving Supplemental Security Insurance (SSI) or Social Security Disability Insurance (SSDI), and 2 percent (two) did not report the type of compensation (Table III). In comparison, only 7 percent (thirteen) of the 189 patients who had not been receiving Workers' Compensation at baseline (and who answered the question on the survey) were receiving disability compensation at the time of the four-year follow-up ($p < 0.001$). This comparison of the proportions receiving disability compensation at the time of follow-up was not affected by the initial type of management of the patient. In the operatively managed group, 29 percent (sixteen) of the fifty-six patients who had been receiving Workers' Compensation at baseline and 4 percent (five) of the 118 who had not were receiving disability compensation at the time of follow-up ($p < 0.001$). In the non-operatively managed group, the corresponding values were 26 percent (twenty) of seventy-seven and 11 percent (eight) of seventy-one ($p = 0.03$).

At four years, the unadjusted relative odds of a patient receiving disability benefits if that patient had been receiving Workers' Compensation initially was 5.0 (95 percent confidence interval, 2.6 to 10.3) (derived from data in Table III). In multivariate models adjusting for possible confounders, this relative odds of receiving disability benefits at four years decreased to 3.5 (95 percent confidence interval, 1.7 to 7.6) (Table IV). In these models, other determinants of outcome included symptoms for more than six months, not having graduated from college, and any of a set of comorbid conditions. Each of these variables increased the odds of a patient receiving disability compensation two to

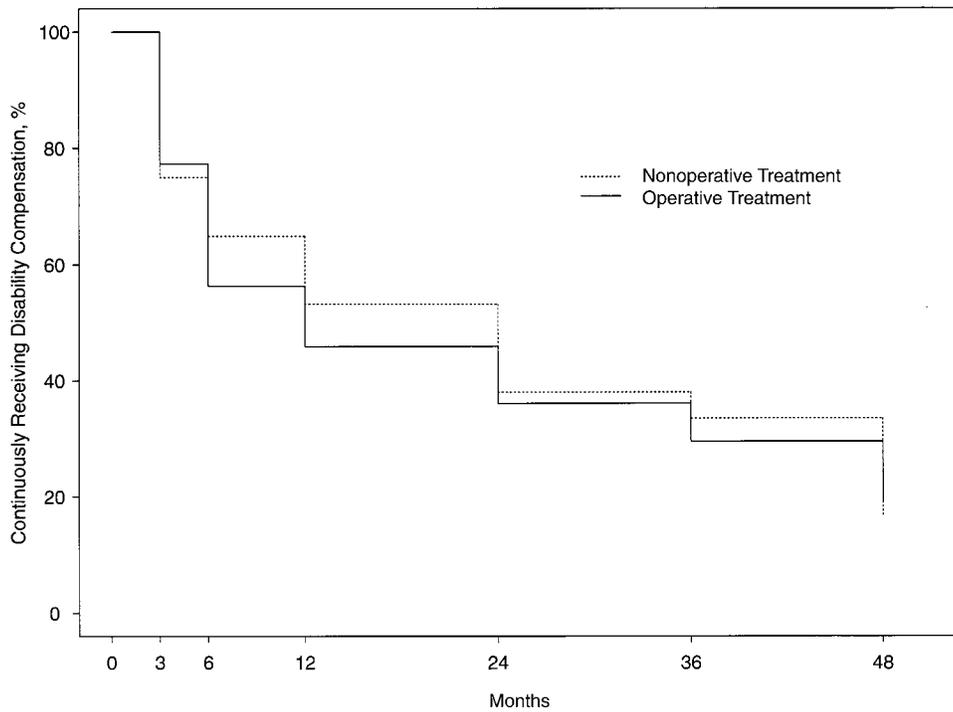


FIG. 1-A

Figs. 1-A and 1-B: Kaplan-Meier curves²⁰ showing disability outcomes over time, according to the initial type of treatment, for patients who had been receiving Workers' Compensation at baseline.

Fig. 1-A: Time to the first report by the patient that he or she had stopped receiving disability compensation.

sixfold. Whether the patient had retained an attorney at baseline was also examined in separate multivariate models because this variable is highly correlated with the application for Workers' Compensation (Pearson

correlation coefficient, 0.45; $p < 0.001$) (derived from data in Table I). In models including both variables, retaining an attorney was a predictor of receiving disability benefits at four years (odds ratio, 3.9; 95 percent

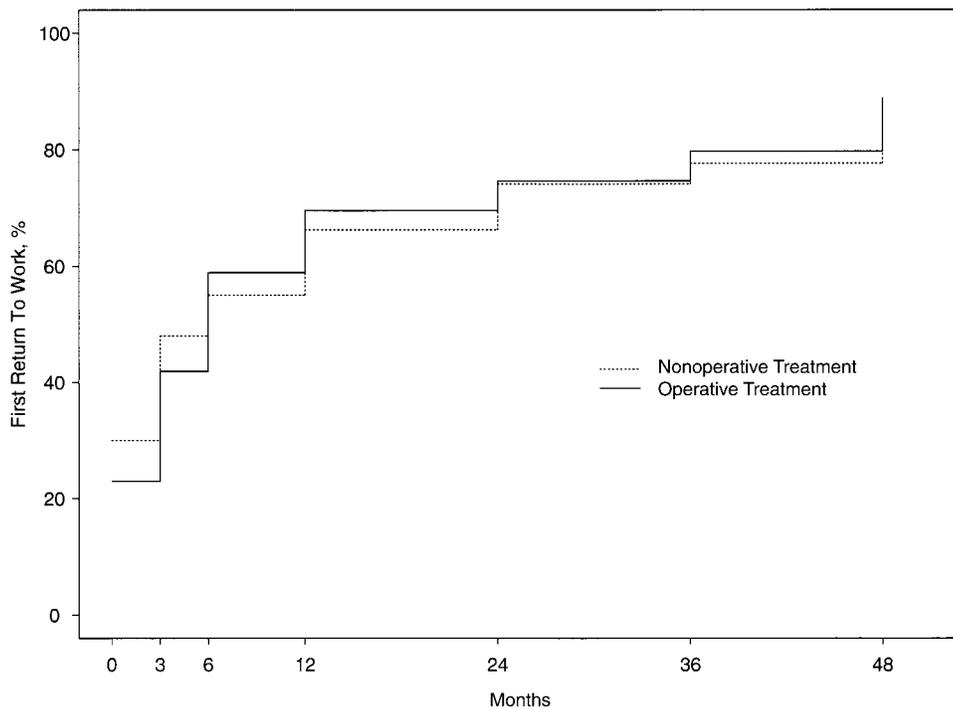


FIG. 1-B

Time to the first return to work.

TABLE V
SYMPTOM, FUNCTIONAL STATUS, AND SATISFACTION OUTCOMES AT THE TIME
OF THE FOUR-YEAR FOLLOW-UP ACCORDING TO THE TYPE OF TREATMENT

	Operative Treatment*		Nonoperative Treatment*		P Value
	Patients Receiving Workers' Comp. at Baseline (N = 56)	Patients Not Receiving Workers' Comp. at Baseline (N = 120)	Patients Receiving Workers' Comp. at Baseline (N = 79)	Patients Not Receiving Workers' Comp. at Baseline (N = 71)	
Relief from pain†					
Low-back	20 (36%)	81 (68%)	17 (22%)	36 (51%)	<0.001‡
Lower limb	26 (46%)	94 (78%)	29 (37%)	42 (59%)	<0.001‡
Mean change in modified score of Roland and Morris ^{27,30} between baseline and follow-up (points)	-9.3	-12.5	-4.8	-4.4	§
Quality of life at least moderately improved	35 (63%)	106 (89%) of 119	36 (47%) of 76	43 (67%) of 64	<0.001‡
Satisfied with current state of back symptoms	24 (43%)	85 (71%)	23 (30%) of 76	36 (51%)	<0.001‡

*The data are expressed as the number of patients, with the percentage in parentheses, except as noted. Any denominator that differed from the n value is indicated. The denominators differed slightly because not all patients answered each question on the survey.

†The pain was considered to be relieved if it was neither frequent (occurring "very rarely" or "not at all") nor bothersome (rated as 0 or 1 on a 0 to 6-point scale).

‡The statistical analysis, which compared patients who initially had been receiving Workers' Compensation with those who had not while controlling for operative or nonoperative treatment, was performed with use of the Cochran-Mantel-Haenszel test or multiple linear regression modeling.

§The statistical analysis, which compared patients who initially had been receiving Workers' Compensation with those who had not, stratified by operative ($p = 0.008$) or nonoperative ($p = 0.76$) treatment, was performed with use of t tests.

confidence interval, 1.8 to 8.3) independent of the effect of Workers' Compensation at baseline (odds ratios, 2.9; 95 percent confidence interval, 1.4 to 6.4).

Work Status

Most of the patients were employed at the time of the four-year follow-up, regardless of the Workers' Compensation status at baseline. However, a slightly, but insignificantly, smaller percentage of patients were working in the group that initially had been receiving Workers' Compensation than in the group that initially had not been receiving Workers' Compensation (80 percent [106 of 133] compared with 87 percent [166 of 190]; $p = 0.09$) (Table III). Of the patients who reported that they were working at the time of follow-up, those who had been receiving Workers' Compensation at baseline were less likely to have returned to their usual job than those who had not been receiving Workers' Compensation at baseline (67 percent [sixty of eighty-nine] compared with 98 percent [139 of 142]; $p < 0.001$), but they were as likely to be working full-time (70 percent [sixty-two of eighty-nine] compared with 75 percent [105 of 140]; $p = 0.45$). As with disability compensation outcomes, the comparison of the proportion of patients who were working at four years according to Workers' Compensation status at baseline was not affected by the type of initial management that the patient had received. In the operatively managed group, 82 percent (forty-five) of the fifty-five patients who had received Workers' Compensation and 88 percent (105) of the 120 who had not were employed

at the time of follow-up ($p = 0.36$). In the nonoperatively managed group, the corresponding values were 78 percent (sixty-one) of seventy-eight and 87 percent (sixty-one) of seventy ($p = 0.20$).

Multivariate analyses that examined initial Workers' Compensation status and other baseline variables revealed that the likelihood of a patient working at the time of the four-year follow-up was independently related to younger age, better perceptions of general health, and less severe low-back pain. In the final model with these independent covariates, receiving Workers' Compensation at baseline was not significantly associated with working at four years (odds ratio, 0.6; 95 percent confidence interval, 0.3 to 1.2; $p = 0.13$) (Table IV).

Longitudinal Changes in Disability Compensation and Work Status

Disability Compensation

Four hundred and four patients completed at least one follow-up survey: 88 percent (176) of the 199 patients who had been receiving Workers' Compensation at baseline and 95 percent (228) of the 241 who had not been receiving Workers' Compensation ($p = 0.02$). In the group that initially had been receiving Workers' Compensation, the cumulative probability (as determined by Kaplan-Meier analysis) of the patient first reporting that he or she no longer received disability compensation was 51 percent at one year, 63 percent at two years, and 68 percent at three years. Over the four-year follow-up period, 133 (76 percent) of the 176 patients reported that

they had stopped receiving disability compensation at least once. Among these patients, 101 (76 percent) reported that they were not receiving disability compensation at subsequent follow-up surveys.

Rates of disability compensation over time were not associated with the type of treatment (operative or nonoperative) for patients who initially had been receiving Workers' Compensation ($p = 0.70$) (Fig. 1-A). Even after adjusting for baseline predictors, including the level of education, the duration of the current episode, and comorbid conditions, the type of treatment was unrelated to the rate of disability compensation over time ($p = 0.87$). Of the 228 patients who had not been receiving Workers' Compensation at baseline, thirty-six (16 percent) reported that they had received disability compensation at some time during the study period. There were no differences with regard to this variable according to the initial type of treatment ($p = 0.57$).

Work Status

Kaplan-Meier analysis²⁰ demonstrated that, of 174 patients who initially had been receiving Workers' Compensation, 69 percent reported that they were working by one year; 74 percent, by two years; and 78 percent, by three years. Over the four-year follow-up period, 143 (82 percent) of the patients who initially had been receiving Workers' Compensation reported working at a job for pay at least once. Of these patients, eighty-five (59 percent) reported no subsequent periods during which they were not working. Of 351 patients who reported their work status on at least two occasions after the three-month follow-up interval, eighty-eight (59 percent) who initially had been receiving Workers' Compensation and 164 (81 percent) who had not been receiving Workers' Compensation at baseline reported stable long-term employment ($p < 0.001$).

Work status over time was not influenced by the type of treatment for the patients who initially had been receiving Workers' Compensation ($p = 0.74$) (Fig. 1-B). There was no significant difference in work status over time between patients who had been managed operatively and patients who had been managed nonoperatively, even after adjustment for baseline predictors that included age, severity of low-back pain, and general health status based on the SF-36 ($p = 0.91$). Of the patients who had not been receiving Workers' Compensation at baseline, 185 (81 percent) were working. Of these patients, forty-one (22 percent) reported that they had been unemployed at least once during the previous four years, and this variable did not differ according to the initial form of management ($p = 0.28$).

Other Outcomes at the Time of the Four-Year Follow-up

Patients who had been receiving Workers' Compensation at baseline had significantly less relief from symp-

toms and significantly less improvement in quality of life than those who had not been receiving Workers' Compensation at baseline (Table V). After adjustment for independent predictors of outcome in multivariate models, it was demonstrated that patients who had been receiving Workers' Compensation at baseline were less likely to report relief from low-back pain or pain in the lower limb and were less satisfied with their current state (odds ratio, 0.4 to 0.5; all $p \leq 0.05$). Even the eighty-seven patients who initially had been receiving Workers' Compensation but had then stopped receiving compensation and had returned to work by the time of the four-year follow-up had worse outcomes than the 159 patients who had not been receiving disability compensation at baseline or at the time of the four-year follow-up. For example, in an analysis of the patients who were not receiving disability compensation and were working at the time of the four-year follow-up, it was found that pain in the lower limb was relieved in 60 percent (fifty-two) of the eighty-seven patients who initially had been receiving Workers' Compensation compared with 79 percent (125) of the 159 patients who had not been receiving Workers' Compensation at baseline ($p = 0.01$ with use of the Cochran-Mantel-Haenszel test to control for the type of treatment).

While operative treatment was not associated with disability outcomes, patients who had been managed operatively, regardless of the initial Workers' Compensation status, fared much better, in terms of symptoms, functional status, and satisfaction, than those who had been managed nonoperatively (Table V). For example, pain in the lower limb was at least partially alleviated in 46 percent (twenty-six) of fifty-six operatively managed patients compared with 37 percent (twenty-nine) of seventy-nine nonoperatively managed patients who initially had been receiving Workers' Compensation. The corresponding values for the patients who had not been receiving Workers' Compensation were 78 percent (ninety-four) of 120 and 59 percent (forty-two) of seventy-one. Operative treatment remained a strong independent predictor of symptom, functional status, and satisfaction outcomes in multivariate models, increasing the likelihood of improvement three to four-fold (all $p < 0.001$).

Discussion

We assessed the effect of disability compensation status at baseline on long-term outcomes for patients with sciatica. While most patients who had been receiving Workers' Compensation at baseline eventually returned to work and stopped receiving disability compensation, their overall outcomes were significantly worse than those of the patients who had not been receiving Workers' Compensation at baseline. These differences could not be explained by baseline features or the type of treatment.

There were important differences in characteristics

between the patients who were receiving Workers' Compensation at baseline and those who were not. Patients who were receiving Workers' Compensation were more likely to be young, male, smokers, less educated, and involved in physically demanding jobs. Similar features have been observed among patients with other musculoskeletal disorders who were receiving Workers' Compensation^{16,21,29}. While those who were receiving Workers' Compensation were more likely to perform physical labor, we found no difference in reported stress caused by the job or satisfaction with the job. Objective findings from physical examination were similar whether or not patients were receiving Workers' Compensation. However, of the patients for whom imaging studies were available for independent review, those receiving Workers' Compensation were less likely to have moderate or severe findings. Additionally, patients who were receiving Workers' Compensation had symptoms that were less likely to be unilateral and more likely to be present for more than six months. Finally, while the severity of symptoms related to the sciatica was comparable between the two groups at the start of the study, patients who were receiving Workers' Compensation reported greater functional limitations. More detailed information on clinical and nonclinical factors¹⁰ might help to explain this discrepancy between the objective findings and the reported limitations in functional status. A patient's perception of pain and its functional effect may be influenced by his or her Workers' Compensation status¹⁵.

In the present report, longitudinal assessment of disability compensation and work status revealed that most patients who received Workers' Compensation eventually returned to work and no longer received any form of disability compensation. However, some patients reported that they continued to receive disability payments (approximately 50 percent at one year and 30 percent at three years) and were not working (approximately 30 percent at one year and 20 percent at three years) for long periods. Although some patients who initially returned to work were not able to maintain long-term employment, most (66 percent) remained working and were not receiving disability compensation at the time of the four-year follow-up.

The four-year outcomes for the patients who had been receiving Workers' Compensation at the baseline evaluation were worse than those for patients who had not been receiving Workers' Compensation at baseline. These outcomes included relief from symptoms, change in functional status, and satisfaction, which were all inferior for patients who initially had been receiving Workers' Compensation. Patients who had been receiving Workers' Compensation were more likely to be receiving some form of disability benefits after four years (27 percent compared with 7 percent for the patients who had not been receiving Workers' Compensation; $p < 0.001$), although they were only slightly less likely to be

working (80 percent compared with 87 percent; $p = 0.09$). These results persisted after adjusting for other potential predictors of long-term disability and work status.

While operative treatment was associated with significantly better relief from symptoms, functional status, and satisfaction, it had no significant effect on disability or work outcomes at the time of the four-year follow-up. We previously reported that operative treatment provided slight advantages in terms of disability and work outcomes at the time of a six-month follow-up⁵. However, these differences were small and were no longer significant by the time of a one-year follow-up³, and they remained insignificant through four years. In contrast, the greater relief from symptoms, improvement in functional status, and satisfaction that were associated with operative treatment were still significant at the time of the one-year follow-up and persisted through four years.

Despite the common belief that receiving disability benefits negatively influences outcomes, the evidence bearing on this issue has been contradictory^{9,13,14,16,24,26,29,31}. A variety of methodological issues may account for these conflicting results. First, different measures of outcome reported by patients or physicians (both blinded and unblinded) have been used in different studies. Second, not all investigators have controlled for differences in clinical features other than disability status. Third, studies often involve small numbers of patients and include a variety of different back disorders.

Many of these problems were overcome in our study with the prospective collection of detailed baseline and follow-up information on a large number of patients who had the same low-back disorder. Detailed baseline assessment included sociodemographic data; findings of physical examination; patient-reported symptoms, functional status, and disability; and work status. A range of outcome variables was assessed, including work and disability status as well as resolution of symptoms, functional status, and satisfaction. There were important differences between patients who initially had been receiving Workers' Compensation and those who had not. However, there was sufficient overlap in baseline features and a large enough sample size to permit statistical adjustment of differences in outcomes according to baseline characteristics.

Several important limitations of the study should be noted. While Workers' Compensation status was verified at the initial evaluation, the work status at baseline and the long-term disability and work outcomes were determined by unconfirmed reports from the patients. Second, more patients who initially had been receiving Workers' Compensation were lost to follow-up than those who had not, especially by the time of the four-year survey. The effect of this factor is not clear, although patients who did not complete all of the follow-up surveys may have had worse outcomes than those who did³. Finally, the nature of

Workers' Compensation law varies, and this may affect the ability to generalize our findings in Maine to other states and regions.

Disability due to low-back pain and sciatica is a major problem in terms of physical limitation and financial hardship for individuals and lost productivity and high costs of care for industry and society as a whole^{12,18}. Patients with disabling back pain who enter the Workers' Compensation system face an adversarial process that can, in the end, reward disability⁷. Because the diagnosis is not infallible and critically depends on patients' reports of symptoms, perceptions of pain and their functional effect can be skewed by the Workers' Compensation process.

The injured worker needs the physician to validate his or her symptoms to get financial support¹⁵. The important role of the patient's symptoms and their potential to lead the physician to the wrong diagnosis and to potentially ineffective treatments have led physicians to develop objective findings, such as the signs described by Waddell et al.³⁵, that can identify patients with inappropriate pain responses. Physicians may avoid operating on patients who are thought to view an operation as a way to validate their claim of a back injury. Thus, reluctance to offer certain forms of treatment to patients who are seeking Workers' Compensation is understandable³⁴. Indeed, our patients who initially had been receiving Workers' Compensation were less likely to be managed operatively even though the objective evidence of sciatica was similar to that for patients who had not been receiving Workers' Compensation².

Nevertheless, a physician's reluctance to operate on a patient with sciatica who is receiving Workers' Compensation must be tempered by the fact that the patient may benefit from an operation. Our findings that the type of treatment did not influence long-term disability

or work status do not imply that all patients who are receiving disability compensation should be managed nonoperatively. The better symptom and functional status outcomes for the operatively managed patients who initially had been receiving Workers' Compensation may justify operative management as long as patients and surgeons recognize that the goal of the management is to reduce symptoms and improve function but not necessarily to hasten the return to work.

Our observations highlight the challenges in caring for patients who have disabling back pain and sciatica. Physicians evaluating the need for an elective operation in patients with sciatica who are receiving Workers' Compensation need better methods to identify those who will benefit. Patients need to understand the likely effects of alternative forms of treatment on the symptoms, functional status, and disability status. Given the time constraints of office visits, providing patients with more detailed information about treatment outcomes may improve decisions for individual patients and result in better outcomes³³. Employers, insurers, and policymakers also need to understand that, while certain forms of treatment may not markedly reduce disability benefit claims, reductions in symptoms, improvement in functional status, and enhanced patient satisfaction remain important, valid outcomes. Changes in the Workers' Compensation system, such as creation of a less adversarial atmosphere for compensation claims⁷, more accommodating workplaces¹⁷, and efforts to better prepare individuals to return to physically demanding work²⁵, may encourage patients with resolving symptoms to return to work and to stop collecting disability compensation sooner. Finally, research that assesses both medical and work-based interventions is needed to better define their relative roles in efficient treatment strategies.

References

1. Andersson, G. B.; Brown, M. D.; Dvorak, J.; Herzog, R. J.; Kambin, P.; Malter, A.; McCulloch, J. A.; Saal, J. A.; Spratt, K. F.; and Weinstein, J. N.: Consensus summary of the diagnosis and treatment of lumbar disc herniation. *Spine*, 21(24S): S75-S78, 1996.
2. Atlas, S. J.; Singer, D. E.; Keller, R. B.; and Deyo, R. A.: Predictors of lumbar disc surgery in patients with sciatica. *Clin. Res.*, 41: 513A, 1993.
3. Atlas, S. J.; Deyo, R. A.; Keller, R. B.; Chapin, A. M.; Patrick, D. L.; Long, J. M.; and Singer, D. E.: The Maine Lumbar Spine Study, Part II. 1-year outcomes of surgical and nonsurgical management of sciatica. *Spine*, 21: 1777-1786, 1996.
4. Atlas, S. J.; Deyo, R. A.; Patrick, D. L.; Convery, K.; Keller, R. B.; and Singer, D. E.: The Quebec Task Force Classification for spinal disorders and the severity, treatment, and outcomes of sciatica and lumbar spinal stenosis. *Spine*, 21: 2885-2892, 1996.
5. Atlas, S. J.; Singer, D. E.; Keller, R. B.; Patrick, D. L.; and Deyo, R. A.: Application of outcomes research in occupational low back pain: the Maine Lumbar Spine Study. *Am. J. Indust. Med.*, 29: 584-589, 1996.
6. Baldwin, M. L.; Johnson, W. G.; and Butler, R. J.: The error of using returns-to-work to measure the outcomes of health care. *Am. J. Indust. Med.*, 29: 632-641, 1996.
7. Bigos, S. J.; Baker, R.; Lee, S.; and Vaegter, K.: Back injury compensation: overcoming an adversarial system. *J. Musculoskel. Med.*, 11(6): 17-24, 1994.
8. Bigos, S. J., and Battie, M. C.: The impact of spinal disorders in industry. In *The Adult Spine: Principles and Practice*, pp. 151-161. Edited by J. W. Frymoyer. Philadelphia, Lippincott-Raven, 1997.
9. Committee on Pain, Disability, and Chronic Illness Behavior: Rehabilitation approaches and issues in chronic pain. In *Pain and Disability: Clinical, Behavioral, and Public Policy Perspectives*, pp. 232-260. Edited by M. Osterweis, A. Kleinman, and D. Mechanic. Washington, D.C., Institute of Medicine, National Academy Press, 1987.
10. Deyo, R. A., and Diehl, A. K.: Psychosocial predictors of disability in patients with low back pain. *J. Rheumatol.*, 15: 1557-1564, 1988.
11. Deyo, R. A.; Andersson, G.; Bombardier, C.; Cherkin, D. C.; Keller, R. B.; Lee, C. K.; Liang, M. H.; Lipscomb, B.; Shekelle, P.; Spratt, K. F.; and Weinstein, J. N.: Outcome measures for studying patients with low back pain. *Spine*, 19(18S): S2032-S2036, 1994.

12. **Frymoyer, J. W., and Durett, C. L.:** The economics of spinal disorders. In *The Adult Spine: Principles and Practice*, pp. 143-150. Edited by J. W. Frymoyer. Philadelphia, Lippincott-Raven, 1997.
13. **Gallagher, R. M.; Williams, R. A.; Skelly, J.; Haugh, L. D.; Rauh, V.; Milhous, R.; and Frymoyer, J.:** Workers' Compensation and return-to-work in low back pain. *Pain*, 61: 299-307, 1995.
14. **Greenough, C. G., and Fraser, R. D.:** The effects of compensation on recovery from low-back injury. *Spine*, 14: 947-955, 1989.
15. **Hadler, N. M.:** The injured worker and the internist. *Ann. Intern. Med.*, 120: 163-164, 1994.
16. **Hadler, N. M.; Carey, T. S.; and Garrett, J.:** The influence of indemnification by Workers' Compensation insurance on recovery from acute backache. North Carolina Back Pain Project. *Spine*, 20: 2710-2715, 1995.
17. **Hadler, N. M.:** Back pain in the workplace. What you lift or how you lift matters far less than whether you lift or when [editorial]. *Spine*, 22: 935-940, 1997.
18. **Hadler, N. M.:** Workers with disabling back pain [editorial]. *New England J. Med.*, 337: 341-343, 1997.
19. **Hoffman, R. M.; Wheeler, K. J.; and Deyo, R. A.:** Surgery for herniated lumbar discs: a literature synthesis. *J. Gen. Intern. Med.*, 8: 487-496, 1993.
20. **Kalbfleisch, J. D., and Prentice, R. L.:** *The Statistical Analysis of Failure Time Data*. New York, John Wiley and Sons, 1980.
21. **Katz, J. N.; Punnett, L.; Simmons, B. P.; Fossel, A. H.; Mooney, N.; and Keller, R. B.:** Workers' Compensation recipients with carpal tunnel syndrome: the validity of self-reported health measures. *Am. J. Pub. Health*, 86: 52-56, 1996.
22. **Keller, R. B.; Atlas, S. J.; Singer, D. E.; Chapin, A. M.; Mooney, N. A.; Patrick, D. L.; and Deyo, R. A.:** The Maine Lumbar Spine Study, Part I. Background and concepts. *Spine*, 21: 1769-1776, 1996.
23. **Klein, B. P.; Jensen, R. C.; and Sanderson, L. M.:** Assessment of Workers' Compensation claims for back strains/sprains. *J. Occupat. Med.*, 26: 443-448, 1984.
24. **Lanes, T. C.; Gauron, E. F.; Spratt, K. F.; Wernimont, T.; Found, E. M.; and Weinstein, J. N.:** Long-term follow-up of patients with chronic back pain treated in a multidisciplinary rehabilitation program. *Spine*, 20: 801-806, 1995.
25. **Mayer, T. G.; Gatchel, R. J.; Mayer, H.; Kishino, N. D.; Keeley, J.; and Mooney, V.:** A prospective two-year study of functional restoration in industrial low back injury. An objective assessment procedure. *J. Am. Med. Assn.*, 258: 1763-1767, 1987.
26. **Melzack, R.; Katz, J.; and Jeans, M. E.:** The role of compensation in chronic pain: analysis using a new method of scoring the McGill Pain Questionnaire. *Pain*, 23: 101-112, 1985.
27. **Patrick, D. L.; Deyo, R. A.; Atlas, S. J.; Singer, D. E.; Chapin, A.; and Keller, R. B.:** Assessing health-related quality of life in patients with sciatica. *Spine*, 20: 1899-1909, 1995.
28. **Pransky, G., and Himmelstein, J.:** Outcomes research: implications for occupational health. *Am. J. Indust. Med.*, 29: 573-583, 1996.
29. **Rainville, J.; Sobel, J. B.; Hartigan, C.; and Wright, A.:** The effect of compensation involvement on the reporting of pain and disability by patients referred for rehabilitation of chronic low back pain. *Spine*, 22: 2016-2024, 1997.
30. **Roland, M., and Morris, R.:** A study of the natural history of back pain. Part I: development of a reliable and sensitive measure of disability in low-back pain. *Spine*, 8: 141-144, 1983.
31. **Sanderson, P. L.; Todd, B. D.; Holt, G. R.; and Getty, C. J.:** Compensation, work status, and disability in low back pain patients. *Spine*, 20: 554-556, 1995.
32. **Spitzer, W. O.; LeBlanc, F. E.; Dupuis, M.; Abenhaim, L.; Belanger, A. Y.; Bloch, R.; Bombardier, C.; Cruess, R. L.; Drouin, G.; Duval-Hesler, N.; LaFlamme, J.; Lamoureux, G.; Nachemson, A.; Pagé, J. J.; Rossignol, M.; Salmi, L. R.; Salois-Arsenault, S.; Suissa, S.; and Wood-Dauphineé, S.:** Scientific approach to the assessment and management of activity-related spinal disorders. A monograph for clinicians. Report of the Quebec Task Force on Spinal Disorders. *Spine*, 12(7S): S1-S59, 1987.
33. **Spunt, B. S.; Deyo, R. A.; Taylor, V. M.; Leek, K. M.; Goldberg, H. I.; and Mulley, A. G.:** An interactive videodisc program for low back pain patients. *Health Educat. Res.*, 11: 535-541, 1996.
34. **Vaccaro, A. R.; Ring, D.; Scuderi, G.; Cohen, D. S.; and Garfin, S. R.:** Predictors of outcome in patients with chronic back pain and low-grade spondylolisthesis. *Spine*, 22: 2030-2035, 1997.
35. **Waddell, G.; McCulloch, J. A.; Kummel, E.; and Venner, R. M.:** Nonorganic physical signs in low-back pain. *Spine*, 5: 117-125, 1980.
36. **Ware, J. E., Jr., and Sherbourne, C. D.:** The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med. Care*, 30: 473-483, 1992.