The incidence of compensated musculoskeletal disorders, such as neck and back pain, is on the rise in the United States.\(^1\) Neck pain is endemic in workers throughout the industrial world and is responsible for a significant burden of disability among workers every year.\(^2-5\) Without intervention, 60% to 80% of workers with a history of neck pain reported recurrence of pain 1 year later.\(^6\)

Typically, patients with neck pain are first managed with conservative treatments, which include nonsteroidal anti-inflammatory drugs and opioid pain medications, physical therapy, chiropractic manipulation, and epidural injections. The goals of conservative treatment are reduction of pain and improvement of...
function. When conservative management fails, patients are often referred for further evaluation, which may include surgical consultation.\(^7\) In the cervical spine, decompression and fusion provide a greater than 90% likelihood of relieving radicular symptoms and stabilizing or improving myelopathy.\(^8,9\) However, for patients with axial neck pain without radiculopathy, surgical intervention is not usually considered, except for those with severe pain that does not resolve with conservative management.\(^10\)

Average annual health care costs incurred by patients with chronic pain, excluding the cost of surgical procedures, range from $13,000 to $19,000.\(^11,12\) Frequent use of opioids in managing chronic pain has been a major strain on the US health care system. Evaluation of the direct costs of opioid use in the insured population showed that prescription drug claims for opioids constitute approximately 20% of all prescriptions.\(^13,14\) The use of opioids dramatically affects workers’ compensation populations, which are considered high-risk groups for work-related musculoskeletal disorders. Many studies suggest that the workers’ compensation population has poorer outcomes compared with the general population. Studies of patients with workers’ compensation claims show that opioid use is associated with catastrophic claim costs and prolonged disability in an already at-risk cohort.\(^16,19\) Medical costs can become tremendous, especially in patients receiving opioids and undergoing spinal surgery.\(^20\)

This study examined the effect of preoperative opioid use on functional and surgical outcomes, mainly return-to-work status, after single-level cervical fusion for degenerative disk disease (axial neck pain without radiculopathy) within a 3-year follow-up period after surgery for patients with workers’ compensation claims after a work-related injury.

### MATERIALS AND METHODS

#### Study Design

The authors collected data on cervical comorbidities in 21,139 subjects who filed claims with the Ohio Bureau of Workers’ Compensation between 1993 and 2011 after a work-related injury. From this population, 3170 patients were identified who underwent single-level cervical fusion surgery and had a minimum of 3 years of follow-up after surgery with Current Procedural Terminology (CPT) codes. Among patients who underwent single-level cervical fusion, 281 were identified who had documented cervical degenerative disk disease with International Classification of Diseases, Ninth Revision (ICD-9), codes (Table 1). Of these patients, those who received opioid prescriptions before surgery were identified. Two cohorts were constructed. The opioid group included 77 patients who had opioid prescriptions before surgery. The control group included 204 patients who underwent fusion with no previous opioid use. Figure 1 shows the patient selection flow diagram.

Patients were excluded if they had a history of smoking or use of prescription smoking deterrents, as identified by ICD-9 codes, or if they had follow-up of less than 3 years after surgery. Patients were excluded if they had index cervical surgery performed with a different technique, if they had multilevel cervical fusion, or if they had a history of major cervical surgery before the index fusion. In addition, patients were excluded if they had other cervical comorbidities or ICD-9 codes that may constitute an indication for cervical fusion (ie, radiculopathy, myelopathy, fracture, tumor).

Information was collected on several other independent variables, including age at index fusion, sex, days absent from work, and time from injury to surgery. In addition, patients who had any form of psychological evaluation, received psychotherapy, had litigation, or were awarded permanent disability benefits before surgery were identified.

#### Table 1

<table>
<thead>
<tr>
<th>Description</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degenerative disk disease(^a)</td>
<td></td>
</tr>
<tr>
<td>Cervical spondylolisthesis without myelopathy</td>
<td>721.0(^b)</td>
</tr>
<tr>
<td>Degeneration of cervical intervertebral disk</td>
<td>722.4(^b)</td>
</tr>
<tr>
<td>Fusion technique</td>
<td></td>
</tr>
<tr>
<td>Anterior cervical fusion: single level(^c)</td>
<td>22554(^d)</td>
</tr>
<tr>
<td>Posterior cervical fusion: single level(^c)</td>
<td>22600(^d)</td>
</tr>
<tr>
<td>Anterior cervical disectomy and fusion: single level(^c)</td>
<td>22551(^d)</td>
</tr>
<tr>
<td>Posterior cervical laminectomy</td>
<td>63045/63048(^d)</td>
</tr>
<tr>
<td>Posterior cervical laminotomy/foraminotomy</td>
<td>63020/63035(^d)</td>
</tr>
<tr>
<td>Posterior revision laminectomy</td>
<td>63040/63043(^d)</td>
</tr>
<tr>
<td>Posterior decompression</td>
<td>63001/63015(^d)</td>
</tr>
</tbody>
</table>

**Abbreviations:** CPT, Current Procedural Terminology; ICD-9, International Classification of Diseases, Ninth Revision.

\(^a\)Patients included in the study were subjects who had only the ICD-9 codes mentioned in this Table. All subjects who had codes for other cervical comorbidities were eliminated.

\(^b\)CPT codes for cervical fusion were used to identify the study population. The other CPT codes (including the cervical fusion codes) provided in this Table identify the surgical interventions that were performed within the follow-up period after surgery.

\(^c\)CPT code.
Patients were considered permanently disabled if they were awarded either partial or total permanent disability benefits. For each subject’s index fusion, the following information was obtained: fusion technique performed, the use of instrumentation at index fusion, and the use of an autograft or any other type of graft at index fusion.

Outcomes

**Primary.** The primary outcome measure was whether patients met specific return-to-work criteria. The criteria, outlined by Anderson et al.,\(^1\) were used as an indicator of positive surgical outcome. Successful return to work was defined as return to work and continuous at-work status for at least 6 months within 3 years after surgery.

**Secondary.** A number of secondary outcomes after surgery were measured, including return-to-work rates within the first year, days absent from work, new litigation, new permanent disability award, surgical complications (failed surgery [nonunion, pseudarthrosis], complex regional pain syndrome, dysphagia, vocal cord paralysis, and surgical site complications), and additional major cervical surgery within the 3-year follow-up period. Major cervical surgical procedures included fusion, laminectomy, laminotomy/foraminotomy, and decompression.

Analysis

To study the effect of preoperative opioid use on return-to-work status after single-level cervical fusion, multivariate logistic regression analysis was used. The dependent variable was whether the return-to-work criteria were met. The regression model included a number of independent variables, including use of opioids before surgery, age, sex, psychological evaluation, litigation within 3 years before surgery, permanent disability award, out-of-work status for more than 6 months, more than 2 years from injury to surgery, instrumentation, autograft type, and surgical approach at index fusion.

Chi-square tests were used to compare binary and categorical variables, and Student’s \( t \) tests were used to compare continuous variables in the 2 groups. Table 2 shows the presurgical characteristics of each cohort, and Table 3 shows intraoperative details. \( P<.05 \) was considered statistically significant. All analyses were performed with Statgraphics Centurion version XVI software (Statpoint Technologies, Inc, Warrenton, Virginia). The study was performed at University Hospitals Case Medical Center in Cleveland, Ohio. All data were collected from the Ohio Bureau of Workers’ Compensation database.

**RESULTS**

The authors identified 77 patients (27.4%) who received opioids before surgery. A total of 204 subjects (72.6%) were identified in the control group who did not receive opioids prior to surgery.

**Return-to-Work Status**

Within the 3-year follow-up period after surgery, 28 patients (36.4%) in the opioid group and 115 patients (56.4%) in the control group met the return-to-work criteria. Patients who used opioids were less likely than the control group to meet the return-to-work criteria (odds ratio [OR], 0.44; 95% confidence interval [CI], 0.26-0.76; \( P=.0028 \)).

The rate of return to work within the first year after fusion was 24.7% in the opioid group compared with 45.6% in the control group. Patients who used opioids were less likely than patients in the control group to return to work within the first year after surgery (OR, 0.39; 95% CI, 0.22-0.70; \( P=.0014 \)).

Among the population of patients who underwent single-level cervical fusion,
opioid use before surgery was a negative predictor of return-to-work status (OR, 0.46; 95% CI, 0.25-0.85; P=.01). Other presurgical factors that were significant negative predictors of return-to-work status were age older than 50 years at surgery (OR, 0.40; 95% CI, 0.20-0.78; P=.006), psychological evaluation (OR, 0.33; 95% CI, 0.11-0.99; P=.03), more than 2 years from injury to surgery (OR, 0.38; 95% CI, 0.21-0.67; P=.0006), and permanent disability award (OR, 0.33; 95% CI, 0.20-0.55; P=.01) (Table 4). With the regression model, a chi-square goodness of fit test determined that logistic function adequately fit the observed data and indicated that there was no reason to reject the adequacy of the fitted model at the 95% confidence level.

### Days Absent From Work

For patients who met the return-to-work criteria, those who used opioids were absent from work an average of 65 days more than the control patients (P=.12). Median number of days absent was also higher in the opioid group (185 days) compared with the control group (140 days) (Figure 2).

When all patients were considered, the average number of days absent from work was 255 days higher in the opioid group compared with the control group (P=.0001). The median number of days absent from work was also higher in the opioid group.

### Opioid Use

Average length of opioid use was 474 days (SD, ±668; median, 212 days). Patients received an average of 60.75 mg morphine-equivalents per day (SD, ±75.8; median, 41.6 mg morphine-equivalents per day).

Within the opioid group, patients who met the return-to-work criteria received an average of 72.15 mg morphine-equivalents per day before surgery compared with 54.23 mg morphine-
equivalents per day for patients who did not meet the return-to-work criteria ($P=0.30$). Average length of opioid use was 337 days for patients who met the return-to-work criteria compared with 552 days for patients who did not meet the return-to-work criteria ($P=0.17$).

**Discussion**

Despite the abundance of research on return to work, most studies simply use the return-to-work date as an indication of successful return to work. On the other hand, many studies report recurrence of sick leave for patients with occupational injuries after surgery. Thus, structured criteria to represent those who successfully return to work after surgery will provide a more reliable and accurate prediction of the interventions used for occupational injuries, especially in a workers’ compensation setting. The criteria used in this study were established by Anderson et al in a study of subjects with workers’ compensation claims who underwent lumbar fusion. Successful return to work was defined as continuous return-to-work status for at least 6 months within a 3-year follow-up period after surgery.

This study evaluated the effect of preoperative opioid use on functional and surgical outcomes, mainly return-to-work status after single-level cervical fusion for degenerative disk disease (axial neck pain without radiculopathy) for patients receiving benefits after work-related injuries. In addition to assessment of the effect on opioid use on return-to-work status, the study evaluated psychosocial, surgical, and population-specific factors that may have affected the outcomes of cervical fusion in patients with workers’ compensation claims who had cervical degenerative disk disease.

Subjects who received opioid prescriptions before surgery had worse return-to-work status compared with those who did not use opioids. Although only one-third of patients who received opioids before surgery maintained stable, continuous return-to-work status for more than 6 months within 3 years after surgery, more than half of those who did not use opioids successfully returned to work according to the same criteria. In addition, one-fourth of the opioid group had their first documented return-to-work date within 1 year after surgery compared with almost half of those with no opioid use.

In addition, patients with preoperative opioid use were absent from work for more than 8 months compared with those with no opioid use. In addition, those with opioid use had a higher rate of additional major cervical surgery within 3 years after the index cervical fusion. In addition, although there was no statistical significance, patients in the opioid group who successfully returned to work had

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**Table 4: Predictors of Return to Work**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative opioid use</td>
<td>0.46</td>
<td>0.25-0.85</td>
<td>.01</td>
</tr>
<tr>
<td>Age &gt;50 y at index fusion</td>
<td>0.40</td>
<td>0.20-0.78</td>
<td>.006</td>
</tr>
<tr>
<td>Male sex</td>
<td>1.09</td>
<td>0.64-1.86</td>
<td>.74</td>
</tr>
<tr>
<td>Absent from work &gt;6 mo before index fusion</td>
<td>0.78</td>
<td>0.46-1.33</td>
<td>.36</td>
</tr>
<tr>
<td>Psychological evaluation before index fusion</td>
<td>0.33</td>
<td>0.11-0.99</td>
<td>.03</td>
</tr>
<tr>
<td>Litigation &lt;3 y before index fusion</td>
<td>0.66</td>
<td>0.37-1.19</td>
<td>.16</td>
</tr>
<tr>
<td>Injury to surgery &gt;2 y</td>
<td>0.38</td>
<td>0.21-0.67</td>
<td>.0006</td>
</tr>
<tr>
<td>Awarded permanent disability before index fusion</td>
<td>0.33</td>
<td>0.20-0.55</td>
<td>.01</td>
</tr>
<tr>
<td>Instrumentation at index fusion</td>
<td>0.92</td>
<td>0.43-1.99</td>
<td>.84</td>
</tr>
<tr>
<td>Autograft at index fusion</td>
<td>1.05</td>
<td>0.57-1.95</td>
<td>.86</td>
</tr>
</tbody>
</table>

**Figure 2:** Days absent from work within 3-year follow-up after fusion. Abbreviations: CI, confidence interval; RTW, return to work.
that showed worse return-to-work status in patients who used opioids before surgery.

When these variables were compared between groups, no significant differences were found in age at surgery, sex, absence from work for more than 6 months before surgery, litigation, or awarded disability benefits. On the other hand, an interval of more than 2 years from injury to surgery and initial psychological diagnostic evaluation and subsequent psychotherapy were noted at significantly higher rates in the opioid cohort.

The higher rate of psychological evaluation for a minority of patients in both groups is an important factor that should be taken into consideration when managing patients with chronic diskogenic pain that does not respond to conservative measures, with surgical intervention as a possible final treatment. Patients who received psychological evaluation may be at risk for psychological distress, which may be an important contributor to higher preoperative opioid use, long-term disability, and worse functional outcomes after spinal surgery.35,36 Although most patients who were evaluated received psychotherapy, the sample size is too small to allow conclusions to be drawn about the effect of psychological evaluation, distress, and psychotherapy on postsurgical outcomes for the study population. Future studies are needed to assess whether preoperative psychological evaluation and cognitive-behavioral therapy in patients with work-related injuries improve functional outcomes after spine surgery.

**Limitations**

A limitation of this study is that it was based on administrative data in a retrospective design collected from the Ohio Bureau of Workers’ Compensation for patients who qualified for workers’ compensation benefits. Many studies claim that administrative data can be used with reasonable precision to study work injuries and outcomes. Wang et al.37 used

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**Table 5**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Opioid Group (n=77)</th>
<th>Control Group (n=204)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major cervical surgery after index fusiona</td>
<td>18 (23.4%)</td>
<td>16 (7.8%)</td>
<td>.0004</td>
</tr>
<tr>
<td>Surgical complication after index fusiona</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonunion/pseudarthrosis</td>
<td>2 (2.6%)</td>
<td>1 (0.5%)</td>
<td>.12</td>
</tr>
<tr>
<td>Complex regional pain syndrome</td>
<td>1 (1.3%)</td>
<td>0</td>
<td>.10</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>1 (1.3%)</td>
<td>3 (1.5%)</td>
<td>.91</td>
</tr>
<tr>
<td>Vocal cord paralysis</td>
<td>0</td>
<td>1 (0.5%)</td>
<td>.53</td>
</tr>
<tr>
<td>Surgical site complication</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>New litigation after index fusiona</td>
<td>12 (15.6%)</td>
<td>35 (17.2%)</td>
<td>.75</td>
</tr>
<tr>
<td>Newly awarded permanent disability after index fusiona</td>
<td>13 (16.9%)</td>
<td>22 (10.8%)</td>
<td>.16</td>
</tr>
</tbody>
</table>

*Abbreviation: N/A, not applicable.*

*aWithin 3 years after index fusion.*

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a shorter period of opioid use compared with those who did not return to work.

In a review of the SPORT trial by Radcliff et al.,28 patients who were treated with opioids for back pain had significantly worse baseline pain; however, at final follow-up, no long-term difference in outcome was associated with opioid use compared with the nonopioid group. In fact, opioid medications did not prevent a significant number of patients from undergoing spinal surgery, and opioids were not superior to other, nonopioid drugs.29 Similar studies of workers’ compensation populations showed that patients who received opioid prescriptions early after injury were 3 times more likely to undergo spinal surgery compared with the nonopioid group; the opioid group also had a higher risk of chronic opioid use.29-31

The quality of evidence to support the use of opioids in spinal pain is low. Opioids may provide greater short-term pain relief compared with placebo, but opioids seem to have little effect on improving long-term function, as was shown in the current study.32

Initiation of a trial of opioids for long-term management of chronic pain should be undertaken with caution because the use of opioids did not show any difference in pain and function compared with other conservative measures. Thus, the decision to include opioids in the treatment plan for neck pain should be approached with caution, particularly for workers’ compensation patients who may be considered for surgical intervention for their neck pain after all conservative measures fail.33,34

In the current study, compared with the control group, subjects with preoperative opioid use were more than 3 times more likely to undergo another major cervical surgery within the next 3 years after index fusion. This finding suggests that surgery may not be the best intervention for patients with cervical diskogenic neck pain who have workers’ compensation claims.

The regression model showed that, in addition to preoperative opioid use, disability, surgery more than 2 years after injury, age older than 50 years at surgery, and psychological evaluation before surgery were also negative predictors of return to work after surgery. Although these risk factors may indicate a more severe condition at baseline, they were all accounted for in the final regression model.
ICD-9-Clinical Modification and CPT codes to identify cervical spine procedures and indications for surgery, and they compared these findings with corresponding operative notes. They used an algorithm with high sensitivity and specificity for fusion (>95%). Oleinick and Zaidman found that, because of their size, statewide workers’ compensation administrative databases can have substantial use for the study of work injuries and correlated days absent from work.

**Conclusion**

Patients with workers’ compensation claims who had cervical degenerative disk disease (diskogenic neck pain without radiculopathy) and used opioids before single-level cervical fusion had significantly worse functional outcomes compared with the control group. Further studies are necessary to determine whether this relationship is generalizable to other orthopedic procedures and other workers’ compensation systems. Physicians must be attentive when considering opioid use to manage chronic musculoskeletal pain, especially when surgical intervention is planned.

**References**


3. Buitenhuis J, de Jong PJ, Jaspers JP, Groot W. Fusion (>95%). Oleinick and Zaidman found that, because of their size, statewide workers’ compensation administrative databases can have substantial use for the study of work injuries and correlated days absent from work.


