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# Spine surgery outcomes in a workers' compensation cohort

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## Abstract

**Introduction:** Lumbar spine surgery (fusion, disc replacement or decompression) is common, yet indications are unclear and outcomes, particularly in a workers' compensation setting, are not consistently favourable. This study aimed to determine the outcomes of spine surgery in an Australian workers' compensation cohort.
**Methods:** A retrospective review of prospectively collected data from WorkCover NSW and insurer agents was performed. Subjects were included if they had lumbar spine decompression, fusion or disc replacement procedures performed between 1 January 2004 and 31 December 2006 (inclusive). Main outcome measures were as follows: need for further lumbar spine surgery, return to work (RTW), return to pre-injury duties (PID) and need for ongoing physical treatment or prescription opioids. All outcomes were measured at 24 months post-surgery.
**Results:** A total of 476 patients had undergone lumbar spine surgery within the workers' compensation system. The revision surgery rate was 9.2%. The RTW rate and return to PID rate were 50.3% and 14.2%, respectively. The proportion of patients still undergoing treatment was 77.7%. The rates of RTW (or PID) and need for ongoing treatment were significantly worse in patients undergoing fusion and disc replacement, compared with patients undergoing decompressive procedures (laminectomy, discectomy).
**Discussion:** The findings do not support the use of lumbar spine fusion or disc replacement surgery as a method of achieving RTW and relief of pain in patients treated under workers' compensation.

## Introduction

Low back pain (LBP) is a common complaint in Australia and other developed countries. LBP (defined as any back pain between the costal margins and the gluteal folds from any cause) has a point prevalence of 15–30%, a 1-year prevalence of 50% and a lifetime prevalence of 60–80%.[1,2] It is particularly an issue in workers' compensation populations, where LBP accounts for a large portion of insurance claims and is responsible for a significant financial burden.[2,3]

Surgery is often used in the treatment of low back conditions, with surgical interventions largely divided into decompressive procedures and stabilization (fusion, arthrodesis) procedures. Recently, intervertebral total disc replacement (TDR) has also been used in place of fusion. The evidence for the use of spine fusion for low back conditions is often based on observational studies. A Cochrane review of spine fusion for LBP noted conflicting evidence from the few randomized controlled trials (RCTs) performed.[4] In one RCT of treatment for LBP, fusion surgery was noted to be superior to usual non-operative treatment.[5] However, in later trials comparing fusion to more active alternatives (a structured exercise-based rehabilitation programme or cognitive behavioural therapy), there was no significant advantage to surgical treatment.[6,7] For decompressive procedures, a Cochrane review noted that discectomy for radiculopathy was associated with more rapid relief of symptoms, but there was no significant difference in medium- to long-term results.[8]

Rates of uptake of surgery vary geographically, and there have been reports of increasing utilization rates for fusion surgery in the lumbar spine over the recent decades, particularly for degenerative conditions.[9–11] Surgery is commonly used to address low back conditions in workers' compensation populations, despite some evidence that surgical outcomes are inferior in these populations, compared with non-workers' compensation cohorts.[12–14] Recent publications have drawn attention to spine surgery outcomes in workers' compensation populations, indicating higher than expected revision rates and high rates of ongoing pain and disability. These reports, however, have not included Australian populations.[15,16]

In light of the increasing uptake of spine surgery for low back complaints, the debatable evidence of these forms of treatment over non-operative alternatives, reports of poor outcomes in workers' compensation populations and the lack of Australian outcome data, we aimed to report the outcomes of spine surgery for low back complaints (excluding acute fractures) in the workers' compensation population in our state (New South Wales (NSW), Australia). We also aimed to identify the predictors of worse outcomes.

## Materials and methods

Ethics approval was sought and granted by the University of New South Wales Human Research Ethics Committee. WorkCover NSW and the insurers were approached and agreed to provide the information necessary to complete the study. No financial support for the study was received by WorkCover NSW or the insurers. Postal costs incurred by WorkCover NSW were reimbursed by the research centre.

Subjects were identified using the WorkCover NSW database. WorkCover NSW is the government agency responsible for all workers' compensation-related activity in NSW, and insurance companies act as agents for WorkCover NSW and handle the insurance directly with employers.

WorkCover could not directly identify patients who had undergone spine surgery; therefore, search criteria were developed to identify this population. The search criteria to detect patients who had undergone spinal surgery for LBP were as follows:

- Bodily location of injury – upper or lower back, and
- Nature of primary injury – fracture of vertebral column, sprains and strains of joint and adjacent muscles or dorsopathies (disorders of the spinal vertebrae and intervertebral discs).

This was combined with at least one of the following criteria:

- Total medical treatment payments (surgeon, assistant, anaesthetist and outpatient physiotherapy fees) greater than $2000 in any one calendar month during the period January 2004–December 2006
- Total hospital payments (hospital, implants and inpatient physiotherapy fees) greater than $2000 in any one calendar month during the period January 2004–December 2006.

It was considered unlikely that spinal surgery would be performed with a total medical or hospital cost of less than $2000 in any month, and hence this minimum value was chosen. This allowed screening of fewer subjects than if no lower limit was placed on costs. Fracture of the vertebrae was included in the search criteria, as it was possible that in some cases injuries not involving fractures may have been reported as fractures. Any cases subsequently found to have involved acute fractures or dislocations of the spine were excluded. These were excluded as spinal fractures include a broad spectrum of injuries that have different indications for surgery than other conditions. Any subjects that underwent cervical or thoracic spine surgery were excluded as the focus of the study was lumbar surgery. Cases with grade 2 (or higher) spondylolisthesis were excluded because this diagnosis is currently an accepted indication for spine fusion surgery and is normally considered unlikely to be related to work conditions (outside of acute fractures or dislocations).

The primary outcomes were return to work (RTW) status, ongoing treatment (any form of physical therapy, or prescription opioids) and revision surgery, all measured at 24 months. RTW was classed as any work or pre-injury duties (PID). Revision surgery at 24 months was defined as any further lumbar surgery, including decompression, spinal fusion and TDR.

Data were extracted from electronic copies of correspondence (medical certificates, operation reports, consultation reports, medico-legal reports and allied health reports) and insurance data relating to payments and work status. Data gathered from the files included the primary outcomes and the type of surgery performed (decompression, spinal fusion or TDR); the level of surgery; surgeon specialty (orthopaedic surgery or neurosurgery); age; gender; insurer; and the indications for surgery.

Data were analysed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA) using chi-square analyses for categorical and dichotomous data, and Student's *t*-tests for continuous data. Significance was set at $P = 0.05$. Regression analyses for predictors of worse outcomes were performed in a backward stepwise manner beginning with all variables significant at $P = 0.25$ or less, and sequentially excluding variables with $P > 0.05$.

## Results

Files were reviewed between April 2010 and October 2010 at the insurance agencies' head offices.

The search revealed that the majority of the claims were evenly spread ($n > 100$) across the four major insurance agents (GIO, Allianz, QBE and CGU) and 13 patients were under Employers Mutual (EM). A total of 103 claims were redistributed from the larger agents to smaller agents during an administrative change in 2006 where claims were selected at random if they had a date of injury in the calendar years 1999–2003, inclusive. These were excluded as they were difficult to trace and were not considered a source of bias due to the random nature of selection.

Thirty patient files were missing; these were non-electronic files that had been moved offsite for storage and were not retrievable. Patients who had not undergone spine surgery were excluded. These patients had usually undergone surgery to another body region under separate claims (e.g. shoulder surgery) within the study period, which explains why they had satisfied the criteria for surgical costs.

The flowchart showing selection of the final cohort is given in Figure 1. Of the 476 subjects, the majority were male ($n = 366$, 77.1%). The mean and median age at time of surgery was 41 years; age varied between 18 and 68 years. Decompression was the most common type of surgery performed (72.8%), followed by fusion (19.4%) and TDR (7.6%), and there was a single case of TDR and spinal fusion together (0.2%). Surgery was performed most often at L5/S1 (46.7%), then at L4/L5 (32.2%), then on multiple levels (16.8%) and least often on other single levels (4.2%).

Neurosurgeons (54.2%) performed more operations than orthopaedic surgeons (45.8%). The average medical cost per patient was $36 531.87 and the average hospital cost per patient was $16 337.49. The average medical cost and hospital costs, respectively, per patient

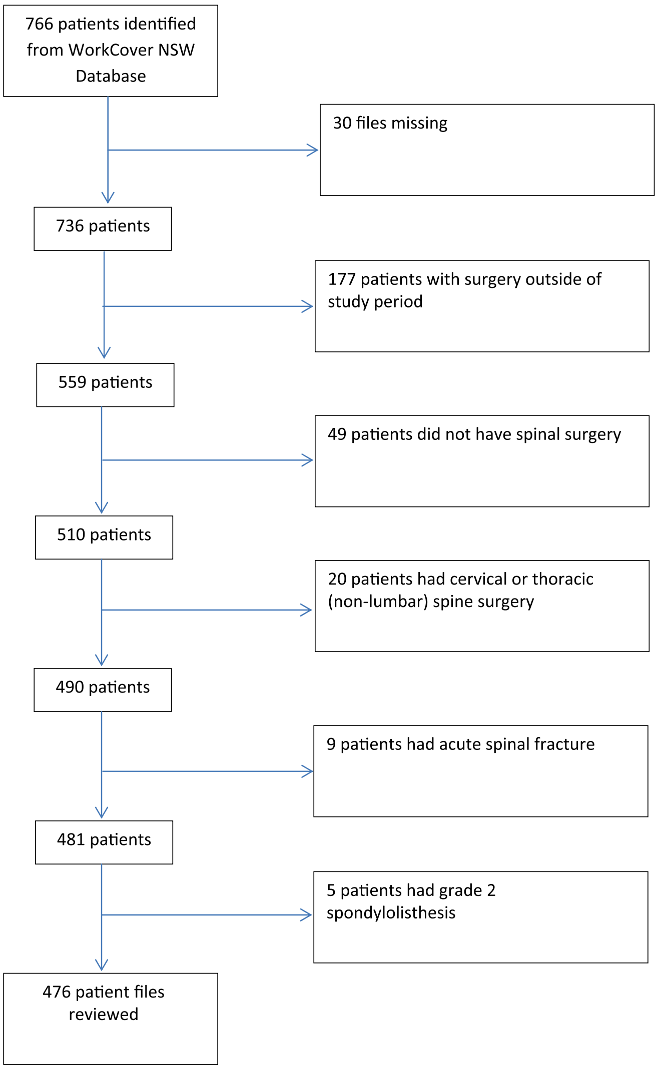


**Fig. 1.** Flowchart of exclusions.

by surgery type were as follows: decompression surgery – $30 900.49 and $11 825.90; fusion surgery – $49.936.53 and $30 617.11; and for TDR surgery – $56 726.26 and $22 940.37. The average medical and hospital costs per patient for those operated on by an orthopaedic surgeon were $36 990.58 and $16 677.60, respectively, while these costs for patients operated on by a neurosurgeon were $36 144.25 and $16 050.11, respectively.

The overall rate of revision surgery at 24 months post-operation was 9.2%. The associations between revision rates and other variables are summarized in Table 1. There was no significant association between revision surgery at 24 months and insurance agency, surgeon specialty or type of surgery. The rate of revision surgery for each surgeon (in those that performed five or more initial surgeries) varied between 0% and 37.5%. The mean age of subjects who required revision surgery was 43.7 years, compared with 41.3 years for the remainder ($P = 0.13$).

Patient RTW and return to PID at 24 months were 50.3% and 14.2%, respectively. The mean age at time of surgery of patients that had returned to work at 24 months was 40.8 years, compared with 42.0 years in those that did not ($P = 0.21$). The associations between RTW and other variables are summarized in Table 2. Orthopaedic surgeons had worse patient RTW and PID outcomes compared with neurosurgeons. Possible confounding between the two significant variables (type of surgeon and type of surgery) was explored with multivariate analysis (logistic regression) for the effect of these two variables on RTW. The adjusted effect of surgeon type was not significant ($P = 0.80$), as the rate of fusion was much higher in orthopaedic surgeons (26.3% versus 16.7%). On multivariate analysis, procedure type remained highly significant ($P = 0.008$), with worse RTW outcomes in fusion and TDR patients. There was no significant interaction (effect modification) between surgeon type and procedure type ($P = 0.36$).

Ongoing treatment (in any form) at 24 months occurred in 77.7% of patients. The associations between ongoing treatment and other variables are summarized in Table 3. Ongoing treatment rates were higher in fusion and TDR patients, compared with patients who had undergone decompressive procedures. On multivariate analysis (logistic regression) of procedure type and gender for each treatment outcome, procedure type remained significant and gender was not significant.

**Table 1** Unadjusted rates of revision surgery at 24 months post-operation

| Independent variable | Revision rate | *P*-value |
|---|---|---|
| Age | (Overall) 9.2% | 0.13 |
| Gender | Female 11.9% | 0.27 |
| | Male 8.5% | |
| Insurer | 7.3–11.2% | 0.90 |
| Surgeon speciality | Orthopaedic 8.3% | 0.49 |
| | Neurosurgeon 10.1% | |
| Type of surgery | Decompression 9.8% | 0.75 |
| | Fusion 6.5% | |
| | TDR 11.1% | |

TDR, total disc replacement.

## Discussion

In a workers' compensation cohort of patients undergoing spine fusion, TDR or spinal decompression procedures, the outcomes at 24 months were dependent on the type of surgery, with spine fusion and TDR having significantly worse outcomes for RTW and need for ongoing treatment (opioids and physical therapies). The revision rates for all types of procedure were similar.

RTW (and in particular PIDs) is a goal of workers' compensation patient management not only for the benefits of the insurer and employer but also because employment has substantial health, social and financial benefits.[17–19] Our RTW rate after spine fusion (36.3% or 63.7% disability rate) is similar to 1994 and 2006 Washington, and 2010 Ohio workers' compensation population studies of fusion outcomes, which found work disability rates of 68%, 63.9% and 62%, respectively, at 2 years post-surgery.[16,20,21] RTW outcomes after decompression (55.1% RTW and 17.3% PID) were lower than a 2009 Utah workers' compensation population study on discectomy outcomes, which described 81.4% RTW and 47.8% PID outcomes.[22] This difference may be due to the Utah study RTW outcomes being

**Table 2** Unadjusted rates of return to work (RTW) and pre-injury duties (PIDs) at 24 months post-operation

| Independent variable | RTW rate (%) | *P*-value | PID rate (%) | *P*-value |
|---|---|---|---|---|
| Age | (Overall) 49.8 | 0.21 | (Overall) 14.1 | 0.55 |
| Gender | Male 51.0 | 0.61 | Male 14.6 | 0.70 |
| | Female 48.1 | | Female 13.1 | |
| Insurer | 46.7–61.5 | 0.68 | 11.5–23.1 | 0.71 |
| Surgeon speciality | Orthopaedic 44.2 | 0.01 | Orthopaedic 8.8 | 0.002 |
| | Neurosurgeon 55.5 | | Neurosurgeon 18.8 | |
| Type of surgery | Decompression 55.1 | 0.005 | Decompression 17.3 | 0.007 |
| | Fusion 36.3 | | Fusion 3.3 | |
| | TDR 40.0 | | TDR 11.1 | |

TDR, total disc replacement.

**Table 3** Unadjusted rates (%) of ongoing treatment (all forms), opioid treatment and physical therapy treatment at 24 months post-operation

| Independent variables | Subgroup | All forms | *P*-value | Opioid treatment | *P*-value | Physical therapy | *P*-value |
|---|---|---|---|---|---|---|---|
| Age | Overall | 77.7 | 0.25 | 50.1 | 0.81 | 37.9 | 0.92 |
| Gender | Female | 87.6 | 0.02 | 52.6 | 0.58 | 45.7 | 0.06 |
| | Male | 77.1 | | 49.4 | | 35.6 | |
| Insurer | 5 agents | 61.5–86.1 | 0.04 | 43.6–57.7 | 0.35 | 28.7–49.6† | 0.36 |
| Surgeon speciality | Orthopaedic | 79.3 | 0.93 | 54.0 | 0.14 | 39.7 | 0.42 |
| | Neurosurgery | 79.7 | | 46.9 | | 36.1 | |
| Type of surgery | Decompression | 76.0 | 0.009 | 42.9 | <0.0001 | 34.5 | 0.07 |
| | Fusion | 88.9 | | 69.9 | | 45.6 | |
| | TDR | 88.9 | | 71.2 | | 47.2 | |

†Excluding one insurance agent with $n = 13$ and physical therapy rate at 24 months = 1/13 (7.7%). TDR, total disc replacement.

measured *at least* 2 years post-operation. When TDR was compared with fusion in a 2009 study in a Swedish population, there was no significant difference in the RTW outcomes for these procedures[23]; this is supported by findings that the results for TDR and spine fusion were similar.

The revision surgery rate at 24 months post-surgery was lower than the figures reported from Utah, Washington and Ohio studies (23.8%, 22% and 22%, respectively) for lumbar fusions at 24 months.[16,22,24] However, another study found a revision rate of 18%, 5 years after fusion surgery, a figure more consistent with our findings.[25]

Ongoing treatment rates at 24 months were worse for TDR and fusions than decompressions. Ongoing treatment suggests ongoing pain and symptoms. The Ohio study found a similar opioid utilization rate (76%) in spinal fusion patients at just 90 days.[21] Recent studies have questioned the effectiveness and safety of long-term opioid use for LBP.[26–28]

We contend that the rates of undesirable outcomes observed here, that is, rates of revision surgery and use of ongoing treatment, should be considered to be conservative estimates. It is likely that our methods underestimated the numbers of revisions and patients with ongoing treatment as our classification relied on medical correspondence, which may have been incomplete, particularly if the patient had moved or if the claim had settled (after which time there may have been no documentation). Furthermore, given that the presence of revision surgery or ongoing treatment was based on contemporaneous clinical notes, it is unlikely that the figures were overestimated.

A potential limitation of this study is that we missed a minority of patients due to transfer of some files from the large insurance agents to smaller ones. We do not believe that this significantly biased the sample, as the file transfer was random in nature and only represented a small proportion of subjects.

We acknowledge that this is a retrospective study relying on the availability of recorded and collected data from a third party. The lack of patient-reported outcomes limits the clinical relevance of the chosen outcomes. Our study also has no non-operative control group. Nevertheless, the advantage of the approach we took is that a large cohort can be assessed over an extended period for minimal cost, and that the records retrieved are contemporaneous. The large number of surgeons involved, and therefore the low numbers of operations for each surgeon, means that the study was likely to be underpowered to detect a difference between surgeons.

The low RTW rates and high ongoing treatment rates, particularly for spine fusion and TDR surgery, along with the poor evidence base for these procedures, forces us to question the role of fusion and TDR surgeries in a workers' compensation population. Furthermore, the results of spinal fusion in workers' compensation patients have previously been shown to be inferior to non-workers' compensation patients.[14,15,21] In light of these results, consideration should be given to providing closer scrutiny of the indications for, and results of, spine surgery in this population.

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