Single Level Lumbar Fusion For Degenerative Disc Disease Is Associated With Worse Outcomes Compared To Fusion For Spondylolisthesis In A Workers’ Compensation Setting

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Introduction: Multiple studies report more consistent and often better outcomes among patients undergoing lumbar fusion for spondylolisthesis when compared to patients undergoing fusion for degenerative disc disease (DDD) and discogenic low back pain (LBP). U.S. workers’ compensation (WC) subjects tend to have worse clinical outcomes following lumbar fusion than the general population. For the WC population, the ability to make a stable return to work (RTW) after fusion is of particular clinical importance. However, studies of subjects from several WC jurisdictions report RTW rates ranging from 26%-36% and reoperation rates from 22%-27% after fusion.

Despite WC being a commonly reported risk factor for worse fusion outcomes, relatively few studies exist identifying pre-fusion risk factors for worse outcomes within this clinically-distinct population. Such information would not only help guide medical decision making and likely improve outcomes, but it could also help curb medical and state costs. Therefore, the objective of this study was to compare outcomes between WC subjects that underwent lumbar fusion for spondylolisthesis with WC subjects that underwent fusion for DDD and discogenic LBP without lumbar instability or deformity. Primarily, we wanted to determine the impact fusion indication has on postoperative RTW status.

Methods: Our retrospective cohort study included 869 WC subjects from the Ohio Bureau of Workers’ Compensation (BWC) who underwent posterolateral lumbar fusion (PLF) with or without posterior lumbar interbody fusion (PLIF) of a single level between 1993-2013 for the primary indication of either spondylolisthesis or DDD and discogenic LBP without spinal instability or deformity. We used a combination of ICD-9 diagnosis and CPT procedural codes to identify all subjects. All included subjects had a minimum of 3 years of follow-up. We used an already published CPT coding schema to characterize each subject’s index lumbar fusion. We excluded subjects that underwent fusion of any anterior or lateral approaches, had a positive smoking history, had fewer than 3 years follow-up, underwent a multi-level fusion, and/or underwent fusion for an indication other than DDD or spondylolisthesis. From our final study population of 869 WC subjects, 620 underwent discogenic fusion, forming the DDD cohort, and 269 underwent fusion for spondylolisthesis, forming the spondylolisthesis cohort. Importantly, we evaluated all outcomes after each subject’s index lumbar fusion after WC-qualifying workplace injury.

The primary outcome in this study was the ability to make a stable RTW within a reasonable timeline after fusion. Specifically, subjects were considered returned to work if they made a stable return within 2 years of fusion and maintained this for more than 6 months of the following year. We measured a
number of secondary outcomes at 3 years after index fusion (AIF), including: number of days each subject was absent from work, prescription opioid analgesic utilization, net medical costs paid by the Ohio BWC, psychotherapy utilization, additional major lumbar surgeries, and rates of failed back surgery syndrome and postoperative permanent disability. We collected data for a number of independent variables, including: lumbar comorbidity before index fusion (BIF), psychotherapy utilization BIF, age at fusion, gender, income, major lumbar surgeries BIF, concurrent decompression with fusion, time between injury and index fusion, fusion technique, instrumentation, graft type, and rates of permanent disability, failed back syndrome, and legal representation BIF.

To determine the impact fusion indication had on RTW status, we utilized a multivariate logistic regression analysis, correcting for all independent variables previously described. Secondary outcomes were compared between the DDD and spondylolisthesis cohorts using t-tests and $\chi^2$ tests.

**Results:** Undergoing fusion for spondylolisthesis was positively associated with RTW status when compared to the DDD cohort ($p < 0.050; OR 1.42$). $36.4\% (98/269)$ of subjects in the spondylolisthesis cohort met our RTW criteria, compared to only $24.4\% (151/620)$ of the DDD cohort. Additional predictors of RTW status included: age over 50 at time of fusion ($p < 0.025; OR 0.66$), more than 2 years between injury and index fusion ($p < 0.003; OR 0.59$), permanent disability BIF ($p < 0.005; OR 0.61$), legal representation BIF ($p < 0.001; OR 0.30$).

The following were statistically significant population differences between the spondylolisthesis and DDD cohorts before undergoing fusion: the DDD cohort had more subjects with previous lumbar surgery BIF, more time between injury and index fusion, higher rates of permanent disability BIF, higher rates of psychotherapy utilization BIF, higher rates of preoperative failed back syndrome, and higher rates of disc herniation. However, we corrected for all of these covariates and more in the multivariate regression model.

Compared to the spondylolisthesis cohort, subjects in the DDD cohort were, on average, prescribed opioid analgesics for 294 additional days after fusion ($p < 0.001$), which equated to nearly 25,000 additional morphine equivalents ($p < 0.001$). Daily morphine load was similar between each cohort. The DDD cohort was absent from work for 164 additional days within 3 years AIF compared to the spondylolisthesis cohort ($p < 0.001$). Also, average medical costs paid by the Ohio BWC for the DDD cohort between fusion and 3 years after was $75,885.0 per subject, compared to $64,219.9 per subject among the spondylolisthesis cohort ($p < 0.001$). No other secondary outcome measures differed significantly between cohorts.

**Discussion:** Among a population of 889 Ohio WC subjects, we present evidence that undergoing PLF with or without PLIF for spondylolisthesis is associated with a significantly higher RTW rate, less postoperative time out of work, shorter postoperative use of opioid analgesics, and lower overall medical costs compared to undergoing the same procedure for DDD and discogenic LBP. Other results are consistent with the biopsychosocial model now commonly used to describe the WC population, as highlighted by age, permanent disability, legal representation, and psychotherapy utilization being significant predictors of RTW status. It should be noted that we treated psychotherapy utilization as a marker for psychological comorbidity. Psychotherapy utilization was the single greatest predictor of RTW status, thus stabilization of a WC patient’s psychological health before fusion could greatly improve postoperative outcomes.
Our study was limited by its observational and retrospective design. However, this study included the entire population of Ohio WC subjects that fit our study design, which helps avoid bias and increases the chances of having a distribution of covariates that would be present in other populations of such cases. Also, the completeness of our data could have been possibly limited by the use of administrative information. However, a study of CPT and ICD-9 coding data from a large Veterans Affairs database, when compared to actual medical records, provided accurate data with sensitivities and specificities ≥ 95%.

Significance: Ohio WC subjects with spondylolisthesis had significantly better lumbar fusion outcomes compared to subjects who underwent discogenic fusion. Discogenic fusion subjects were also associated with more preoperative psychosocial factors which negatively impacted outcomes.

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