Obesity and litigation predict workers’ compensation costs associated with interbody cage lumbar fusion

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Abstract

BACKGROUND CONTEXT: Results of lumbar fusion surgery have been mixed and procedures are costly. Interbody cage lumbar fusion (ICLF) has been advanced to improve arthrodesis and clinical outcomes; however, little attention has been given to ICLF costs or potential predictors of these expenses.

PURPOSE: To depict medical and compensation costs associated with ICLF in a Utah cohort of patients receiving workers’ compensation as well as to investigate predictors of costs.

STUDY DESIGN/SETTING: A retrospective-cohort research design was used involving completion of presurgical and postsurgical medical record reviews and accrual of medical and compensation costs. Presurgical variables included in a regression model were presurgical spinal pathophysiology rating, obesity, and litigation status.

PATIENT SAMPLE: Forty-three consecutive patients who were compensated by the Workers’ Compensation Fund of Utah and underwent ICLF.

OUTCOME MEASURES: Total accrued compensation and medical costs.

METHODS: A retrospective review of presurgical variables and total accrued compensation and medical costs was conducted.

RESULTS: Multiple regression analysis indicated that nonpathophysiological factors predicted compensation costs (lawyer involvement \( b = 0.40 \); obesity \( b = 0.34 \)). Specifically, compensation for those with versus without lawyers was $41,657 versus $24,837, and for those who were obese versus nonobese was $46,152 versus $28,168. Arthrodesis was correlated with medical costs \( r = -0.47, p = .002 \), with incurred costs for patients achieving solid fusion versus pseudarthrosis equaling $38,881 versus $71,655, respectively.

CONCLUSIONS: Considerable costs were associated with ICLF, particularly for those who were obese, involved in litigation, or failed to achieve solid fusion. With regard to compensation costs, the findings support the importance of assessing nonpathophysiological factors in spinal fusion patients.

Keywords: Lumbar fusion; Medical costs; Compensation costs; Obesity; Litigation

Introduction

The effects of low back pain (LBP) are wide reaching in terms of both the number of people involved and economic cost. It is estimated that 80% of the U.S. population will experience LBP at some point in their lives, resulting in a projected overall economic toll of nearly $171 billion \cite{1,2}. The costs associated with medical treatment of chronic LBP are estimated to range from $9,000 to $19,000 per
Poor outcomes from surgical procedures may have a considerable impact on the limited resources of a health-care system as well as potentially increased financial and physical burdens to patients. Characteristics of patients at risk for poor ICLF outcome and increased costs have not yet been sufficiently identified in the literature. Although litigation has been shown to be associated with poorer outcomes after ICLF in one study [27], it has not been studied with regard to medical and compensation costs. Similarly, obesity has been found to increase the risk for development of musculoskeletal pain [29–31] and poorer functional outcome after spinal surgery [32], but little is known regarding its association with ICLF outcomes. Examination of patient characteristics and other issues within the presurgical environment may offer a basis for targeted interventions and improving patient selection, thereby also improving spinal fusion outcomes and reducing costs. The purpose of the present study was to examine the costs associated with ICLF and investigate a multivariate predictive model of presurgical variables that include a combination of biopsychosocial influences.

Methods

Study design

A retrospective-cohort design was used, which involved the coding of pre- and postsurgical information from medical records and assessing compensation and medical costs via the Workers’ Compensation Fund of Utah (WCFU) computer databases. This study received institutional review board approval from Utah State University, and access to patient medical records was granted by WCFU.

Patient inclusion criteria and identification

All WCFU patients were eligible for inclusion if they had undergone ICLF from 1997 to 2000, had no presurgical diagnosis of vertebral fracture, and were at least 18 months postsurgery at the time of record review. For each patient, lumbar fusion surgery resulted from a verified workplace low back injury. Workers covered by the federal workers’ compensation systems and self-insured employers were excluded. Approximately 53% of Utah workers are insured by the WCFU. Potential patients were identified by current procedural terminology codes in the WCFU databases.

Procedures

Presurgical medical record data were collected using a standardized review procedure documented elsewhere [17,33]. The data abstractor was one of the authors, and he was not involved with the treatment of the patients. Presurgical radiology reports for each patient’s lumbar spine were also obtained and independently reviewed. A diagnostic pathophysiological severity rating was calculated for...
each patient by another one of the authors who is a physician trained in orthopedic medicine. He was blind to the patient’s surgical or cost outcomes. The presurgical variables coded for this study included body mass index at the time of surgery, litigation defined as patient private lawyer involvement in their case at the time of surgery, and spinal diagnostic severity rating.

**Materials and instruments**

**Diagnostic Severity Rating Index (DSRI)**

The DSRI provided a summary score of spinal pathophysiology and was slightly modified from the coding system used in previous studies [19,34]. This instrument allows for the coding of seven major types of common lumbar spinal diagnoses (degenerative changes, facet changes, disc bulge, lysis, lysis, foraminal stenosis, and central stenosis) and provides a graduated scale for each diagnosis from none (0) to severe (3). Additionally, the DSRI is applied to four intervertebral levels (L2–L3, L3–L4, L4–L5, and L5–S1) with the total score being based upon the sum of the scores from each of the levels. Higher scores reflect greater spinal pathophysiology. This revised instrument has been previously shown to have good interrater reliability [27].

**Arthrodesis outcome**

The operating surgeons routinely reviewed postoperative radiographs and reported the progression of bone consolidation in the patient’s medical record. Consequently, arthrodesis was determined by reviewing medical records for the surgeons’ assessments of the radiographs, with the final determination of solid fusion coded as a dichotomous variable (yes/no). These surgeons were not otherwise involved in the study.

**Medical and compensation costs**

Total medical and compensation costs were retrieved from the databases of WCFU. Compensation costs included all wage replacement and the final impairment settlement. Medical costs included all direct and ancillary medical care, including rehabilitation services. The time interval for calculating costs was from the time of injury to determination of maximum medical improvement (MMI). In Utah, MMI is judged as the point in time at which an injured worker has realized the maximum amount of improvement from an injury given the current standard of medical care. The operating surgeon is responsible for monitoring the patient’s status and declaring the date of MMI, at which point the patient’s degree of impairment is assessed, recommendations are made about ability to return to work, and a final settlement is determined. The specific date for MMI used in this study was the official date coded in WCFU computer records. It should be noted that the WCFU covers lifetime medical costs for work-related injuries, thus it is possible for ICLF patients to receive additional medical costs beyond MMI. However, because we needed to draw a logical line for calculating total medical costs and MMI appeared to be the point at which the majority of these costs are achieved for most patients, we selected MMI date as the criterion.

**Statistical analysis**

Descriptive statistics were used to characterize the sample and the medical and compensation costs accrued through WCFU. Standardized mean difference effect sizes were calculated for comparison of ICLF cost outcomes with an existing sample of WCFU non-ICLF patients [35]. Multiple regression analyses were performed with arthrodesis outcome, the radiology severity rating, obesity status based on body mass index at the time of surgery, and litigation at time of surgery as the predictors and medical and compensation costs as the dependent variables. Arthrodesis status was entered in the first step of the regression equation, whereas the remaining three presurgical predictors were entered in the second step of the regression to allow for examination of the relative importance (using standardized beta weights) of the respective predictor variables beyond the potential influence of achieving solid fusion. All data were analyzed using the Statistical Packages for Social Sciences (SPSS) version 10 for Windows with an alpha level of .05 considered statistically significant.

**Results**

**Characteristics of patients and ICLF surgery performed**

Descriptive data for the ICLF patients are displayed in Table 1. The total population included 43 patients of whom 79% were male and all were Caucasian. Preoperative diagnoses, which may co-occur in patients, were as follows: degenerative disc disease (60.5%), disc herniation (60.5%),

**Table 1**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n=43)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, male</td>
<td>34</td>
<td>79.1</td>
</tr>
<tr>
<td>Married</td>
<td>28</td>
<td>65.1</td>
</tr>
<tr>
<td>Education, ≥high school</td>
<td>35</td>
<td>81.4</td>
</tr>
<tr>
<td>Obesity, BMI&gt;30</td>
<td>7</td>
<td>16.3</td>
</tr>
<tr>
<td>Lawyer involvement</td>
<td>16</td>
<td>37.2</td>
</tr>
<tr>
<td>Number of previous back surgeries</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>13</td>
<td>30.2</td>
</tr>
<tr>
<td>One</td>
<td>17</td>
<td>39.5</td>
</tr>
<tr>
<td>Two</td>
<td>9</td>
<td>20.9</td>
</tr>
<tr>
<td>Three or more</td>
<td>4</td>
<td>9.3</td>
</tr>
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</table>

**Table 2**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Min–Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>40.4</td>
<td>9.2</td>
<td>28–64</td>
</tr>
<tr>
<td>DSRI</td>
<td>9.67</td>
<td>4.69</td>
<td>3–29</td>
</tr>
</tbody>
</table>

BMI=body mass index; DSRI=diagnostic severity rating index.
spinal stenosis (23.3%), spondylolisthesis (18.6%), motor segmental instability/motion (9.3%), and pseudarthrosis (7.0%).

In nearly 85% of the patients, the ICLF was their first lumbar fusion, whereas the index surgery was the second and third fusion surgeries for 9.3% and 7.0% of the patients, respectively. The ICLF approach performed was divided equally between posterior and anterior (41.9%), whereas a circumferential approach was taken in 16.3% of the surgeries. The Ray and BAK interbody cage devices were the predominant choices of instrumentation, with these used in 51.2% and 25.6% of the operations, respectively. Patients had one lumbar level operated upon during the procedure in 55.8% of the cases, whereas the remaining 44.2% had a two-level ICLF performed. The vast majority of lumbar surgeries involved either L5–S1 or L4–L5 levels, with these sites being the target in 76.7% and 55.8% of the surgeries, respectively. Eighty-one percent of the surgeries were reported to have no complications of any type during the perioperative period or follow-up. The most frequent complications that did occur included superficial (2.3%) and deep (2.3%) infection, instrumentation failure (2.3%), and failed back syndrome (9.3%). An in-hospital surgical mortality secondary to internal bleeding was also documented in one case. The average length of hospital stay for the remaining patients after ICLF surgery was 4.6 days (SD=1.4, range=3–9).

Medical and compensation costs

The average time to MMI was 385 days (SD=222), which was significantly correlated with total medical costs (r(41)=-0.47, p=.002), indicating that arthrodesis was associated with lower medical costs. That is, patients with solid fusion incurred an average of $38,881 (SD=$19,307) in medical expenditures compared with $71,655 (SD=$43,047) for those failing to achieve arthrodesis. It was very interesting to note, however, that achieving solid fusion was not significantly correlated with total compensation costs (r(41)=-.20; p=.195).

Presurgical variables and prediction of ICLF costs

Examination of the intercorrelations among the presurgical variables indicated that multicollinearity was not a concern for interpretation of the regression weights for subsequent analyses. Using simultaneous-entry multiple linear regression analysis to predict the total compensation costs, while also partialing out arthrodesis, the three-variable model (litigation, obesity, spinal pathology severity rating) was statistically significant (F=3.94, p=.009) with an R-square of .299. Two of the predictor variables (presurgical lawyer involvement and obesity) had statistically significant regression beta weights (Table 3). In multiple linear regression, beta weights are interpreted as indicating the expected change in the dependent variable (eg, ICLF costs) associated with a unit change in the predictor variable, with lower medical costs. That is, patients with solid fusion incurred an average of $38,881 (SD=$19,307) in medical expenditures compared with $71,655 (SD=$43,047) for those failing to achieve arthrodesis. It was very interesting to note, however, that achieving solid fusion was not significantly correlated with total compensation costs (r(41)=-.20; p=.195).

Arthrodesis outcome

Arthrodesis was established in 78.6% of the cases, with one individual excluded owing to in-hospital mortality.

Table 3

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Coefficients</td>
</tr>
<tr>
<td></td>
<td>Unstandardized coefficients</td>
</tr>
<tr>
<td></td>
<td>β</td>
</tr>
<tr>
<td>Arthrodesis</td>
<td>-9.978</td>
</tr>
<tr>
<td>Obesity</td>
<td>16,597</td>
</tr>
<tr>
<td>DSRI</td>
<td>-394</td>
</tr>
<tr>
<td>Constant</td>
<td>-9,266</td>
</tr>
</tbody>
</table>

DSRl=Diagnostic Severity Rating Index.

* Model summary: p<.01; R=.547; R²=.299.
while partialing out the other predictor variables. However, because of the lack of comparability of the beta weights, it is helpful to examine the standardized beta weights to address the relative importance of the respective predictor variables. Given this, lawyer involvement at the time of surgery (β = .398) and obesity (β = .337) were comparable in terms of predictive importance, whereas presurgical severity rating of spinal pathology (β = −.089) was not influential in accounting for the variance in costs. As seen in Figure 1, obese patients received nearly $18,000 more than nonobese patients ($46,152.56 vs. $28,168.21) in compensation, while those patients with lawyers received nearly $17,000 more than those patients without lawyers ($41,657.03 vs. $24,837.44). The multiple regression analysis predicting total medical expenses was not statistically significant (p > .05).

Discussion

In the present study, the medical and compensation costs associated with ICLF were considerable, with the former comprising 60% of the average overall workers’ compensation expenditures of nearly $77,000. Compared with a similar sample of Utah workers’ compensation patients undergoing posterolateral lumbar fusion [35], whose medical costs comprised 53% of the total costs, the expenditures associated with ICLF were greater than anticipated in light of initial claims that the procedure yielded shorter hospitalizations, better patient outcomes, and improved cost-effectiveness [23–25]. Seventy-nine percent of the patients in the current study established arthrodesis after ICLF, which is generally commensurate with those reported elsewhere in the literature for non-ICLF techniques [14,34]. However, this rate is considerably lower than the impressive rates of 92% and higher reported by the developers of ICLF devices [23–25]; likely reflecting the careful selection of patients in the clinical trials and restriction of inclusion of patients with complicated psychosocial issues (eg, pending litigation). We believe the arthrodesis rate and costs associated with ICLF observed in the present study are likely more reflective of typical injured workers with LBP.

Our finding that litigation at the time of surgery was associated with higher compensation costs (ie, nearly $17,000) is consistent with previous studies [35–37]. In fact, several LBP studies have shown a relationship between litigation/compensation and increased rates of disability and greater levels of posttreatment pain [16,38–42]. Interestingly, post hoc analyses of litigation and presurgical spinal pathophysiological ratings did not reveal a statistically significant (F = .786, p = .381) difference between those patients employing the services of an attorney versus those not involved in litigation. Taken together, these findings suggest that in this population of patients, recommendations about performing an invasive procedure such as ICLF should be made with caution. The data from this study do not, however, support the position that patients receiving compensation or involved in litigation cannot benefit from surgical interventions or ICLF. It may be that patients involved in litigation experience poorer outcomes and seek more compensation to offset the additional personal expenditures they have amassed as a result of the poor outcome or loss of income. It is also important to note that the presence of litigation/compensation (or secondary gain) does not necessarily confirm that lumbar fusion patients are malingering. Indeed there is likely a complex psychophysiological relationship between perceived symptoms, pain, disability, and documented organic insult. The findings from the current study are similar to those reported elsewhere [18,32,37], suggesting that litigious patients may also experience an increased somatic sensitivity to pain as a consequence of financial incentives and social-contextual variables. Nevertheless, it is important to remember that it remains standard medical practice for surgeons to require evidence of spinal pathophysiology via routine radiographs before performing spinal fusion procedures [43,44].

The relationship between obesity-associated morbidity and health-care costs has been widely recognized as a public health problem [45]. The present investigation also found that patients considered obese (body mass index ≥ 30) had 61% (ie, nearly $18,000) greater compensation expenditures than did their nonobese counterparts undergoing ICLF. There was, however, no association between obesity and ICLF-related medical costs. Our findings support two recent studies examining lumbar surgery with obese individuals [46,47], which found no significant differences between obese patients and control groups with regard to duration of surgery, blood loss, duration of hospitalization, and most clinical outcomes. Interestingly, however, Gepstein and colleagues [47] found that the percentage of very dissatisfied patients was significantly higher among obese patients and that increased body mass index had a negative impact on pain perception (ie, greater pain) and activities of daily living after surgery. Although not assessed in our current study, the latter finding is consistent with our observation that obese individuals garnered considerably greater compensation costs and reports elsewhere that dissatisfaction, limited functioning, and increased pain perception are related.
to poorer outcomes and higher compensation costs [32,37,38]. An additional hypothesis that was not directly assessed in the present investigation, is that obesity is related to a more sedentary lifestyle which in turn leads to chronic LBP [31]. This theory was indirectly supported in that we did not find a significant relationship between presurgical spinal pathology or medical costs associated with ICLF in obese patients. Rather, obesity was related to compensation costs which are a reflection of disability status (and a corollary of decreased functioning and mobility). Certainly, further data are necessary to explain the association found between obesity and workers’ compensation expenditures associated with lumbar fusion.

Unlike obesity and litigation, arthrodesis was not associated with compensation costs, but rather was negatively correlated with medical costs. That is, achieving a solid fusion was related to significantly lower medical costs associated with undergoing ICLF. This finding is not entirely unexpected with the sample studied considering the nature of workers’ compensation and medical costs. That is, compensation costs include wage replacement and, if applicable, a final permanent disability settlement related to the injury. Moreover, total compensation cost is a function of the length of time on disability. Medical costs, on the other hand, include expenses paid toward the spinal fusion procedure, hospitalization, and physician appointments that accrue as a result of actual treatment provided to the patient. Thus, achieving arthrodesis would signify to the surgeon and insurance carrier that medical care has been completed, whereas an individual’s ability to return to gainful employment and discontinue collecting disability/compensation benefits is more subjective in nature and influenced by nonmedical social and environmental-contextual contingencies. For instance, some individuals may view successfully obtaining compensation after a poor surgical outcome (eg, final permanent disability payment) as likely only when obtaining representation and services from an attorney [36].

The findings from this study have several important implications. Lumbar fusion studies have typically emphasized biomedical outcomes and technical success with correspondingly less attention to other outcomes such as medical costs and patient compensation expenditures. The current study is also a rare examination of presurgical predictors of costs associated with lumbar fusion and, to our knowledge, the only investigation identifying nonpathophysiological factors related to costs for ICLF. Thus, this study provides additional support for consideration of biopsychosocial factors involved in health care. Specifically, the presurgical variables that emphasized potential psychosocial factors (ie, litigation, obesity) predicted compensation costs, whereas the biological variables (ie, presurgical spinal pathology, arthrodesis) were not related to compensation expenditures. This finding is not surprising, given that biological factors appear to be more instrumental in the initiation of pain, whereas psychosocial factors play a greater role in the exacerbation and maintenance of chronic pain [32] and are also important variables in the complex mix of factors that determine disability and functional limitations. A related implication of this study is the potential utility of assessing presurgical variables in assisting with identification of patients likely to have a poor response to spinal fusion procedures or to accrue considerable costs relative to the anticipated benefit. In particular, recognition of patients at risk for litigation or considered obese could signal the need to implement interventions designed to reduce these risk factors, such as early coordinated case management between injured workers and employers as well as lifestyle and weight loss interventions.

Additionally, it may be helpful to provide information to health-care providers as to the importance of these risk factors relative to spinal pathology and develop further criteria for noting when a second opinion may be indicated.

Although the current investigation is the only known study having used a multivariable model to predict ICLF workers’ compensation expenditures, limitations exist with the use of a retrospective-cohort design. This design lacked direct comparison/control groups, used existing groups of patients, and relied upon extant medical records. Thus, it is conceivable that potential bias and error may have influenced the data and findings. For instance, using such a design may leave patient outcomes open to being influenced by regression to the mean, natural history, or placebo effects [48]. It is notable that these biases would, however, likely produce effects appearing as more favorable patient outcomes such as reduced pain and increased functioning. Reliance on medical records for gathering presurgical and postsurgical information also has several inherent problems that were unavoidable in the current examination of ICLF. Although thorough and standardized reviews were conducted, it is possible that data may sometimes be missing or influenced by factors beyond the control of the researchers. For instance, we relied upon operating surgeons reliably recording in the medical record the postsurgical complications such as failed back syndrome. Another limitation of the current investigation is the relatively homogeneous small sample size, which restricted our ability to consider other potential predictors and generalize to other populations. The current findings, therefore, need to be further validated with diverse and larger samples, using a prospective design comparing other surgical methods and nonsurgical treatments, examination of additional types of costs and funding sources, and randomized controlled trials.

References


