

Clinical Study

# Factors affecting length of stay after elective posterior lumbar spine surgery: a multivariate analysis

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**Abstract**

**BACKGROUND CONTEXT:** Elective posterior lumbar fusion is a common surgical procedure, but reported length of hospital stay is variable (usually 3–7 days). The effect of a limited number of factors on length of stay (LOS) has previously been evaluated. However, multivariate analysis using LOS as a dependent variable to separate potentially confounding variables has not been performed.

**PURPOSE:** To facilitate setting of realistic expectations and considering the significant costs of hospitalization, it would be ideal to have a clear understanding of the variables affecting LOS for this surgery.

**STUDY DESIGN/SETTING:** This is a retrospective case series at a tertiary care center.

**PATIENT SAMPLE:** One hundred three patients undergoing elective, open, one- to three-level posterior lumbar instrumented fusion (with or without decompression) by the orthopedic spine service at our institution between January 2010 and June 2012 were included in the study.

**OUTCOME MEASURES:** LOS was determined from the date of surgery to the date of discharge.

**METHODS:** Preoperative factors (patient demographics, previous surgery, levels instrumented, American Society of Anesthesiologists [ASA] score, and major medical comorbidities including diabetes, hypertension, malignancy, pulmonary disease, or heart disease), intraoperative factors (complications, drain placement, estimated blood loss, blood transfusion, fluids administered, operating room time, and surgery time), and postoperative factors (drain removal, blood transfusion, complications, and discharge destination) were collected and analyzed with multivariate stepwise regression to determine predictors of LOS. “Postoperative complications” were excluded as an independent variable from the regression analysis because of its close relationship with LOS. No funding was received for the completion of this study, and there are no potential conflicts of interests.

**RESULTS:** Our sample included 70 one-level, 26 two-level, and 7 three-level operations. Average LOS was  $3.6 \pm 1.8$  days (mean  $\pm$  SD) with the range 0 to 12 days. Of this cohort, 79% (81 of 103) had a stay of 4 days or less. The only preoperative variables associated with LOS in the multivariate model were age ( $p = .038$ ) and ASA score ( $p = .001$ ). History of heart disease ( $p = .005$ ) was significantly associated with a decreased hospital stay. Intraoperative complications included six dural tears and one pedicle fracture. No intraoperative factors were found to be associated with a longer LOS. Postoperative complications occurred in 32% of patients (33 of 103). Common complications included anemia requiring transfusion (11), altered mental status (8), pneumonia (4), hardware complications requiring reoperation (3). Only one serious complication, renal failure, occurred. Average LOS for patients with a postoperative complication was  $5.1 \pm 2.3$  vs.  $2.9 \pm 0.9$  days for patients with no complication ( $p < .001$ ). Discharge to a subacute or nursing facility ( $p < .001$ ) was

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significantly associated with increased LOS. Levels fused were not predictive of LOS, possibly due to the skew toward one-level cases in our sample.

**CONCLUSION:** Patients who are older and have widespread systemic disease tend to stay in the hospital longer after surgery. Contrary to our expectations, no single comorbidity was predictive of longer hospital stays. Heart disease was associated with a shorter LOS, but this may have been due to a more extensive preoperative workup and closer medical management. Intraoperative events did not affect LOS; however, postoperative events did. These data should prove useful for counseling patients and setting expectations of patients and the health care team. © 2015 Elsevier Inc. All rights reserved.

*Keywords:* Fusion; Lumbar; Posterior; Length of stay; Complications; Comorbidities

## Introduction

Decompression and instrumented fusion of the lumbar spine may be an appropriate option for certain conditions of the lumbar spine and is one of the most common procedures performed by spine surgeons. Average hospital stays after this procedure range from 3 to 6.7 days in previous studies [1–3]. This length of stay (LOS) variable is important from a patient perspective and is an important factor in determining health care costs in patients undergoing spine surgery. Baseline costs of each extra day in the hospital run close to \$1,000 [4], and inpatient hospital charges (not including instrumentation or surgical charges) are closely linked with LOS [5].

In aggregate, treatments of lumbar pathology are associated with yearly costs approaching \$50 billion in the United States alone [6]. Lumbar fusion costs represented about half of all spine surgery spending in 2003 [7], and the cost of hospitalization for spine surgery has been rising, with medical costs for lumbar fusion rising nearly fivefold between 1992 and 2003 [7,8]. These costs are not to be taken lightly.

Length of stay is important to consider for reasons other than cost. The importance of optimizing patient experience has clearly been receiving greater attention. It has been shown that preoperative counseling before orthopedic procedures can reduce patient stress, leading to a faster recovery and shorter hospitalization [9]. Furthermore, increased LOS has been associated with adverse outcomes such as hospital-acquired infections [10,11] and increased risk of deep vein thrombosis [12–14]. These are intermediate variables on the pathway to potentially life-threatening outcomes. Moreover, longer LOS consumes physician time and decreases a department's potential surgical volume. Knowledge of the factors determining LOS can help surgeons guide treatment and preoperative expectations and help patients and their families plan postoperative care and return to function.

Many independent variables have been shown to influence LOS. Preoperative variables associated with increased LOS include increased age [15], morbid obesity [16], diabetes [17], metabolic syndrome [18], opioid use [19], greater number of comorbid conditions [19], and unemployment [19]. Perioperative variables associated with increased LOS include use of fibrin sealant [4], open as opposed to

minimally invasive surgery [20], adverse intraoperative events [21], fluids administered [22], and drain use [4]. Postoperative variables including blood transfusion and complications have also been associated with increased LOS [3].

Multivariate analysis is a powerful tool used to separate confounding variables that are often incorrectly believed to individually be potential outcome predictors. In the spine literature, such multivariate analyses have been reported for LOS with minimally invasive lumbar spine surgery and revision spine surgery [3,22]. For patients undergoing minimally invasive lumbar spine surgery, a number of perioperative factors including blood loss, longer surgical time, and crystalloid administration were associated with a stay greater than 24 hours, whereas age was found to be the only significant predictor of longer hospital stays after revision surgery. To our knowledge, LOS has yet to be considered as the dependent variable in a multivariate analysis for traditional, open lumbar fusion.

The purpose of the present study was to identify variables via multivariate analyses that predict a longer hospital stay after open elective posterior lumbar fusions. We hope this information will be useful for guiding patient selection, preoperative counseling, and postoperative decision making.

## Methods

Patients who underwent posterior lumbar fusion surgery at a single institution between January 2010 and June 2012 were identified, and their electronic medical records and charts were reviewed. All procedures were consecutively performed by one of three fellowship-trained orthopedic spine surgeons at our institution. This study received approval from our Human Investigation Committee.

Patients treated with a combined anterior/posterior approach, patients treated with minimally invasive techniques, or patients requiring more than three levels of instrumentation were excluded. Trauma cases were also excluded.

Demographic data collected included gender; age; body mass index; presence or absence of smoking, alcohol, opiate, or illicit drug use; marital status; and employment status.

Other preoperative variables recorded included previous lumbar surgery, levels instrumented, American Society of

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