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Clinical Study

# Trends in the surgical treatment of lumbar spine disease in the United States

William C. Pannell, MD[a,*], David D. Savin, MD[b], Trevor P. Scott, MD[a], Jeffrey C. Wang, MD[a], Michael D. Daubs, MD[a]

[a]*Department of Orthopaedic Surgery, University of California at Los Angeles, 1250 16th St #2100A, Santa Monica, CA 90404, USA*
[b]*Department of Orthopaedic Surgery, University of Illinois at Chicago, 835 S Wolcott Ave, Room E270, M/c 844, Chicago, IL 60612, USA*

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**Abstract**

**BACKGROUND CONTEXT:** There is a lack of agreement among spine surgeons as to the best surgical treatment modality for many degenerative lumbar diseases. Although there are many studies examining trends in spinal surgery, specific studies reporting the variations in surgical treatment in the United States for these diseases are lacking.

**PURPOSE:** The aim of this study was to analyze trends in lumbar spinal fusion methods for common lumbar pathologies in the United States.

**STUDY DESIGN/SETTING:** National insurance database review: 2004–2009.

**PATIENT SAMPLE:** Data is taken from United Healthcare and represents more than 25 million patients.

**OUTCOME MEASURES:** No outcomes were measured in this study.

**METHODS:** Using a private insurance database, we identified patients who underwent one of five types of instrumented single-level lumbar spinal fusion for the 10 most common primary diagnoses. Surgery rates were reviewed from 2004 to 2009 and were stratified according to patient age, patient gender, and region in the United States. Poisson regression analysis was performed to determine regional and demographic differences in treatment modality. The authors received no funds in support of this work.

**RESULTS:** A total of 23,986 patients met our search criteria. Of the five fusion types, posterior lumbar interbody fusion (PLIF) with posterolateral fusion (PLF) was the most common (45%), followed by PLF (19%), anterior lumbar interbody fusion (ALIF, 16%), PLIF (10%), and ALIF with PLF (9%). There was a significant increase in PLIF with PLF ($p<.0001$), PLIF ($p<.0001$), PLF ($p=.012$), ALIF ($p<.0001$), and ALIF with PLF ($p<.0001$) from 2004 to 2009. After controlling for gender, there were significant differences between regions for all fusion types ($p<.0001$). The likelihood of a posterior fusion increased with age. Anterior fusions were more common in the 30- to 49-year-old age range than in patents older than 50. For patients in age groups older than 30, there was an increased number who underwent a circumferential fusion or an ALIF ($p<.022$). Fusion types were significantly different between genders ($p<.026$). Both genders had an overall increase in the number of fusions ($p<.001$) over the time period studied.

FDA device/drug status: Not applicable.

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The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

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* Corresponding author. Department of Orthopaedic Surgery, University of California at Los Angeles, Santa Monica, CA 90404, USA. Tel.: (916) 220-6707.

*E-mail address*: will.pannell@gmail.com (W.C. Pannell)

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**CONCLUSIONS:** There are large differences in the United States for surgical treatment methods for lumbar spine pathology. These differences are likely multifactorial, with both patient and surgeon traits playing a role. Illustrating these differences will hopefully lead to outcomes research to determine the indications, efficacy, and appropriateness of these surgical methods, an important step on the path toward standardization of care. 

*Keywords:* Lumbar; Fusion; Demographics; Primary; Single; Surgery; Trends

## Introduction

Lumbar spine fusion surgery has increased and continues to grow as new implants, approaches, and surgical techniques are developed [1]. Despite similar incidence and prevalence rates of spinal disorders worldwide, the United States has the highest rate of spine surgery in the world. [1–3] There are large regional variations in the surgeries performed within the United States [1,3–10]. Patient factors, including age, health, body habitus, lifestyle, and type of insurance, as well as surgeon factors, such as training background, likely account for some of these differences [11–14]. Although studies have documented regional variability in the type of spinal fusions, few studies have addressed the demographic variability of procedures for a given diagnosis, with respect to age, gender, year, and region [15,16]. With the changing medical climate in the United States, it has become increasingly important to illustrate these differences as standards of care, for surgical decision-making are constantly evolving. The present study seeks to add to current literature by addressing specific fusion methods based on diagnosis, as well as adding recent data from a private insurance database.

## Materials and methods

Patients who underwent any of five types of instrumented single-level lumbar fusion (posterior lumbar interbody [PLIF], posterolateral-PLF, PLIF with PLF, anterior lumbar interbody [ALIF], and ALIF with PLF) were identified using the private insurance database PearlDiver (PearlDiver Technologies, Inc., Fort Wayne, IN, USA), which contains health records from United Healthcare's more than 25 million member population. Patients who underwent transforaminal lumbar interbody fusion (TLIF) were grouped with those undergoing PLIF. Current Procedural Terminology (CPT) and International Classification of Diseases, Ninth Revision (ICD-9) codes were used to query the database for the 10 most common primary diagnoses from the eligible lumbar fusions. Database search codes were written so as to exclude those patients undergoing multilevel procedures. Searches were done by primary diagnosis, but secondary diagnoses were not excluded. In addition to analyzing differences in surgical treatment for a given diagnosis, the data were broken down by region in the United States (midwest [MW], northeast [NE], south [SO], West [WE]), patient age, patient gender, and year of procedure (2004 through 2009). United Healthcare's span of orthopedic patients was unequally distributed, with 25% in the MW, 13% NE, 45% SO, and 17% WE. To normalize for differences in patient populations, the results were reported as occurrence rates, defined as the number of procedures for a subgroup of interest per 10,000 database patients.

### *Statistical method*

Poisson regression was used to analyze region, gender, age, and year, allowing authors to control for variables and report on the effects of individual variables. Pairwise gender comparisons were done using a chi-squared analysis; p values less than .05 were considered significant.

### *Source of funding*

No funding was received in support of this study.

## Results

### *Diagnosis*

Of the 23,986 cases identified, the 10 most common diagnoses were degenerative disk disease (DDD) (28%), herniated nucleus pulposus (HNP) (20%), stenosis (19%), acquired spondylolisthesis (13%), congenital spondylolisthesis (7%), spondylosis without myelopathy (5%), radiculopathy (3%), postlaminectomy syndrome (2%), back pain (2%), and disorders of the sacrum (1%). The most common method of fusion was PLIF with PLF (45%), regardless of diagnosis (Fig. 1). Posterolateral fusion was the second most common (19%), but was outnumbered by ALIF in patients with DDD, HNP, and back pain (Fig. 1). There was a slight increase in the number of posterolateral fusions done for stenosis as compared with other diagnoses. Overall, ALIF with PLF was the least frequent surgery, although more common than PLIF and PLF for patients with DDD.

### *Temporal trends*

Overall fusion rates increased significantly from 2004 to 2009 for patients with stenosis, DDD, HNP, acquired spondylolisthesis, radiculopathy, and spondylosis without myelopathy ($p<.0001$). Of these diagnoses, stenosis increased the most, from 2.0 to 3.3 per 10,000 patients. Rates of fusion for back pain, congenital spondylolisthesis, and disorders of the sacrum decreased over the time period studied, although none reached significance (Fig. 2). With