

Clinical Study

Comparison of complications, costs, and length of stay of three different lumbar interbody fusion techniques: an analysis of the Nationwide Inpatient Sample database

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Abstract

BACKGROUND CONTEXT: Lumbar interbody fusion (LIF) techniques have been used for years to treat a number of pathologies of the lower back. These procedures may use an anterior, posterior, or combined surgical approach. Each approach is associated with a unique set of complications, but the exact prevalence of complications associated with each approach remains unclear.

PURPOSE: To investigate the rates of perioperative complications of anterior lumbar interbody fusion (ALIF), posterior/transforaminal lumbar interbody fusion (P/TLIF), and LIF with a combined anterior-posterior interbody fusion (APF).

STUDY DESIGN/SETTING: Retrospective review of national data from a large administrative database.

PATIENT SAMPLE: Patients undergoing ALIF, P/TLIF, or APF.

OUTCOME MEASURES: Perioperative complications, length of stay (LOS), total costs, and mortality.

METHODS: The Nationwide Inpatient Sample database was queried for patients undergoing ALIF, P/TLIF, or APF between 2001 and 2010 as identified via International Classification of Diseases, ninth revision codes. Univariate analyses were carried out comparing the three cohorts in terms of the outcomes of interest. Multivariate analysis for primary outcomes was carried out adjusting for overall comorbidity burden, race, gender, age, and length of fusion. National estimates of annual total number of procedures were calculated based on the provided discharge weights. Geographic distribution of the three cohorts was also investigated.

RESULTS: An estimated total of 923,038 LIFs were performed between 2001 and 2010 in the United States. Posterior/transforaminal lumbar interbody fusions accounted for 79% to 86% of total LIFs between 2001 and 2010, ALIFs for 10% to 15%, and APF decreased from 10% in 2002 to less than 1% in 2010. On average, P/TLIF patients were oldest (54.55 years), followed by combined approach (47.23 years) and ALIF (46.94 years) patients ($p < .0001$). Anterior lumbar interbody fusion, P/TLIF, and combined surgical costs were \$75,872, \$65,894, and \$92,249, respectively ($p < .0001$). Patients in the P/TLIF cohort had the greatest number of comorbidities, having the highest prevalence for 10 of 17 comorbidities investigated. Anterior-posterior interbody fusion group was associated with the greatest number of complications, having the highest incidence of 12 of the 16 complications investigated.

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.

The authors have no potential conflicts of interest with regard to this study.

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CONCLUSIONS: These data help to define the perioperative risks for several LIF approaches. Comparison of outcomes showed that a combined approach is more expensive and associated with greater LOS, whereas ALIF is associated with the highest postoperative mortality. These trends should be taken into consideration during surgical planning to improve clinical outcomes. © 2014 Elsevier Inc. All rights reserved.

Keywords: Lumbar interbody fusion; Anterior approach; Posterior approach; Combined approach; Complications; Geographic distribution

Introduction

Lumbar interbody fusion (LIF) techniques have been used for years to treat a number of pathologies of the lower back including spinal stenosis, spinal deformity, and radiculopathy secondary to degenerative disc disease (DDD)/herniation recalcitrant to conservative management [1–4]. Lumbar interbody fusion involves fusion of two adjacent vertebrae through the disc space to immobilize the intervertebral joint and prevent painful movement. Posterior lumbar interbody fusion (PLIF) using bone chips to catalyze bony fusion was first described by Briggs et al. [5]. Southwick et al. [1] introduced the anterior lumbar interbody fusion (ALIF) using a retroperitoneal approach. In the ALIF procedure, the interbody space is accessed through the abdominal cavity involving reflection of the retroperitoneum, dissection through the anterior longitudinal ligament, and removal of the intervertebral disc for implant insertion [1,2]. The transforaminal lumbar interbody fusion (TLIF) is an alternative posterior approach described by Harms et al. [6]. Different approaches, including extreme lateral and combined approaches, have been since described [7]. Modern LIFs use pedicle screws, cages, allograft, iliac autograft, or recombinant human bone morphogenetic protein to promote fusion [8,9].

The anterior, posterior, and transforaminal LIFs are the most common LIF procedures [7,10,11]. Each approach is associated with unique complications and benefits. Anterior lumbar interbody fusion has been advocated for minimal epidural scar tissue formation, avoidance of trauma to the paraspinal musculature and posterior ligament structures, and restoration of sagittal alignment. However, the decision for ALIF brings the potential for vascular complications because of proximity of the major vessels, abdominal organs, and hypogastric sympathetic plexus to the dissection [2,10,12]. The PLIF and TLIF procedures are associated with neural complications because of proximity to neural elements and retraction of neural elements involved in the approach [2,10]. However, the exact relationship among different perioperative complications, length of stay (LOS), comorbidity burden, total cost, and LIF approaches is still unclear. These complications should be thoroughly understood before selecting a surgical approach to anticipate, prevent, and manage serious adverse events [12,13]. Using the Nationwide Inpatient Sample (NIS) database, this retrospective study helps to further elucidate this

relationship to enable clinicians to make a more informed decision about which approach to use for LIF surgery. The study also aims to investigate the geographic distribution of ALIFs, P/TLIFs, and combined anterior-posterior interbody fusions (APFs).

Methods

The study used data from the NIS database between 2001 and 2010. The NIS is a part of the Healthcare Cost and Utilization Project sponsored by the Agency for Healthcare Research and Quality. The database contains an approximate 20% stratified sample of US hospital admissions, for a total of between 7 and 8 million admissions per year [14]. The database contains information on patient demographics, hospital characteristics, LOS, payment source, total hospital charges, outcomes, and procedure and diagnosis codes using the International Classification of Diseases, ninth revision (ICD-9) system.

Patients undergoing an ALIF or P/TLIF were identified via corresponding ICD-9 procedure codes (81.06 and 81.08, respectively). The ICD-9 coding system does not distinguish between PLIF and TLIF procedures; for this reason, both the procedures are grouped into one cohort. Patients who underwent a combined APF approach for interbody fusion were identified via the presence of both the ICD-9 procedure codes. Patients who had a code for revision LIF (81.36, 81.38) were excluded from this study.

Patient demographics, including age, gender, specific comorbidities (Appendix A), and overall comorbidity burden as estimated by a modified Charlson comorbidity index, hospital characteristics, and primary diagnosis (Appendix B), were compared among the ALIF, P/TLIF, and combined approach patient populations [15]. National trends in the utilization of the two procedures were estimated using sample weights provided as part of the NIS database. Trends of patient age and average comorbidity burden over time were analyzed. Outcomes including LOS, 14 specific complications (Appendix C), total hospital charges, and mortality were compared among the three groups. Postoperative complications were identified via ICD-9 diagnosis codes (996.X–999.X).

Univariate analysis included chi-square test and *t* tests for categorical and continuous data, respectively. A series of multivariate logistic regression models were used to

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