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Clinical Study

A perioperative cost analysis comparing single-level minimally invasive and open transforaminal lumbar interbody fusion

Kern Singh, MD[a,*], Sreeharsha V. Nandyala, BA[a], Alejandro Marquez-Lara, MD[a], Steven J. Fineberg, MD[a], Mathew Oglesby, BA[a], Miguel A. Pelton, BS[a], Gunnar B. Andersson, MD, PhD[a], Darya Isayeva, BS[b], Briana J. Jegier, PhD[b], Frank M. Phillips, MD[a]

[a]*Department of Orthopaedic Surgery, Rush University Medical Center, 1611 W. Harrison St, Chicago, IL 60612, USA*
[b]*Rush University Medical Center, 1611 W. Harrison St, Chicago, IL 60612, USA*

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Abstract

BACKGROUND CONTEXT: Emerging literature suggests superior clinical short- and long-term outcomes of MIS (minimally invasive surgery) TLIFs (transforaminal lumbar interbody fusion) versus open fusions. Few studies to date have analyzed the cost differences between the two techniques and their relationship to acute clinical outcomes.

PURPOSE: The purpose of the study was to determine the differences in hospitalization costs and payments for patients treated with primary single-level MIS versus open TLIF. The impact of clinical outcomes and their contribution to financial differences was explored as well.

STUDY DESIGN/SETTING: This study was a nonrandomized, nonblinded prospective review.

PATIENT SAMPLE: Sixty-six consecutive patients undergoing a single-level TLIF (open/MIS) were analyzed (33 open, 33 MIS). Patients in either cohort (MIS/open) were matched based on race, sex, age, smoking status, medical comorbidities (Charlson Comorbidity index), payer, and diagnosis. Every patient in the study had a diagnosis of either degenerative disc disease or spondylolisthesis and stenosis.

OUTCOME MEASURES: Operative time (minutes), length of stay (LOS, days), estimated blood loss (EBL, mL), anesthesia time (minutes), Visual Analog Scale (VAS) scores, and hospital cost/payment amount were assessed.

METHODS: The MIS and open TLIF groups were compared based on clinical outcomes measures and hospital cost/payment data using SPSS version 20.0 for statistical analysis. The two groups were compared using bivariate chi-squared analysis. Mann-Whitney tests were used for non-normal distributed data. Effect size estimate was calculated with the Cohen *d* statistic and the *r* statistic with a 95% confidence interval.

RESULTS: Average surgical time was shorter for the MIS than the open TLIF group (115.8 minutes vs. 186.0 minutes respectively; p=.001). Length of stay was also reduced for the MIS versus the open group (2.3 days vs. 2.9 days, respectively; p=.018). Average anesthesia time and EBL were also lower in the MIS group (p<.001). VAS scores decreased for both groups, although these

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* Corresponding author. Department of Orthopaedic Surgery, Rush University Medical Center, 1611 W. Harrison St, Chicago, IL 60612, USA. Tel.: (312) 432–2373; fax: (708) 492–5373.

E-mail address: kernsingh@hotmail.com (K. Singh)

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scores were significantly lower for the MIS group (p<.001). Financial analysis demonstrated lower total hospital direct costs (blood, imaging, implant, laboratory, pharmacy, physical therapy/occupational therapy/speech, room and board) in the MIS versus the open group ($19,512 vs. $23,550, p<.001). Implant costs were similar (p=.686) in both groups, although these accounted for about two-thirds of the hospital direct costs in the MIS cohort ($13,764) and half of these costs ($13,778) in the open group. Hospital payments were $6,248 higher for open TLIF patients compared with the MIS group (p=.267).

CONCLUSIONS: MIS TLIF technique demonstrated significant reductions of operative time, LOS, anesthesia time, VAS scores, and EBL compared with the open technique. This reduction in perioperative parameters translated into lower total hospital costs over a 60-day perioperative period. Although hospital reimbursements appear higher in the open group over the MIS group, shorter surgical times and LOS days in the MIS technique provide opportunities for hospitals to reduce utilization of resources and to increase surgical case volume.

Keywords: Minimally invasive spine surgery; TLIF; Costs; Payments; Outcomes; Reimbursements

Introduction

As health care costs continue to grow in the United States, attention has been increasingly focused on evaluating the efficacy, value, and cost-effectiveness of treatments patients receive. Approximately 200,000 lumbar fusions are performed in the United States each year to treat disorders of the spine [1–4]. As such, it is not surprising that there has been considerable interest in reducing the costs of these procedures [5–7].

Transforaminal lumbar interbody fusion (TLIF) is commonly used to treat degenerative pathologies of the lumbar spine. Traditionally, TLIF procedures have been performed via an open approach involving retraction of the paraspinal muscles from the midline for the duration of the procedure. With recent advances in microscopy, tissue retractors, and other specialized instruments, spine surgeons can perform this procedure with a minimally invasive surgical (MIS) approach. Reports of MIS TLIF have noted superior results to the traditional open procedure in terms of injury to soft tissue, postoperative back pain, blood loss, need for transfusion, time to ambulation, length of stay (LOS), and functional restoration [8–11]. Theoretically, these advantages should result in cost savings during the perioperative period.

Although both MIS and open procedures have been shown to safely and effectively treat disorders of the lumbar spine, concerns exist with respect to the costs associated with performing MIS procedures [12–14]. Furthermore, published data in reference to costs associated with MIS in the lumbar spine are limited [10,11,15,16]. We hypothesize that hospital costs would be decreased for the MIS technique, as LOS, blood loss, and postoperative pain are expected to be less. The purpose of this study was to determine if there are differences in the perioperative costs and charges for patients treated with primary single-level MIS compared with open TLIF. In addition, the cost and charge data will be analyzed to determine factors that contribute to any differences noted.

Materials and methods

Patient selection

After obtaining institutional review board approval, we performed a retrospective analysis of hospital costs and payments for patients undergoing TLIF with a diagnosis of either lumbar degenerative disc disease (DDD), degenerative spondylolisthesis, or spinal stenosis. All patients had failed conservative management, including medications, a minimum of 6 weeks of physical therapy, and epidural injections when indicated. All patients were treated at a single academic medical center by two orthopedic spine surgeons (one performing MIS and one performing open TLIFs) between July 1, 2008, and June 30, 2010. Patients requiring two or more levels of fusion or who were undergoing revision surgery were excluded from the study. A total of 124 patients were identified. Thirty-three patients treated with open TLIF were matched with 33 patients treated MIS TLIF based on demographic characteristics (race, age, gender), Charlson Comorbidity Index (CCI), diagnosis, and insurance type. Table 1 describes the comorbidities used to calculate the CCI. Overall hospital direct costs and collections, LOS, readmissions (60-day postoperative window), and discharge status were obtained from the medical center finance department.

Surgical technique

With the open TLIF procedure, a midline incision followed by subperiosteal muscular dissection to the facet joints bilaterally was undertaken. A unilateral facetectomy was performed followed by a single intervertebral cage and bilateral pedicle screw fixation. Neural decompression was also performed. For the MIS TLIF, a unilateral approach was undertaken through a paramedian skin incision using the Wiltse technique under fluoroscopy. Unilateral pedicle screws were placed percutaneously over a guide wire. The laminectomy, bilateral decompression, and transforaminal lumbar interbody fusion were performed via a 21-mm