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The Spine Journal 12 (2012) 209–215

THE SPINE JOURNAL

Clinical Study

Comparison of unilateral versus bilateral instrumented transforaminal lumbar interbody fusion in degenerative lumbar diseases

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Received 12 November 2010; revised 19 August 2011; accepted 22 January 2012

Abstract

BACKGROUND CONTEXT: Transforaminal lumbar interbody fusion (TLIF) has become a well-established technique that is traditionally performed with bilateral pedicle screw (PS) fixation. There are only a small number of case reports of unilateral instrumented TLIF. To our knowledge, there have been few well-designed studies comparing unilateral versus bilateral instrumentation with TLIF.

PURPOSE: To compare clinical and radiographic outcomes in a selected series of patients treated with unilateral versus bilateral PS instrumented TLIF.

STUDY DESIGN: Prospective randomized study in one unit.

PATIENT SAMPLE: A total of 80 patients were enrolled in this study. Thirty-seven patients (17 men and 20 women; average age 57.1 years) were randomized to the unilateral PS group and 43 patients (18 men and 25 women; average age 58.2 years) to the bilateral PS group.

OUTCOME MEASURES: The demographic data collected from both groups were gender, age, preoperative index diagnosis, degenerated segment, and single/double level of fusion. Operative time, blood loss, hospital time, and implant costs were also evaluated. Postsurgical pain and functional results were analyzed by the visual analog scale (VAS), modified Prolo (mProlo) scores, and Oswestry Disability Index (ODI). Radiographic examinations were carried out to assess total fusion rates, screw failure, and general complications.

METHODS: Patients were randomized into the unilateral or bilateral PS instrumented TLIF group based on a computer-generated number list. Patients were asked to return to hospital for follow-up at 4 weeks, 3 months, 6 months, 12 months, and thereafter once a year after surgery.

RESULTS: The mean follow-up was 25.3 months, with a range of 18 to 32 months. There were no significant differences between the two groups in terms of demographic data. The unilateral PS group had a significantly shorter operative time, less blood loss, and reduced implant costs compared with the bilateral PS group, although hospital time was the same for double-level cases. The average postoperative VAS, mProlo, and ODI scores improved significantly in both groups, with no significant difference between groups. The total fusion rate, screw failure, and general complication rate were not significantly different.

CONCLUSIONS: Unilateral PS instrumented TLIF is a viable treatment option generating better results, especially in terms of operative time, blood loss, and hospital time for single-level disease and implant costs. No decrease in the fusion rate or increase in the complication rate was observed in this group. Further improved study design and a longer period of follow-up are needed to confirm this effect.

Keywords: Transforaminal; Interbody fusion; Unilateral; Bilateral; Fixation

Introduction

Transforaminal lumbar interbody fusion (TLIF) has become a popular and well-established procedure initially described by Harms et al. [1] in the early 1990s. This method has obvious advantages because of its unilateral nature, which causes less destruction of the posterior elements and less gross destabilization of the spine, thus maximizing

FDA device/drug status: Approved (Saber lumbar I/F cage system; pedicle screws [MOSS MIAMI spine system]).

Author disclosures: ***HX:*** Nothing to disclose. ***YT:*** Nothing to disclose. ***MC:*** Nothing to disclose.

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doi:10.1016/j.spinee.2012.01.010

EVIDENCE & METHODS

Context
Unilateral pedicle screw constructs have been shown to be equally effective as bilateral constructs in short segment lumbar arthrodesis. Transforaminal lumbar interbody fusion (TLIF) is a commonly performed procedure that adds an anterior stabilization to a posterior procedure. The experience of many surgeons has suggested that unilateral pedicle screw instrumentation may be sufficient, but quality evidence is lacking.

Contribution
In this small RCT, the authors found that unilateral instrumentation resulted in less operative time, less blood loss, shorter hospital stays, and less costs when compared to TLIF with bilateral instrumentation with similar clinical and radiological outcomes.

Implication
The findings are commensurate with many surgeons' experience. While the available background information suggests unilateral procedures are comparable to bilateral, this study is likely underpowered to detect small differences in efficacy or uncommon adverse events. Nonetheless, it is clear that unilateral is less morbid and less costly in this small study, and these findings should be a strong incentive to test this hypothesis in a larger and more diverse clinical trial. While the potential cost savings in implant and operative time may be very high, a small increase in serious but uncommon complications may overwhelm those savings.

—*The Editors*

fusion stability [2]. Stable fusion helps to improve the results of surgical treatment required in these cases. It is generally accepted that pedicle screw (PS) fixation is necessary to maintain the initial stability of the segment before successful interbody fusion. Traditionally, bilateral PS instrumented TLIF is regarded as a widely accepted method for the management of a variety of spinal conditions. This standard procedure provides rigid fixation and confers both biomechanical and clinical advantages [3–5]. However, several researchers [6–8] have shown that excessively rigid fixation may result in clinically adverse effects, such as device-related osteoporosis because of stress shielding of the vertebra, absorption of grafted bone, thus reducing the fusion rate, and adjacent segment degeneration [9–11]. In addition, the cost-effectiveness of instrumentation is worthy of attention.

Recently, some authors [12,13] have shown that unilateral PS instrumented spinal fusion provides comparable results and is as effective as a bilateral PS construct. Tuttle et al. [14] retrospectively reviewed 47 cases of TLIF augmented with unilateral PS via a paramedian approach. They reported a fusion rate of 97% without neurologic complications. Beringer and Mobasser [15] conducted a small series of TLIF procedures with unilateral PS augmentation. After six months' follow-up, all eight cases showed good clinical results, and the fusion rate was 100%. Deutsch and Musacchio [16] and Kim et al. [17] have also demonstrated the effectiveness of unilateral PS fixation. However, these studies are mainly case reports highlighting good results and high fusion rates. There are few published studies comparing unilateral versus bilateral PS fixation in the TLIF procedure. The purpose of this prospective randomized study was to compare the perioperative data, clinical outcomes (according to visual analog scale [VAS], modified Prolo [mProlo] score, and Oswestry Disability Index [ODI] score), implant costs, fusion rates, and complications between unilateral and bilateral PS instrumented TLIF.

Materials and methods

Patient population

After the approval by the institutional review board, a series of 80 consecutive patients was recruited during a 4-year period from June 2005 to May 2009 and randomly divided into two groups using a computer-generated number list: Group 1, unilateral PS instrumented TLIF using a minimally invasive method, and Group 2, bilateral PS instrumented TLIF using a conventional open method. All patients had predominant complaints of low back pain and unilateral radicular pain. All patients underwent at least 6 months of nonoperative management before surgery. The patients' demographic characteristics and procedure data are listed in Table 1. Indications for surgery were as follows [18–21]: spinal stenosis with spondylolisthesis, low-grade degenerative spondylolisthesis without significant stenosis (stable or unstable), huge lumbar disc herniation, discogenic low back pain confirmed by postdiscography computed tomography (CT) (Fig. 1, Left) and magnetic resonance imaging (Fig. 1, Right), ultralateral disc herniation and recurrent lumbar disc herniation with significant mechanical back pain, and unilateral radiculopathy. Patients who had obvious symptoms or signs of tumor, infection, or severe osteoporosis were not included in this study.

Surgical techniques

In Group 1, after induction of general anesthesia, a skin incision 2 to 3 cm lateral to the midline (Fig. 2) was made using a C-arm image intensifier (PHILIPS BV-25; Philips, Amsterdam, the Netherlands) to identify the location of the interbody access site. The ipsilateral facet joint was exposed after blunt separation between the longissimus and multifidus muscles in a standard Wiltse muscle splitting approach. We performed a unilateral facetectomy on the symptomatic side. Posterior decompression was included when the patients had concomitant canal stenosis.