



## Clinical Study

# Long-term outcomes of transforaminal lumbar interbody fusion in patients with spinal stenosis and degenerative scoliosis

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**Abstract**

**BACKGROUND CONTEXT:** Patients with spinal deformity may present with complaints related to either the deformity itself or the manifestations of the coexisting spinal stenosis. There are reports of successful management of lumbar pathology in the absence of global sagittal or coronal imbalance, with limited decompression and fusion, addressing only the symptomatic segment.

**PURPOSE:** Our study examined the long-term outcomes of transforaminal lumbar interbody fusion (TLIF), a less extensive procedure, based on the experience of the senior author over the past 10 years.

**STUDY DESIGN/SETTING:** This was a retrospective study of symptomatic lumbar spinal stenosis and spinal deformity managed by one surgeon at The Cleveland Clinic since 2003.

**PATIENT SAMPLE:** Forty-one patients were included in the study.

**OUTCOME MEASURES:** The present study measures the long-term clinical functional outcomes of these patients through EQ-5D (EuroQol five dimensions questionnaire), PHQ-9 (Patient Health Questionnaire), and PDQ (Pain Disability Questionnaire) forms, along with documented radiographic parameters and Charlson Comorbidity Index (CCI).

**METHODS:** There were no funding or potential conflicts of interest associated biases in the present study. Patients with symptomatic lumbar spinal stenosis with neutral global alignment in the sagittal and coronal planes and symptomatic stenosis at the deformity level were treated by limited fusion and TLIF, and had a follow-up period of at least 5 years. Excluded were patients under 18 years of age, had more than three levels of fusion, and had an active spinal malignancy or recent spinal trauma. The grouping variables were curve magnitude, revision surgeries, and TLIF levels. Clinical outcomes were compared in all the grouping variables. Analysis of variance (ANOVA) and chi-square tests were utilized;  $p < .05$  was considered statistically significant.

**RESULTS:** The average age and follow-up period were  $66 \pm 10$  and 7.5 years, respectively. There was no statistical difference between patients with curves measuring between  $10^\circ$  and  $20^\circ$  and greater than  $20^\circ$  for EQ-5D, PHQ-9, and PDQ. Patients had worse PDQ data with larger curves compared with smaller curves at both 5 years and final follow-up. Although there was no statistical significance between preoperative coronal curve magnitude and revision surgeries, patients with curves greater than  $20^\circ$  had higher rates of revision surgeries (75%;  $p = .343$ ) in the global lumbar curve deformity group. Although there was no statistical significance for patients who underwent revision surgeries,

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those patients had low PHQ-9 values at the final follow-up ( $p=.09$ ). The revision surgery rate was 48% in one-level TLIF and 18% in two-level TLIF. Moderate pain disability scores were noticed for one-level TLIF patients (mean=75) compared with two-level TLIF patients (mean=27) at the final follow-up, and approached statistical significance in this comparison ( $p=.06$ ).

**CONCLUSION:** Although this topic has a limited audience to spinal deformity surgeons, the prevalence of patients who present with adult spinal deformities has been increasing. Short segment fusion, in the setting of modest spinal deformity, is a reasonable and safe option. Further study on the concept of short segment fusions in the growing patient population is required as more comprehensive fusions do have noted complication rates, and a compromise must be reached between the extent of surgery that is enough to provide pain relief and disability and the degree of surgery that is too much to be tolerated in terms of complication rates. © 2017 Elsevier Inc. All rights reserved.

**Keywords:** Degenerative scoliosis; Limited fusion; Long-term outcomes; Lumbar stenosis; Short segment fusion; Transforaminal lumbar interbody fusion (TLIF)

## Introduction

Degenerative spinal deformity presents a complex problem in modern spine surgery. Its prevalence is estimated at 68% among the healthy adult population with an average age of 70.5 years [1]. Patients may present with complaints related to either the deformity itself or the manifestations of the co-existing spinal stenosis. A recent study suggested that up to 97% of patients with deformity experience symptoms of stenosis [2]. There are no uniform recommendations or well-accepted algorithms for management of these patients. Operative treatment in patients with degenerative scoliosis has been shown to be more effective than nonsurgical treatments for management of both back pain [3] and leg pain [4]. A survey of orthopedic and neurological surgeons demonstrated statistically significant differences in decision-making, with orthopedic surgeons more readily using fusion [5]. In general, the goals of surgical management for adult spinal deformity include improving regional and global alignment, treating the symptoms of spinal stenosis, and preventing progression of the deformity and adjacent segment degeneration.

Studies emphasize the importance of global spine alignment for the patient's well-being and surgical outcomes [6]. Although extensive surgery including multilevel fusion may be needed in patients with a decompensated deformity (primarily global balance in sagittal plane), much less invasive procedures may be sufficient for the management of spinal stenosis. At the same time, benefits of a limited procedure should be weighed against the risks of progression of the deformity or accelerated adjacent level degeneration, which would require additional procedures. Although several predictors of progression of degenerative scoliosis have been described [7], it is not clear whether they can be applied to surgically treated patients. The most rational algorithm is yet to be developed.

In an attempt to initiate this process, a recent publication from Washington University described their decision-making algorithm [8]. The approach consists of six levels of surgical procedures dependent on clinical presentation and the results of imaging studies. It extends from simple

decompression without fusion to extensive correction of the entire deformity. In their decision-making, the authors use arbitrary numbers based on their experience. Several other centers reported their experience with limited procedures in the setting of deformity [9–12]. The short follow-up period of these studies is the main drawback on those reports.

Our study examined the long-term outcomes of transforaminal lumbar interbody fusion (TLIF), a less extensive procedure, based on the experience of the senior author over the past 10 years.

## Methods

There were no conflicts of interest or funding sources for the present study. This was a retrospective study that included patients who had symptomatic lumbar spinal stenosis as well as a concomitant spinal deformity managed surgically at The Cleveland Clinic by one of the authors (RDO) since 2003. Patients also had degenerative lumbar scoliosis with neutral global alignment in the sagittal and coronal planes and symptomatic stenosis (Figure A) at the deformity level (neurogenic claudication or radiculopathy), were treated with limited decompression and TLIF addressing the symptomatic level only (Figure B), and had a follow-up period of 5 years or longer. Excluded were patients under the age of 18 years, underwent more than three levels of fusion, and had an active spinal malignancy or recent spinal trauma from the study.

Forty-one patients met the inclusion criteria. We retrospectively reviewed and documented the patients' demographic data, medical history, surgical records, revision surgeries, clinical functional outcomes, and radiographic parameters. Clinical functional outcomes were measured by EQ-5D (EuroQol five dimensions questionnaire), PHQ-9 (Patient Health Questionnaire), and PDQ (Pain Disability Questionnaire) scores. EQ-5D is a standardized instrument used for measuring generic health status (EQ-5D range:  $-0.109$  to  $1.0$ , a higher score indicates a better quality of life) [13]. The Patient Health Questionnaire is a multiple-choice self-report inventory copyrighted by Pfizer Incorporated that is used as a screening and diagnostic tool for mental health disorders of depression,

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