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Minimally Invasive Laminectomy in Spondylolisthetic Lumbar Stenosis

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ABSTRACT

Background: Degenerative lumbar stenosis associated with spondylolisthesis is common in elderly patients. The most common symptoms are those of neurogenic claudication with leg pain. Surgery is indicated for those who fail conservative management. The generally accepted recommendation is to perform a laminectomy and a fusion at the involved level.

Methods: We reviewed our results for minimally invasive single-level decompression without fusion performed by the senior author in patients with symptomatic lumbar stenosis with spondylolisthesis with no dynamic instability from 2008 to 2011 at a single institution. Outcomes were measured using the visual analog scale (VAS), Prolo Economic Functional Rating Scale, and revised Oswestry Disability Index (ODI) at initial presentation and at 3-month, 6-month, and 1-year follow-up time points.

Results: Records for 28 patients (19 males, 9 females) were reviewed. The success rate, defined as improvement in pain and functional outcome without the need for surgical fusion, was 86%. VAS scores decreased by 6.3 points, Prolo scores increased by 3.5 points, and the ODI decreased by 31% at 1 year. All changes were statistically significant.

Conclusion: Minimally invasive decompression alone can be a reasonable alternative to decompression and fusion for patients with spondylolisthetic lumbar stenosis and neurogenic claudication with leg pain. Decompression without fusion should be considered for older patients and for patients who are not ideal fusion candidates.

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INTRODUCTION

Degenerative spondylolisthesis associated with symptomatic lumbar stenosis resulting in neurogenic claudication is a common pathology, especially in elderly populations.[1-6] Cases that are refractory to conservative management require surgery.[1-3,5-9] Although the preferred surgical intervention is debatable,[10,11] studies generally recommend performing a decompression and fusion of the involved level.[1,2,5,8,12-18] Fusion is performed because instability, as evidenced by the spondylolisthesis, is thought to be a major contributor to lumbar stenosis and the associated symptoms of back and leg pain.[1]

The addition of instrumented fusion to a decompression increases operative time, blood loss, perioperative and postoperative morbidity, and length of hospital stay.[1,11,19] From a healthcare economics standpoint, instrumented fusion adds significantly to cost because of these issues and the cost of hardware.[9] Clinically, decompression and instrumented stabilization are effective for the treatment of lumbar stenosis resulting from degenerative spondylolisthesis. However, given the increasing population of elderly patients with significant medical comorbidities and the growing demands to offer effective treatment without significant added cost, we believe that surgical fusion may not be necessary for everyone.

Minimally invasive surgery (MIS) for spinal decompression has resulted in shorter hospital stays and less postoperative pain than open procedures for nonspondylolisthetic patients and comparable outcomes to open decompression have been demonstrated.[20-22] An effective technique for providing central and bilateral foraminal decompression of lumbar stenosis is to perform a bilateral minimally invasive decompression via a unilateral approach.[19,21-24] We routinely perform this minimally invasive procedure on patients with lumbar stenosis with normal spinal alignment.

Good clinical outcomes have been reported in patients who underwent a fusion procedure for symptomatic lumbar stenosis with spondylolisthesis and developed pseudarthrosis.[8,13,14] As previous

studies have shown, progression of spondylolisthesis in patients who only received a decompression procedure does not necessarily correlate with poorer long-term outcomes.[3,4,21]

We hypothesized, as others have suggested,[2,9,19,21,22,24-26] that decompression alone could yield symptomatic and functional improvement and disability reduction. The senior author (CJB) has been performing MIS laminectomy decompression without fusion on patients with single-level lumbar stenosis and grade 1 spondylolisthesis without evidence of dynamic instability. To examine our outcomes, we retrospectively reviewed our patients' pain, disability, and functional status at several follow-up time points.

METHODS

Patient Selection

In this retrospective case series, we included all patients treated by the senior author at a single institution for lumbar stenosis with bilateral MIS laminectomy via a unilateral approach without fusion from 2008 to 2011. All patients presented with neurogenic claudication resulting in leg pain greater than back pain and Meyerding grade 1 spondylolisthesis seen on x-ray, computed tomography (CT) scan, or magnetic resonance imaging. None of the patients had had previous surgery at the level in question. The absence of a pars defect was confirmed on x-ray or CT, and segmental instability was excluded in all patients on flexion-extension x-rays by ruling out sagittal plane translation at the involved segment. All patients previously had used 1 or more measures of conservative management: behavior/work modification, medical treatment, physical therapy, epidural steroid injections, and/or conservative observations for 6 months or more before surgical intervention was offered.

Procedure

Microsurgical minimally invasive bilateral decompressive lumbar laminectomy via a unilateral approach, as described by previous authors,[19,21-24] was performed using the Minimal Exposure Tubular Retractor (METRx) system (Medtronic) with approach from the side with worse leg pain. An ipsilateral hemilaminectomy and medial partial facetectomy were performed with microscopic magnification. The thickened ligamentum flavum was removed until either epidural fat or the dura was well visualized. The contralateral lamina and facet were undercut. Bilateral nerve roots and neuroforamina were then decompressed. Midline posterior bony and soft tissue elements were left undisturbed and great care was taken to remove no more than one-third of any facet joint.

Surgical Outcomes

Outcomes were measured using the visual analog scale (VAS) for pain, the Prolo Economic Functional Rating Scale, and the revised Oswestry Disability Index (ODI) for back pain.[27] The VAS is a visual version of the numerical rating scale in which 0 corresponds to no pain and 10 to the worst pain imaginable. The Prolo Scale assesses the patient's functional and economic status via a 2-item questionnaire, and the rating scale ranges from 2 (poor) to 10 (excellent). The ODI is a 10-section questionnaire evaluating the patient's level of disability resulting from pain. The rating scale ranges from 0% (no disability) to 100% (bed-bound). The data were obtained from chart reviews for patients who presented at each visit (initial presentation, 3 months, 6 months, and 12 months postoperatively). Complications of intraoperative dural tear, postoperative hematoma requiring surgical revision, and need for surgical fusion at follow-up were also reviewed.

Statistical Analysis

Statistical evaluation was performed using a 1-way analysis of variance comparing the scores at initial presentation and at 3-, 6-, and 12-month follow-ups. A P value <0.05 was considered statistically significant.

RESULTS

Twenty-eight patients (68% male), ranging in age from 62 to 89 years (mean 75 years), met the selection criteria. Figure 1 shows the typical imaging findings of the patients in our study. Surgical success was defined as a decrease in VAS score $\geq$4 points at the latest follow-up appointment. Surgical outcome was successful for 24 of the 28 patients, representing an 86% success rate.

VAS, Prolo, and ODI numerical scores were collected at each follow-up appointment. Strong statistical significance was reached for all outcome measures. The VAS scores (Figure 2) decreased from a mean of 8.6 ± 0.83 at initial presentation to 4.0 ± 1.0 at 3 months, 2.7 ± 1.0 at 6 months, and 2.3 ± 1.1 at 1 year ($P<0.001$). The Prolo scores (Figure 3) increased from a mean of 4.2 ± 0.31 at initial presentation to 6.2 ± 0.60 at 3 months, 6.8 ± 0.72 at 6 months, and 7.7 ± 0.74 at 1 year ($P<0.001$). The ODI scores (Figure 4) decreased from $57\% \pm 4.2\%$ at initial presentation to $40\% \pm 6.6\%$ at 3 months, $33\% \pm 7.8\%$ at 6 months, and $26\% \pm 8.8\%$ at 1 year ($P<0.001$).

One dural tear without cerebrospinal fluid leakage or symptoms occurred. No patient had a reoperation or delayed operative fusions at the latest follow-up.

DISCUSSION

Microsurgical minimally invasive bilateral decompressive lumbar laminectomy via a unilateral ap-

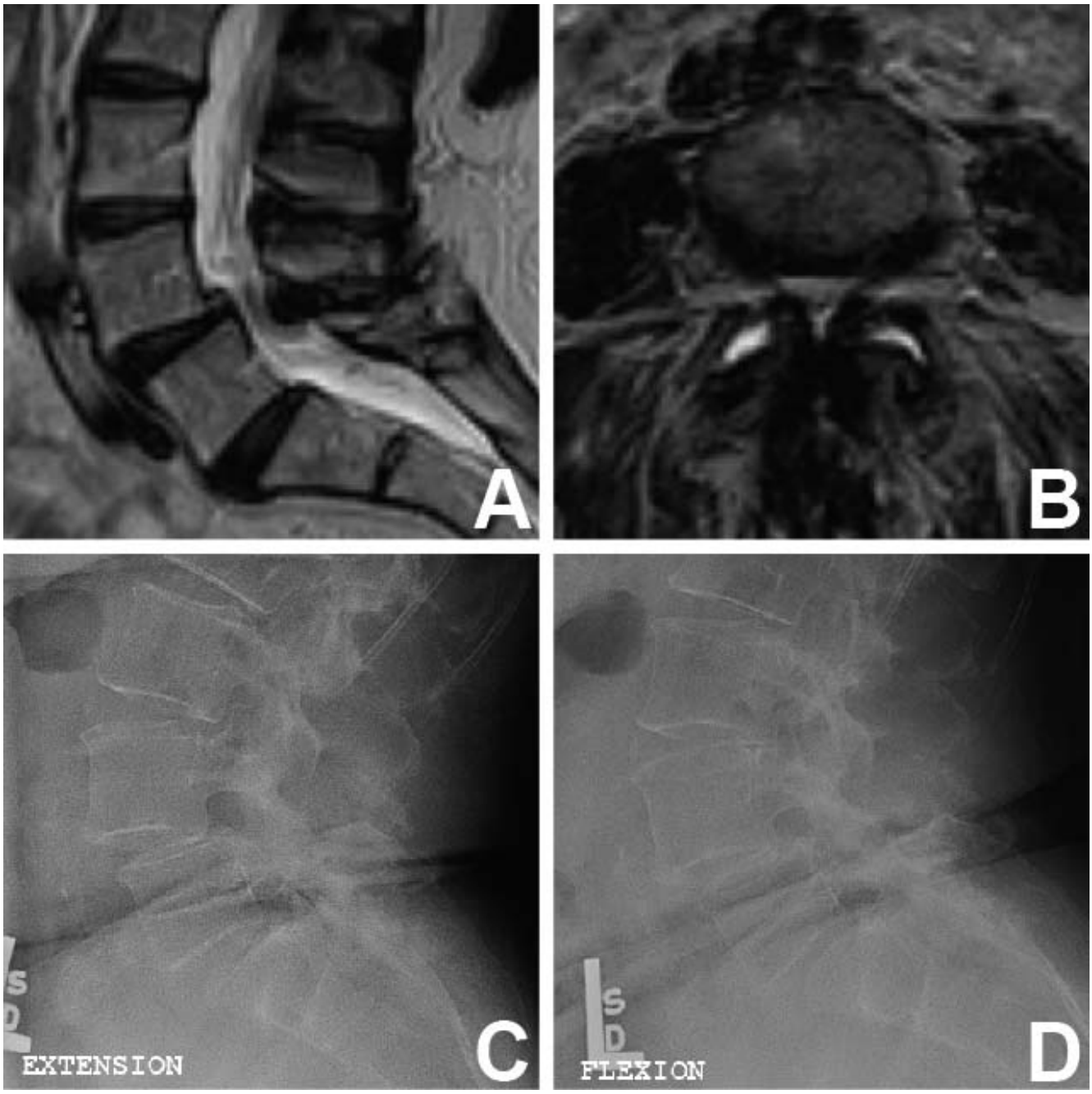

Figure 1. Typical imaging findings in the patients included in our series. (A) Sagittal T2-weighted magnetic resonance imaging (MRI) showing L4-L5 spinal canal stenosis and grade 1 spondylolisthesis of L4 over L5. (B) Axial T2-weighted MRI of the same patient through L4-L5 showing spinal canal and bilateral foraminal stenosis with facet hypertrophy and thickened ligamentum flavum. Extension (C) and flexion (D) radiographs of the same patient showing no dynamic change in the degree of spondylolisthesis.

proach without fusion resulted in decreased pain and disability and improved functional status in our patients. Because of the additional costs associated with instrumented fusion, we feel certain that use of minimally invasive decompression without fusion also provides healthcare cost savings for patients and hospitals, although we did not quantify costs in our study. As illustrated in our patients' demographics, lumbar stenosis with spondylolisthesis primarily affects the elderly population. The multiple medical comorbidities prevalent in this population may confer an increased risk of morbidity and mortality to

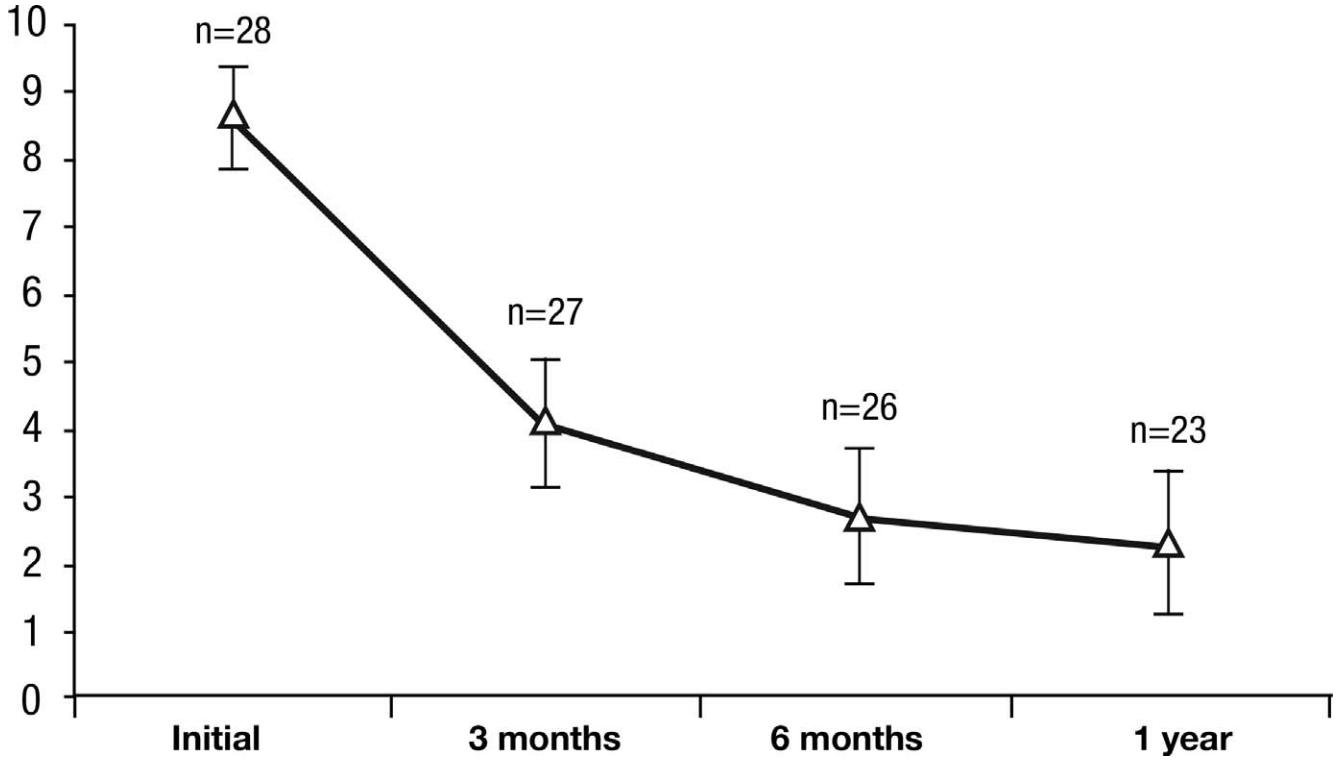

Figure 2. Visual analog scale mean scores for our patients from initial presentation through the follow-up time points. The rating scale ranges from 0 (no pain) to 10 (worst pain imaginable). Error bars represent 95% confidence intervals.

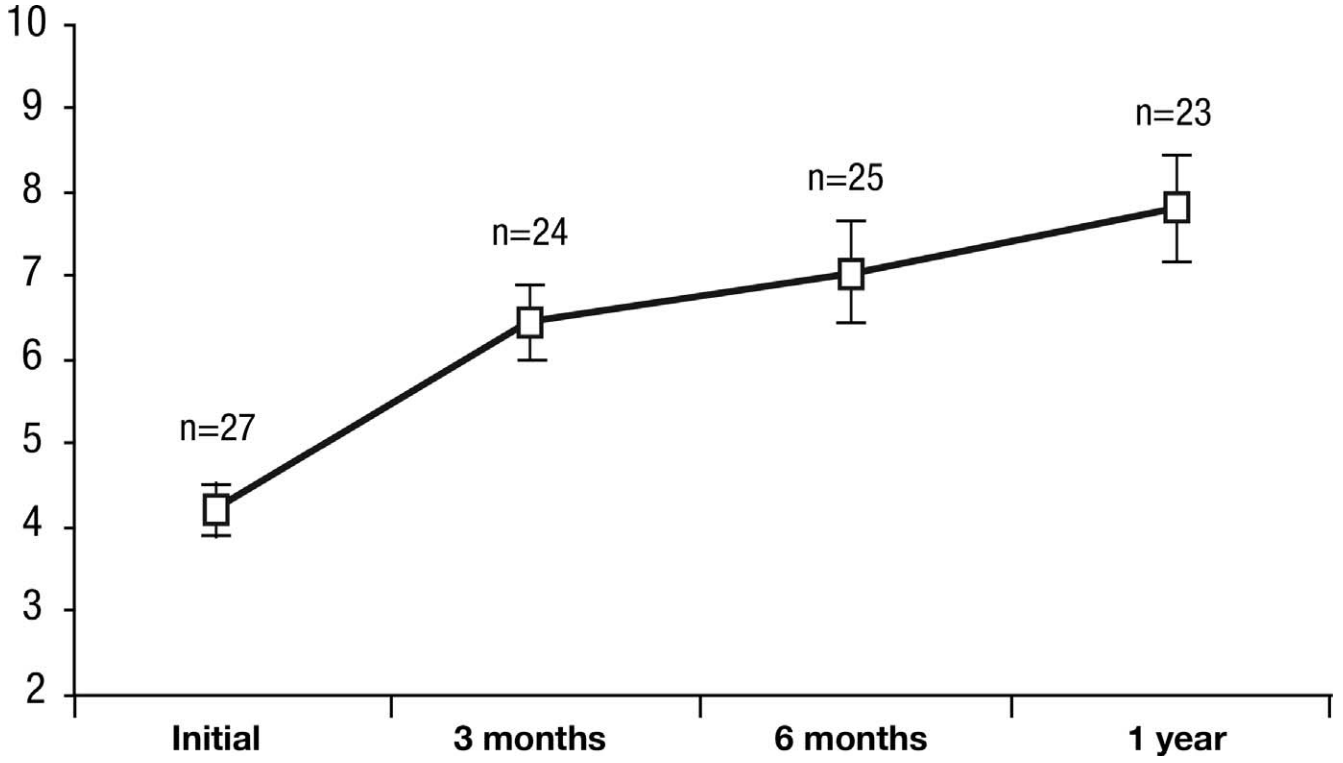

Figure 3. Prolo Economic Functional Rating Scale mean scores for our patients from initial presentation through follow-up time points. The rating scale ranges from 2 (poor) to 10 (excellent). Error bars represent 95% confidence intervals.

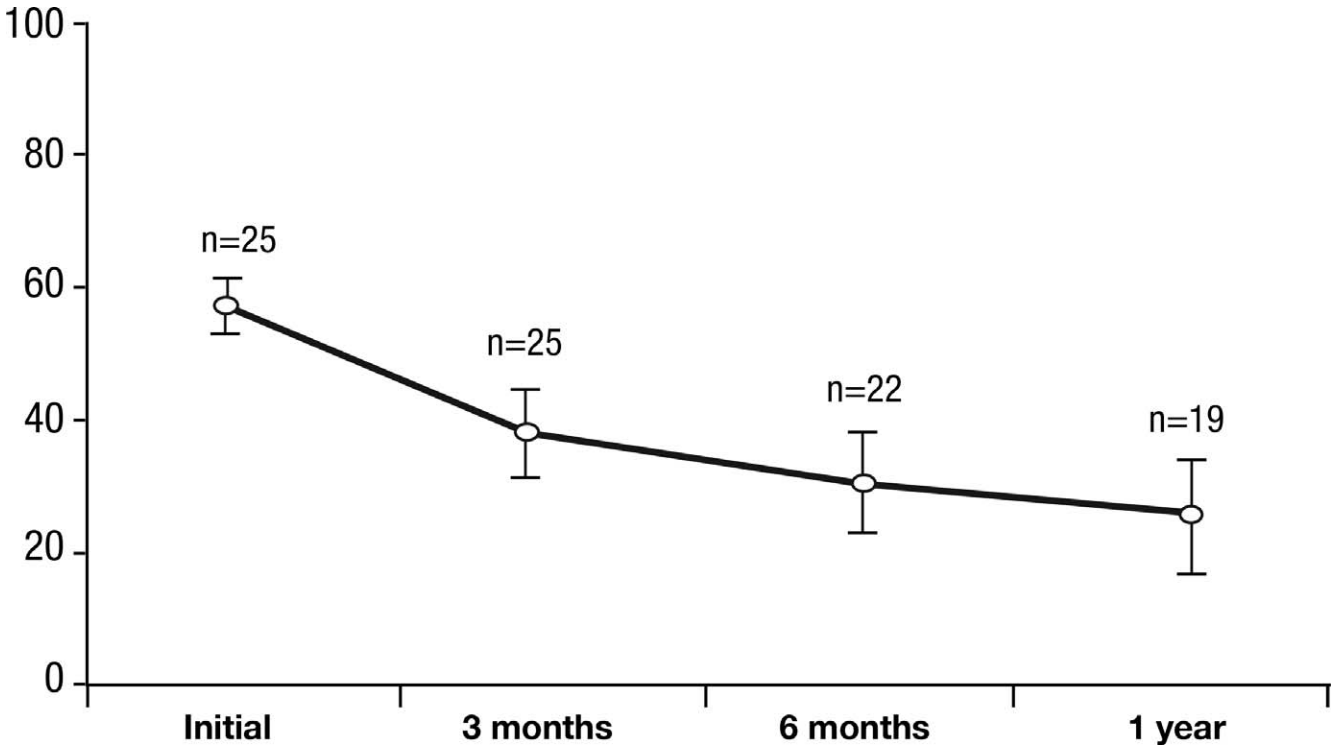

Figure 4. Revised Oswestry Disability Index mean scores for our patients from initial presentation through follow-up time points. The rating scale ranges from 0% (no disability) to 100% (bed-bound). Error bars represent 95% confidence intervals.

extensive surgery or prolonged hospital stays. Minimally invasive spinal surgery results in decreased hospital stays and avoiding instrumented arthrodesis decreases operative time, making minimally invasive procedures an attractive option for elderly patients. Using a minimally invasive technique that preserves the paraspinal muscular and ligamentous structures has been shown to result in improved biomechanical stability of the spine compared to open surgery.[19,24,28]

The recommendation to augment decompression with a fusion procedure in lumbar stenosis with spondylolisthesis was primarily based on literature about open surgical techniques.[1,2,5,8,12-18] The relative preservation of spinal stability with minimally invasive spinal surgery may justify questioning the need to fuse patients who have the pathology of the patients in our study. However, we do not have follow-up imaging that evaluates the progression of spondylolisthesis. Some authors have reported no correlation between increased radiographic instability and poor outcomes in patients who underwent laminectomy for lumbar stenosis.[3,4,21]

This study has several noteworthy limitations: (1) a retrospective noncontrolled review of only 1 surgeon's experience has built-in selection bias; (2) we did not review and compare this data to the senior author's outcomes in patients who received MIS decompression plus fusion; (3) some patients did not present at follow-up; (4) radiographic evaluation for progression of spondylolisthesis upon follow-up was inconsistent; and (5) the follow-up period was only 1 year. Further randomized prospective evaluation of MIS decompression alone versus MIS decompression with fusion is warranted. We plan to provide more quantification of outcomes and a comparative cost analysis with long-term follow-up, including an evaluation of spondylolisthesis progression with follow-up flexion-extension x-rays.

CONCLUSION

Elderly patients with degenerative spondylolisthesis and symptomatic lumbar stenosis with neurogenic claudication and leg pain can obtain significant pain relief and functional improvement with microsurgical minimally invasive bilateral decompressive lumbar laminectomy alone. Minimally invasive decompressive laminectomy without fusion is a safe and viable treatment for this patient population. Decompression without fusion should be strongly considered and potentially offered to symptomatic patients of advanced age who have failed conservative therapy and to patients who have medical comorbidities and relative contraindications for extensive surgery.

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