Randomized controlled trials for degenerative lumbar spondylolisthesis: which patients benefit from lumbar fusion?

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Patients with lumbar stenosis often suffer from symptoms of radiculopathy and claudication. If nonoperative measures, including physical therapy and epidural steroid injections, fail to control their symptoms, patients may be offered surgery. The majority of patients with lumbar stenosis do not have spondylolisthesis, and when these patients undergo surgical treatment, it is typically decompression alone, based on previously published guidelines.18,19

Some patients with lumbar stenosis also have spondylolisthesis, and this may be associated with a significant complaint of mechanical back pain. Patients with this constellation of findings may be offered lumbar decompression with or without fusion. Recently, conflicting studies have been published on the efficacy of decompression alone versus decompression with fusion for the treatment of symptomatic lumbar stenosis with spondylolisthesis.5,7

Patients with degenerative Grade I or II spondylolisthesis are not all the same.14 Some have mechanical low-back pain when there is axial load or stress on the lumbar spine, suggesting instability. Others have radiographic evidence of instability noted on dynamic plain lumbar radiographs. These nuances have been difficult to capture in prior published studies and make the generalization of study results difficult to apply to individual patients. The surgical options for treatment of lumbar stenosis with spondylolisthesis are reflected in prior lumbar guideline publications, which state that fusion should be considered in selected patients.17,20

The past decade has seen a focus on the efficacy of spinal decompression with or without fusion surgery, based on patient-reported outcomes. In the coming decade there will be an additional emphasis on durability, cost-effectiveness, and ultimately on the value of spinal surgery. This transition from a sole focus on the efficacy of surgical treatment to an analysis of cost-effectiveness or value has become an increasingly important priority.

Our purpose is to examine the recently published randomized controlled trials that attempt to decipher the role of decompression with or without fusion for the treatment of symptomatic stenosis with spondylolisthesis and to assess the value of the addition of fusion to a decompression in the treatment paradigm.

Randomized Controlled Trials

Recently, 2 new randomized controlled trials (RCTs) evaluated the utility of adding a fusion when performing a decompressive laminectomy for lumbar stenosis with Grade I lumbar spondylolisthesis: “A randomized, controlled trial of fusion surgery for lumbar spinal stenosis” (the Swedish Spinal Stenosis Study, clinicaltrials.gov registration number NCT01994512), by Försth et al.,5 and “Laminectomy plus fusion versus laminectomy alone
for lumbar spondylolisthesis” (the Spinal Laminectomy versus Instrumented Pedicle Screw [SLIP] trial, clinical trials.gov registration number NCT00109213), by Ghogawala et al.7 Both studies contribute data that add to our knowledge base, although they reached different conclusions. The Swedish trial randomized 247 patients with lumbar stenosis with or without spondylolisthesis and included patients with 1 or 2 levels of disease. This trial did not include dynamic lumbar radiographs and therefore did not attempt to differentiate between those patients with radiographic instability (> 3 mm motion on dynamic lumbar imaging) or not. This study did not detect any difference in the treatment arms using the Oswestry Disability Index (ODI) as the primary outcome measure.

The SLIP trial, on the other hand, was a smaller study that focused upon a homogeneous population of patients with nonmobile single-level Grade I spondylolisthesis. Figures 1 and 2 illustrate the importance of defining the patient population using radiographic data. The patient in Fig. 1 has single-level spondylolisthesis with stenosis and was included in the SLIP study. The images in Fig. 2 are from a different case; the imaging demonstrates 2 levels of pathology, and this patient would therefore have been eligible for the Swedish study but would not have been eligible for the SLIP study. The SLIP investigators found superior health-related quality of life, measured using the SF-36 physical component summary (PCS) score for patients who underwent fusion in addition to decompression. This benefit was maintained at 2, 3, and 4 years following randomization. The Swedish study did not analyze the single-level spondylolisthesis cases separately, and therefore it is not possible to compare the trials directly.

Neither trial detected a difference using the disease-specific ODI instrument, which was the primary outcome measure in the Swedish trial and a secondary outcome measure in the SLIP study. A careful examination of the data from the SLIP study suggests that single-level spondylolisthesis might be associated with better ODI scores over time. At 4 years, the difference in ODI score between groups was 9 points favoring fusion (p = 0.05). Using a minimum clinically important difference (MCID) of 10 points for ODI, 61% of patients treated with laminectomy alone achieved the MCID for ODI, while 85% of patients treated with fusion and laminectomy achieved the MCID (p = 0.04). The sample-size estimate for the SLIP study was based on a published pilot study that examined the comparative effectiveness of adding lumbar fusion for patients with Grade I spondylolisthesis.6 Nevertheless, it is not clear that either trial was appropriately powered to detect a difference of 10 points even if it existed. In Tables 1 and 2, we summarize the estimates for the sample size that would be required in a future trial to detect a difference between mean ODI scores (90% power) or to detect differences in the proportion of a patient population that achieves an MCID of 10 points for ODI. Assuming a standard deviation of 16, a total of at least 110 patients with single-level Grade I spondylolisthesis would be required to have 90% power to detect a between-groups difference of 10. These sample-size estimates do not take into account loss to follow-up. Future investigators would likely inflate these numbers by 10%–15% to account for interim analyses and expected rates of loss to follow-up. This lack of power is a major concern for focusing upon ODI when analyzing the results of both trials.

The SLIP study focused upon the health-related quality of life of patients with spinal stenosis and spondylolisthesis and identified a clinically meaningful improvement in those patients treated with lumbar fusion. The emphasis on health-related quality of life is consistent with a shift to patient-centered care, as seen in the orthopedic joint replacement literature. In addition, a focus on generic health-related quality of life is necessary for the comparison of the impact of different health interventions in our society. The magnitude of treatment benefit associated with lumbar fusion in the SLIP study is comparable to the level of improvement in health-related quality of life following hip arthroplasty.15

**Evidence-Based Practice Guidelines**

When creating clinical practice guidelines, a clinical question is posed. Then, the available literature is searched, graded, and interpreted to create a clinically useful recommendation to address the clinical question. In the latest version of the “Guidelines for the performance of lumbar fusion,” a Grade B–level recommendation was provided, indicating moderate support for the performance of fusion in conjunction with decompression in patients with neurogenic claudication or radiculopathy due to stenosis as-

![FIG. 1. Lumbar flexion (A) and extension (B) radiographs, and sagittal (C) and axial T2-weighted (D) MR images obtained in a 76-year-old man with neurogenic claudication and L4–5 spondylolisthesis.](image-url)