Editorial

Fusion in degenerative spondylolisthesis: how to reconcile conflicting evidence

Adam M. Pearson

Department of Orthopaedics, Geisel School of Medicine at Dartmouth, Hanover, New Hampshire Department of Orthopaedics, Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire, USA

Correspondence to: Adam M. Pearson, MD, MS, Assistant Professor of Orthopaedic Surgery. Geisel School of Medicine at Dartmouth, 1 Medical Center Dr. Lebanon, NH 03745, USA. Email: adam.pearson@hitchcock.org.

Submitted May 31, 2016. Accepted for publication Jun 07, 2016.
doi: 10.21037/jss.2016.06.02
View this article at: http://dx.doi.org/10.21037/jss.2016.06.02

The role of fusion in degenerative spondylolisthesis (DS) was hotly debated in the 1990s, until two studies were performed suggesting that patients undergoing fusion in addition to laminectomy had better outcomes and less progression of listhesis than patients undergoing laminectomy alone (1,2). These were single center studies that used rudimentary randomization techniques and generally subjective, surgeon-reported outcomes. While relatively high quality studies for the time, they would be viewed as no better than Level 2 evidence today. Based largely on the results of these studies, laminectomy and fusion became the standard treatment for DS, and over 95% of DS patients undergoing surgery in the United States now undergo a fusion (3). More recently, the role of fusion has been questioned, especially as less invasive decompressive techniques have been developed (4). As a result, two RCTs were performed comparing laminectomy to laminectomy and fusion, with the results recently published in the *New England Journal of Medicine*.

Försth *et al*. reported the results of the Swedish Spinal Stenosis Study (SSSS), which included 247 patients, 135 of whom had DS (5). They randomized patients to either decompression alone (D) or decompression and fusion (DF). All DS patients underwent a midline laminectomy, and 90% of the fusion patients were treated with an instrumented posterolateral fusion with either local bone graft or iliac crest bone graft (a small proportion underwent interbody fusion or uninstrumented fusion). Sixty percent of patients had one level surgery, with the remaining 40% undergoing two level surgery. The primary outcome measure was the Oswestry Disability Index (ODI) at two year follow-up. Secondary outcomes included the European Quality of Life-5 Dimensions (EQ-5D) and the Zurich Claudication Questionnaire (ZCQ). Patients were followed for 5 years. Ghogawala *et al*. performed the Spinal Laminectomy *vs*. Instrumented Pedicle screw (SLIP) study that similarly randomized 66 DS patients to D or DF. The D group underwent a midline laminectomy, and the DF group underwent a posterolateral instrumented fusion using iliac crest bone graft. All patients had surgery at one level. The primary outcome was the Short Form-36 (SF-36) Physical Component Summary score (PCS) at 2-year follow-up, and the ODI was a secondary outcome measure. Patients were followed for four years.

In the SSSS DS cohort, there were no significant differences on the ODI (16 point improvement in DF group *vs*. 20 point improvement in D group at 2 years), or any other patient reported outcome, through 5 years of follow-up. Loss to follow-up was less than 5% at 2 years. In the SLIP trial, the SF-36 Physical Component Summary (PCS) at 2 years was the primary outcome measure, and the DF group improved by about 6 points more than the D group (a clinically and statistically significant difference). The SLIP trial also evaluated ODI scores and reported an improvement of 26 points in the DF group *vs*. 18 in the D group at 2 years (P=0.06). Loss to follow-up at 2 years was 14%. Additionally, the 4 year reoperation rate was 34% in the D group (all repeat surgeries were at the index level) and 14% in the DF group (all repeat surgery at adjacent levels). In contrast, reoperation rates in the SSSS were the same for the two groups (21% D *vs*. 22% DF, with up to 6.5 years of follow-up). The authors of the two studies

reached essentially opposite conclusions, with the SSSS concluding that there was no advantage of fusion, while the SLIP trial determined that fusion both improved clinical outcome measures and reduced reoperation rate.

These studies present a conundrum for the practicing spine surgeon, since they both appeared to use similar methodologies to study the same question, yet reached substantially different conclusions. The patients in the two studies seem quite similar at baseline and had similar operations. The main driver in the difference in ODI improvement at 2 years was that the DF group in the SLIP trial improved substantially more than the DF group in the SSSS (26 *vs.* 20 points). The outcomes for the D group in the two studies was similar (18 points SLIP *vs.* 20 points SSSS). The degree of ODI improvement at 2 years in the SLIP trial DF group was similar to that observed in the DS surgical group in the Spine Patient Outcomes Research Trial (SPORT, 24 points), with the vast majority of these patients undergoing DF (6). It is unclear what was driving these differences in outcomes in the DF groups between the American and Swedish studies, though there may be unmeasured differences in the patient population or unreported differences in surgical techniques. Forty percent of the Swedish patients underwent two level procedures, which may have resulted in worse outcomes for the fusion patients. In SPORT, the DS patients who underwent multilevel laminectomy and fusion had worse outcomes than those undergoing single level procedures (7). However, in the SPORT stenosis cohort, the number of levels decompressed was not associated with outcomes (8). It may be that increasing the number of levels fused leads to worse outcomes, while decompressing additional levels without fusion does not. There may also be cultural or language differences that affect how patients report their outcomes. For example, among DS patients undergoing DF, 89% of the SPORT patients reported satisfaction with their outcomes compared to 64% in the SSSS. The difference in reoperation rates also raises questions. The reoperation rates in the SSSS were similar for the two treatment groups, however, the reoperation rate was over twice as high for the D group compared to the DF group in the SLIP trial. While there was no D group in the SPORT DS study, the 4-year reoperation rate among the DF fusion patients was 15%, nearly identical to the DF patients in the SLIP trial (14%). Reoperation rate is a difficult outcome measure to interpret, as it reflects the subjective preferences of the surgeons and patients involved in the treatment decision. It would have been helpful to have patient reported outcome data on the patients undergoing reoperation both before and after the revision surgery.

Even after thorough analysis of these papers, it may not be possible to completely explain the differences in outcomes. A simplistic explanation may simply be that American and Swedish patients and surgeons are different, and the results in one nation may not generalize to the other. These studies do reinforce the concept that DS represents a wide spectrum of disease that affects a heterogeneous patient population. We currently tend to treat DS with a one size fits all approach, with the majority of patients in the United States undergoing a laminectomy and instrumented posterolateral fusion (with or without interbody support). These studies reinforce that some DS patients do not derive much benefit from a fusion, and different surgical techniques may be best suited to different patient populations. Unfortunately, there is no scientific data to guide surgical technique selection in DS based on individual patient characteristics. Until there is, many surgeons will likely continue to perform DF in an effort to avoid a difficult revision surgery at the index level. At the same time, surgeons may be more comfortable performing a laminectomy alone in older patients with medical comorbidities and stable appearing slips. DS patients deciding about whether or not to undergo a fusion in addition to laminectomy should be educated about the pros and cons of the procedure in a shared decision-making process (9,10). They should understand that fusion is a more invasive operation with a somewhat higher complication rate and longer recovery period, but it might prevent progression of listhesis and reduce the need for reoperation at that level.

Acknowledgements

None.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

Comment on: Ghogawala Z, Dziura J, Butler WE, *et al*. Laminectomy plus Fusion versus Laminectomy Alone for Lumbar Spondylolisthesis. N Engl J Med 2016;374:1424-34.

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Cite this article as: Pearson AM. Fusion in degenerative spondylolisthesis: how to reconcile conflicting evidence. J Spine Surg 2016;2(2):143-145. doi: 10.21037/jss.2016.06.02

