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International Journal of Spine Surgery 7 (2013) e24–e28

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The value of adding posterior interbody fusion in the surgical treatment of degenerative lumbar spine disorders: A systematic review

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Abstract

Background: Posterolateral fusion (PF) is a common method by which to achieve fusion in lumbar spine surgery. It has been reported that posterior interbody fusion (PIF) yields a higher fusion rate and a better functional and clinical outcome. Our objective was to determine whether PIF improves the clinical and radiologic outcomes in adults surgically treated for degenerative lumbar spine conditions compared with PF.
Methods: We performed a systematic search of electronic databases, bibliographies, and relevant journals and meta-analyses.
Results: Of 2798 citations identified, 5 studies met our inclusion criteria (none of which was a randomized controlled trial), with a total of 148 patients in the PIF group (intervention) and 159 in the PF group (control). Pooled meta-analyses showed that nonunion rates were lower in the intervention group (relative risk, 0.22; 95% confidence interval [CI], 0.08–0.62). The intervention group had a significantly higher disc height (weighted mean difference, 3.2 mm; 95% CI, 1.9–4.4 mm) and lower residual percent slippage (weighted mean difference, 6.3%; 95% CI, 3.9%–8.7%) at final follow-up. There were no significant differences in segmental or total lumbar lordosis. Because of heterogeneity of results, no conclusions could be made with regard to functional benefits.
Conclusions: This review suggests that PIF achieves a higher fusion rate and better correction of certain radiographic aspects of deformity over PF. It also showed a slight but not significant trend toward a better functional outcome in the PIF group. The lack of randomized controlled trials and the methodologic limitations of the available studies call for the planning and conduct of a sufficiently sized, methodologically sound study with clinically relevant outcome measures. Until this has been done, the current evidence regarding the beneficial effects of PIF should be interpreted with caution.

Keywords: Posterolateral fusion; Posterior interbody fusion; Degenerative lumbar spine

Posterolateral spinal fusion is a long-established treatment for various degenerative disorders of the lumbar spine.[1] Since its initial description, few other techniques have been described to achieve fusion of the lumbar spine, including posterior lumbar interbody fusion (PLIF)[2] and unilateral transforaminal posterior lumbar interbody fusion (TLIF).[3] The addition of interbody fusion (PLIF/TLIF) allows decompression of the exiting nerve root by distraction of the collapsed disc space and optimizes fusion in the load-bearing vertebral bodies with rich blood supply. The interbody fusion can be performed through an anterior or posterior approach. The addition of posterior interbody fusion (PIF) is more technically demanding, is associated with a higher complication rate when compared with posterolateral fusion (PF) only, and adds time and cost to the procedures.[4,5] There have been few recent studies comparing PF and PIF in the treatment of degenerative lumbar spine conditions. However, the small sample sizes and the different methods by which to assess outcome have limited the clinical relevance of the findings.[6–10]

The objective of this systematic review is to answer the following question: Does the addition of PIF compared with PF alone improve the clinical and radiologic outcomes in adult patients undergoing surgical treatment for lumbar spine degenerative conditions?

Methods

Eligibility criteria

We identified relevant articles with the following inclusion criteria: (1) the target population consisted of adult

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2211-4599
http://dx.doi.org/10.1016/j.ijsp.2013.01.003

patients undergoing surgical treatment of lumbar spine degenerative conditions (excluding tumor trauma and infection) with a minimum follow-up of 2 years; (2) the intervention was posterolateral with or without instrumentation compared with PIF (either PLIF or transforaminal lumbar interbody fusion with or without instrumentation); and (3) the outcome measure was patient-centered disease-specific functional outcome.

Study identification

A computerized search of the electronic databases Embase (1980–2006) and Ovid Medline and PubMed Medline (1966–February 2006) was performed. A hand search of the *European Spine Journal*, *Spine*, and the *Journal of Spinal Disorders & Techniques*, as well as bibliographies of identified studies and relevant narrative reviews, was performed to identify further studies.

Assessment of study quality

We assessed each published study for the quality of the study design using the Newcastle-Ottawa 8-point scale for assessment of nonrandomized studies.[11] This scale grades the reporting of the studies based on the representativeness of samples, baseline factors, assessment of outcome, statistical analysis or study design, and length of follow-up.

Data extraction

For each eligible study, data were extracted and checked for accuracy. Specifically, the sizes and demographic data of the intervention and control groups, type of fusion, underlying diagnoses, length of follow-up, loss to follow-up, fusion rate, radiologic parameters, and clinical outcomes at final follow-up were recorded.

Data analysis

Because of the variety of clinical outcome tools used in the studies, surgical results were predefined as satisfactory if the patient had a score of less than 40 on the Oswestry Disability Index, a score of greater than 7 on the Prolo scale, or a greater than 40% gain in the Beaujon score or if the final outcome was rated as excellent or good. An outcome rating of excellent, good, significantly better, satisfied, or success was considered a satisfactory outcome, whereas ratings of fair, poor, same, worse, slightly satisfied, slightly dissatisfied, or unsuccessful were classified as unsatisfactory clinical outcomes.

For each study, the abstracted data were entered into Review Manager software, version 4.2, for statistical analysis. Pooled relative risks (RRs) of dichotomous variables (complication, nonunion, or poor outcome) and weighted mean differences of continuous variables (final disc space height and percent of spondylolisthesis slippage) were calculated with a random-effects model[12] and used to compare PF and PIF. Statistical heterogeneity of pooled studies was tested and evaluated with the Higgins I^2 test of heterogeneity at a significance level of $P < .1$.[13]

Results

Study identification

The literature search identified 2798 potentially relevant citations, 1982 from Medline and 816 from Embase. The application of eligibility criteria eliminated all but 5 articles from our study. Four studies were retrospective comparative studies, and one was a prospective nonrandomized trial. Isthmic spondylolisthesis was the preoperative diagnosis in 4 studies.[6,7,9,10] Degenerative disc disease, recurrent disc herniation, spondylolisthesis, and spinal stenosis were the indications for surgery in the fifth.[8] These studies evaluated 307 patients (148 patients in the intervention group [PIF] and 159 patients in the control group [PF]). A minimum of 2 years' follow-up was available for all patients. The sample sizes ranged from 35 to 100 patients. The details of the included studies are summarized in Table 1.

Study quality

Only 1 study stated clearly that the cases represented all the patients who underwent the intervention during the study period after the application of strict inclusion and exclusion criteria.[8] The only prospective study in this review failed to give details on the representativeness of the sample or baseline factors, did not use a validated outcome assessment scale, and did not adequately describe the surgical details or the study design and statistical analysis.[6] Validated outcome assessment scales were used in only 1 study,[9] and the mean follow-up period was 2 to 3 years in all but 1 study, which had a 6-year follow-up.[6] By use of the Newcastle-Ottawa quality assessment scale, none of the included studies met the criteria for a high-quality study. The patient-specific functional outcome evaluation tools included the following: Oswestry Disability Index, Prolo Economic and Functional Scale, Beaujon score, Modified Somatic Perception Questionnaire, Zung Depression Scale, and Kirkaldy-Willis criteria.

Nonunion

Two studies defined solid fusion when there was formation of crossing bony trabeculae and motion was less than 4 on flexion-extension on radiographs.[7,10] Madan and Boeree[9] used the previously mentioned criteria to define union in addition to the criteria of Lenke et al.[14] defining bony union, and La Rosa et al.[7] added the absence of halo around the implant on radiographs to define solid union. Bony fusion was graded according to the classification of Brantigan and Steffee[15] in the study by Lidar et al.[8] The radiologic criteria and classification of fusion data were not reported in 1 study.[6]

Pooled results showed that nonunion was observed in 3 patients (2%) in the intervention group (PIF) and 21 patients (13%) in the control group (PF). This was statistically significant ($P = .002$; RR, 0.21; 95% confidence interval [CI], 0.08–0.56) and is shown in Fig. 1.