

Meta-analysis of the results of lumbar spine fusion

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The role of lumbar spine fusion for many spinal conditions remains controversial, with conflicting evidence on treatment effectiveness. Diagnostic criteria for segmental instability remain uncertain; the selection of patients for laminectomy and fusion or laminectomy alone is uncertain in many cases; multiple anatomical approaches each have their advocates; and the value of various internal fixation devices remains unclear. Furthermore, there are wide geographic and inter-specialty variations in rates of lumbar fusion (1).

In this environment, we undertook a systematic literature synthesis concerning the outcomes of lumbar spine fusion which was recently reported elsewhere (2). This article will summarize the major results of that study and provide a selective update of articles published since that article was prepared.

Methods

The details of our literature synthesis are described elsewhere (2). Briefly, we searched the MEDLINE bibliographic database from 1966 through April, 1991 to identify English-language articles concerning lumbar spine fusion. Additional articles were identified from article bibliographies, book chapters, and six spine surgeons. We excluded articles concerned primarily with congenital anomalies, severe deformities, or systemic diseases. We required that the articles included have at least one year of follow-up data for at least 30 adults who underwent fusion. In addition, some baseline clinical descriptive data were required. Out of 472 articles initially identified, 250 appeared relevant, and only 47 met the inclusion criteria.

Copies of the articles were masked to remove information identifying authors, institutions, journal, and year of publication. Two investigators independently extracted data concerning research methods and outcomes on a standardized coding form. Any disagree-

ments were discussed to reach a consensus. A uniform outcome rating system was used for all articles so that, as a minimum, outcomes could be categorized as satisfactory (excellent, good, improved) or unsatisfactory (fair, poor, unimproved) (2).

In addition, we performed another MEDLINE search in November, 1992, to identify relevant articles published since April, 1992. We report here results of a small number of very recent articles which address important uncertainties.

Results

Quality of research methods: We were unable to identify randomized trials of any fusion technique compared with other fusion techniques, surgery without fusion, or nonsurgical treatment. The original literature synthesis identified four prospective studies, and this article reviews a fifth. Only seven of the studies clearly assessed outcomes independently of the operating surgeon. Most articles omitted important details of the patient preoperative characteristics, surgical techniques, and patient outcomes. For example, of the 47 studies in the original literature synthesis, only 12 reported the average duration of patients' symptoms; 20 reported the percentage of patients who had leg pain prior to surgery; and only 8 reported the percentage of patients with normal neurologic findings. One-fourth of the articles failed to report how many intervertebral levels were fused, and three-fourths omitted specific information on patient return-to-work (2).

Prospective studies (n 4) reported a mean of 54% successful outcomes vs. 73% successful outcomes in retrospective studies (n 18). Twenty-five studies were not included in this comparison because it was unclear whether they were conducted prospectively or retrospectively (2).

Surgery techniques: There were four studies in the original literature synthesis comparing surgery for disc

Table 1. Average proportion of satisfactory outcomes of lumbar spine fusion reported in the literature (2)

	n	% Success
All studies	44	68
Herniated disc	5	70
Spondylolisthesis	7	82

herniation with and without lumbar fusion. Only one reported significantly better results with fusion, but the patients in the two study groups were clearly different at baseline. Furthermore, the nonfusion group had an extremely low success rate (39%), far below that in most reported series (2).

One additional recently published prospective comparative study (briefly discussed in the original review) alternately assigned patients to decompressive laminectomy or laminectomy and fusion (bilateral lateral intertransverse-process arthrodesis). This study included only patients with single level degenerative spondylolisthesis with spinal stenosis. It is unclear whether outcomes were determined independently of the operating surgeon, and whether the two patient groups differed significantly in characteristics other than treatment procedure. A significant difference in favor of fusion was reported, with 96% excellent or good results in the fusion group, versus 44% in the nonfusion group (3).

There were 16 studies which reported using no instrumentation, and 12 reported using instrumentation with all fusions. The clinical success rate was not significantly different in these studies (71% success in the instrumented studies, 67% in the non-instrumented studies) (2). The rate of instrumentation removal averaged 8% among the six studies which reported this (2). In a very recent retrospective study, patients with herniated discs and no prior surgery who had discectomies and posterior lateral fusion were categorized into four groups: those who had no internal fixation, or fixation with Knodt rods, Harrington rods, or variable spine plating. The clinical success rate was highest in the group who had no instrumentation. Furthermore, reoperations were far more common among those who had internal fixation devices (11–43% depending on the device; 4).

Table 1 shows the overall proportion of satisfactory outcomes for all studies, in the original literature synthesis, and a separate listing for studies consisting solely of patients with herniated discs or spondylolisthesis as the original indication. These studies did not differ significantly in outcomes, although there was a trend for more success among patients with spondylo-

Table 2. Average proportion of satisfactory fusion outcomes according to the type of fusion (2)

	n	% Success	% Solid fusion
Posterior	9	66	88
Posterolateral	19	68	89
Anterior interbody	5	67	73
PLIF	5	75	95

listhesis. Table 2 shows the percent of satisfactory clinical outcomes according to the type of fusion procedure. There were no significant differences among these approaches. Although clinical outcomes were generally comparable, the percentage of patients with a solid arthrodesis at follow-up was lowest for anterior interbody fusions (73%), significantly below posterolateral fusions (89%) or posterior lumbar interbody fusions (95%) (2).

Complications were relatively common. In the studies reporting specific complications, an average of 3.7% of patients had deep vein thrombosis, 2.8% had neurological injury, and 8.7% developed chronic donor site pain. Instrumentation failure was reported in 7.3% of instrumented cases. Pseudarthrosis averaged 14% overall in the studies in the literature synthesis. There was a significant relationship between percentage of patients with solid arthrodesis and percentage with satisfactory outcomes (2). However, it is clear in individual studies that pseudarthrosis does not preclude a successful clinical result (3, 5).

Discussion

This systematic review of the literature demonstrated that little is known about how results of lumbar spine fusion compared with those of alternative procedures. Most studies of patients with herniated discs failed to show an advantage of fusion surgery over discectomy without fusion, and there were no comparative studies for patients with degenerative disc disease without herniation. There were also no comparative studies for patients with uncomplicated spinal stenosis, although a single non-randomized comparative trial suggested an advantage of fusion with decompressive laminectomy over laminectomy alone for patients with single level degenerative spondylolisthesis and spinal stenosis (3).

Perhaps the most striking finding of this review was the wide range of successful outcomes (16–95%). It is unclear whether this represents true differences in clinical success rates, or simply differences in study design. Incomplete follow-up, retrospective designs,

and lack of independent outcome raters may substantially influence results. The difference in successful outcomes between prospective (54%) and retrospective (73%) studies clearly suggests that study design has an important influence on the reported successful outcome rate.

We conclude that the indications for lumbar spine fusion for the disorders reviewed here are not scientifically established; that there is a wide range of satisfactory outcomes, in part depending on study design; that the average of 68% success may overestimate the actual clinical results, due to study design flaws and the possibility of publication bias; that there is little support for one fusion technique over others; and that randomized controlled trials are necessary to compare fusion with other surgical and nonsurgical approaches to various lumbar spine disorders.

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