Article Commentary

Axial interbody arthrodesis of the L5-S1 segment: a systematic review of the literature

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Background

Various traditional techniques of arthrodesis of the lumbosacral junction have been used to alleviate lower back and leg pain caused by degenerative disc disease or other spine diseases. These techniques are associated with complications such as inadequate restoration of foraminal height (1) and increased risk of retrograde ejaculation (2,3). A new minimally invasive technique, axial interbody arthrodesis, utilizes the anatomical tissue plane between the sacrum and peritoneal contents, and involves the surgical steps of discectomy, bone grafting and insertion of an axial-directed cylindrical implant (AxiaLIF). Although there is a growing body of research on the clinical applications of this technique, such literature is limited almost exclusively to case series and case reports, and the evidence has not been systematically reviewed.

Aims

The authors (4) conducted a systematic review to determine the fusion rate and safety profile (including complication rate, revision/subsequent surgery rate) of axial interbody arthrodesis of the L5-S1 motion segment.

Search and inclusion criteria

A systematic MEDLINE search, via PubMed, for literature published between January 1, 2000 and August 17, 2014, was independently performed by two authors. This was supplemented by hand-searches of the reference lists of included studies and any other eligible studies were also included.

All peer-reviewed articles related to axial interbody arthrodesis of the lumbosacral junction were identified, and those reporting on the outcomes of L5-S1 fusion rate and complication rates were included. Pathologies of degenerative disc disease, spondylolisthesis, scoliosis, spondylosis, pseudarthrosis and revision surgery were included. Only studies on adult human subjects and in the English language were included.

Data extraction

Abstracts of identified articles were reviewed, and if the article was deemed to be potentially eligible from the abstract content, a full review of the article was performed. For included articles, L5-S1 fusion rates and all reported complications were noted. The latter included: pseudarthrosis at L5-S1, revision and/or subsequent surgery, infections, postoperative radiculopathy, neurological deficits, bowel perforations, retroperitoneal hematomas and/or vascular injury, and significant medical complications. Besides these outcome measures, included studies were identified by its level of evidence, as retrospective or prospective, with or without a reported conflict of interest, and comprising patients with degenerative or deformity-based spinal disease and the underlying diagnoses.

Statistical methods

All extracted data from included studies were analyzed using the lme4 package in the R programming language. A generalized linear mixed-effects model (GLMM) was used to fit the data, with fixed effects being prospective/

retrospective, conflict of interest (yes/no) and degenerative/deformity-based, and random effect being the study. For all fixed effects, P values were reported, based on estimated parameter values and standard errors.

Out of all outcome measures, four had sufficient data from across the studies to allow a formal statistical analysis. These included: L5-S1 pseudarthrosis, all complications except pseudarthrosis, revision/subsequent surgery and postoperative infection. Rates of complication were reported for each outcome, as well as the 95% confidence intervals (CI).

Results

74 articles were identified from the literature searches. Of these, 15 studies comprising 700 patients were included in the analysis. Thirteen of the 15 articles were case series (Level IV evidence) and two were retrospective cohort studies (Level III evidence). Four of the studies were prospective studies, and the remaining eleven were retrospective. Eleven of the 15 studies self-reported a conflict of interest, while the remaining did not.

L5-S1 pseudarthrosis was verified by CT in twelve of the 15 studies and by plain radiography in the remaining three studies. Overall, the L5-S1 pseudarthrosis rate was 6.9% (95% CI: 1.0-16.2%). The rate of all complications excluding L5-S1 pseudarthrosis was 12.9% (95% CI: 4.5-27.5%). The rate of revision and/or subsequent surgery was 14.4% (95% CI: 11.3-20.1%), and the infection rate was 5.44% (95% CI: 2.50-9.66%).

All three fixed effects were found to have significant impact on the rate of all complications excluding L5-S1 pseudarthrosis. Compared to retrospective studies, prospective studies showed a significantly higher complication rate (36.8% *vs.* 8.7%, P=0.003) and a higher rate of additional surgery (22.6% *vs.* 12.9%, P=0.03). Conflict of interest in authors was found to be associated with a significantly lower rate of complications (12.4% *vs.* 17.8%, P<0.0001). Finally, patients with deformity-based spinal diseases were associated with a significantly higher complication rate (46.3% *vs.* 9.2%, P=0.004), than patients with degenerative spinal diseases.

Limitations

Several limitations exist for this study. Firstly, the strength of the evidence of studies analyzed in this systematic review (as measured on the level of evidence scale) is relatively weak, as typical in spine research (5). Due to the considerable paucity of relevant research published to date, no level I or level II evidence study was included, and only four out of 15 studies involved prospectively collected data. There is potential self-serving bias, as eleven of the 15 included studies reported conflict of interest. As shown in the results of this study, conflict of interest in authorship is associated with a significantly lower rate of complications. In addition, heterogeneity in surgical procedures may also affect the outcomes measured in this review. There is significant variation in the use of posterior instrumentation (stand-alone constructs, pedicle screws, facet screws) and in the choice of bone graft and biological enhancers, both between studies and within the same study. Lastly, no patient-reported clinical outcome or radiographic outcome aside from fusion was analyzed in this review. It is hoped that future studies use a prospective, randomized and non-industry-funded approach to address the weaknesses of the present study.

Clinical implications

A systematic review of the literature on axial interbody arthrodesis of the lumbosacral junction indicated that the surgical method is associated with a low L5-S1 pseudarthrosis rate (6.85%) and a moderate complication rate (12.90%). However, these values may be underestimates, owing to a high proportion of studies with retrospectively collected data and reported conflict of interest analyzed in the systematic review.

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Footnote

Conflicts of Interest: The authors have no conflicts of interests to declare.

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