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Review

Survivorship and clinical outcomes after multi-level anterior lumbar reconstruction with stand-alone anterior lumbar interbody fusion or hybrid construct

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ABSTRACT

In multilevel disc disease, there is still uncertainty regarding whether multiple total disc replacement is more effective and safer than fusion. Our objective was to measure and compare the clinical outcome of multilevel hybrid constructs with stand-alone anterior lumbar interbody fusion (ALIF) using a retrospective analysis. Sixty-four patients with chronic low back pain determined to be from two or three-level degenerative disc disease were included. Thirty-three patients were treated with hybrid fusion and 31 with ALIF. Several parameters were retrospectively reviewed, including blood loss, operation time, hospital stay, Visual Analog Scale (VAS) score, Oswestry Disability Index (ODI), and survivorship without the need for revision surgery. Telephone follow-ups were conducted to ascertain survivorship, clinical outcomes (VAS, ODI) and patient satisfaction. Operation time was longer in the hybrid group ($p = 0.021$). The hybrid group showed a significant improvement in VAS and ODI with 52.2% and 50.0% improvement *versus* 28.3% and 25.5% in the ALIF group ($p < 0.05$). At the telephone follow-up for patient satisfaction, 95.7% (n = 22) of the hybrid group were satisfied and 95.2% (n = 21) of the ALIF group were satisfied. Seventy-four percent (n = 17) in the hybrid group and 85.7% (n = 18) in the ALIF group would choose to do the initial surgery again. Kaplan–Meier analysis showed 80.5% survivorship for hybrids and 75.9% for ALIF at 5 years. With our clinical outcomes in VAS and ODI scores, these results, when taken together, indicate that hybrid fusion is a valid and viable alternative to ALIF fusion, with at least equal if not better clinical outcomes in terms of survivorship, back pain, and disability scores.

1. Introduction

Back pain affects roughly 50–80% of the population in a lifetime. It is second only to respiratory infection as the most common reason for doctor visits [1]. For severe disc degeneration with refractory pain, spinal arthrodesis is usually performed. Concerns persist over the long-term consequences of a rigid fusion on the remaining levels [2,3]. Longer fusion constructs carry increased risk for poor outcome [4]. Based on these concerns, there has been an increasing interest in motion preservation devices [5]. The advantage of an artificial disc is that it preserves motion at operated levels, and theoretically avoids excessive strains on the non-operated levels, which may lead to adjacent level disease.

In multilevel disc disease, there is still uncertainty regarding whether multiple total disc replacement (TDR) is more effective and safer than fusion. Siepe et al. observed that multilevel disc replacement with ProDisc (DePuy Synthes, West Chester, PA, USA) had significantly higher complication rates and inferior outcomes compared to single-level TDR [6]. Delamarter et al. published short-term results on two-level lumbar degenerative disc disease showing clinical advantages of TDR in terms of pain relief and functional recovery [7]. A limited number of studies showed mixed success of artificial disc surgery for multilevel disc disease.

An alternative to a multilevel disc replacement procedure is to apply a hybrid model by combining a fusion procedure at the caudal level and disc replacement at the level above. Erkan et al. showed that the motion at the TDR level in a hybrid mode was similar to that of two-level disc replacement [8]. To our knowledge there has only been one study that reported a clinical series of lumbar hybrid fusion [9]. In this study, we compared the clinical outcome

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of multilevel hybrid constructs with anterior lumbar interbody fusion (ALIF).

2. Materials and methods

A retrospective review of clinical and radiographic parameters of patients who had anterior lumbar reconstructive surgeries from November 2004 to August 2009 was conducted. These patients had two or three-level symptomatic lumbar degenerative disc disease. A total of 64 patients were identified who fulfilled the following inclusion and exclusion criteria. All patients underwent a left anterior retroperitoneal approach. Patients were treated at our university medical center by one of our two spine surgeons.

Degenerative disc disease was determined by history, physical examination, and radiographic studies. Our inclusion criteria for both hybrid and ALIF groups were patients between 18 to 65 years old, two or three-level degenerative disc disease with no instability or mild Grade I spondylolisthesis with mild or no signs of facet arthrosis, and both MRI and provocative discography concordant with imaging studies. Patients were excluded if they had any instability greater than Grade I spondylolisthesis, concurrent posterior fusion, major deformity (such as scoliosis greater than 15°), prior reconstructive surgeries (other than laminectomies or microdiscectomies), infection, or tumor.

2.1. Analysis of radiological parameters

We retrospectively reviewed preoperative radiological studies to evaluate for degenerative disc disease, using MRI to determine the presence of Modic changes at the endplates, as well as discography. We reviewed all available plain radiographs and CT scans postoperatively. For disc replacements, we analyzed the position of the artificial disc for device migration or subsidence $\geqslant$3 mm, implant loosening, and loss of disc height >3 mm. For ALIF, we looked at extent of fusion mass, implant position, and any radiographic signs of loosening.

2.2. Analysis of clinical parameters

We retrospectively reviewed preoperative clinical parameters including age, sex, operative time, estimated blood loss, need for intraoperative blood products, hospital stay, pre- and postoperative Visual Analog Scale (VAS) score for the back pain, and Oswestry Disability Index (ODI). We classified failure as return to the operating room for any subsequent operations on the lumbar spine such as removal of malpositioned implants, additional fusion at the index level, pain pump placement, revision surgery for pseudarthrosis, and additional fusion for adjacent level disease. We set failure as an endpoint. In patients who did not fail according to their records from the initial surgery, a telephone follow-up was completed to ascertain if any further lumbar spine surgeries were performed, as well as the most current VAS, ODI, patient satisfaction, and perceived improvement of symptoms.

2.3. Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (IBM, Armonk, NY, USA). Significance of differences between data sets was calculated using the t-test. The incidence for surgical intervention after index surgery was calculated. Kaplan–Meier survivorship curve with 95% confidence intervals was constructed. For patient responses in the follow-up survey, a chi-square test for significance was performed.

3. Results

Sixty-four patients who matched our criteria were found. Of these, 33 patients (13 men, 20 women) were identified who underwent hybrid fusion (Fig. 1) and 31 patients (six men, 25 women) were identified who underwent two or three-level ALIF (Fig. 2). The hybrid group had one patient with a prior single-level lumbar laminectomy, while the ALIF group had one patient with a prior single-level laminectomy and one patient with a single-level microdiscectomy.

In the 25 (76%) patients who underwent two-level hybrid fusions, ALIF was performed at the caudal level and disc replacement at the cephalad level. For the eight (24%) patients who had three-level hybrid fusions, five patients had one disc at the most cranial level and two ALIF on caudal levels, while the remaining three patients had two disc replacements and one ALIF at the most caudal level. In the ALIF group, 25 (81%) had two-level fusion while six patients (19%) had three-level fusions. This data is summarized in Table 1.

3.1. Clinical outcome

The clinical outcomes are summarized in Table 2–4. Patients were significantly younger in the hybrid group with an average age of 42.8 years *versus* 49.7 years in the ALIF group. Operative time was also substantially increased in the hybrid group. No statistical differences were noted in blood loss and hospital stay (Table 2).

Forty-one patients who had both preoperative and postoperative VAS and ODI were found. Of these, 16 were in the hybrid group, and 25 were in the ALIF group. The VAS for back pain is presented in Table 3. All 41 patients in this study presented with low back pain with a mean preoperative score of 6.7 (standard deviation [SD]:2.3) in the hybrid group and 6.7 (SD:0.98) in the ALIF group. The mean VAS for back pain decreased to 3.2 (SD:2.2) postoperatively in the hybrid group *versus* 4.8 (SD:1.03) in the ALIF group. The improvement for hybrid and ALIF groups was 52.2% *versus* 28.3%, respectively ($p = 0.038$).

The ODI is presented in Table 4. In the hybrid group, mean preoperative ODI decreased from 55.0 (SD:18.4) to 27.5 postoperatively (SD:22.7). In the ALIF group, mean preoperative ODI decreased from 58.3 (SD:6.1) to 43.4 (SD:7.8) postoperatively. The improvement was statistically higher in the hybrid group at 50% *versus* the ALIF group at 25.5% ($p = 0.049$).

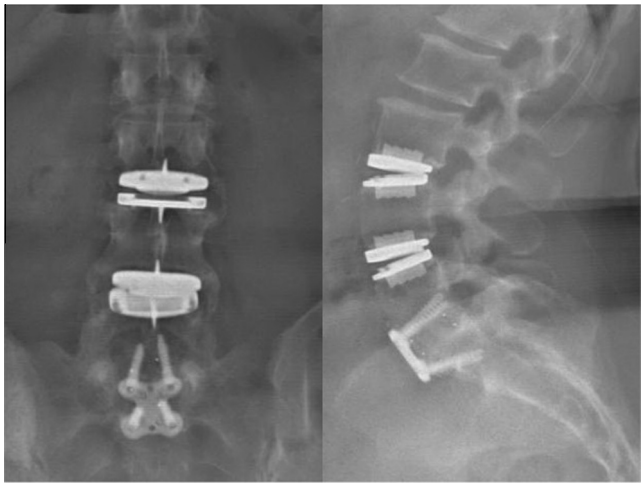

Fig. 1. (Left) Anteroposterior and (right) lateral radiographs showing hybrid fusion with a combination of anterior lumbar interbody fusion and total disc replacement.