Affective disorders influence clinical outcomes after revision lumbar surgery in elderly patients with symptomatic adjacent-segment disease, recurrent stenosis, or pseudarthrosis

Clinical article

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Object. Depression and persistent low-back pain (LBP) are common and disabling problems in elderly patients (> 65 years old). Affective disorders, such as depression and anxiety, are also common in elderly patients, with a prevalence ranging from 4% to 16%. Depressive symptoms are consistently associated with functional disability. To date, few studies have assessed the predictive value of baseline depression on outcomes in the setting of revision spine surgery in elderly patients. Therefore, in this study, the authors assessed the predictive value of preoperative depression on 2-year postoperative outcomes.

Methods. A total of 69 patients undergoing revision neural decompression and instrumented fusion for adjacent-segment disease (ASD, n = 28), pseudarthrosis (n = 17), or same-level recurrent stenosis (n = 24) were included in this study. Preoperative Zung Self-Rating Depression Scale (ZDS) scores were assessed for all patients. Preoperative and 2-year postoperative visual analog scale (VAS) scores for back pain (VAS-BP) and leg pain (VAS-LP) and the Oswestry Disability Index (ODI) were also assessed. The association between preoperative ZDS score and 2-year improvement in disability was assessed via multivariate regression analysis.

Results. Compared with preoperative status, 2-year postoperative VAS-BP was significantly improved after surgery for ASD (9 ± 2 vs 4.01 ± 2.56, respectively; p = 0.001), as were pseudarthrosis (7.41 ± 1 vs 5.0 ± 3.08, respectively; p = 0.02) and same-level recurrent stenosis (7 ± 2.00 vs 5.00 ± 2.34, respectively; p = 0.003). Two-year ODI was also significantly improved after surgery for ASD (29 ± 9 vs. 23.10 ± 10.18, respectively; p = 0.001), as were pseudarthrosis (28.47 ± 5.85 vs 24.41 ± 7.75, respectively; p = 0.001) and same-level recurrent stenosis (30.83 ± 5.28 vs 26.29 ± 4.10, respectively; p = 0.003). Independent of other factors—age, body mass index, symptom duration, smoking, comorbidities, severity of preoperative pain, and disability—increasing preoperative ZDS score was significantly associated with lower 2-year improvement in disability (ODI) after revision surgery in elderly patients with symptomatic ASD, pseudarthrosis, or recurrent stenosis.

Conclusions. The extent of preoperative depression is an independent predictor of less functional improvement following revision lumbar surgery in elderly patients with symptomatic ASD, pseudarthrosis, or recurrent stenosis. Timely diagnosis and treatment of depression and somatic anxiety in this cohort of patients may contribute to improvement in postoperative functional status.

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Key Words: • affective disorder • depression • spine outcome • functional disability • lumbar

Low-back pain (LBP) is a leading cause of disability among elderly patients. Adjacent-segment disease (ASD), pseudarthrosis, and lumbar spinal stenosis are well-defined causes of disability in the elderly and have been increasingly recognized as causes of LBP and claudication. Although surgical treatment has been traditionally contraindicated in patients of advanced age, there is increasing debate regarding the need for surgical intervention in these patients.6,11,15,16,29,33 However, surgical repair of the degenerated lumbar spine in an aging population is often technically challenging, and revision surgery can be particularly challenging in this patient population. Given the rapidly increasing elderly population, the often
contradictory body of literature on surgical intervention in the elderly, and an increasing number of individuals undergoing operative treatment. Evaluation of the preoperative factors that independently predict outcome is critical.

A growing body of evidence suggests that preoperative psychological predisposition may affect surgical outcomes in all patients undergoing spine surgery. In the 1970s, Spengler and colleagues used the Minnesota Multiphasic Personality Inventory to demonstrate a strong correlation between psychological factors and clinical outcomes in patients undergoing lumbar discectomy. Junge and colleagues, in a study of patients undergoing lumbar discectomy, demonstrated that baseline psychological predispositions were useful in predicting poor clinical outcomes after spine surgery. Similarly, a recent study by Adogwa and colleagues demonstrated that depression and somatic anxiety adversely affect clinical outcomes. The authors also suggested that patients with a high baseline level of depression and somatic anxiety were less likely to express satisfaction with the overall quality of health care received. However, there is a paucity of data assessing the effect of preoperative psychological status on outcomes in elderly patients undergoing revision spine surgery.

Given the limited data assessing the effect of preoperative depression on surgical outcomes in elderly patients with failed index lumbar surgery, and a steep increase in the number of surgeries performed, we set out to evaluate the predictive value of preoperative depression on improvement in functional disability after revision lumbar surgery for ASD, pseudarthrosis, or recurrent stenosis, using validated patient-reported outcome instruments.

Methods

Patient Selection

The data for this study were collected at Vanderbilt University, covering the years 2009–2011. A total of 69 consecutive elderly patients (≥65 years old) undergoing revision lumbar decompression and instrumented fusion for symptomatic back and leg pain from pseudarthrosis (n = 17), ASD (n = 28), or same-level recurrent stenosis (n = 24) were included in this longitudinal study. Pseudarthrosis was defined as: 1) dynamic radiographic and CT evidence of pseudarthrosis (lack of bridging bone across motion segments, or pedicle screw halos and motion on dynamic radiographs); 2) corresponding mechanical LBP; and 3) prior attempted arthrodesis at that level. Adjacent-segment disease was defined as: 1) prior instrumented lumbar fusion for degenerative lumbar stenosis; 2) MRI evidence of disc degeneration, listhesis, or stenosis at the adjacent segment; and 3) mechanical low-back and leg pain localizing to the adjacent segment. Same-level recurrent stenosis was defined as: 1) prior lumbar laminectomy; 2) MRI evidence of same-level recurrent stenosis; and 3) presence of mechanical back and radicular leg pain. All patients included in this study were at least 65 years old and failed at least 6 months of conservative therapy. Patients were excluded if they had an extraspinal cause of back pain such as trauma, infection, instrumentation failure, or neoplasm, or were unwilling to participate with the study’s follow-up requirements.

Clinical Outcome Measures

Institutional review board approval was obtained prior to contacting any patients for the outcome assessment. Patient demographics, clinical presentation, indications for surgery, radiological studies, and operative variables were assessed for each case. Patient-assessed outcome measures were prospectively obtained via phone interview. Preoperative and 2-year postoperative pain, disability, and quality of life were assessed by phone interviews conducted by an independent investigator who was not involved with clinical care; the questionnaires included the visual analog scale (VAS) for low back pain (VAS-BP), and leg pain (VAS-LP), Oswestry Disability Index (ODI), and Zung Self-Rating Depression Scale (ZDS). The EuroQol Group–5 Dimension (EQ-5D) and 12-Item Short-Form Health Survey (SF-12) instruments were used to measure health state utility and general health-related quality of life, respectively.

The ZDS was used to assess preoperative depression. It is a 20-item questionnaire with well-established reliability and validity that rates the 4 common characteristics of depression: the pervasive effect, the physiological equivalents, psychomotor activities, and other disturbances. The score on the ZDS ranges from 20 (no depression) to 80 (major depression), with a cutoff value greater than 49 indicating significant depression.

Statistical Analysis

The primary aim of this study was to assess the independent effect of preoperative depression on 2-year response to surgery (change in disability as reflected by ODI score). Parametric data are expressed as means ± standard deviations and were compared using the Student t-test. Nonparametric data are expressed as median (interquartile range) and were compared using the Mann-Whitney U-test. Nominal data were compared using the chi-square test. Variables trending or significantly associated with 2-year ODI in univariate regression analysis (p < 0.10) were entered into a multiple logistic regression model to identify the independent predictors of postoperative outcome (change in ODI score). Stepwise multiple regression was performed to identify all variables that were independently associated with 2-year ODI (p < 0.05).

Results

Baseline Characteristics

A total of 28 patients underwent revision instrumented arthrodesis for ASD, 24 underwent decompression and extension of fusion for same-level recurrent stenosis, and 17 underwent revision neural decompression and instrumented fusion for pseudarthrosis. The baseline characteristics are given in Table 1. Overall, the mean age ± SD was 70 ± 4.50 years (44 women, 25 men). Twelve patients (17.39%) had diabetes and 9 (13.04%) were smokers. The
mean body mass index (BMI) was 29.31 ± 8.68, and the mean duration of time between prior and revision surgery was 3.51 ± 3.63 years (ASD 3.30 ± 3.09 years; pseudarthrosis 3.97 ± 3.94 years). At presentation, overall VAS-BP score was 7.72 ± 1.42 (ASD 9 ± 2; pseudarthrosis 7.47 ± 1; same-level recurrent stenosis 7.0 ± 2.0). The overall mean preoperative ODI and EQ-5D (scaled to US) index scores were 29.55 ± 6.91 and 0.35 ± 0.25, respectively. The mean preoperative SF-12 physical component, mental component, and ZDS scores were 24.54 ± 7.71, 44.12 ± 9.81, and 40.43 ± 7.04, respectively (Table 1). All 69 patients completed their 2-year follow-up questionnaire via phone interview.

Two-Year Outcomes

Pain and disability were significantly improved 2 years after surgery in patients who underwent revision lumbar surgery for all causes (Table 2). Back pain (VAS-BP) was significantly improved 2 years after surgery for ASD (9 ± 2 vs 4.01 ± 2.56, p = 0.001), pseudarthrosis (7.41 ± 1 vs 5.0 ± 3.08, p = 0.02), and same-level recurrent stenosis (7 ± 2.0 vs 5.00 ± 2.34, p = 0.003). Leg pain (VAS-LP) was also significantly improved 2 years after surgery for ASD (6 ± 4 vs 4 ± 3.38, p = 0.002) and same-level recurrent stenosis (7.21 ± 1.85 vs 3.87 ± 4.23, p = 0.001). Two-year ODI was significantly improved after surgery for ASD (29 ± 9 vs 23.10 ± 10.18, p = 0.001), pseudarthrosis (28.47 ± 5.85 vs 24.41 ± 7.75, p = 0.001), and same-level recurrent stenosis (30.83 ± 5.28 vs 26.29 ± 4.10, p = 0.003). Similarly, the 2-year SF-12 physical component score was significantly improved after surgery for ASD (26 ± 9 vs 31.74 ± 11.89, p = 0.003), pseudarthrosis (23.9 ± 7.63 vs 30.99 ± 10.17, p = 0.001), and same-level recurrent stenosis (23.57 ± 6.54 vs 28 ± 6.49, p = 0.004; Table 2).

Correlation Between Preoperative Depression and Improvement in Disability

For patients undergoing revision neural decompression and instrumented fusion for ASD, the following parameters were associated with 2-year improvement in low-back-specific disability (ODI score) based on the univariate analysis: age, sex, smoking history, intraoperative blood loss, operative time, history of diabetes, baseline level of disability (preoperative ODI score), and preoperative level of depression (preoperative ZDS score). When included in a multivariate regression model, BMI, preoperative ODI, and preoperative ZDS score remained independently predictive of 2-year improvement in low-back-specific functional disability (ODI; Table 3). Patients in the top quartile (most depressed) versus bottom quartile (least depressed) of preoperative ZDS scores experienced a 1.6-fold reduced mean improvement in ODI 2 years after surgery (p = 0.001; Fig. 1).

For patients undergoing revision instrumented arthrodesis for pseudarthrosis, the following parameters were associated with 2-year improvement in low-back-specific disability (ODI score) based on the univariate analysis: baseline level of disability (preoperative ODI score), preoperative level of depression (preoperative ZDS score), patient age, history of diabetes, intraoperative blood loss, smoking history, and the duration of the operation. When included in a multivariate regression model, smoking history, preoperative ODI, and preoperative ZDS score remained independently predictive of 2-year improvement in low-back-specific disability (ODI; Table 3). Patients in the top quartile (most depressed) versus bottom quartile (least depressed) of preoperative ZDS scores experienced a 1.4-fold reduced mean improvement in ODI 2 years after surgery (p = 0.001; Fig. 1).

For patients undergoing decompression and exten-

TABLE 1: Baseline characteristics of 69 patients undergoing revision decompression and extension of fusion constructs for symptomatic ASD, same-level recurrent stenosis, or pseudarthrosis

<table>
<thead>
<tr>
<th>Baseline Presentation</th>
<th>Pseudarthrosis</th>
<th>ASD</th>
<th>Same-Level Recurrent Stenosis</th>
<th>Combined Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of patients</td>
<td>17</td>
<td>28</td>
<td>24</td>
<td>69</td>
</tr>
<tr>
<td>mean age (yrs)</td>
<td>71 ± 4.47</td>
<td>71 ± 5.00</td>
<td>69 ± 3.33</td>
<td>70 ± 4.50</td>
</tr>
<tr>
<td>male (%)</td>
<td>5 (29.41)</td>
<td>13 (46.43)</td>
<td>7 (29.17)</td>
<td>25 (36.23)</td>
</tr>
<tr>
<td>smoking (%)</td>
<td>1 (5.88)</td>
<td>5 (17.86)</td>
<td>3 (12.50)</td>
<td>9 (13.04)</td>
</tr>
<tr>
<td>diabetes (%)</td>
<td>1 (5.88)</td>
<td>5 (17.86)</td>
<td>6 (25.00)</td>
<td>12 (17.39)</td>
</tr>
<tr>
<td>BMI</td>
<td>30.66 ± 3.56</td>
<td>30.23 ± 6.5</td>
<td>28.06 ± 11.64</td>
<td>29.31 ± 8.68</td>
</tr>
<tr>
<td>duration between index &amp; revision surgery (yrs)</td>
<td>3.0 ± 4.15</td>
<td>3.30 ± 3.09</td>
<td>3.97 ± 3.94</td>
<td>3.51 ± 3.63</td>
</tr>
<tr>
<td>VAS-LP</td>
<td>6 ± 4</td>
<td>8 ± 4</td>
<td>7.21 ± 1.85</td>
<td>4.13 ± 4.57</td>
</tr>
<tr>
<td>VAS-BP</td>
<td>7.47 ± 1</td>
<td>9 ± 2</td>
<td>7 ± 2.00</td>
<td>7.72 ± 1.42</td>
</tr>
<tr>
<td>ODI</td>
<td>28.47 ± 5.85</td>
<td>29 ± 9</td>
<td>30.83 ± 5.28</td>
<td>29.55 ± 6.91</td>
</tr>
<tr>
<td>EQ-5D utility score</td>
<td>0.36 ± 0.18</td>
<td>0.34 ± 0.26</td>
<td>0.35 ± 0.16</td>
<td>0.35 ± 0.25</td>
</tr>
<tr>
<td>SF-12 PCS</td>
<td>23.9 ± 7.63</td>
<td>26 ± 9</td>
<td>23.57 ± 6.54</td>
<td>24.54 ± 7.71</td>
</tr>
<tr>
<td>SF-12 MCS</td>
<td>44.52 ± 10.25</td>
<td>43 ± 12</td>
<td>45.02 ± 6.58</td>
<td>44.12 ± 9.81</td>
</tr>
<tr>
<td>ZDS</td>
<td>39.94 ± 8.84</td>
<td>41.71 ± 5.85</td>
<td>39.29 ± 6.95</td>
<td>40.43 ± 7.04</td>
</tr>
</tbody>
</table>

* Values expressed as mean ± SD, unless otherwise indicated. MCS = mental component score; PCS = physical component score.
sion of instrumented fusion for same-level recurrent stenosis, the following parameters were associated with 2-year improvement in low-back-specific disability (ODI) based on the univariate analysis: smoking history, BMI, number of vertebral levels involved, history of diabetes, baseline level of disability (preoperative ODI score), and preoperative level of depression (preoperative ZDS score). When included in a multivariate regression model, preoperative ODI and preoperative ZDS score remained independently predictive of 2-year improvement in low-back-specific disability (ODI; Table 3). Compared with patients in the top quartile (most depressed) of preoperative ZDS scores, patients in the bottom quartile (least depressed) experienced a 2-fold increase in mean improvement in ODI 2 years after surgery (p = 0.001; Fig. 1).

**Discussion**

Persistent LBP is one of the most disabling and challenging conditions afflicting the elderly, and depression is known to affect a disproportionate number of elderly patients. However, there is a limited body of research dedicated to defining the role of baseline depression in postoperative outcomes in this patient population. In a 2-year longitudinal cohort study, we set out to assess the predictive value of preoperative depression on improvement in functional capacity in elderly patients undergoing revision surgery for symptomatic pseudarthrosis, ASD, and same-level recurrent stenosis. In all 3 disease states, the presence and magnitude of preoperative depression was significantly and independently associated with poorer outcomes after surgery. As expected, the degree of preoperative disability was also associated with improvement in postoperative functional capacity. Other variables, such as BMI and smoking history, were not universally predictive, although these factors appeared to be more significant for ASD and pseudarthrosis, respectively. Independent of these factors, ZDS score was predictive of 2-year improvement in functional capacity; therefore, the ZDS profile may be valuable in risk-stratifying elderly patients undergoing revision lumbar surgery.

A number of previous studies have found an association between preoperative depression and treatment outcomes after spine surgery, and most have found depression to have a deleterious effect. Carreon and colleagues reported that patients who were not under “mental distress” preoperatively had better clinical outcomes after lumbar fusion. Carreon and colleagues reported that patients who were not under “mental distress” preoperatively had better clinical outcomes after lumbar fusion. It is important to note that the prior studies were not limited to elderly patients. Similarly, Sinikallio and colleagues reported that in elderly patients, preoperative depression was independently associated with reduced postoperative functional improvement. As in these prior studies, we observed less improvement in functional capacity in elderly patients with increased baseline levels of depression. This result highlights the influence of baseline depression on how patients report their pain and disability and their perception of functional improvement following surgery.

The extent of preoperative disability has been shown to predict postoperative outcome. Trief and colleagues, in a prospective study of 160 patients undergoing spine fusion, demonstrated that patients with more pain or poorer function preoperatively also reported more pain or poorer function postoperatively (assessed by VAS and ODI scores). Carreon and colleagues, in a prospective longitudinal cohort of 489 patients undergoing lumbar fusion, showed that patients with worse preoperative disability achieved greater postoperative improvement in disability (assessed by ODI scores).

**TABLE 2: Improvement in reported pain and disability 2 years after revision lumbar neural decompression and instrumented fusion***

<table>
<thead>
<tr>
<th>Outcome Metric</th>
<th>Pseudarthrosis</th>
<th>ASD</th>
<th>Recurrent Stenosis</th>
<th>All Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS-BP</td>
<td>1.94 ± 2.81</td>
<td>4.35 ± 3.16</td>
<td>2 ± 2.23</td>
<td>2.94 ± 3.01</td>
</tr>
<tr>
<td>VAS-LP</td>
<td>—</td>
<td>2.24 ± 4.46</td>
<td>3 ± 3.78</td>
<td>2.48 ± 4.10</td>
</tr>
<tr>
<td>ODI</td>
<td>4.05 ± 7.65</td>
<td>6 ± 13.63</td>
<td>4.54 ± 5.97</td>
<td>5.01 ± 10.01</td>
</tr>
<tr>
<td>SF-12 PCS</td>
<td>4.09 ± 6.30</td>
<td>5.97 ± 13.29</td>
<td>3.64 ± 5.51</td>
<td>4.07 ± 9.53</td>
</tr>
</tbody>
</table>

* Scores given as mean improvement ± SD. Mean 2-year improvement in VAS-BP score ranged from 1.94 to 4.35, in VAS-LP from 2.24 to 3, in ODI from 4.05 to 6, and in SF-12 PCS from 3.64 to 5.97.

**TABLE 3: Independent preoperative predictors of functional improvement (change in ODI score) following revision lumbar surgery in elderly patients, according to diagnosis***

<table>
<thead>
<tr>
<th>Diagnosis Subgroup</th>
<th>Coefficient</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>-1.45</td>
<td>0.05</td>
</tr>
<tr>
<td>preop ODI</td>
<td>4.03</td>
<td>0.01</td>
</tr>
<tr>
<td>preop ZDS</td>
<td>-2.03</td>
<td>0.05</td>
</tr>
<tr>
<td>pseudarthrosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>smoker</td>
<td>-2.06</td>
<td>0.03</td>
</tr>
<tr>
<td>preop ODI</td>
<td>2.27</td>
<td>0.05</td>
</tr>
<tr>
<td>preop ZDS</td>
<td>-2.20</td>
<td>0.02</td>
</tr>
<tr>
<td>same-level recurrent stenosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>preop ODI</td>
<td>4.36</td>
<td>0.01</td>
</tr>
<tr>
<td>preop ZDS</td>
<td>-1.76</td>
<td>0.02</td>
</tr>
</tbody>
</table>

* For all 3 diagnoses, increasing preoperative ZDS score (more depression) and degree of baseline functional disability (preoperative ODI) were independently associated with lower postoperative improvement in disability. For pseudarthrosis, a smoking history was also independently associated with lower postoperative improvement in disability. For ASD, greater BMI was independently associated with reduced postoperative improvement.
reported similar findings. Similar to the aforementioned studies, we observed a basement effect in elderly patients who reported greater preoperative back-related disability (low baseline function). This result suggests the importance of adjusting for varying degrees of preoperative function when assessing postoperative outcomes.

Numerous studies of factors influencing the outcomes of spine surgery have examined whether smoking is a predictor of poor outcomes. Slover et al.36 and den Boer et al.14 showed that smoking negatively affects outcomes in patients undergoing lumbar spine surgery. Glassman et al. found that smokers were more likely to develop pseudarthrosis following spinal fusion.23 Brown and colleagues demonstrated that smokers had decreased levels of PO2 and concluded that inadequate oxygenation of blood flow to the bone graft is more likely to occur in smokers and results in the formation of fibrous tissue rather than bone.9 In contrast, Block et al. did not find that smoking significantly influences clinical outcome.5 Interestingly, in the current study, smoking was not universally predictive of poor outcomes; however, in a multivariate regression analysis of variables affecting outcomes in patients undergoing revision surgery for pseudarthrosis, smoking was found to be independently associated with less improvement in functional disability. Although it has been suggested that decreased oxygenation of blood in smokers leads to pseudarthrosis following spinal fusion, smoking may also be a proxy for other negative health behaviors that contribute to poorer outcomes.

It has been long been speculated that obesity is correlated with poor outcomes in spine surgery. Obesity is associated with longer and more technically challenging operations, and increased weight also places greater strain on the spine itself.7 Block et al. demonstrated that obesity was a predictor of poor outcomes in patients undergoing spine surgery.8 Djurasovic and colleagues found that obese patients had greater overall disability (assessed by ODI score) following lumbar spine surgery; however, both obese and nonobese patients experienced significant improvement in disability after surgery.17 Similarly, several studies have shown that obese and nonobese patients have similar outcomes after lumbar spine surgery in the setting of specific surgical indications.4,23 Carreon et al. found no relationship between preoperative BMI and

![Graph](https://via.placeholder.com/150)

**Fig. 1.** Change in ODI outcome scores for each diagnostic subgroup 2 years after revision surgery, stratified by most depressed (top quartile of preoperative ZDS score) and least depressed (bottom quartile of preoperative ZDS score). Patients in the top quartile of the preoperative ZDS score (most depressed) demonstrated significantly less improvement in disability (ODI) 2 years after revision surgery.
change in disability following lumbar fusion. In our study, increasing BMI was not universally predictive of poor outcomes; however, in the multivariate regression model, increasing BMI was associated with reduced improvement in disability in patients undergoing revision surgery for ASD.

The results of our study should be interpreted while considering several notable limitations of our study. First, the study was initiated after patients underwent surgery. At the time of surgery, pre- and perioperative variables were recorded in a registry and were assessed post hoc at the time of the study’s initiation. Several variables were not available for this study: whether the operations were performed at the same/outside institutions, the 3- to 6-month postoperative outcomes following the index surgeries, and the duration of time between index surgery and the subsequent onset of symptoms (the disease-free interval after index surgery). Additionally, the type of depression affecting each patient, the type and dose of antidepressant medications, or the duration of symptoms prior to index spine surgery were not available at the time of this study. However, despite these limitations, we believe that it is important to recognize that higher baseline depression scores (higher preoperative ZDS scores) were independently associated with less improvement in postoperative functional capacity and health status 2 years after revision lumbar surgery. This finding is noteworthy because it suggests that elderly patients with baseline affective disorders may report less functional improvement and overall dissatisfaction with care, independent of surgical effectiveness. Future randomized controlled studies are needed to corroborate these findings.

Conclusions

In this study we found that the extent of preoperative depression is an independent predictor of less functional improvement following revision lumbar surgery in elderly patients with symptomatic ASD, pseudarthrosis, or recurrent stenosis. Timely diagnosis and treatment of depression and somatic anxiety in this cohort of patients may contribute to improvement in postoperative functional status.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Adogwa, Bagley. Acquisition of data: all authors. Analysis and interpretation of data: all authors. Drafting the article: Adogwa, Kudya, Johnson, Fulchiero, Miller, Heang, Cheng, Bagley. Critically revising the article: all authors. Reviewed and submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Adogwa. Statistical analysis: Adogwa. Study supervision: Adogwa, Cheng, Bagley.

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