Observational Study of Depression in Patients Undergoing Cervical Disc Arthroplasty: Evidence of a Correlation between Pain Relief and Resolution of Depression

Matthew F. Gornet, Anne G. Copay, Francine W. Schranck and Branko Kopjar

*Int J Spine Surg* 2016, 10 ()
doi: [https://doi.org/10.14444/3011](https://doi.org/10.14444/3011)
[http://ijssurgery.com/content/10/11](http://ijssurgery.com/content/10/11)

This information is current as of May 22, 2019.

**Email Alerts**  Receive free email-alerts when new articles cite this article. Sign up at:  [http://ijssurgery.com/alerts](http://ijssurgery.com/alerts)
Observational Study of Depression in Patients Undergoing Cervical Disc Arthroplasty: Evidence of a Correlation between Pain Relief and Resolution of Depression

Matthew F. Gornet, MD,1 Anne G. Copay, PhD,2 Francine W. Schranck, BSN,2 Branko Kopjar, MD, MS, PhD3

1The Orthopedic Center of St. Louis, St Louis, MO, 2SPIRITT Research, St. Louis, MO, 3Department of Health Services, University of Washington, Seattle, WA

Abstract

Background
Depression has been associated with inferior outcomes following lumbar spine surgery. Our purpose was to investigate the prevalence of depression and its impact on the outcomes of a large sample of cervical disc arthroplasty patients and to examine the change in depression occurring in conjunction with changes in disability and pain.

Methods
A cohort of 271 patients who underwent single or multi-level cervical disc arthroplasty at a single orthopedic center filled out the Neck Disability Index, Medical Outcomes Study SF-36, numerical rating scales for neck pain and arm pain, preoperatively and 12-month postoperatively. Patients were classified as Depressed or Non-Depressed, based on their preoperative SF-36 Mental Component Summary (MCS) score. Preoperative scores, 12-month postoperative scores, and change in scores (adjusted for preoperative scores, smoking status, and strenuous job) were compared between Depressed and Non-Depressed. Next, patients in the 2 groups were subdivided into 4 groups: Always Depressed, Never Depressed, No Longer Depressed, and Newly Depressed, based on their combined preoperative and postoperative MCS scores. The same score comparisons were conducted among the 4 groups.

Results
Forty-four percent (118 of 271) of the patients in our sample were Depressed. Despite a significant improvement after surgery, Depressed patients had poorer pre- and postoperative scores than Non-Depressed patients for NDI, MCS, neck pain and arm pain. Two-thirds (80 of 118) of the Depressed patients were No Longer Depressed at 12 months and had postoperative scores similar to the Never Depressed patients. Eight percent (12 of 153) of the Non-Depressed patients became Newly Depressed by 12 months and had postoperative scores similar to the Always Depressed patients.

Conclusions
Depression is a common occurrence in patients with cervical disorders. Relief from pain and disability after cervical disc arthroplasty can be associated with relief from depression, but poor outcomes may also result in patients becoming depressed.

Introduction
Depression is often the uninvited companion of chronic pain. According to the American Academy of Pain Medicine, 77% of chronic pain sufferers report feeling depressed. Depression also often accompanies back pain; 46% of depressed individuals suffer from back pain or sciatica. The National Center for Health Statistics reports that adults with low back pain are more than 4 times as likely to experience serious psychological distress as people without low back pain. Furthermore, studies have shown that depressed patients obtain less pain relief from lumbar spine surgery than non-depressed patients. Although the association between depression and
low back pain has been well-documented, less infor-

mation is available about the relationship between
depression and neck pain. One study found that, out
of a group of 89 patients with cervical spondylotic
myelopathy, more than a third suffered from depres-
sion or anxiety.\textsuperscript{12} As it does with lumbar surgery, de-
pression also appears to diminish the benefits of cer-
vical surgery. Preoperative depression, measured by
the PHQ-9 (a self-administered patient questionnaire
focusing on the symptoms of depression), predicted
lower improvement on the EQ-5D (a standardized,
self-assessment instrument used to measure health
outcomes) after posterior cervical fusion.\textsuperscript{13} Similarly,
the PHQ-9 scores in 61 cervical arthroplasty patients
were associated with their 12-month postoperative
outcomes, specifically, Neck Disability Index, Short
Form-12, and pain scores.\textsuperscript{14} However, these studies
did not examine the association between postopera-
tive depression scores and disability or pain scores.

Our purpose was to investigate the prevalence of de-
pression and its impact on the outcomes of a large
sample of cervical disc arthroplasty patients. Sec-
darily, we examined the change in depression occur-
ing in conjunction with changes in disability and
pain.

**Material and Methods**

**Sample**

In this prospective, comparative, observational co-
hort study at a single large orthopedic center, consec-
tutive patients aged 18 years and older who were un-
dergoing cervical disc arthroplasty for symptomatic
cervical disc conditions were prospectively enrolled
and followed between December 2007 and March
2012. The study was approved by the institutional re-
view board (IRB), and all patients gave their in-
formed consent prior to enrollment.

**Patient-Reported Outcomes**

Patients were asked to answer the following standard
questionnaires: the Neck Disability Index (NDI),\textsuperscript{15}
umerical rating scales (0 to 10) for neck pain and
arm pain,\textsuperscript{16} and the Medical Outcomes Study Short
Form-36-item questionnaire (SF-36).\textsuperscript{2} The patient-
reported outcomes (PRO) were collected preopera-
tively, and at 1.5, 3, 6, and 12 months, and annually
thereafter. The change from preoperative scores to
12-month scores is the object of our analysis.

**Depression**

Typically, 2 summary scales are derived from the
SF-36: the physical component summary (PCS) and
the mental component summary (MCS). The MCS
provides an indication of psychological well-being.
Low MCS scores are indicative of depression. In the
Medical Outcomes Study, individuals diagnosed
with depression had an average MCS score of 34.84.\textsuperscript{2}
Another study used the Center for Epidemiologic
Studies–Depression Scale (CES-D) to diagnose de-
pression in patients and comparatively established
that an MCS score of 35 was able to correctly identi-
fy 87% of the patients as depressed or not.\textsuperscript{17}

In our study, patients with a preoperative MCS score
below 35 were classified as *Depressed* and patients
with a preoperative MCS score ≥ 35 as *Non-
Depressed*.

The preoperative and 12-month MCS scores were
considered jointly to further classify patients into 4
groups: *Never Depressed* (preoperative and 12-month
MCS ≥ 35), *Always Depressed* (preoperative and
12-month MCS < 35), *Newly Depressed* (preoperative
MCS ≥ 35 and 12-month MCS < 35), and *No Longer
Depressed* (preoperative MCS < 35 and 12-month
MCS ≥35).

**Socio-demographic data**

We collected the following preoperative socio-
demographic data: age, gender, body mass index
(BMI), smoking status, Workers’ Compensation sta-
tus, employment status, involvement in litigation,
performance of physically demanding work, and edu-
cational level.

**Medical data**

We recorded co-morbidities, diagnoses, number of
arthroplasty levels, and complications and re-
operations.

**Analyses**

Preoperative sociodemographic characteristics,
scores from patient-reported outcomes, and medical
data were compared between the *Depressed* and *Non-

Downloaded from http://ijssurgery.com/ by guest on May 22, 2019
Depressed groups using the Student t test for continuous data and using the chi-square test for categorical data. Repeated-measures analysis of variance was used to assess the patient-reported outcomes from preoperative to 1 year. We compared the change in preoperative score between the Depressed and Non-Depressed patients at 1 year with analysis of covariance, adjusting for preoperative scores, smoking status and strenuous job. The same analyses were carried out for the 4 patients groups. Statistical analyses were performed with SPSS (version 22, SPSS Inc., Chicago, IL).

Results
Prevalence of depression
Of the 271 patients with 12-month follow-up data, 118 (44%) had an MCS score below 35 and were classified as Depressed. Preoperative and surgical characteristics are reported in Table 1. Depressed patients were more likely to be smokers and to have physically demanding jobs than Non-Depressed patients. Depressed patients also reported higher preoperative disability, neck pain, and arm pain than Non-Depressed patients (Table 2).

Effects of depression on outcomes
Except for PCS scores, Depressed patients had worse outcome scores both preoperatively and at 12 months after surgery. They had higher disability, higher neck pain, higher arm pain, and lower MCS scores at 12 months than Non-Depressed patients (Table 2). However, both Depressed and Non-Depressed patients achieved statistically significant improvement on all scores at 12 months. Furthermore, Depressed patients improved more than Non-Depressed patients in NDI and MCS scores, but less in PCS scores (Table 2 and Figure 1).

After adjusting for preoperative scores, smoking status, and strenuous work (these preoperative variables were significantly different between the 2 groups), the change in outcome scores remained statistically different between Depressed and Non-Depressed patients (Table 3). Notably, Depressed patients had greater improvement in disability, depression, and neck pain than Non-Depressed patients. Despite this greater improvement, their 12-month scores indicated that Depressed patients experienced greater disability, pain, and depression 12 months postoperatively (Table 2).

Effect of outcomes on depression
Table 4 shows the preoperative and 12-month scores for the Never Depressed (n=140), Always Depressed (n=39), No Longer Depressed (n=80), and Newly Depressed (n=12) groups. The improvement is statistically significant for all groups but different between

<table>
<thead>
<tr>
<th>Characteristic/Variable</th>
<th>Depressed n=118</th>
<th>Non-Depressed n=153</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>45.7 (9.2)</td>
<td>45.5 (8.7)</td>
<td>.876</td>
</tr>
<tr>
<td>Body mass index (kg/m^2)</td>
<td>28.8 (5.4)</td>
<td>28.8 (6.0)</td>
<td>.984</td>
</tr>
<tr>
<td>Time to treatment (days)</td>
<td>391.0 (286.5)</td>
<td>412.7 (372.9)</td>
<td>.614</td>
</tr>
<tr>
<td>Male gender</td>
<td>69 (58.5%)</td>
<td>85 (55.9%)</td>
<td>.674</td>
</tr>
<tr>
<td>Smoker</td>
<td>65 (55.1%)</td>
<td>61 (40.1%)</td>
<td>.015</td>
</tr>
<tr>
<td>Workers’ Compensation</td>
<td>86 (72.9%)</td>
<td>108 (71.1%)</td>
<td>.740</td>
</tr>
<tr>
<td>Litigation</td>
<td>83 (70.3%)</td>
<td>93 (61.2%)</td>
<td>.117</td>
</tr>
<tr>
<td>Strenuous job</td>
<td>90 (78.3%)</td>
<td>93 (63.7%)</td>
<td>.011</td>
</tr>
<tr>
<td>Currently employed</td>
<td>108 (91.5%)</td>
<td>138 (92.0%)</td>
<td>.888</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than high school</td>
<td>12 (10.7%)</td>
<td>26 (18.2%)</td>
<td>.515</td>
</tr>
<tr>
<td>High school</td>
<td>54 (48.2%)</td>
<td>68 (47.6%)</td>
<td></td>
</tr>
<tr>
<td>Associate degree</td>
<td>24 (21.4%)</td>
<td>25 (17.5%)</td>
<td></td>
</tr>
<tr>
<td>College</td>
<td>13 (11.6%)</td>
<td>13 (9.1%)</td>
<td></td>
</tr>
<tr>
<td>Master/Professional</td>
<td>9 (8.0%)</td>
<td>11 (7.7%)</td>
<td></td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td>.238</td>
</tr>
<tr>
<td>Discogenic pain</td>
<td>50 (42.4%)</td>
<td>63 (41.4%)</td>
<td></td>
</tr>
<tr>
<td>Herniated disc</td>
<td>37 (31.4%)</td>
<td>61 (40.1%)</td>
<td></td>
</tr>
<tr>
<td>Radiculopathy</td>
<td>30 (25.4%)</td>
<td>28 (18.4%)</td>
<td></td>
</tr>
<tr>
<td>Number of comorbidities</td>
<td></td>
<td></td>
<td>.583</td>
</tr>
<tr>
<td>None</td>
<td>81 (68.6%)</td>
<td>108 (71.1%)</td>
<td></td>
</tr>
<tr>
<td>1 comorbidity</td>
<td>27 (22.9%)</td>
<td>36 (23.7%)</td>
<td></td>
</tr>
<tr>
<td>2 comorbidities</td>
<td>9 (7.6%)</td>
<td>8 (5.3%)</td>
<td></td>
</tr>
<tr>
<td>3 comorbidities</td>
<td>1 (0.4%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Number of re-operations</td>
<td>4 (3.4%)</td>
<td>6 (3.9%)</td>
<td>.810</td>
</tr>
<tr>
<td>Number of AEs</td>
<td>8 (6.8%)</td>
<td>5 (3.3%)</td>
<td>.407</td>
</tr>
<tr>
<td>Number of operated levels</td>
<td></td>
<td></td>
<td>.136</td>
</tr>
<tr>
<td>1 level</td>
<td>60 (50.8%)</td>
<td>82 (53.9%)</td>
<td></td>
</tr>
<tr>
<td>2 levels</td>
<td>45 (38.1%)</td>
<td>63 (41.4%)</td>
<td></td>
</tr>
<tr>
<td>3 levels</td>
<td>13 (11.0%)</td>
<td>7 (4.6%)</td>
<td></td>
</tr>
</tbody>
</table>

AE: adverse events, * n = 112 Depressed and 137 Non-Depressed.
groups. The rate of improvement differs between groups for NDI and PCS.

Figure 2 depicts the preoperative to 12-month improvement of the 4 groups. The *No Longer Depressed* group exhibited the sharpest decline in neck disability. At 12 months, the disability level of the *No Longer Depressed* and *Never Depressed* patients was much lower than that of the *Newly Depressed* and *Always Depressed* patients. The *Never Depressed* patient group reported the greatest improvement in general health as indicated by their PCS scores. At 12 months, the general health level of the *Never Depressed* and *No Longer Depressed* patients was higher than the 2 other patient groups. Neck pain and arm pain decreased at a similar rate for the 4 groups.

Table 2. Preoperative and 12-month postoperative Patient-Reported Outcomes: mean (standard deviation).

<table>
<thead>
<tr>
<th>Group</th>
<th>NDI Preop</th>
<th>NDI 12 mo</th>
<th>PCS Preop</th>
<th>PCS 12 mo</th>
<th>MCS Preop</th>
<th>MCS 12 mo</th>
<th>Neck Pain Preop</th>
<th>Neck Pain 12 mo</th>
<th>Arm Pain Preop</th>
<th>Arm Pain 12 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressed</td>
<td>62.4 (15.1)</td>
<td>31.6 (21.1)</td>
<td>35.5 (6.6)</td>
<td>42.5 (11.4)</td>
<td>27.0 (5.6)</td>
<td>41.9 (12.0)</td>
<td>7.6 (1.6)</td>
<td>3.3 (2.5)</td>
<td>5.8 (2.8)</td>
<td>3.0 (2.7)</td>
</tr>
<tr>
<td>Non-Depressed</td>
<td>48.5 (15.1)</td>
<td>22.8 (18.3)</td>
<td>33.7 (6.7)</td>
<td>45.1 (10.2)</td>
<td>46.6 (8.2)</td>
<td>51.3 (10.5)</td>
<td>6.6 (2.0)</td>
<td>2.7 (2.4)</td>
<td>4.8 (2.8)</td>
<td>1.8 (2.4)</td>
</tr>
</tbody>
</table>

| P*              | <.001     | .688      | <.001     | <.001     | <.001     | <.001     | .251          | .755          |
| P†              | <.001     | <.001     | <.001     | <.001     | <.001     | <.001     |               |               |
| P‡              | .050      | <.001     | <.001     | .251      | .755      |           |               |               |

NDI, Neck Disability Index; PCS, Physical Component Summary of the SF-36; MCS, Mental Component Summary of the SF-36. *Probability for difference between Depressed and Non-Depressed patients. † Probability for difference from preoperative to 12-month postoperative. ‡ Probability for interaction between depression status and change preoperative to 12-month.

Fig. 1. Preoperative and 12-month scores of Depressed and Non-Depressed patients for NDI, PCS, MCS, neck pain, and arm pain. NDI: neck disability index (lower scores indicate improvement); PCS: physical component summary of the SF-36; MCS: mental component summary of the SF-36 (higher scores indicate improvement).
However, due to higher preoperative pain levels, the 12-month pain levels differed among some groups. Notably, the Never Depressed and No Longer Depressed patient groups had the lowest pain levels at 12 months.

Table 5 reports the preoperative to 12-month change in scores for the 4 groups, adjusted for preoperative scores, smoking status, and strenuous work. The change in all scores is significantly different among the 4 groups; however, the change in MCS is due to the definition of the 4 groups. The No Longer Depressed had the greatest improvement in NDI, neck pain, and arm pain. On the contrary, the Newly Depressed patients had the smallest improvement in NDI, neck pain, and arm pain.

Discussion

A large proportion of individuals who have neck pain are depressed. We found that 44% of the patients in our sample were depressed; this proportion is in line with the proportions of depression reported for patients suffering from low back pain.\(^9,18-20\) We also found that depressed patients reported higher levels of disability and pain. It is our contention that it is just as likely that depression results from higher levels of pain and disability rather than depression heightening pain and disability.

All patients, Depressed and Non-Depressed alike, were significantly improved at 12 months after surgery. However, the 12-month outcomes of the Depressed patients were poorer than those of the Non-Depressed patients. At 12 months after surgery, the Depressed patients had higher NDI, neck pain, and arm pain scores than Non-Depressed patients. This situation is similar to that of lumbar spine surgical patients, in whom it has been found that patients suffering from depression preoperatively will have diminished improvement in their patient-reported outcomes after surgery.\(^4-11\)

However, we also demonstrated that one should not conclude that depression hinders the recovery from cervical spine surgery. In our sample, 68% of the pa-

Table 3. Change in preoperative Patient-Reported Outcomes at 12 months: mean (SD).

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Depressed</th>
<th>Non-Depressed</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDI</td>
<td>30.6 (22.0)</td>
<td>25.7 (20.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PCS</td>
<td>7.0 (9.5)</td>
<td>11.3 (10.1)</td>
<td>.002</td>
</tr>
<tr>
<td>MCS</td>
<td>14.9 (12.4)</td>
<td>4.7 (11.4)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Neck pain</td>
<td>4.3 (2.8)</td>
<td>3.9 (2.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Arm pain</td>
<td>2.8 (3.2)</td>
<td>2.9 (3.1)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Table 4. Preoperative and 12-month postoperative Patient-Reported Outcomes: mean (standard deviation).

<table>
<thead>
<tr>
<th>Group</th>
<th>NDI Preop</th>
<th>NDI 12 mo</th>
<th>PCS Preop</th>
<th>PCS 12 mo</th>
<th>MCS Preop</th>
<th>MCS 12 mo</th>
<th>Neck Pain Preop</th>
<th>Neck Pain 12 mo</th>
<th>Arm Pain Preop</th>
<th>Arm Pain 12 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never Depressed</td>
<td>47.2 (14.6)</td>
<td>20.6 (16.8)</td>
<td>34.1 (6.8)</td>
<td>45.9 (10.2)</td>
<td>47.2 (8.2)</td>
<td>53.4 (8.1)</td>
<td>6.5 (2.0)</td>
<td>2.5 (2.3)</td>
<td>4.8 (2.8)</td>
<td>1.7 (2.3)</td>
</tr>
<tr>
<td>Always Depressed</td>
<td>66.2 (13.7)</td>
<td>42.9 (17.2)</td>
<td>33.5 (5.5)</td>
<td>38.5 (9.2)</td>
<td>26.0 (6.1)</td>
<td>28.5 (5.1)</td>
<td>7.6 (1.4)</td>
<td>4.0 (2.5)</td>
<td>5.9 (2.8)</td>
<td>3.5 (2.8)</td>
</tr>
<tr>
<td>Newly Depressed</td>
<td>64.0 (12.4)</td>
<td>47.8 (15.6)</td>
<td>28.9 (3.3)</td>
<td>35.7 (4.9)</td>
<td>39.7 (5.3)</td>
<td>27.8 (5.9)</td>
<td>7.3 (1.8)</td>
<td>4.3 (2.4)</td>
<td>5.4 (2.9)</td>
<td>3.1 (3.0)</td>
</tr>
<tr>
<td>No Longer Depressed</td>
<td>60.2 (15.5)</td>
<td>26.3 (20.6)</td>
<td>36.5 (6.9)</td>
<td>44.5 (11.9)</td>
<td>27.5 (5.3)</td>
<td>48.6 (8.3)</td>
<td>7.6 (1.7)</td>
<td>2.9 (2.4)</td>
<td>5.8 (2.8)</td>
<td>2.8 (2.6)</td>
</tr>
</tbody>
</table>

P* <.001 <.001 <.001 <.001 <.001

P† <.001 <.001 <.001 <.001 <.001

P‡ .005 <.001 <.001 <.001 .120 .613

NDI, Neck Disability Index; PCS, Physical Component Summary; MCS, Mental Component Summary. *Adjusted for preoperative scores, smoking status, and strenuous work.
patients who were depressed preoperatively were no longer depressed at 12 months; those patients reported the greatest improvement in pain and disability. On the other hand, 8% of the patients who were not depressed preoperatively had become depressed by 12 months after surgery. Those patients reported the smallest improvement in disability and pain. Given that depression seems to be erased by good outcomes and spurred by poor outcomes, it seems logical to assume that outcomes are responsible for depressive states after surgery and not the other way around. This possibility has already been suggested for lumbar spine patients.20,21

Table 5. Change in Patient-Reported Outcomes from preoperative to 12 months: mean (SD).

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Never Depressed</th>
<th>Always Depressed</th>
<th>Newly Depressed</th>
<th>No Longer Depressed</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDI</td>
<td>26.2 (20.2)</td>
<td>23.3 (19.0)</td>
<td>16.2 (17.9)</td>
<td>34.6 (22.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PCS</td>
<td>11.5 (10.3)</td>
<td>4.8 (7.0)</td>
<td>6.8 (4.6)</td>
<td>8.1 (10.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MCS</td>
<td>6.2 (10.6)</td>
<td>2.5 (5.7)</td>
<td>-12.0 (8.5)</td>
<td>21.3 (9.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Neck pain</td>
<td>4.0 (2.9)</td>
<td>3.6 (2.8)</td>
<td>2.9 (2.8)</td>
<td>4.6 (2.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Arm pain</td>
<td>3.0 (3.1)</td>
<td>2.5 (3.1)</td>
<td>2.3 (2.5)</td>
<td>3.1 (3.2)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

NDI, Neck Disability Index; PCS, Physical Component Summary; MCS, Mental Component Summary. *Adjusted for preoperative scores, smoking status, and strenuous work.
comes were similar to those of the Newly Depressed patients. It is not possible to definitively say whether the persistence of the depression was due to the mediocre outcomes, or whether the depression caused the mediocre outcomes. It is possible that both situations exist in this group of patients.

It has been suggested that depressed patients should not be candidates for spinal fusion or, at least, should be treated for their depression prior to surgery.\textsuperscript{11} We are aware of a patient without prior history of mental disorders who was required to undergo a full psychological evaluation to obtain health insurance authorization for spine surgery. Our results indicate that the widely held belief that depression causes poorer surgical outcomes should be reconsidered. In particular, further study should be conducted to investigate the association between depression and outcomes of spine surgery.

A limitation of our study resides in its definition of depression based on a single questionnaire score. A rigorous diagnosis of depression would require an extensive evaluation of the patient. Nevertheless, spine surgery studies have traditionally relied on a single indicator of depression or psychological state, such as MCS.\textsuperscript{5,22} We relied on the MCS score as an index of depression for three reasons. First, the MCS score has been shown to be related with other measures of depression and to be a valid measure of depression.\textsuperscript{2,17,23-25} Second, MCS is part of the SF-36 questionnaire that is widely used in clinical assessment and, thus, available for a large number of patients. Third, and most importantly, many studies of spine surgeries have specifically included MCS as a predictor of surgery outcomes and have concluded that a low MCS score is a predictor of poor outcomes.\textsuperscript{6,11,22} We, thus, felt that it was important to further investigate the association between MCS and surgery outcomes.

Also, our sample was constituted of arthroplasty patients and it is possible that the reported outcomes may have been influenced by the patients’ perception of arthroplasty as a state-of-art treatment, as opposed to fusion, the standard of care. However, it has been found elsewhere that relief of pain and disability was positively correlated with relief of depression after lumbar fusion.\textsuperscript{20} Hence, the lifting of depression concomitant with pain relief is not exclusive to arthroplasty.

Conclusion

Neck pain invites depression, a condition that it shares with low back pain and other chronic pain syndromes. Depression, pain, and disability are inter-related and depression does not necessarily impair improvements from spine surgery. When a depressed patient is a candidate for cervical spine surgery, the decision for surgical treatment should not be based on a preoperative diagnosis of depression.

References

1. American Society of Anesthesiologists Task Force on Chronic Pain Management, American Society of Regional Anesthesia and Pain Medicine. Prac-


Table 6. NDI Change from preoperative to 12 months: mean (SD).

<table>
<thead>
<tr>
<th>NDI</th>
<th>Non Depressed Non Smoker N=91</th>
<th>Non Depressed Smoker N=61</th>
<th>Depressed Non Smoker N=55</th>
<th>Depressed Smoker N=65</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Ops</td>
<td>47.8 (15.6)</td>
<td>49.5 (14.4)</td>
<td>60.8 (16.0)</td>
<td>63.3 (14.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>12-month</td>
<td>22.8 (18.8)</td>
<td>22.7 (17.6)</td>
<td>35.3 (21.5)</td>
<td>28.8 (20.3)</td>
<td>.001</td>
</tr>
<tr>
<td>Change</td>
<td>25.0 (20.6)</td>
<td>26.8 (19.1)</td>
<td>25.5 (19.9)</td>
<td>34.5 (23.1)</td>
<td>.029</td>
</tr>
</tbody>
</table>

NDI, Neck Disability Index.

Downloaded from http://ijssurgery.com/ by guest on May 22, 2019


**Disclosures & COI**

Dr. Copay has nothing to disclose. Dr. Gornet reports owning stock from Bonovo, consultancy from K2M, grants, research support, and consultancy from Medtronic, stock from Ouroborus, stock from Paradigm Spine, stock from International Spine and Orthopedic Institute, and stock from Nocimed, outside the submitted work. Dr. Kopjar has nothing to disclose. Ms. Schranck has nothing to disclose.

**Corresponding Author**

Matthew F. Gornet, MD, The Orthopedic Center of St. Louis, 14825 N. Outer Forty Road, Suite 200, St Louis, MO 63141. mfgspine@gmail.com.

Published 1 April 2016.

This manuscript is generously published free of charge by ISASS, the International Society for the Advancement of Spine Surgery. Copyright © 2016 ISASS. To see more or order reprints or permissions, see http://ijssurgery.com.