



Workers compensation patients experiencing depression report meaningful improvement in mental health scores after anterior cervical discectomy and fusion

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ABSTRACT

Background: Mental health has been demonstrated to affect postoperative outcomes. No prior literature has reported the relationship between preoperative mental health on outcomes following anterior cervical discectomy and fusion (ACDF) in the Workers Compensation (WC) population.

Methods: WC claimants who underwent primary ACDF were identified from a single-surgeon retrospective database. Patients were separated by SF-12 MCS score into Depressed (<45.6) or Not Depressed (ND) (≥ 45.6) cohorts. Patient-reported Outcome Measurement Information System Physical Function (PROMIS PF), SF-12 Physical Component Score (SF-12 PCS), SF-12 MCS, visual analog scale (VAS) neck/arm pain, and Neck Disability Index (NDI) were collected and compared within and between groups. Minimum clinically important difference (MCID) achievement rates were compared between groups.

Results: Depressed patients had greater length of stay ($p = 0.007$) and postoperative narcotic consumption ($p = 0.026$). Depressed patients improved at 12-week to 2-year PROMIS PF, 6-month SF-12 PCS, 6-week to 6-month SF-12 MCS, 6-week to 6-month and 2-year VAS neck, all VAS arm, and 6-month NDI ($p \leq 0.045$, all). ND patients improved at 12-week to 1-year PROMIS PF, 6-month to 2-year SF-12 PCS, 12-week to 1-year VAS neck, 6-week to 1-year VAS arm, and 12-week to 1-year NDI ($p \leq 0.044$, all). Between groups, ND patients reported superior PROMIS PF, SF-12 MCS, VAS neck, VAS arm, and NDI scores at two or more periods ($p \leq 0.045$, all). MCID achievement rate regarding SF-12 MCS was greater in the Depressed cohort at all postoperative points up to 1 year ($p \leq 0.020$, all).

Conclusion: Depressed patients tended to have a greater length of stay and postoperative narcotic consumption immediately after surgery. Not depressed patients reported more favorable physical and mental function, pain, and disability scores preoperatively and postoperatively. Depressed patients reported greater MCID achievement in mental function following surgery. Depressed patients with WC have a greater likelihood of reporting tangible improvement in mental health scores following ACDF.

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1. Introduction

Mental health has been demonstrated to influence perception of pain.¹ Poor mental health, scaled by degree of severity, has been associated with increased prevalence and degree of pain.^{2,3} Poor mental health has been associated not only with inferior pain

outcomes following surgery, but inferior function and disability outcomes as well.^{4,5} A multitude of studies have sought to further understand the relationship between preoperative mental health and outcomes following spine surgery.^{4–10} In patients who are more vulnerable to inferior outcomes at baseline, preoperative mental health may play an important role in exacerbating risk of poor outcome. Workers' Compensation (WC) status has been studied extensively with regard to outcomes after surgical intervention and has been isolated as an independent risk factor for poor outcomes after surgery.^{11–13} Specifically regarding orthopaedic interventions, WC status patients may suffer a 2-fold increase to risk for inferior outcomes following surgery when compared to those

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Abbreviation list

ACDF	Anterior Cervical Discectomy and Fusion
WC –	Worker's Compensation
ND –	Not Depressed
ASA	American Society of Anesthesiologists
SF-12 MCS	12-item Short Form Mental Component Score
SF-12 PCS	12-item Short Form Physical Component Score
VAS	Visual Analog Scale
PROMs	Patient-reported Outcome Measures
NDI	Neck Disability Index
MCID	Minimum Clinically Important Difference
PROMIS PF	Patient-reported Outcome Measurement Information System Physical Function
BMI	Body Mass Index
CCI	Charlson Comorbidity Index
LOS –	Length of Stay
OME	Oral Morphine Equivalents
IRB =	Institutional Review Board

without WC.¹¹ Therefore, it is necessary to study factors that may influence these outcomes in WC status patients. This study aims to evaluate the relationship between preoperative mental health on outcomes following anterior cervical discectomy and fusion in the WC population.

1.1. Methods

1.1.1. Patient population

Following acquisition of Institutional Review Board approval and patient consent, patients who underwent ACDF with SF-12 MCS scores reported preoperatively and WC status were searched for in a prospectively maintained single-surgeon registry. Indications for surgery included the presence of cervical spine pathology, including herniation of the nucleus pulposus, degenerative disc disease, or presence of central or foraminal stenosis on magnetic resonance imaging, with concurrent symptoms of pain or weakness refractory to conservative management. Exclusion criteria included patients with private insurance or Medicare/Medicaid or patients with an indication for surgery including infection, trauma, or malignancy. Patients were divided into two cohorts by reported preoperative SF-12 MCS. A prior study by Vilagut et al. (2013), reported an SF-12 MCS of 45.6 to maximize sensitivity and specificity for identifying depression.¹⁴ As such, this cutoff was used for separating the groups into the two cohorts, with those <45.6 categorized as “depressed” and those with a score ≥45.6 categorized as “not-depressed” (ND).

1.1.2. Data collection

Demographics and perioperative characteristics were collected for both cohorts. Categorical variables studied included self-reported gender, ethnicity, American Society of Anesthesiologists (ASA) classification (<2 or ≥2), presence of common comorbidities (smoking, diabetes, and hypertension), spinal pathology, and number of fused levels. Continuous variables studied included age, body mass index (BMI), Charlson Comorbidity Index (CCI), operative time, estimated blood loss, length of stay (LOS), and day of surgery visual analog scale (VAS) pain and narcotic consumption, reported in oral morphine equivalents (OME). Patient-reported Outcome Measures (PROMs) studied included Patient-reported Outcomes Measurement Information System Physical Function (PROMIS PF), SF-12 Physical Component Score (SF-12 PCS), SF-12

MCS, VAS neck pain, VAS arm pain, and Neck Disability Index (NDI). Collection of PROM surveys occurred in the preoperative phase and at several periods postoperatively: 6 weeks, 12 weeks, 6 months, 1 year, and 2 years.

1.1.3. Statistical analysis

All statistical analysis was conducted using Stata 17.0 (StataCorp LP, College Station, TX) software. Inferential statistics were used for comparison of all data within and between groups. Chi-square tests were utilized for all categorical variables between groups. Independent sample t-tests were used for comparison of continuous variables between groups. Paired sample t-tests were used for comparison of preoperative PROM scores to postoperative scores at each time point. The arithmetic difference between PROM scores preoperatively and each point postoperatively were calculated and compared to values in the literature that have been reported as magnitudes denoting clinically tangible levels of improvement. These values, known as the minimal clinically important difference (MCID) are as follows: 4.5 for PROMIS PF, 8.1 for SF-12 PCS, 8.5 for NDI, 2.6 for VAS neck pain, and 4.1 for VAS arm pain.^{15,16} A p-value of less than 0.05 was used for determination of significance for all statistical tests.

1.2. Results

1.2.1. Descriptive analysis

Eighty-one patients were identified for the current study. Fifty-one patients were assorted into the “Depressed” group while 30 patients were categorized as ND. There were no significant differences in demographics observed between groups, with the majority of patients in both groups being caucasian (65.4%) and male (74.1%) (Table 1). A large proportion of patients in both groups suffered from recurrent herniation of the nucleus pulposus (85.2%) with just over half with central stenosis (51.9%) (Table 2). Most patients underwent single-level fusion (64.2%) (Table 2). Neither operative time nor estimated blood loss differed significantly between cohorts (Table 2). Length of stay was significantly greater in the depressed cohort (17.6 h versus 9.6 h in the ND group, $p = 0.007$) (Table 2). While postoperative VAS pain on the day of surgery was not significantly different between groups ($p = 0.585$), narcotic consumption on the day of surgery was significantly greater in the depressed cohort (46.9 OME versus 26.7 OME in the ND cohort, $p = 0.026$) (Table 2).

1.2.2. Primary outcome measures

The depressed cohort reported significant improvement in mean PROMIS PF score from baseline at all time points at and after 12 weeks postoperatively ($p \leq 0.045$, all) (Table 3). The ND cohort reported significant improvement in PROMIS PF at 12 weeks, 6 months, and 1 year postoperatively ($p \leq 0.044$, all) (Table 3). Between groups, the ND cohort reported higher PROMIS PF scores preoperatively at and 12 weeks and 6 months postoperatively ($p \leq 0.020$, all) (Table 3). Regarding SF-12 PCS, the depressed cohort reported a significantly lower score at 6 months ($p = 0.015$), and did not display significant improvement at any period (Table 3). The ND cohort reported significant improvement at all periods at and after 6 months postoperatively ($p \leq 0.007$, all) (Table 3). There were no significant differences in SF-12 PCS score between groups at any evaluated period (Table 3). SF-12 MCS score was improved in the depressed cohort at all time points postoperatively, but only noted significance for the 6-week, 12-week, and 6-month periods ($p \leq 0.012$, all) (Table 3). SF-12 MCS score did not significantly change in the ND cohort postoperatively (Table 3). Between groups, the ND cohort continued to report significantly superior scores at all postoperative time points ($p \leq 0.017$, all) (Table 3). VAS neck

Table 1
Patient demographics.

Characteristic	Total (n = 81)	Depressed (n = 51)	Not Depressed (n = 30)	^a p-value
Preoperative SF-12 MCS Score (mean ± SD)	42.9 ± 13.0	34.9 ± 8.6	56.3 ± 6.3	–
Age (mean ± SD, years)	46.9 ± 8.8	46.0 ± 8.6	48.4 ± 9.0	0.240
Gender				0.683
Female	25.9% (21)	27.5% (14)	23.3% (7)	
Male	74.1% (60)	72.6% (37)	76.7% (23)	
Ethnicity				0.254
Caucasian	65.4% (53)	58.8% (30)	76.7% (23)	
African-American	17.3% (14)	17.7% (9)	16.7% (5)	
Hispanic	13.6% (11)	19.6% (10)	3.3% (1)	
Asian	1.2% (1)	2.0% (1)	0.0% (0)	
Other	2.5% (2)	2.0% (1)	3.3% (1)	
BMI (mean ± SD, kg/m ²)	30.2 ± 5.8	30.1 ± 5.4	30.3 ± 6.4	0.915
Comorbidities				
Smoker	21.0% (17)	27.5% (14)	10.0% (3)	0.063
Hypertension	17.3% (14)	15.7% (8)	20.0% (6)	0.620
Diabetes	8.6% (7)	7.8% (4)	10.0% (3)	0.739
ASA Classification				0.842
<2	24.2% (15)	25.0% (10)	22.7% (5)	
≥2	75.8% (47)	75.0% (30)	77.3% (17)	
CCI Score (Mean ± SD)	1.3 ± 1.4	1.5 ± 1.4	1.1 ± 1.3	0.319
Insurance Type				
Workers' Comp	100.0% (81)	100.0% (51)	100.0% (30)	–

BMI = body mass index; CCI = Charlson Comorbidity Index; ASA = American Society of Anesthesiologists; SD = standard deviation; Workers' Comp = workers' compensation

^a p-values calculated using Student's t-test for continuous variables and chi-square analysis for categorical variables.

Table 2
Perioperative characteristics.

Characteristic	Total (n = 81)	Depressed (n = 51)	Not Depressed (n = 30)	^a p-value
Spinal Pathology				
Herniated Nucleus Pulposus	85.2% (69)	80.4% (41)	93.3% (28)	0.113
Degenerative Disc Disease	7.4% (6)	11.8% (6)	0.0% (0)	0.051
Central Stenosis	51.9% (42)	49.0% (25)	56.7% (17)	0.506
Foraminal Stenosis	4.9% (4)	5.9% (3)	3.3% (1)	0.609
No. Levels Fused				0.356
Single-level	64.2% (52)	58.8% (30)	73.3% (22)	
Two-level	34.6% (28)	39.2% (20)	26.7% (8)	
Three-level	1.2% (1)	2.0% (1)	0.0% (0)	
Operative Time (Mean ± SD; min)	59.7 ± 17.4	61.8 ± 19.5	56.1 ± 12.8	0.156
Estimated Blood Loss (Mean ± SD; mL)	37.3 ± 22.5	39.6 ± 23.7	33.3 ± 20.1	0.227
Length of Stay (Mean ± SD; hours)	14.6 ± 12.8	17.6 ± 14.4	9.6 ± 7.5	0.007
Postoperative Vas pain	5.0 ± 2.2	5.2 ± 2.1	4.9 ± 2.2	0.585
POD 0				
Postoperative Narcotic Consumption (OME)	39.4 ± 39.7	46.9 ± 45.3	26.7 ± 23.3	0.026
POD 0				

POD = postoperative day; mL = milliliters; SD = standard deviation; OME = oral morphine equivalents.

^a p-values calculated using Student's t-test for continuous variables and chi-square analysis for categorical variables. Boldface indicates significance.

pain scores improved significantly in the depressed cohort at all periods except for the 1-year mark ($p \leq 0.046$) (Table 3). The ND cohort demonstrated significantly improved VAS neck scores at the 12-week, 6-month, and 1-year periods ($p \leq 0.020$, all) (Table 3). Between groups, the ND cohort demonstrated significantly superior scores preoperatively and at 12 weeks postoperatively ($p \leq 0.003$, both) (Table 3). In the depressed cohort, VAS arm pain scores improved significantly at all postoperative periods evaluated ($p \leq 0.045$) (Table 3). In the ND cohort, VAS arm pain scores improved significantly at all time points up to and including 1 year postoperatively ($p \leq 0.010$, all) (Table 3). VAS arm scores were significantly better in the ND cohort preoperatively and at 12 weeks postoperatively ($p \leq 0.045$, both) (Table 3). NDI score was significantly improved in the depressed cohort at 6 months ($p = 0.024$) (Table 3). The ND cohort reported significantly improved NDI scores at 12 weeks, 6 months, and 1 year postoperatively ($p \leq 0.016$, all) (Table 3). NDI scores were significantly superior in the ND

cohort preoperatively and up to 6 months postoperatively ($p \leq 0.010$, all) (Table 3). Rates of MCID achievement did not significantly differ between cohorts with regard to PROMIS PF, SF-12 PCS, VAS neck or arm scores, or NDI (Table 4). MCID achievement frequency was significantly greater in the depressed cohort with regard to SF-12 MCS at 6 weeks, 12 weeks, 6 months, 1 year, and overall ($p \leq 0.020$, all) (Table 4).

1.3. Discussion

Workers' Compensation status has been associated with greater risk of negative outcomes across a myriad of surgical procedures.^{11–13, 17–20} The influence of WC status has been studied extensively in orthopaedic surgery, with a systematic review and meta-analysis covering 20 years conducted by de Moraes et al. (2013) reporting those with WC to have twice as great a risk for a negative outcome following intervention.¹¹ Prior studies by Gruson

Table 3
Mean patient reported outcomes.

PROM	Depressed Mean ± SD	^a p-value	Not Depressed Mean ± SD	^a p-value	^b p-value
PROMIS PF					
Preoperative	32.8 ± 4.2	—	38.3 ± 8.0	—	0.014
6-week	36.0 ± 6.3	0.123	39.3 ± 8.6	0.760	0.256
12-week	36.7 ± 7.6	0.045	49.2 ± 8.6	0.005	<0.001
6-month	39.3 ± 7.5	0.007	46.8 ± 5.0	0.010	0.020
1-year	44.8 ± 6.9	0.006	48.7 ± 9.4	0.044	0.377
2-year	41.7 ± 9.5	0.015	48.9 ± 11.4	0.103	0.158
SF-12 PCS					
Preoperative	37.0 ± 11.8	—	32.2 ± 8.7	—	0.058
6-week	36.1 ± 11.1	0.266	32.9 ± 6.9	0.450	0.254
12-week	41.8 ± 13.2	0.078	37.7 ± 10.9	0.096	0.267
6-month	35.5 ± 8.6	0.015	39.7 ± 8.2	< 0.001	0.135
1-year	34.8 ± 8.6	0.418	43.5 ± 8.2	0.003	0.090
2-year	34.9 ± 15.3	0.242	46.8 ± 8.2	0.007	0.057
SF-12 MCS					
Preoperative	34.9 ± 8.6	—	56.3 ± 6.3	—	—
6-week	40.1 ± 10.2	< 0.001	53.7 ± 8.9	0.164	<0.001
12-week	39.8 ± 8.8	0.001	53.1 ± 9.9	0.152	<0.001
6-month	39.0 ± 13.4	0.012	52.8 ± 11.0	0.118	0.002
1-year	38.7 ± 15.1	0.200	56.6 ± 9.5	0.784	0.003
2-year	38.5 ± 10.8	0.292	52.2 ± 11.0	0.214	0.017
VAS neck					
Preoperative	7.4 ± 1.8	—	5.7 ± 2.3	—	0.003
6-week	4.7 ± 2.8	< 0.001	4.6 ± 2.2	0.063	0.809
12-week	5.2 ± 2.2	< 0.001	3.3 ± 2.4	< 0.001	0.002
6-month	4.7 ± 3.0	< 0.001	3.2 ± 2.2	< 0.001	0.059
1-year	4.9 ± 2.1	0.223	3.5 ± 2.7	0.020	0.173
2-year	4.7 ± 2.7	0.046	3.8 ± 2.6	0.070	0.533
VAS arm					
Preoperative	6.8 ± 2.2	—	5.5 ± 2.7	—	0.045
6-week	4.4 ± 2.8	< 0.001	3.4 ± 2.6	0.005	0.163
12-week	4.9 ± 2.8	0.001	2.5 ± 2.2	< 0.001	<0.001
6-month	4.6 ± 3.0	0.005	3.1 ± 2.6	0.001	0.074
1-year	3.8 ± 2.5	0.035	3.1 ± 2.1	0.010	0.399
2-year	4.7 ± 3.1	0.045	3.5 ± 2.7	0.121	0.487
NDI					
Preoperative	57.9 ± 15.6	—	42.6 ± 16.6	—	<0.001
6-week	51.5 ± 17.3	0.082	38.6 ± 17.5	0.437	0.007
12-week	50.4 ± 20.2	0.052	28.4 ± 15.7	< 0.001	<0.001
6-month	44.6 ± 27.4	0.024	27.7 ± 15.5	< 0.001	0.010
1-year	37.5 ± 22.7	0.265	25.4 ± 19.1	0.016	0.154
2-year	40.6 ± 23.1	0.076	22.9 ± 21.3	0.082	0.162

^a p-values calculated using paired sample t-test to determine preoperative to postoperative improvement.

^b p-values calculated using Student's t-test to compare mean PROMs between both cohorts. Boldface indicates significance.

et al. (2013) and Morris et al. (2015) have reported significantly worse physical function, pain, and satisfaction outcomes in WC patients undergoing upper extremity surgery when compared to their non-WC counterparts.^{18,19} In spine surgery, studies have demonstrated that patients with WC status report increased postoperative pain and disability with decreased satisfaction following intervention.^{12,13,17} However, a study by Gornet et al. (2016) reported that patients with WC did not suffer inferior outcomes compared to those with other varieties of insurance.²¹ Regardless, there is a clear potential for those with WC status to risk inferior outcomes after spine surgery which demands further study of variables that may synergistically impact outcomes in this patient population.

In this current study, we sought to determine the potential impact preoperative mental health, as reported by SF-12 MCS, may have on this at-risk population in patients undergoing ACDF. Poor mental health has been associated with increased incidence or perception of pain along with increased disability.^{1,22–24} In prior studies of the influence of preoperative mental health on outcomes after spine surgery, lower mental health scores were associated

Table 4
Minimum clinically important difference.

PROM	Depressed %, (n)	Not Depressed %, (n)	*p-value
PROMIS PF			
6-week	53.9% (7)	27.3% (3)	0.188
12-week	53.3% (8)	60.0% (6)	0.742
6-month	63.6% (7)	71.4% (5)	0.732
1-year	85.7% (6)	62.5% (5)	0.310
2-year	60.0% (6)	85.7% (6)	0.252
Overall	76.5% (13)	78.6% (11)	0.889
SF-12 PCS			
6-week	10.3% (3)	19.1% (4)	0.381
12-week	22.9% (8)	27.8% (5)	0.693
6-month	38.9% (7)	36.8% (7)	0.898
1-year	37.5% (3)	46.2% (6)	0.697
2-year	33.3% (3)	55.6% (5)	0.343
Overall	34.2% (14)	56.0% (14)	0.081
SF-12 MCS			
6-week	75.9% (22)	14.3% (3)	< 0.001
12-week	42.9% (15)	11.1% (2)	0.019
6-month	61.1% (11)	21.1% (4)	0.013
1-year	75.0% (6)	23.1% (3)	0.020
2-year	44.4% (4)	22.2% (2)	0.317
Overall	73.2% (30)	28.0% (7)	< 0.001
VAS neck			
6-week	50.0% (15)	30.8% (8)	0.145
12-week	46.7% (14)	46.2% (12)	0.969
6-month	55.2% (16)	52.2% (12)	0.829
1-year	20.0% (2)	53.3% (8)	0.096
2-year	42.9% (3)	50.0% (3)	0.797
Overall	76.5% (26)	67.9% (19)	0.449
VAS arm			
6-week	21.4% (6)	26.9% (7)	0.637
12-week	17.2% (5)	38.5% (10)	0.078
6-month	26.9% (7)	39.1% (9)	0.363
1-year	20.0% (2)	33.3% (5)	0.467
2-year	16.7% (1)	40.0% (2)	0.387
Overall	40.6% (13)	53.6% (15)	0.316
NDI			
6-week	46.4% (13)	30.8% (8)	0.238
12-week	41.4% (12)	65.4% (17)	0.075
6-month	57.7% (15)	65.2% (15)	0.590
1-year	60.0% (6)	53.3% (8)	0.742
2-year	71.4% (5)	66.7% (4)	0.853
Overall	78.1% (25)	71.4% (20)	0.550

*p-values calculated using chi-square analysis.

Boldface indicates significance.

with greater pain,⁴ inferior function and disability scores,⁵ and even increased narcotics consumption postoperative.²⁵ However, some studies reported inferior preoperative PROMs in patients with lower preoperative mental health scores, but similar rates of improvement for patients regardless of preoperative mental health score.^{6–8}

Specifically regarding ACDF, studies assessing the influence of preoperative mental health on outcomes have been conflicted. Some studies have demonstrated inferior preoperative mental health scores to be associated with significantly inferior long-term outcomes with regard to pain, physical function, and disability measures.^{9,26,27} However, many studies have demonstrated inferior preoperative mental health to be associated with lower outcome measure scores before and after surgery, but report that patients improve to similar extents regardless of preoperative mental health.^{10,28–31} Further, Goh et al. (2019) reported patients with lower preoperative mental health scores were more likely to report greater improvement in mental health postoperatively.³⁰ Identifying mental health as a specific, synergistic risk factor in patients with WC is necessary, as optimization of mental health prior to cervical spine surgery in heterogeneous patient groups has demonstrated significant potential in mitigating risk for inferior

postoperative outcomes seen in classically depressed patients.³² However, it should be known that the intricate relationship between mental health and surgical outcomes is bidirectional and complex, with resolution of chronic pain or disability associated with concurrent improvement in mental health scores, with magnitude of effect potentially even varying by gender.^{33,34}

In our patient population, patients with preoperative depression were observed to have greater LOS and increased postoperative narcotic consumption. These findings are similar to those reported by Patel et al. (2019) and may be due to increased perception of pain by the depressed cohort in the immediate postoperative period.^{1,25}

1.3.1. Physical function

PROMIS PF scores improved at multiple postoperative time points for both depressed and ND cohorts. While the ND cohort reported superior PROMIS PF scores compared to the depressed cohort at early postoperative points, this significance did not extend to the 1- or 2-year marks. Further there was no significant difference in rate of MCID achievement between cohorts in PROMIS PF. SF-12 PCS scores significantly decreased in the depressed cohort at the 6-month mark and did not report significant improvement at any point. In contrast, SF-12 PCS scores were markedly increased in the ND cohort at and beyond 6 months postoperatively. Between groups, there was no significant difference in SF-12 PCS scores at any period. Similarly, there was no significant difference in the rate of MCID achievement for SF-12 PCS. The results from our study regarding PROMIS PF scores most closely resemble the findings of Goh et al. (2019) and Colantonio et al. (2022) due to the initial inferiority of physical function score in the depressed cohort with similar rates of improvement for both patient subsets.^{10,30} In contrast, our findings regarding SF-12 PCS score more closely resemble the results demonstrated by Carr et al. (2011), who reported decreased postoperative physical function in depressed patients following ACDF.⁹ It is unclear why each physical function outcome measure would report contrasting results with the other, but such a difference may be explained by the survey nature in which these measures are collected, which allows for varying interpretations of wording with regard to each measure.

1.3.2. Mental health

The depressed cohort reported significant improvement in SF-12 MCS score in the short-term, with significance noted up to 6 months postoperatively. While significance did not continue at the 1- and 2-year marks, mean scores remained improved compared to preoperative baseline, indicating that loss of significance may be due to loss to follow-up. In contrast, the ND cohort did not report significant improvement at any period, with postoperative MCS scores lower than preoperative baseline at all but one period, although insignificantly. Further, MCID achievement rate was significantly greater in the depressed cohort at all periods except for the 2-year mark, at which time the achievement rate was still 2-fold the rate of the ND cohort. However, between groups, MCS scores remained superior in the ND cohort at all time points evaluated. These findings were most consistent with the Goh et al. (2019) study, demonstrating that patients with depressive symptoms may be more likely to experience clinically significant improvement in mental health postoperatively compared to those without depressive symptoms.³⁰

1.3.3. Pain

Both depressed and ND cohorts experienced significant improvement in VAS neck and arm scores at multiple periods postoperatively. Between groups, the ND cohort reported significantly better scores preoperatively and at 12 weeks postoperatively for both pain outcome measures, but did not report significantly

better scores at or past 6 months following surgery. Similarly, there was no significant difference in MCID achievement rate for either VAS neck or VAS arm pain scores between groups at any time point. Once again, these findings most consistently match with those demonstrated by Goh et al. (2019).³⁰

1.3.4. Disability

NDI scores were lower in the depressed cohort when compared to preoperative baseline; however, significance was only noted at the 6-month mark. NDI score was decreased at all periods postoperatively in the ND cohort, but with significance only found at 12 weeks, 6 months, and 1 year. Between groups, NDI scores remained significantly lower in the ND cohort up to 6 months after surgery. No difference in MCID achievement rate was noted between groups at any studied period. These results echo previous findings within this study regarding pain, demonstrating that independent of preoperative mental status, patients report significant improvement postoperatively following ACDF, consistent with the Goh et al. (2019) and Colantonio et al. (2022).^{10,30}

1.3.5. Limitations

As a retrospective study conducted utilizing a single-surgeon registry, there are several clear limitations. Primarily, use of a single-surgeon registry led to decreased sample size which may limit the strength of the study, especially at later periods as patients are lost to follow-up. Further, use of a single-surgeon database benefits from a more homogeneous population in preventing admission of confounding factors, such as differences in surgical technique or patient selection, but limits generalizability of the conclusions. Additionally, with all studies utilizing PROMs, there is bias involved due to the survey format in which patients report current status at each point. Finally, while patient groups were separated by an SF-12 MCS of 45.6 to maximize sensitivity and specificity for identifying depression, this does not account for outliers in each that may more dramatically affect outcomes than expected and limits the generalizability of these findings.

2. Conclusion

Independent of preoperative mental health, patients with Workers' Compensation status undergoing ACDF demonstrated improvement in pain and disability outcomes. Depressed patients exhibited improvement in PROMIS PF, but not SF-12 PCS postoperatively. Patients with higher preoperative mental health scores demonstrated improvement in physical function via both outcome measures evaluated. Depressed patients reported improvement in mental health postoperatively and were more likely to achieve tangible clinical improvement in mental health following ACDF. Further study of patients with Workers' Compensation status is necessary to understand the nuances affecting outcomes after spine surgery.

CRedit authorship contribution statement

Timothy J. Hartman: Conceptualization, Methodology, Visualization, Formal analysis, Software, Investigation, Writing – original draft, Writing – review & editing. **James W. Nie:** Conceptualization, Methodology, Visualization, Formal analysis, Software, Investigation, Writing – original draft, Writing – review & editing. **Keith R. MacGregor:** Project administration, Data curation, Investigation, Writing – review & editing. **Omolabake O. Oyetayo:** Project administration, Data curation, Investigation, Writing – review & editing. **Eileen Zheng:** Project administration, Data curation, Investigation, Writing – review & editing. **Kern Singh:** Conceptualization, Methodology, Supervision, Resources, Investigation,

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Further reading

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