

Disability at Presentation and Patient-Reported Outcomes among Cervical Disc Replacement Recipients in an Outpatient Setting

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INTRODUCTION: No prior study to our knowledge has evaluated the influence of preoperative neck disability index (NDI) on postoperative outcomes following cervical disc replacement (CDR) in an ambulatory surgical center (ASC) setting. We aim to determine the impact of varying degree of preoperative disability on postoperative patient-reported outcome measures (PROMs) and minimal clinically important difference (MCID) achievement in patients with herniated nucleus pulposus (HNP) undergoing outpatient CDR surgery.

METHODS:

A retrospective dataset of a spinal surgeon was searched to identify patients meeting the following inclusion criteria: those diagnosed with HNP undergoing primary, single-level CDR in an ASC setting. Patients with diagnoses of spondylolisthesis or degenerative scoliosis were excluded. Individuals receiving CDR for infection, malignancy, or trauma were removed from the study. Patients were divided using the measures of central tendency (mean, median) for preoperative NDI score among included patients into two groups: NDI ≤39 and NDI >39 group.

RESULTS:

One-hundred and six total patients were included, 31 in the NDI ≤39 group and 32 in the NDI >39 group. The average age among patients was 45.2 years. Most patients were non-obese (68.3%) and male (60.3%). No demographic differences were observed among preoperative NDI cohorts. All patients presented with HNP (100.0%), with several patients also having central stenosis (47.6%) and foraminal stenosis (28.6%). A significantly greater proportion of higher NDI patients presented with foraminal stenosis (p=0.012). The average surgical time was 58.3 minutes, while the average estimated blood loss and length of stay were 25.9 mL and 6.5 hours, respectively. No perioperative characteristics differed among NDI groups. The NDI ≤39 group significantly improved for VAS neck from 6-weeks to 6-months, VAS arm at 6-weeks/12-weeks, NDI from 12-weeks to 1-year, and PROMIS-PF at all time points (p≤0.044, all). The NDI >39 group improved for VAS neck, VAS arm, and SF-12 PCS from 6-weeks to 6-months, NDI at all timepoints, and PROMIS-PF at 6-months (p≤0.045, all). Mean scores across all PROMs were inferior among the NDI >39 cohort (p≤0.005, all). Postoperative VAS neck and NDI were significantly higher among NDI >39 patients at 6-weeks (p≤0.009, both), while SF-12 PCS and PROMIS-PF scores were lower among this cohort at 12-weeks/1-year and 6-weeks/6-months, respectively (p≤0.046, all). MCID achievement rates for PROMIS-PF were significantly greater in the lower NDI group at 6-weeks and overall. No other differences were however observed in MCID achievement.

DISCUSSION AND CONCLUSION: Patients presenting with higher baseline disability demonstrated worse pain and disability scores in the early postoperative period and inferior physical function scores throughout the entire postoperative period. While MCID achievement was comparable for pain and disability PROMs, clinically meaningful improvements in physical function were less likely among patients presenting with higher levels of NDI.

Table 1. Patient Demographics

Characteristic	Total	NDI ≤39 (n=31)	NDI >39 (n=32)	p-value
Age (mean(SD))	45.2(10.1)	45.0(10.0)	45.4(10.2)	0.714
Gender				0.165
Female	39.7% (25)	48.4% (15)	31.3% (10)	
Male	60.3% (39)	51.6% (16)	68.7% (22)	
Ethnicity				0.670
African American	8.1% (5)	9.7% (3)	6.3% (2)	
Asian	1.6% (1)	0.0% (0)	3.2% (1)	
Hispanic	4.8% (3)	3.2% (1)	6.3% (2)	
White	85.5% (55)	87.1% (27)	83.9% (28)	
Other				
Diabetic Status				0.306
Non-Diabetic	98.4% (62)	96.8% (30)	100.0% (32)	
Diabetic	1.6% (1)	3.2% (1)	0.0% (0)	
Obesity Status				0.319
Non-Obese	68.3% (43)	74.2% (23)	62.5% (20)	
Obese	31.8% (20)	25.8% (8)	37.5% (12)	
Smoking Status				0.962
Non-Smoker	87.3% (55)	87.1% (27)	87.5% (28)	
Smoker	12.7% (8)	12.9% (4)	12.5% (4)	
Blood Pressure				0.421
Normotensive	87.3% (55)	85.9% (28)	90.6% (29)	
Hypertensive	12.7% (8)	14.1% (5)	8.0% (3)	
ASA score				0.118
<2	38.7% (24)	48.4% (15)	29.0% (9)	
≥2	61.3% (38)	51.6% (16)	71.0% (22)	
CCI Score				0.214
<2	87.0% (20)	93.3% (14)	75.0% (24)	
≥2	13.0% (3)	6.7% (1)	25.0% (8)	
Insurance Type				0.115
Medicare/Medicaid	3.2% (2)	3.2% (1)	3.1% (1)	
Workers' Comp	23.8% (15)	19.4% (6)	28.1% (9)	
Private	73.0% (46)	77.4% (24)	68.8% (22)	

Table 2. Intraoperative Characteristics

Characteristic	Total	NDI ≤39 (n=31)	NDI >39 (n=32)	p-value
Spinal Pathology				
HNP	100.0% (31)	100.0% (31)	100.0% (32)	-
Central	47.0% (30)	51.6% (16)	43.8% (14)	0.332
Foraminal	21.9% (14)	12.9% (4)	31.3% (10)	0.002
Stenosis	21.9% (14)	12.9% (4)	31.3% (10)	0.002
Operative Time	58.3(10.1)	59.0(10.4)	57.5(9.7)	0.481
Estimated Blood Loss	25.9(10.1)	25.9(10.1)	25.9(10.1)	0.101
Length of Stay	6.5(1.0)	6.5(1.0)	6.5(1.0)	0.311
Postoperative Pain	3.0(1.0)	3.0(1.0)	3.0(1.0)	0.861
Postoperative NDI	18.0(10.1)	17.0(10.1)	19.0(10.1)	0.111
Postoperative VAS Neck	18.0(10.1)	17.0(10.1)	19.0(10.1)	0.111
Postoperative VAS Arm	18.0(10.1)	17.0(10.1)	19.0(10.1)	0.111
Postoperative SF-12 PCS	18.0(10.1)	17.0(10.1)	19.0(10.1)	0.111
Postoperative PROMIS-PF	18.0(10.1)	17.0(10.1)	19.0(10.1)	0.111

Table 3. Patient Reported Outcome Measures

PROM	NDI ≤39	NDI >39	p-value	NDI ≤39	NDI >39	p-value
VAS Neck						
Preoperative	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
6-weeks	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
12-weeks	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
6-months	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
1-year	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
Overall	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
VAS Arm						
Preoperative	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
6-weeks	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
12-weeks	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
6-months	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
1-year	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
Overall	18.0(10.1)	19.0(10.1)	0.001	18.0(10.1)	19.0(10.1)	0.001
NDI						
Preoperative	28.0(10.1)	30.0(10.1)	0.001	28.0(10.1)	30.0(10.1)	0.001
6-weeks	28.0(10.1)	30.0(10.1)	0.001	28.0(10.1)	30.0(10.1)	0.001
12-weeks	28.0(10.1)	30.0(10.1)	0.001	28.0(10.1)	30.0(10.1)	0.001
6-months	28.0(10.1)	30.0(10.1)	0.001	28.0(10.1)	30.0(10.1)	0.001
1-year	28.0(10.1)	30.0(10.1)	0.001	28.0(10.1)	30.0(10.1)	0.001
Overall	28.0(10.1)	30.0(10.1)	0.001	28.0(10.1)	30.0(10.1)	0.001
SF-12 PCS						
Preoperative	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
6-weeks	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
12-weeks	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
6-months	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
1-year	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
Overall	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
PROMIS-PF						
Preoperative	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
6-weeks	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
12-weeks	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
6-months	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
1-year	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001
Overall	45.0(10.1)	40.0(10.1)	0.001	45.0(10.1)	40.0(10.1)	0.001

Table 4. Minimum Clinically Important Difference

PROM	NDI ≤39 % (n)	NDI >39 % (n)	p-value
VAS Neck			
6-weeks	45.0% (9)	41.2% (7)	0.815
12-weeks	70.0% (12)	72.7% (16)	0.883
6-months	81.3% (9)	79.0% (15)	0.850
1-year	57.5% (4)	16.7% (1)	0.125
Overall	62.5% (15)	72.0% (18)	0.613
VAS Arm			
6-weeks	31.6% (6)	37.5% (6)	0.713
12-weeks	35.3% (6)	57.9% (11)	0.175
6-months	44.4% (4)	46.7% (7)	0.916
1-year	42.9% (3)	33.3% (2)	0.725
Overall	36.4% (8)	54.0% (12)	0.226
NDI			
6-weeks	57.9% (11)	50.0% (8)	0.640
12-weeks	68.8% (13)	81.8% (18)	0.356
6-months	83.0% (7)	84.2% (16)	0.199
1-year	85.7% (6)	66.7% (4)	0.416
Overall	72.7% (10)	83.3% (20)	0.184
SF-12 PCS			
6-weeks	27.3% (3)	26.7% (4)	0.973
12-weeks	45.5% (5)	26.7% (4)	0.320
6-months	60.0% (3)	42.9% (5)	0.928
1-year	50.0% (3)	16.7% (1)	0.221
Overall	47.3% (8)	40.0% (8)	0.866
PROMIS-PF			
6-weeks	58.3% (7)	10.2% (2)	0.049
12-weeks	72.7% (8)	20.0% (7)	0.250
6-months	85.7% (6)	76.9% (10)	0.639
1-year	57.5% (4)	20.0% (2)	0.319
Overall	65.7% (15)	60.0% (12)	0.662

ASA = American Society of Anesthesiologists; CCI = Charlson Comorbidity Index; SD = Standard Deviation; Workers' Comp = workers' compensation
*p-values calculated using Chi-square analysis or Student's t-test for independent samples for categorical and continuous variables, respectively
Boldface indicates significance

SD = standard deviation
*p-values calculated using Student's t-test for independent samples to assess change from preoperative to postoperative values within each group
†p-values calculated using Student's t-test for independent samples to assess difference in mean PROMs between groups
Boldface indicates significance

*p-values calculated using chi-square analysis
Boldface indicates significance