

Influence of Preoperative Physical Function Scores on Outcomes after Single-Level Cervical Disc Replacement (CDR)

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INTRODUCTION: Several studies have examined the relationship between preoperative Patient Reported Outcome Measurement Information System Physical Function (PROMIS PF) as a prognostic factor for postoperative outcomes. Few studies have examined this relationship as it applies to cervical disc replacement (CDR). We aim to determine the influence of preoperative PROMIS PF scores on perioperative and postoperative outcomes, the latter determined via patient-reported outcome measures (PROMs) and the degree of achievement rates of minimum clinically important difference (MCID) following single-level CDR.

METHODS:

A prospectively maintained database from a single-surgeon at an academic center was retrospectively reviewed for patients who had undergone single-level CDR with recorded preoperative PROMIS PF scores. Exclusion criteria included patients with surgical indications including infection, fracture, or malignancy. Patients were divided by the mean preoperative PROMIS PF score (40) into two groups: Lower-functioning (preoperative PROMIS PF <40) and higher-functioning (preoperative PROMIS PF ≥40). Each population's demographics and perioperative data were retrieved and analyzed. PROMs evaluated included: Patient-Reported Outcome Measurement Information System (PROMIS PF), 12-item Short Form Physical Composite score (SF-12 PCS), visual acuity scale scores (VAS) for neck and arm, and Neck Disability Index scores (NDI), collected at preoperative, 6-week, 12-week, 6-month, and 1-year time points.

RESULTS:

In total, 57 patients were included and divided into the lower-functioning group (n=24) and the higher-functioning group (n=33) with mean preoperative PROMS PF scores of 34.8 and 44.4, respectively. There were no significant differences found between groups regarding their demographic or perioperative data apart from operative times which were found to be significantly increased in the higher-functioning group (p=0.003). The lower-functioning cohort saw significant improvement in mean scores of all PROMs at the 6-week, 12-week, and 6-month time points. The higher-functioning cohort saw significant improvement in mean scores at multiple time points throughout each PROM, except for SF-12 PCS scores. The higher-functioning group had significantly greater mean postoperative PROMIS PF scores than their counterparts at multiple time points (p≤0.028, all). Mean SF-12 PCS scores were significantly higher in the higher-functioning group preoperatively (p<0.001). VAS neck scores were significantly lower at the preoperative and 12-week postoperative time points for the higher-functioning cohort, but at no postoperative time point (p=0.019). NDI scores were significantly greater in the lower-functioning group at both the preoperative and 6-week postoperative time points (p≤0.027, all). MCID achievement significantly differed between groups in favor of the lower-functioning group regarding the mean SF-12 PCS scores at the 6-month time point and VAS arm scores at the 12-week time point (p≤0.026, all).

DISCUSSION AND CONCLUSION: Each cohort demonstrated significant improvement in all PROMs at multiple time points, except SF-12 PCS in the higher-functioning cohort. The higher-functioning cohort showed significantly better scores in physical function, pain reporting, and disability at one or more time points compared to the lower-functioning cohort; however, this significance was not seen past 12 weeks for any PROM. Further, MCID achievement rates were significantly greater in the lower-functioning group at 6 months for SF-12 PCS and 12 weeks for VAS arm. While both groups found significant improvement in PROM scores throughout the postoperative period, patients with lower preoperative PROMIS PF scores may experience greater rates of clinically noticeable improvements in function and arm pain in the short-mid postoperative time.

Table 1. Patient Demographics

Characteristic	Total (n=57)	Preoperative PROMIS PF <40 (n=24)	Preoperative PROMIS PF ≥40 (n=33)	p-value
Mean Preoperative PROMIS PF Score	40.3(10.9)	34.8(11.7)	44.4(11.3)	-
Age (mean ± SD, years)	55.2(10.0)	53.4(10.8)	56.0(10.0)	0.241
Gender				0.137
Male	47.0% (27)	54.2% (14)	29.0% (10)	
Female	52.9% (29)	41.7% (10)	69.0% (23)	
Ethnicity				0.705
Caucasian	82.5% (47)	87.5% (21)	78.8% (26)	
African American	7.9% (4)	4.2% (1)	9.1% (3)	
Hispanic	7.0% (4)	8.3% (2)	6.1% (2)	
Asian	1.8% (1)	0.0%	3.0% (1)	
Other	1.8% (1)	0.0%	3.0% (1)	
Diabetic Status				0.237
Non-Diabetic	98.3% (56)	95.8% (23)	100.0% (33)	
Diabetic	1.7% (1)	4.2% (1)	0.0% (0)	
Smoking Status				0.746
Nonsmoker	28.0% (16)	28.3% (7)	27.4% (9)	
Smoker	72.0% (40)	71.6% (18)	72.6% (24)	
Hypertension Status				0.776
Non-hypertensive	86.0% (49)	87.5% (21)	84.9% (28)	
Hypertensive	14.0% (8)	12.5% (3)	15.1% (5)	
ASA Classification				0.061
I	30.9% (17)	29.2% (7)	32.3% (10)	
II	69.1% (39)	70.8% (17)	67.7% (23)	
CCI				0.198
Yes	96.3% (54)	100.0% (24)	93.3% (30)	
No	3.7% (2)	0.0% (0)	6.7% (2)	
Injury Type				0.151
Midline-Midlevel	3.5% (2)	8.3% (2)	0.0% (0)	
Midline-Cerv	28.5% (16)	31.7% (8)	24.2% (8)	
Off-midline	68.0% (38)	60.0% (14)	75.8% (25)	

CCI = Cervical Collar Injury; ASA = American Society of Anesthesiologists; SD = standard deviation; "Other" = other; "Comp" = workers' compensation

Table 2. Preoperative Characteristics

Characteristic	Total (n=57)	Preoperative PROMIS PF <40 (n=24)	Preoperative PROMIS PF ≥40 (n=33)	p-value
Spatial Pathology				
Disc Degeneration	98.3% (56)	100.0% (24)	97.0% (32)	0.390
Facet Joint Arthropathy	1.7% (1)	0.0% (0)	3.0% (1)	0.237
Degenerative Spondylolisthesis	14.0% (8)	8.3% (2)	18.2% (6)	0.251
Congenital Spondylolisthesis	50.9% (29)	50.0% (12)	51.5% (17)	0.919
Traumatic Spondylolisthesis	28.5% (16)	29.2% (7)	27.3% (9)	0.688
Other	0.0% (0)	0.0% (0)	0.0% (0)	0.265
C4-C5	1.8% (1)	0.0% (0)	3.0% (1)	
C5-C6	3.0% (2)	4.2% (1)	1.5% (1)	
C6-C7	64.9% (37)	79.2% (19)	54.0% (18)	
C7-T1	28.3% (16)	16.7% (4)	33.3% (11)	
Operative Time (Mean ± SD, min)	48.9(10.1)	47.4(8.1)	50.4(10.2)	0.003
Estimated Blood Loss (Mean ± SD, mL)	26.0(5.0)	26.4(5.9)	25.8(4.6)	0.716
Length of Stay (Mean ± SD, days)	3.7(0.8)	3.6(0.6)	3.7(1.0)	0.532
Postoperative Pain (VAS)	0	0	0	-
Postoperative Nausea (VAS)	0	0	0	-
Complication	18.1% (10)	22.1% (7)	16.9% (6)	0.278

CCI = Cervical Collar Injury; ASA = American Society of Anesthesiologists

Table 3. Mean Patient Reported Outcomes

PROM	Preoperative PROMIS PF Mean ± SD	Preoperative PROMIS PF <40 Mean ± SD	Preoperative PROMIS PF ≥40 Mean ± SD	p-value	tp-value
PROMIS PF	34.8(11.7)	34.8(11.7)	44.4(11.3)	-	-
6-week	40.0(12.8)	0.001	48.6(16.6)	0.001	0.007
12-week	42.6(12.6)	0.007	51.0(19.0)	0.003	0.028
6-month	48.0(14.4)	0.001	56.0(15.0)	0.004	0.112
1-year	48.0(14.4)	0.122	55.0(14.4)	0.005	0.059
SF-12 PCS	Preoperative	29.9(6.7)	38.4(6.0)	-	<0.001
6-week	34.5(5.9)	0.015	40.3(11.8)	0.218	0.107
12-week	37.5(6.2)	0.012	43.8(16.8)	0.007	0.004
6-month	43.3(11.2)	0.004	48.9(19.9)	0.151	0.782
1-year	33.6(14.4)	0.163	41.3(11.4)	0.263	0.227
VAS neck	7.4(1.1)	-	6.0(1.2)	-	0.001
6-week	4.4(1.0)	0.004	2.7(1.2)	0.004	0.007
12-week	2.1(1.5)	<0.001	1.6(1.7)	<0.001	0.004
6-month	2.4(1.1)	<0.001	1.8(1.9)	0.001	0.436
1-year	4.2(1.4)	0.219	3.1(1.4)	0.130	0.016
VAS arm	6.5(1.3)	-	4.8(1.9)	-	0.019
6-week	5.5(1.0)	0.002	2.1(1.7)	0.030	0.172
12-week	2.4(1.8)	<0.001	1.8(1.7)	<0.001	0.004
6-month	2.2(1.8)	0.002	2.3(2.0)	0.010	0.032
1-year	3.9(1.6)	0.262	2.7(2.7)	0.292	0.533
NDI	22.1(17.6)	-	35.6(11.5)	-	<0.001
6-week	38.3(19.7)	0.003	23.6(11.5)	0.064	0.007
12-week	20.8(13.1)	<0.001	17.7(11.0)	<0.001	0.004
6-month	21.3(11.1)	<0.001	21.4(11.7)	0.009	0.054
1-year	22.8(17.7)	0.106	15.0(11.4)	0.007	0.334

tp-value calculated using Student's t-test to compare mean PROMIS PF scores between groups

Table 4. Minimum Clinically Important Difference

PROM	Preoperative PROMIS PF <40 % (n)	Preoperative PROMIS PF ≥40 % (n)	p-value
PROMIS PF			
6-week	69.2% (9)	43.8% (7)	0.170
12-week	75.0% (9)	57.6% (11)	0.332
6-month	92.3% (12)	63.6% (7)	0.085
1-year	60.0% (8)	55.6% (5)	0.872
Overall	50.0% (19)	50.9% (19)	0.182
SF-12 PCS			
6-week	42.9% (6)	20.0% (3)	0.184
12-week	50.0% (5)	33.3% (5)	0.405
6-month	88.9% (8)	33.3% (5)	0.016
1-year	25.0% (3)	33.3% (5)	0.764
Overall	56.5% (13)	43.4% (10)	0.014
VAS neck			
6-week	53.3% (8)	44.4% (6)	0.611
12-week	81.3% (13)	61.9% (13)	0.202
6-month	86.7% (13)	53.9% (7)	0.005
1-year	25.0% (3)	37.5% (3)	0.665
Overall	54.0% (18)	45.5% (15)	0.326
VAS arm			
6-week	50.0% (7)	23.5% (4)	0.125
12-week	57.1% (8)	20.0% (4)	0.026
6-month	50.8% (7)	20.0% (2)	0.069
1-year	25.0% (3)	25.0% (2)	1.000
Overall	64.7% (13)	35.3% (6)	0.116
NDI			
6-week	57.1% (8)	47.1% (6)	0.576
12-week	87.5% (14)	65.0% (13)	0.121
6-month	86.7% (13)	53.9% (7)	0.055
1-year	75.0% (9)	62.5% (5)	0.665
Overall	57.0% (19)	42.4% (14)	0.082

tp-value calculated using chi-square analysis

tp-value calculated using Student's t-test to compare mean PROMIS PF scores between groups