



# Do Patient Expectations Represent a More Important Clinical Difference? A Study of Surgical Outcomes in the Cervical Spine

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**Objective:** This study aims to compare the impact of achieving an MCID or meeting preoperative expectations on patient satisfaction following cervical spine procedures.

**Methods:** A surgical database was retrospectively reviewed for cervical spine surgery patients from 2016 to 2020. Inclusion criteria were primary or revision, single- or multilevel cervical disc arthroplasty or anterior cervical discectomy and fusions (ACDF). Visual analogue scale (VAS) neck and arm pain was assessed preoperatively and postoperatively (6-week, 12-weeks, 6-months, 1-year). Preoperative patient expectation and postoperative satisfaction were recorded. MCID achievement was determined using previously established values. Expectations met and MCID achievement were compared as possible predictors of satisfaction.

**Results:** One hundred and six cervical spine patients were included. Both meeting expectations and achieving MCID were significant predictors of satisfaction for arm pain at 6-weeks and 12-weeks (all  $p \leq 0.007$ ). Achieving MCID significantly predicted satisfaction for neck pain at all timepoints (all  $p \leq 0.007$ ) and meeting expectations predicted satisfaction for neck pain at 6-weeks, 12-weeks, and 1-year (all  $p \leq 0.003$ ). Comparison of coefficients revealed no significant difference in effect size between meeting expectations and achievement of MCID as predictors of patient satisfaction (all  $p > 0.050$ ).

**Conclusion:** MCID achievement and meeting expectations were significant predictors of satisfaction for neck pain and short-term arm pain. Both measures may be similarly useful for interpretation of patient outcomes and the optimal choice of metric may depend on practice-specific factors.

**Key Words:** Total disc replacement, Minimal clinically important difference, Patient reported outcome measures, Patient satisfaction, Cervical vertebrae

## INTRODUCTION

Degenerative pathology of the cervical spine can cause significant axial, radicular, and myelopathic pain. When refractory to conservative treatments, surgical intervention in the form of

anterior cervical discectomy and fusion (ACDF) or cervical disc arthroplasty (CDA) is often indicated [1]. Improvement in pain, as assessed by the Visual Analogue Scale (VAS), has proven to be one of the most important factors contributing to postoperative satisfaction in patients undergoing ACDF [2].

This empirically validated questionnaire is commonly used to assess patient reported outcomes (PROs) regarding neck and arm pain and plays an important role in understanding patient satisfaction [3]. Patients mark their pain level on a linear scale in regard to each question, with one end representing “no pain” and the opposite representing “worst pain” [4]. As healthcare adopts a more patient-centered approach to care, it is critical to identify which methods of characterizing improvements in pain are most important for predicting postoperative satisfaction in the clinical setting.

One frequently used method is minimum clinically important difference (MCID), a metric that quantifies the smallest change in score that a patient perceives as beneficial. It has been increasingly used to assess postoperative improvement because traditional measures of statistical significance may not always translate to meaningful clinical improvement [5]. Its focus on differences that are clinically relevant to the patient allows MCID to provide insight into patient satisfaction. For example, Andresen et al. [6] reported that achievement of MCID for VAS neck and SF-36 PCS was strongly correlated to patient satisfaction following ACDF.

Another way to assess outcomes is through the context of a patient’s preoperative expectations, which have been reported to be predictive of patient satisfaction in the spine population [7-9]. A systematic review of patient expectations across several disciplines reported that more optimistic expectations are associated with better health outcomes [10]. While these studies have identified the importance of preoperative expectations, the impact of meeting expectations on postoperative satisfaction has not been fully explored. Additionally, many expectation studies simply ask patients postoperatively if their expectations were met. This method does not directly compare postoperative outcomes to preoperative expectations and may be susceptible to significant recall bias. This methodological limitation makes it extremely difficult to distinguish between expectations and satisfaction.

As our understanding of the relationship between expectations and satisfaction continues to develop, it is important to compare which method of assessing PROs is highly associated with satisfaction. Identifying a single measure, whether it is patient expectations or MCID, will help guide physicians in providing effective preoperative education and counseling, assist in patient selection, and improve postoperative monitoring. Additionally, determining which metric is most associated with satisfaction can inform future research and allow investigators to better quantify the perceptions and postoperative outcomes of their patients. Our study aims to provide better insight into

patient expectations by quantifying these expectations preoperatively and assessing whether their expectations were met postoperatively. Through this assessment, we will compare meeting preoperative expectations to achievement of MCID and determine which is a better predictor of patient satisfaction regarding arm and neck pain following cervical spine procedures.

## MATERIALS AND METHODS

### 1. Patient Population

Informed patient consent and Institutional Review Board approval (ORA #14051301) were obtained prior to commencement of study activities. A prospectively maintained single-surgeon database was retrospectively reviewed for patients undergoing cervical spine procedures from September 2016 to June 2020. Inclusion criteria were primary or revision, single- or multi-level, elective ACDF or CDA procedures. Exclusion criteria were patients with incomplete preoperative expectations surveys or for whom surgery was indicated due to trauma, infection, or malignancy.

### 2. Data Collection

Patient demographics, preoperative spinal pathology, and perioperative characteristics were collected. Demographics were characterized in terms of age, gender, body mass index (BMI), smoking status, diabetic status, American Society of Anesthesiologists physical classification (ASA), Charlson Comorbidity Index (CCI), ethnicity, and insurance type/payment received. Recorded perioperative variables were number of spinal levels operated, operative duration, estimated blood loss (EBL), and postoperative length of stay.

Arm and neck pain were assessed using VAS neck and VAS arm at preoperative and 6-week, 12-week, 6-month, and 1-year postoperative timepoints. Patient expectations for postoperative neck and arm pain were assessed at the preoperative timepoint. Patient satisfaction with neck pain and arm pain was assessed at each postoperative timepoint.

### 3. Statistical Analysis

All calculations and statistical tests were performed using StataIC 16.1 (StataCorp, College Station, Texas). Descriptive statistics were performed for demographics, preoperative spinal pathologies, and perioperative characteristics (Tables 1, 2).

**Table 1.** Patient demographics

Characteristic	Total (n = 106)
Age (yr), mean $\pm$ SD	47.4 $\pm$ 10.1
Gender	
Female	34.0% (36)
Male	66.0% (70)
Body mass index (BMI)	
< 30 kg/m <sup>2</sup>	56.4% (57)
$\geq$ 30 kg/m <sup>2</sup>	43.6% (44)
Smoking status	
Non-smoker	85.9% (91)
Smoker	14.2% (15)
Diabetic status	
Non-diabetic	91.5% (97)
Diabetic	8.5% (9)
ASA score	
$\leq$ 2	87.8% (86)
> 2	12.2% (12)
CCI score	
< 1	39.0% (30)
$\geq$ 1	61.0% (47)
Ethnicity	
Caucasian	80.2% (85)
African American	6.6% (7)
Hispanic	9.4% (10)
Asian	3.8% (4)
Insurance	
Medicare/medicaid	1.9% (2)
Workers' compensation	26.4% (28)
Private	71.7% (76)

ASA: American Society of Anesthesiologists, CCI: Charlson Comorbidity Index, SD: standard deviation.

In an effort to minimize bias, only patients with preoperative pain scores equal to or greater than respective published MCID values were included in each analysis of satisfaction with arm and neck pain. "Meeting expectations" was defined as a postoperative VAS score less than or equal to the patient's preoperatively reported expectation for postoperative pain. Meeting expectations was determined separately for neck and arm pain for each postoperative timepoint. Achievement of MCID was determined by comparing postoperative improvement in VAS scores from preoperative baseline values to the following previously established threshold values: VAS neck  $\geq$  2.6 [11], VAS arm  $\geq$  4.1 [11]. Mean VAS scores, mean satisfaction, proportion of patients whose expectations were met and proportion of patients that achieved an MCID were reported for each relevant timepoint for both neck and arm pain (Table 3).

Simple linear regression was used to assess both meeting ex-

**Table 2.** Perioperative characteristics

Characteristic	Total (n = 106)
Spinal pathology	
Degenerative disc disease	6.6% (7)
Central stenosis	60.4% (64)
Radiculopathy	5.7% (6)
Myelopathy	5.7% (6)
Myeloradiculopathy	86.8% (92)
Procedure	
Anterior cervical discectomy and fusion	57.6% (61)
Cervical disc arthroplasty	42.5% (45)
Operative levels	
1-Level	68.9% (73)
2-Levels	26.4% (28)
3-Levels	4.7% (5)
Operative time (min), mean $\pm$ SD	57.2 $\pm$ 15.0
Estimated blood loss (mL), mean $\pm$ SD	29.2 $\pm$ 10.8
Length of stay (hr), mean $\pm$ SD	10.5 $\pm$ 8.6

SD: standard deviation.

pectations and achieving MCID as predictors of postoperative satisfaction for neck and arm pain at each postoperative timepoint (Table 4). A post-hoc comparison of beta coefficients was used to directly assess differences in effect sizes of expectations met and MCID achievement as predictors of satisfaction for neck and arm pain at each postoperative timepoint. A p-value  $\leq$  0.05 was set as the threshold for statistical significance in all tests.

## RESULTS

A total of 106 patients were included in the final study cohort. The overall cohort had a mean age of 47.4 years, was 34.0% female, and 43.6% were obese (Table 1). Myeloradiculopathy was the most common preoperative spinal pathology (86.8%), 61 patients underwent ACDF (57.6%) while 45 underwent CDA (42.5%) and a majority of procedures were at a single level (68.9%) (Table 2).

After excluding those patients with preoperative pain scores less than the respective published MCID values, 64 patients were eligible for analysis regarding arm pain outcomes and 88 were eligible for analysis of neck pain outcomes. Mean preoperative VAS arm pain was 6.8  $\pm$  1.5 and mean preoperative VAS neck pain was 6.3  $\pm$  1.9 (Table 3). Mean satisfaction ranged from 6.3 at 6-weeks and 1-year to 7.4 at 6-months for arm pain and from 6.7 at 6-weeks to 7.1 at 12-weeks and 1-year for neck pain. A majority of patients met their preoperative expectations

**Table 3.** Patient reported outcomes

	VAS, mean ± SD	Satisfaction, mean ± SD	Met expectations	Achieved MCID <sup>a</sup>
<b>Arm pain (n = 64)</b>				
Preoperative	6.8 ± 1.5	-	-	-
6-weeks	2.7 ± 3.1	6.3 ± 3.8	48.7 (19)	56.4% (22)
12-weeks	2.9 ± 3.1	6.8 ± 3.8	52.6% (20)	50.0% (19)
6-months	2.1 ± 2.7	7.4 ± 3.2	58.6% (17)	58.6% (17)
1-year	2.9 ± 3.1	6.3 ± 3.7	35.3% (6)	52.9% (9)
<b>Neck pain (n = 88)</b>				
Preoperative	6.3 ± 1.9	-	-	-
6-weeks	3.0 ± 2.6	6.7 ± 3.3	40.7% (22)	63.0% (34)
12-weeks	2.6 ± 2.6	7.1 ± 3.3	50.0% (27)	63.0% (34)
6-months	2.1 ± 2.1	6.8 ± 3.5	41.7% (15)	69.4% (25)
1-year	3.0 ± 3.1	7.1 ± 3.4	45.8% (11)	62.5% (15)

SD: standard deviation.

<sup>a</sup>MCID values based on results of Parker et al. [11].

**Table 4.** Predictors of satisfaction

	Meeting expectations		Achieving MCID		p-value <sup>b</sup>
	Coef.	p-value <sup>a</sup>	Coef.	p-value <sup>a</sup>	
<b>Arm pain</b>					
6-weeks	3.1	0.007	4.3	<0.001	0.068
12-weeks	4.2	<0.001	4.7	<0.001	0.499
6-months	1.9	0.121	2.3	0.055	0.182
1-year	3.2	0.092	3.4	0.055	0.815
<b>Neck pain</b>					
6-weeks	2.6	0.003	1.9	0.039	0.444
12-weeks	3.4	<0.001	2.4	0.008	0.235
6-months	1.9	0.103	3.5	0.004	0.228
1-year	4.3	0.001	3.8	0.006	0.419

Boldface indicates statistical significance.

<sup>a</sup>p-values calculated using simple linear regression to assess meeting expectations or achieving an MCID as a predictor of postoperative satisfaction.

<sup>b</sup>p-values calculated using comparison of coefficients to determine differences in effect size between meeting expectations and achieving MCID as predictors of satisfaction.

for arm pain at 12-weeks (52.6%) and 6-months (58.6%), but not at 6-weeks (48.7%) or 1-year (35.3%) (Table 3). A majority met expectations for neck pain at 12-weeks (50.0%), but not at 6-weeks (40.7%), 6-months (41.7%), or 1-year (45.8%). A majority of patients achieved MCID for both arm pain and neck pain at all timepoints (Table 3). A total of 17 patients included in the arm pain analysis and 24 in the neck pain analysis followed up through the full 1-year postoperative period. Meeting expectations was a significant predictor of postoperative satisfaction for both arm pain and neck pain at 6-weeks (p=0.007, p<0.003), 12-weeks (both p<0.001), and for neck pain only at 1-year (p=0.001) (Table 4). Achieving MCID for arm pain significantly

predicted satisfaction at 6-weeks and 12-weeks (both p<0.001), but not at 6-months (p=0.055), or 1-year (p=0.055). Achieving MCID for neck pain significantly predicted satisfaction at all postoperative timepoints (all p≤0.039). Effect sizes for prediction of satisfaction did not significantly differ between expectations and MCID at any timepoint (all p>0.05).

## DISCUSSION

As value-based assessments of medical treatment become increasingly patient-centered, patient satisfaction has been identified as an important indicator of surgical success. While a number of factors are important for patient satisfaction [12,13], improvement in neck pain has consistently been demonstrated as a key determinant of satisfaction following cervical spine surgery [6,14,15]. While VAS is a well-validated measure of neck and arm pain, there are several ways in which improvements in this metric can be quantified [3]. Both MCID and meeting preoperative expectations significantly predicted patient satisfaction with neck pain and short-term arm pain, and the choice of which metric to use may be best considered on an individual basis.

Patient satisfaction can be characterized through a variety of methods, and previous studies differ with regard to how they assess satisfaction. Asher et al. [12] utilized the North American Spine Society (NASS) satisfaction scale to determine predictors of satisfaction following ACDF. Similar to many other measures, the NASS satisfaction scale characterizes global satisfaction with the procedure and operative experience as a whole, rather than individual aspects, using the following 4 ordinal responses: “Surgery met my expectations,” “I did not improve as much

as I had hoped, but I would undergo the same operation for the same results,” “Surgery helped but I would not undergo the same operation for the same results,” “I am the same or worse compared to before surgery” [16]. As is the case with many similar analyses, the NASS satisfaction scale seems to conflate “expectations met” with “satisfaction,” while our study treats these as separate, although related, entities. In contrast to previous studies, our analysis characterized satisfaction specifically in terms of neck and arm pain, using a 0–10 scale to describe each at every postoperative timepoint. This focused assessment may allow for more direct consideration of the surgical outcomes, compared to more global assessments of satisfaction which may be influenced by factors such as the experience with clinical staff, the hospital setting, etc.

Preoperative expectations have been a topic of interest for many previous studies, which demonstrate their importance in terms of patient-reported outcomes and postoperative satisfaction. Mancuso et al. [17] developed a survey to assess which of the 21 items patients undergoing cervical spine procedures may expect to improve postoperatively (e.g., pain, numbness, physical limitations) and the degree to which improvement is expected. Later studies by Mancuso et al. [18] reported that relieving neck and upper extremity pain, preventing worsening of spinal conditions, and removing control of spinal disease over one’s life were the most common reported patient expectations for surgery. The same group also reported that patients listing higher preoperative expectations tended to be younger, had worse disability, physical function, and mental health scores. Additionally, these individuals also tended to have a lower proportion of expectations fulfilled and less postoperative improvement in disability and pain [8,18]. Alternatively, a study by Soroceanu et al. [7] demonstrated that having a greater proportion of preoperative expectations fulfilled was associated with higher postoperative satisfaction. Interestingly, these authors also demonstrated that patients with loftier preoperative expectations tended to be less satisfied postoperatively yet achieved greater functional improvement.

Although many studies have aimed to explore the fulfillment of expectations following spine surgery, a common shortcoming of such analysis is the failure to quantify these expectations at the preoperative timepoint [18,19]. For example, Mancuso et al. [18] determined patient expectations by asking them at the postoperative timepoint what their expectations were and whether they felt they had been met. However, such methodology may place these studies at increased risk for significant recall bias, which has been well-documented in studies of patient reported outcomes following spine surgery. A study by

Rodrigues et al. [20] demonstrated that patients may generally have poor to moderate ability to recall their preoperative status in terms of neck and arm pain, disability, and quality of life. They noted that patients who were satisfied postoperatively recalled significantly worse preoperative scores than what they had actually reported before surgery, suggesting that relying on patient recall of preoperative status may result in overestimation of surgical efficacy. Furthermore, Aleem et al. [21] reported that recollection of neck pain, arm pain, and disability was generally more severe than the actual preoperative scores and observed that over 30% of patients shifted in regard to which symptom they stated was most predominant when asked at the postoperative timepoint to recall their preoperative condition.

To minimize the risk for recall bias, we asked patients to report what they expected their postoperative pain to be along a 10-point scale, similar to that used by VAS, and recorded these expectations before surgery. These preoperative scores were then compared with their actual postoperative scores to determine whether patients had met their expectations for neck and arm pain at each follow up time. Our analysis demonstrated that roughly half of patients met their expectations for arm pain from 6-weeks to 6-months and for neck pain through 1-year. Of note, a generally similar proportion of patients met their expectations and achieved MCID for arm pain. The exception to this trend was at the 1-year timepoint, which saw a significant drop in expectations met, but less so for MCID achievement. In contrast, a substantially greater proportion of patients achieved MCID than met expectations for neck pain at every postoperative timepoint. This may be partly explained by the substantially higher MCID threshold for clinically important improvement in VAS arm as compared to VAS neck calculated by Parker et al. [11]. In contrast, although patients were generally quite optimistic in terms of their expectations for both neck and arm pain, these values tended to be relatively similar, with mean values of 1.3 and 1.0, respectively.

Meeting preoperative expectations was a statistically significant predictor of satisfaction for both arm pain and neck pain at short-term follow up, but only at 1-year long-term follow up for neck pain. Achieving MCID similarly predicted satisfaction with arm pain only at short-term timepoints. In comparison, however, achieving MCID significantly predicted satisfaction at all postoperative timepoints for neck pain. Interestingly, the 6-month timepoint at which MCID achievement was a significant predictor of neck pain satisfaction, but meeting expectations was not, was also the period of largest discrepancy between the two rates (41.7% vs. 69.4%). In contrast, while a large difference in the proportion of patients meeting expect-

tations vs achieving MCID for arm pain was observed at the 1-year timepoint (35.3% vs. 52.9%), neither metric proved to be a significant predictor of long-term satisfaction with arm pain.

Further analysis comparing beta coefficients revealed no significant differences between achievement of MCID and meeting preoperative expectations in terms of their ability to predict postoperative satisfaction in both arm and neck pain at both short- and long-term follow up. This may reflect the lower rates of achievement rates themselves, where prior studies reported that 71.3% of patients categorized as satisfied had achieved an MCID and 12.5%–44.7% of uncertain or unsatisfied patients achieved an MCID for VAS arm [6]. However, achieving MCID and meeting expectations may both represent a substantial improvement that is appreciated by the patient following cervical spine surgery and our results suggest that these may provide similar predictive capacity for determining patient satisfaction. While both measures appear to be effective long-term predictors of neck pain satisfaction, these outcome metrics may become less relevant to satisfaction with arm pain as the patient progresses through their postoperative recovery.

MCID has been well supported as an important metric for assessing patient-reported outcomes [22], and our results suggest that patient expectations may be a similarly useful measure of outcomes related to neck pain and short-term arm pain. Therefore, the choice of metric may be largely dependent upon physician preference and the needs of their practice. In circumstances where standardization is highly emphasized, such as large multi-provider registries or clinical trials, the more uniform MCID threshold may be preferable. However, the uniformity of MCID may present a drawback if some patients initially present with symptoms that are near or below the level of change considered an “important difference”, though our analysis was specifically adjusted to minimize the effects of this potential bias. In cases where more nuanced patient-specific assessment is called for, considering patients’ outcomes in terms of their preoperative expectations may be favorable. Furthermore, these findings also underline the importance of preoperative education and effectively managing patient expectations. If patient expectations are moderated in a way that allows for a more reasonable chance of achieving the desired outcome, a greater degree of long-term postoperative satisfaction may be realized by a greater number of patients. Given the importance of patient expectations documented in the current study for pain, future research should seek to similarly assess other commonly utilized quality of life measures, such as the Neck Disability Index.

## Limitations

Several limitations are inherent to the current study. First, our cohort consisted of patients undergoing procedures performed by a single attending surgeon at the same academic institution, which may limit the generalizability of our results. Second, while characterization of expectations at the preoperative timepoint minimized risk for recall bias, it may have been challenging for patients to accurately report their true postoperative expectations for pain without a standardized point of reference. Third, assessment of pain through patient reported outcomes also increases the chances of reporting bias, as it is a subjective evaluation. Finally, MCID achievement was only possible for patients with a preoperative pain score greater than or equal to the respective MCID values. We attempted to control for this by only including patients with scores at or above this level in each analysis, however this strategy may have unrealistically downplayed this effect which might be present in a “real world” patient cohort.

## CONCLUSION

Meeting preoperative expectations and achieving MCID both significantly predicted postoperative satisfaction arm pain at short-term timepoints and neck pain at both short- and long-term follow up. When compared directly, neither metric emerged as a significantly stronger predictor of satisfaction than the other. Therefore, assessment of postoperative outcomes may be determined in a practice-specific manner based on the needs of a given provider, patient population, or research endeavor. Nonetheless, physicians should be aware of the importance of their patients’ preoperative expectations for pain improvement. Effective management of these expectations may be critical for maximizing patient satisfaction. Identifying patients that fail to either achieve an MCID or meet their preoperative expectations may highlight opportunities for closer follow up or additional postoperative support.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article.

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