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## Clinical Studies

## Evaluation of Pain Catastrophizing Scale for surgical referral to pain psychology in patients undergoing spinal surgery



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## ABSTRACT

**Background:** Chronic pain is an issue that affects over 100 million Americans daily. Acceptance and Commitment Therapy (ACT) has been found to be beneficial for patients with chronic pain by focusing provider efforts on teaching coping mechanisms for pain instead of eliminating the pain entirely. Current studies demonstrate that ACT significantly improves post-operative chronic pain scores and outcomes.

**Methods:** The 200 patients chosen via random generator were collected and presented to (institution) orthopedic spine surgeons along with additional information such as the patients' history of present illness, Visual Analog Scale (VAS) scores, PROMIS-CAT Pain Interference scores, and status of opiate usage. Surgeons were blinded to the PCS cutoff scores. The (institution) orthopedic spine surgeons then identified which patients they would indicate for ACT and their reasoning. Pre-determined PCS score cut-offs were separately used to determine if a patient was indicated for ACT.

**Results:** The effectiveness of this screening tool was based on the frequency at which the surgeons and PCS scores were complimentary. A department epidemiologist assisted in the analysis of the data with the use of a ROC curve. ROC Curve demonstrated an area under the curve of 0.7784 with a Sensitivity of 0.68 and a Specificity of 0.79. The cut point according to Youden's index is 35. The data showed that the PCS is moderately accurate in its ability to distinguish coinciding patients that the [institution] orthopedic spine surgeons referred for ACT. The adjusted cut-point indicates that patients above a PCS of 35 would be referred to ACT by the orthopedic spine surgeons while those below a PCS score of 35 would not be referred.

**Conclusions:** Using the PCS, a referral with the department pain psychologist would occur by [institution] orthopedic spinal surgeons for patients that are deemed at-risk with a score of at least 35. The goal following this study is to perform future investigations regarding PCS and ACT with patients regarding chronic opioid use and postoperative outcomes. Patients who would be referred for help with chronic pain would be compared to PCS-referred patients and non-referred patients. Pre-operative ACT would be compared to patient outcomes post-operatively. The future aim is to use the cut-offs established in this study for experimental design to evaluate if PCS-referred patients have better pain management post-operatively as compared to the control and previously referred patients.

**Level of Evidence:** Level III diagnostic study.

## Background

Chronic pain affects over 100 million Americans daily [10]. Recent estimates indicate the financial burden of chronic pain manage-

ment costs 560 to 635 billion dollars annually and continues to increase with the growing population of Americans over age 65 [9]. Many patients with chronic pain develop high threat sensitivity, unbridled avoidance, and catastrophizing thinking styles [3,17]. Frequently this pain is

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addressed only biologically through surgery or prescription opioids [15]. Chronic back pain makes up a large subset of people struggling with chronic pain [16]. Treatments using only biological interventions have proven ineffective for management of chronic back pain [16]. They are often associated with increased opioid use, psychological distress, and healthcare utilization [9]. The biopsychosocial model of pain describes pain as a complex dynamic composed of psychological, physiological, and social factors that perpetuate, and potentially exacerbate one another [2,5]. This model shifted the paradigm for pain management, leading to a model that incorporates interdisciplinary care to guide treatment. This use of multiple on-site providers from various specialties to guide comprehensive treatment has been found to improve chronic pain outcomes [2,8–10].

An example of comprehensive treatment for chronic back pain includes the addition of cognitive behavior therapy (CBT) to chronic pain multimodal treatment plans. A literature review by McCracken et al. in 2002, demonstrated that CBT has been shown to reduce chronic pain patients' pain, distress, and pain behavior [12]. Over the past 20 years, clinical studies have continued to demonstrate the utility of CBT in multi-modal chronic pain management. A newer form of behavioral therapy is called Acceptance and Commitment Therapy (ACT) which deviates from CBT in that it focuses on moving beyond challenging destructive thoughts and behavioral patterns towards increasing psychological flexibility to accept current realities [19]. ACT works on increasing psychological flexibility using 6 core processes: acceptance, cognitive defusion, contact with the present moment, self-as-context, values, and committed action. Working with these processes help patients live in a manner that reduces the impact of pain on their lives.

The purpose of pain psychology provided by a clinical health psychologist in the UIHC Department of Orthopedics and Rehabilitation is to help patients shift their focus from eliminating back pain to accepting pain. Our pain psychologist practices behavior medicine and uses Acceptance and Commitment Therapy. A randomized controlled trial showed that subjects who receive ACT had improved overall function when compared to the subjects receiving treatment as usual [7]. Compared to traditional CBT, ACT was rated as more satisfactory and has shown improvement in anxiety, depression, pain intensity, functioning, and quality of life overall [7]. ACT was found to reduce opioid usage in orthopedic trauma patients by 36.5% when compared to the control in a randomized controlled trial [18]. In a longitudinal study, ACT led to 64.8% of patients improving in at least one key domain over the course of three years [19]. ACT has been demonstrated to improve outcomes for patients experiencing chronic pain.

Another tool this study utilized includes the Pain Catastrophizing Scale (PCS) which is a validated patient reported outcome (PRO) used to quantify a patient's pain and determine underlying thought processes [11]. The PCS asks the patient to rate 13 statements describing pain with a score from 0–4, 0 being seen as “not at all” and 4 being “all the time.” Scores are summed from 0–52 with 52 being the most severe. Additionally, the PCS categorizes the patient's pain into 3 sub-scores (rumination, magnification, and helplessness) that indicate intrusive thoughts, inability to cope with pain, and exacerbation of pain symptoms. Increased levels of pain catastrophizing were correlated with increased symptoms and poor prognosis [11]. Previous research assessing ACT-based interventions in patients undergoing orthopedic fracture fixation discussed that future research may benefit when utilizing a PRO measuring psychological flexibility [1].

## Rationale

The University of Iowa Hospitals and Clinics (UIHC) Department of Orthopedics and Rehabilitation currently uses the PCS to evaluate a patient's response to pain and identify catastrophic thinking that may occur. However, currently, there is no standard protocol in place for referring patients to the department's board-certified pain psychologist.

The aim of the study is to evaluate PCS as a screening tool for referral to the pain psychologist in the spine patient population at the UIHC Department of Orthopedics and Rehabilitation. This study will evaluate the comparison of patient PCS scores to partially blinded physician recommendations to determine whether standardized PCS cut-off scores can be effective at identifying patients who would be referred to a pain psychologist for ACT by UIHC orthopedic spinal surgeons.

## Methods

All patients presenting to the spine clinic at UIHC from February 2022 to June 2022 were surveyed using the PCS. Patients indicated for spinal surgery were reviewed retrospectively. Of the 900 patients indicated for spinal surgery, 600 adult spinal patients underwent surgery and had preoperative and postoperative PCS scores.

Two hundred patients were selected via a random number generator to have their PCS scores stratified into referral and non-referral groups. Cut-off points were predetermined with recommendations from the UIHC Department of Orthopedics and Rehabilitation pain psychologist. Patients with preoperative PCS scores of 20 or below were identified as low-risk and unlikely to need a referral for preoperative ACT evaluation. A preoperative PCS score of 20 identified the patient as a potential candidate for preoperative referral for evaluation with the pain psychologist. A preoperative PCS score of 30 identified the patient as high risk and a likely candidate for preoperative psychology evaluation and potential treatment with ACT. Surgeon referral was then compared to referral based on the PCS score of the same patients to evaluate the accuracy of the PCS scoring tool. The surgeons were blinded to the PCS cutoff grading scores and surveyed individually to prevent confounding bias. Each surgeon was presented with patients one by one, given additional information from the retrospective chart review, and answered if they would refer the patient for psychological evaluation with the pain psychologist. Separately, the patient's PCS score was used to recommend an evaluation. A “yes” was given if the patient's preoperative PCS score was above 20 and a “no” was given if the patient's preoperative PCS score was 19 or below.

The same 200 randomly generated patient cases were independently reviewed by an UIHC orthopedic spine surgeon assessing for the likelihood that a patient would benefit from referral to a pain psychologist prior to surgery. Preoperative information, such as the patient's history of present illness, Visual Analog Scale scores (VAS), PROMIS-CAT Pain Interference scores, and status of opiate usage were presented to (institution) orthopedic spine surgeons for review. The surgeons were asked to identify, based on presented data, which of the 200 patients they would indicate for referral to the department's pain psychologist for evaluation and potential ACT evaluation.

Surgeon referral was utilized as the comparison to PCS scoring as no “gold standard” currently exists for cut-off scores to recommend referral to a pain psychologist for orthopedic spinal surgery patients. The study authors acknowledge that physician judgment can have inaccuracies, however surgeon referral serves a starting point for gaining more definitive data toward standardizing PCS scoring recommendations.

Participant characteristics were described using frequencies (percentages) for categorical and continuous variables described using mean±standard deviation (SD), if normally distributed, or median (interquartile range, IQR) if not normally distributed. Agreement between the surgeon's recommendation for referral to the pain psychologist and PCS score using 20 as a cut-point was evaluated using Cohen's kappa statistic individually for each surgeon. Similar methods were used to evaluate whether surgeons agreed on a recommendation for ACT. The kappa statistic was interpreted as ≤0=no agreement, 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41–0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement [4]. Median (IQR) PCS scores of referred patients were compared between surgeons using the Wilcoxon Rank Sum Test. Receiver Operating Characteristic (ROC) curve analysis was next used to determine the Area Under Curve (AUC)

for PCS score to detect surgeon referral using combined surgeon data. Analyses utilized Generalized Estimating Equations to account for participant correlation due to multiple assessments by surgeons. The PCS score cut point for detecting surgeon referral was determined using the Youden index. Analyses were completed using SAS statistical software version 9.4 (SAS Institute Inc., Cary, NC).

**Results**

Demographic data of our cohort demonstrated that the 200 randomly selected participants had a mean±SD age of 62.1±11.7 years and 92 (46%) were male. The median (IQR) PCS score was 28 (15–40) and the mean PROMIS Pain Interference score was 68.3±6.5. 84 (41.5%) participants had a history of opioid use prior to surgery and 125 had PCS scores>20 (Table 1).

Screening tool effectiveness was based on the frequency at which surgeons and PCS scores were complimentary. The data showing agreement between surgeon referral by patient and referral by PCS score>20 are as follows:

Agreement between recommendations and PCS scores are shown by surgeons 1–3 in Table 2. Surgeon 1 had the lowest kappa value of -0.05. However, agreement between recommendations by surgeons 2 and 3 and the PCS showed higher kappa values of 0.50 and 0.30, respectively. After reviewing patients, surgeon 1’s factors for referring patients for evaluation for ACT included patient history, chronicity of problems, and current opioid use. Surgeon 2’s factors for referring patients for evaluation for ACT included chronicity of problems, age, sex, current opioid use, obesity, and current tobacco use. Surgeon 3’s factors for referring patients for evaluation for ACT included chronicity of problems, exacerbation of pain symptoms, obesity, current opioid use, and current tobacco use. None to slight agreement was also found between surgeon 1 and 3 (kappa=0.13). The median (IQR) PCS scores of referred patients varied by surgeon (Table 3).

Comparing each of the surgeons to each other, surgeons 2 and 3 had the highest agreement (kappa=0.43, moderate) while surgeons 1 and 2 had the lowest agreement (kappa=0.04, none) (Table 3). None to slight agreement was also found between Surgeons 1 and 3 (kappa=0.13). The median (IQR) PCS scores of referred patients varied by surgeon (Table 3).

Results of ROC curve analysis showed that a PCS score of 35 or greater was associated with significantly increased odds of surgeon referral (OR=1.08 (95% CI=1.06=1.10), p<.0001. The Area Under the Curve was 0.7784 (Fig. 1).

**Discussion**

PCS is a validated tool for measuring life impact of chronic pain [13]. In this study, the PCS was evaluated as a screening tool to refer patients to the UIHC Department of Orthopedics and Rehabilitation pain psychologist for potential treatment with ACT as per UIHC spinal surgeon judgement. The PCS scoring was compared to surgeon recommendation for referral to pain psychologist. A logistic regression model with a Generalized Estimating Equation (GEE) (Fig. 1) was utilized to evaluate the ability of PCS score to predict surgeon referral. The AUC of the model showed the PCS was moderately accurate in its ability to distinguish between patients who should and should not be referred for psychological intervention when compared to orthopedic spinal surgeon judgement. A prospective study is currently in progress with the goal of directly measuring chronic pain outcomes from care with patients after the PCS scoring was utilized. After conclusion of the study, information collected will further guide the understanding of the utility of PCS as a referral tool for ACT and chronic pain outcomes in spinal patients. Ultimately, utilizing a standardized screening tool to refer patients for evaluation with a pain psychologist for ACT would potentially improve patient outcomes, as ACT has been shown to improve pain functioning, with this study creating initial data before empirical, patient guided outcomes can lead to optimization of the PCS as a screening tool.

**Table 1**  
Demographics of the randomly selected participants n=200.

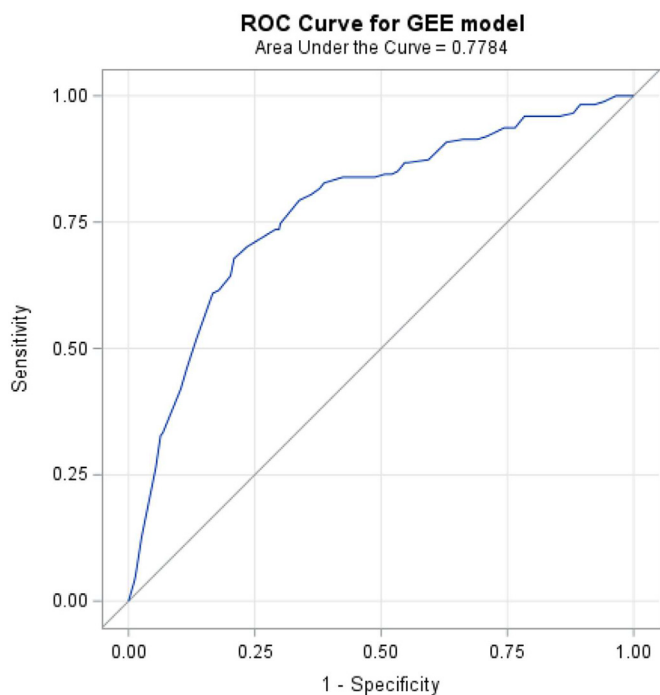
Variable	N	Minimum	Maximum	Median	Interquartile Range		Mean	SD
					Q1	Q3		
Age (years)	200	22.0	84.0	63.0	55.0	72.0	62.1	11.7
Pain Catastrophizing Score	200	0.0	52.0	28.0	15.0	40.0	27.3	14.6
PROMIS Pain Interference Score	200	39.0	84.0	68.0	64.0	72.0	68.3	6.5
Sex (n, % male)	200	92 (46%)						
Opioid use (n, % yes)	200	84 (41.5%)						

**Table 2**  
Surgeon Referral agreement with PCS score cut-point.

Referral	PCS Score						Kappa (95%CI)		
	≤20			>20			p-value		
	1	2	3	1	2	3	1	2	3
No	65 (35.9%)	68 (60.7%)	66 (49.6%)	226 (64.1%)	44 (39.3%)	67 (50.4%)	-0.05 (-0.12-0.02)	0.50 (0.40-0.61)	0.30 (0.19-0.40)
Yes	10 (52.6%)	7 (8.0%)	9 (13.4%)	9 (47.4%)	81 (92.0%)	58 (86.6%)	0.1521	<0.0001	<0.0001

**Table 3**  
Median PCS scores among referred patients by surgeon.

Surgeon	N	Minimum	Maximum	Median	Lower Quartile	Upper Quartile	p-value	
1	19	4.0	50.0	17.0	11.0	46.0	Vs. 2	0.0043
2	88	5.0	52.0	41.0	33.5	46.5	Vs. 3	0.8850
3	67	7	52.0	41.0	33.0	48.0	Vs. 1	0.0072



**Fig. 1.** Details a ROC curve for the data using a GEE model.

The ROC curve analysis (AUC=0.78) showed an acceptable discrimination for the PCS score’s ability to distinguish surgeon referral for ACT. Youden’s index was utilized to determine the cut point at which the PCS was predictive of surgeon referral in our clinic. In this clinic the cut point of 35 indicates that patients who score 34 or less would not be referred for ACT evaluation while patients who score 35 or above would be referred. This allows for future studies a cut point to utilize as a reference during experimental design when determining which patients to refer to evaluation by pain psychologist. The results of the linear regression model (Fig. 1) indicate an AUC of 0.78, showing a fair correlation between PCS scores and surgeon referral to the pain psychologist.

When compared to the PCS screening tool, surgeon 1 had the lowest kappa statistic of -0.05 (Table 2). This is in comparison to a kappa statistic of 0.50 for surgeon 2 (Table 2) and a kappa statistic of 0.30 for surgeon 3 (Table 2) when compared to the PCS screening tool, indicating that interrater reliability may be low with surgeon 1. However, there is moderate agreement between the PCS Screening tool and surgeons 2 and 3.

Common reasoning to refer to the pain psychologist for all three surgeons included a chronicity of problems (with longer chronicity increasing likelihood of referral), obesity (BMI above 30 increasing likelihood), and current tobacco and/or opioid use (with usage increasing likelihood). Factors not universally utilized included sex and age, with only surgeon 1 not utilizing either. In contrast, surgeons 2 and 3 stated that they were more likely to refer female and middle-aged patients. This demonstrates that some preconceived bias regarding who would benefit from ACT therapy may exist. Increased agreement between surgeons 2 and 3 is supported by the data (Table 2) showing agreement between

the three surgeons, with surgeons 2 and 3 having the highest agreement ( $p=.8850$ ) while Surgeon 1 had lower agreements with surgeon 2 ( $p=.0043$ ) and surgeon 3 ( $p=.0072$ ).

### Limitations

Limitations of the study included: a small sample size of surgeons surveyed, lack of ODI scores or radiologic findings when presenting patient data to (institution) spinal surgeons, and current lack of peer-reviewed research evaluating the PCS as a tool for referring patients for ACT and chronic pain management. In the study, only three spinal surgeons were surveyed as the UIHC Department of orthopedic spine surgery consists of three surgeons. Only 200 patients of the qualifying 600 patients were included in the study. The 600 qualifying subjects were reduced to 200 subjects as individually reviewing each case would lengthen the duration of the study significantly. A power analysis determined that 200 subjects would provide adequate statistical power and reasonability for volume of case review. Both the smaller surgeon count and the smaller sample size may have decreased inter-surgeon reliability. Lack of ODI scores or radiologic findings may have impacted the recommendations given by each surgeon.

Current evidence indicates that spinal surgeons have low sensitivity when using their clinical judgement to detect patients who have significant psychological distress impacting their pain levels [6]. This indicates that despite this study supporting the claim that PCS is moderately accurate in referring patients when compared to physician referral, it is only moderately accurate when compared to an imperfect standard of physician judgement. With this in mind, there are currently no other studies that evaluate PCS scoring in a similar manner. Studies that highlight the inaccuracies of spinal surgeon judgement also state that a standardized questionnaire that screens for psychological distress in patients should be considered [6]. The use of surgeon judgment as standard of comparison was required to establish initial cutoffs for the PCS as a screening tool for future studies. These initial cutoffs can be used to evaluate the use of the PCS when testing chronic pain outcomes as well as lead to further optimization of PCS score cut points. However, the lack of studies using the PCS in this context limit the existing scientific data to reference in support of our study design.

Future directions following this study include investigations regarding the PCS and referral to a pain psychologist with patients' chronic pain and post-operative outcomes. Patients who were previously referred for psychological evaluation and potential treatment with ACT for chronic pain would be compared to PCS-referred patients and non-referred patients. Preoperative psychological intervention would be compared to patient outcomes post-operatively. The aim would be to evaluate if PCS-referred patients have better pain management post-operatively as compared to the control and previously referred patients. The cutoffs established in this current study, based off of surgeon referrals, will be utilized when screening patients in this subsequent study. The future study will gather outcome-based measurements to evaluate PCS cutoffs and the use of the PCS as screening tool for ACT.

### Conclusions

The goal of the study was to evaluate if PCS scoring correlates with physician referral to pain psychologist in the initial effort to standardize the referral process in the orthopedic spine patient population. The PCS score demonstrated a moderate ability to distinguish patients who would be referred for psychological evaluation with a pain psychologist by an orthopedic spine surgeon. The Youden's Index adjusted cut point in the current study suggests that patients who score a PCS of 35 or above would be deemed at-risk and referred by the orthopedic spinal surgery team to the department pain psychologist for psychological evaluation while those who score below a PCS score of 35 would be identified as low-risk and not referred. The differences in kappa statistics between surgeon 1 (-0.05), surgeon 2 (0.50), and surgeon 3 (0.30)

could be attributed to the differences in referral reasoning between surgeons, as surgeon 1 did not utilize sex or age when evaluating patients while surgeons 2 and 3 utilized both.

Current literature indicates that clinical health psychologists with expertise in ACT can help patients who are experiencing chronic pain learn how to live in a manner that is consistent with what matters to them [1,3,7,18]. Additionally, pain psychologists can help patients achieve health related behavior changes that can improve a person's experience of pain [14]. Finally, it should be noted that the PCS score alone, though helpful, is only one factor in determining need for psychological intervention in patients who are experiencing pain.

Future studies aim to evaluate if referral to a pain psychologist, based on this study's results of an adjusted cut-point of a PCS score above 35, will demonstrate improved chronic pain outcomes for patients after orthopedic spine surgery.

### Declarations of competing interests

One or more of the authors declare financial or professional relationships on ICMJE-NASSJ disclosure forms.

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