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Longitudinal Treatment Outcomes for an Interdisciplinary Pain Rehabilitation Program: Comparisons of Subjective and Objective Outcomes on the Basis of Opioid Use Status

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Abstract: **Chronic pain is a major public health concern, and widespread use of prescription opioids for chronic pain has contributed to the escalating problem of opioid use disorder. Interdisciplinary pain rehabilitation programs (IPRPs) can be highly effective in discontinuing opioids in patients with chronic pain while also improving functional status. This study sought to examine self-report and performance-based functional outcomes of 2 cohorts of patients enrolled in a 3-week IPRP: patients engaged in interdisciplinary pain treatment and physician-supervised opioid taper versus nonopioid users engaged in interdisciplinary treatment. Immediate and long-term treatment outcomes were assessed using a series of 2 (group: opioid use, no opioid use) × 2 (period: pretreatment, post-treatment) and 2 (group: opioid use, no opioid use) × 2 (period: pretreatment, 6 months post-treatment) mixed model analyses of variance. Group × Period interactions were nonsignificant whereas period effects were significant for all outcomes in directions indicating improvement (*Ps* < .001) at discharge from the program and at 6 months, irrespective of opioid use status. Results support the assertion that IPRPs lead to significant improvements in subjective as well as objective indices of function, irrespective of opioid use status. Implications for our findings are discussed.**

Perspective: ***This article provides support for the effectiveness of interdisciplinary, rehabilitative models of care in improving physical and emotional functioning of patients with chronic pain while simultaneously discontinuing opioid use. The reach of this work is substantial, because opioid dependency and chronic pain are public health problems in the United States.***

Key words: *Interdisciplinary pain treatment, functional restoration, opioid use, opioid cessation, pain outcome measurement.*

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Chronic pain is a major public health concern with profound negative effects on the well-being of millions of Americans. More than 40%, an estimated 100 million U.S. citizens, experience chronic noncancer pain (CNP).[15] The recently released National Pain Strategy estimated that 14% of the adult population in the United States had "high-impact" chronic pain defined as

substantial pain-related decrement in occupational, social, and self-care activities for 6 months or longer.[9] In cases of high-impact pain, psychosocial factors such as mood, anxiety, maladaptive pain appraisals (eg, pain catastrophizing), and passive coping are thought to be particularly relevant. These variables interact with life stressors and social and financial reinforcement of pain behaviors to influence perceived pain and disability.[6]

Available evidence suggests that opioids are increasingly used in the treatment of CNP.[13,25] A recently published study indicating that 61% of 26,000 primary care patients surveyed were receiving long-term chronic opioid therapy.[17] Despite the widespread use of opioids for CNP, evidence supporting long-term efficacy is lacking,[4,5] whereas increased sales and use of greater quantities of prescription opioids has been associated with a parallel increase in number of overdose fatalities.[12,22,33] Furthermore, biologically driven mechanisms such as opioid tolerance and the emerging concern of opioid-induced hyperalgesia can exacerbate pain and call into question the long-term utility of opioid therapy.

One treatment model shown to improve the care of patients with high impact chronic pain, including discontinuation of opioids, involves intensive programs designed to address impairments in pain-related physical and emotional functioning. Interdisciplinary pain rehabilitation programs (IPRPs) with opioid cessation have support for efficacy. Upon completion of an IPRP with opioid cessation, Townsend et al[28] reported that patients who discontinued opioids self-reported significant treatment improvement in immediate and long-term outcomes, and there were no differences in treatment outcomes compared with non-opioid users. These findings occurred despite the fact that the patients receiving opioids at program admission had higher pain severity scores, and 97% were not using opioids at the time of program discharge. Similar results were reported among a sample of veterans with CNP receiving similar IPRP treatment within the VA system[20] and in a large sample (N = 1,194) of patients completing an intensive outpatient program.[14] Although these findings are compelling and provide support for opioid cessation through IPRPs, the authors relied exclusively on patient self-report to assess outcomes. Although patients' perceptions of their functional status are valuable, there may be differences between how patients objectively function and how they believe they function.[11] Additionally, discrepancies can exist between what patients report and in what providers conclude.[24]

In this study, we aimed to replicate and expand on existing research examining the effectiveness of an IPRP with opioid cessation for patients with CNP. We hypothesized that patients not using opioids as well as patients tapered off opioids during treatment will experience significant improvements on self-report and performance-based functional outcomes at post-treatment. We also hypothesized that patients tapered off opioids will experience sustained improvements in functioning that will be similar to patients who were not taking opioids at 6 months post-treatment.

Methods

Patients

Eligible patients for this study were 353 consecutive patients with CNP enrolled in the Mayo Clinic Pain Rehabilitation Center (PRC) from January 2015 to December 2015. All patients completed preadmission assessment by Mayo Clinic staff members to determine their eligibility for inclusion into the comprehensive pain treatment program before their actual admission date. Inclusion criteria were: 1) pain in 1 or more anatomical sites, which was the predominant focus of the clinical presentation and of sufficient severity to warrant clinical attention; 2) pain caused clinically significant distress or impairment in social, occupational, or other important areas of functioning; and 3) there was no evidence to suggest that symptoms were intentionally produced or feigned. Patients were excluded from participating if: 1) pain was caused by a malignant condition (eg, cancer), 2) they had an active moderate or severe alcohol or other substance use disorder, 3) they were assessed to be at acute suicide risk, or 4) they had an active psychotic or mood disorder that required immediate psychiatric management at a different level of care. Assuming patients met inclusion criteria and expressed motivation to initiate treatment, they were scheduled to begin treatment anywhere from a few days to 3 months after the preadmission assessment. The first 2 days of PRC programming are allocated to multidisciplinary evaluation and treatment planning before full immersion into treatment. Over the course of the study, 7 patients presented for their PRC admission appointment but never actually started the program. Of the patients admitted into the program, 59 (17%) did not complete the intensive 3-week outpatient program and were excluded from the final analyses. In addition, 2 patients who completed treatment were excluded from analyses because of excessive missing data. Our final sample consisted of 285 patients (see Fig 1 for the flow diagram of study patients).

Patients were separated into 2 groups on the basis of their opioid use status at the time of admission. The 142 (49.8%) patients taking opioids were compared with the 143 (50.2%) patients who were not taking opioids. Forty-two percent of those who completed the program returned 6-month post-discharge questionnaire data assessing medication use and physical and emotional functioning.

The mean age of the sample was 49.2 years (SD = 14.34). Most of our sample was female (n = 180, 63.2%), Caucasian (n = 253, 88.7%), and married (n = 163, 57.2%). Generalized pain (pain in ≥3 sites) comprised the largest diagnostic category (33.3%; n = 95), with low back pain (25.3%; n = 72) and fibromyalgia (16.8%; n = 48) comprising the next 2 largest diagnostic groups. The average duration of pain was reported to be 10.83 years (range = 6 months to 60 years). Additional descriptive information is shown in Table 1. T-test or χ^2 analyses were conducted to compare patients in our final sample with patients lost to attrition. Comparisons showed that patients in the 2 groups did not differ significantly on any demographic characteristic or pretreatment outcome measures.

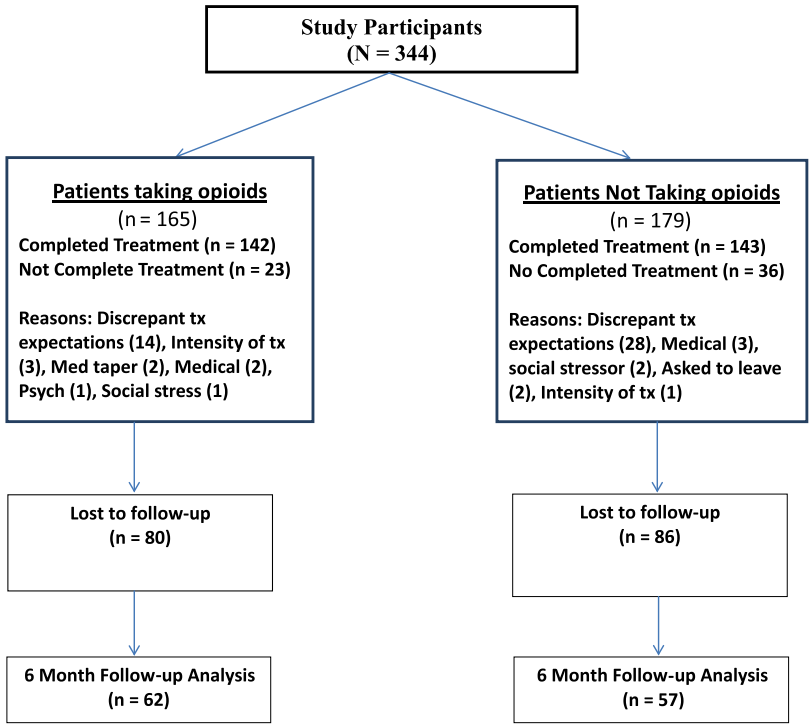

Figure 1. Flow diagram of study patients. Abbreviations: tx, treatment; Med, medication; Psych, psychological issue.

Procedure

Study patients completed all psychosocial questionnaires at 3 time points (pre-treatment, post-treatment, 6 months post-treatment). Descriptions of psychosocial questionnaires can be found under the dependent variable section. Patients who did not complete the 6-month follow-up questionnaire within 2 weeks of mailing were sent a reminder letter encouraging them to complete and return the packet. The functional capacity and performance in activities of daily living outcomes (see dependent variables section) were assessed at pre-treatment and post-treatment only. Informed consent was provided by all study patients for access to their medical records for research purposes. This study was approved by the institutional review board at the Mayo Clinic in Rochester, Minnesota.

Dependent Variables

Medication Use

To ensure accuracy of medication formulation and dosage, a complete medication reconciliation was completed either by the nurse or the pharmacist with every patient upon admission. Medications were categorized into a separate database. Current daily opioid dosing was calculated using information from medical records, medication bottles, patient report, and state prescription

Table 1. Patient Characteristics

	Total Study Sample (N = 285)	*Patients Not Taking Opioids (n = 143)*	*Patients Taking Opioids (n = 142)*	P†
Age, years	49.26 (14.34)	45.31 (13.91)	53.03 (13.76)	.001*
Sex				.94
Female	62.8	70.6	62.9	
Male	37.2	29.4	38.0	
Education	15.10 (2.85)	15.06 (3.03)	15.14 (2.68)	.79
Race				
Caucasian	88.7	87.7	89.7	
Other	11.3	12.3	10.3	
Marital Status				.71
Married	58.6	54.5	61.3	
Single	20.4	23.1	17.6	
Other	21.0	22.4	21.1	
Duration of pain	10.83 (10.34)	10.86 (10.70)	10.81 (10.04)	.97
Current opioid use	49.8			

NOTE. Data are presented as mean (SD) or %.
*$P < .001$.
†χ^2 (categorical) and independent samples t-test.

monitoring programs where available. Opioid intake was converted to oral morphine milligram equivalents (MME) for analysis on the basis of the Centers for Disease Control and Prevention (CDC) conversion.[10] Per CDC chronic pain guidelines, doses of ≥50 daily MME increases the risk for overdose twofold compared with doses of <20 MME per day.[10]

Adjustment to Chronic Pain

The Pain Severity (PS) and Pain Interference (PI) subscales of the West Haven-Yale Multidimensional Pain Inventory[16] were used to assess these factors, and have acceptable levels of reliability and validity.[16,29] Possible scores range from 0 to 6 for each subscale, with higher scores representing greater symptom severity and functional impairment, respectively. The internal consistency of both subscales was appropriate at admission, discharge, and 6-month post-treatment (pain severity = .73–.88, pain interference = .89–.91).

Quality of Life

The Medical Outcomes Study, 36-Item Short Form Health Survey[30] is a measure of 8 domains of health-related quality of life, including: general health perceptions, physical health functioning, mental health functioning, role limitations due to emotional problems, role limitations due to physical health, bodily pain, vitality, and social functioning. The subscales can be combined into 2 summary scores: mental health-related quality of life (MHQOL) and physical health-related quality of life (PHQOL). Items are rated on a Likert-type scale, which are then transformed into percentages (0–100). Lower scores reflect worse QOL. Research supports strong psychometric properties for the measure, including high convergence with clinical data.[19] Internal consistency in the current sample was high at admission, discharge, and 6-month post-treatment (physical health = .87–.90, mental health = .85–.90).

Depressive Symptoms

The Center for Epidemiologic Studies-Depression Scale (CES-D)[23] is a 20-item measure that assesses depressive symptoms experienced during the past week. Research supports the internal consistency ($\alpha = .90$) as appropriate for use in research.[23] Possible scores range from 0 to 60. Higher scores indicate greater depressive symptomology. The internal consistency in the current sample was high at all 3 time points (.91–.93).

Pain Catastrophizing

The Pain Catastrophizing Scale (PCS)[26] is a 13-item scale that measures rumination (eg, "I can't seem to keep it out of my mind"), magnification (eg, "I wonder whether something serious may happen"), and helplessness (eg, "I feel I can't go on") regarding pain. Scores range from 0 to 52 with higher scores reflecting greater levels of catastrophic thinking. Osman et al[21] provided support for the validity of the PCS subscale scores by reporting significant correlations with measures of pain severity, pain interference, and negative affect. In the current sample, internal consistency was appropriate at all 3 time points (.94–.96).

Functional Capacity

The Simmonds Physical Performance Test Battery[24] is a battery of objectively measurable functional tests conducted by physical therapists, including: 5-minute walk test (measured in feet), 50-foot walk test (seconds), timed up-and-go test (seconds), repeated sit-to-stand test (seconds), repeated trunk flexion test (seconds), and loaded reach test (centimeters). Higher scores represent better functioning on the 5-minute walk test and loaded reach test, whereas lower scores represent better functioning on the timed up-and-go test, 50-foot walk test, sit-to-stand test, and repeated trunk flexion test. Research supports the reliability, stability, and validity of the battery.

Performance in Activities of Daily Living

The Canadian Occupational Performance Measure (COPM)[18] is a semistructured interview designed for use by occupational therapists to assess outcomes in areas of self-care, productivity, and leisure. Patients are asked to identify problem areas in daily function and rate their performance (1–10; 1 = not able to do it, 10 = able to do it extremely well) and current satisfaction (1 = not satisfied at all, 10 = extremely satisfied) with their performance level. Lower scores indicate worse performance and satisfaction, respectively. Only the performance subscale was used in the current study. The COPM has been validated across diverse patient populations,[3] including pain.[2]

Treatment Intervention

The Mayo Clinic PRC is an intensive, outpatient interdisciplinary rehabilitation program focusing on functional restoration. Patients admitted into the PRC have generally received extensive medical care and experienced incomplete symptom relief from multiple pharmacologic trials, surgical procedures, and interventional pain procedures. The PRC combines functional restoration with cognitive-behavioral therapy as its chief components. The underlying treatment philosophy emphasizes that when meaningful pain reduction is not possible, treatment approaches must shift toward maximizing functionality. PRC entails concurrent treatment by multiple disciplines including physicians, psychologists, vocational rehabilitative specialists, nurses and clinical nurse specialists, physical therapists, occupational therapists, pharmacists, chemical dependency counselors, and dieticians, all of whom offer convergent expertise with a balance of overlapping and distinct knowledge.

The PRC treatment program is 15 days in duration. Patients attend programming for 8 hours daily for 15 consecutive working days. Admissions occur on a revolving basis and patients are assigned to 1 of 2 treatment teams. Each treatment team consists of up to 15 patients, and the average daily total census is 24 to 27

patients. Patients participate in daily physical and occupational therapy and individual and group-based cognitive-behavioral therapy sessions. All patients meet individually with the multidisciplinary team weekly wherein the patient's treatment progress is discussed.

Physician and pharmacist supervised opioid tapering is a core component of the PRC episode of care. At admission, the daily opioid dose of each patient is determined according to self-report and review of pharmacy records by the pharmacist. The opioid medication the patient is taking at admission is used as the basis of the opioid taper schedule. Oral morphine equivalent doses are calculated for all patients taking daily opioids, including low-potency agents such as tramadol, using the CDC conversion factors guideline.[10] On PRC program admission, opioid use is confirmed with a urine drug screen for all patients. The urine drug sample screens for opioids, amphetamines, barbiturates, benzodiazepines, cocaine, phencyclidine, and tetrahydrocannabinol. Within the first few days of program admission, a taper schedule is developed and initiated in collaboration with treatment team members and the patient. Tapering in the PRC occurs over a mean of 10 days for patients receiving <100 MMEs per day. Structured tapers may also be slower for those with a long duration of opioid use, especially with those with daily use >2 years. Initial taper reductions in opioid dose may be larger, until approximately 50 to 80% of the total initial dose is decreased. The percentage of the total opioid dose is generally reduced by 10 to 20% with each reduction during the first half to two-thirds of the taper, and reduced again by 2.5 to 10% during the final half to one-third of the taper. Response to the tapering process is monitored in all patients with the option to adjust as needed. Details on the programs process of opioid tapering have been previously described.[8] Tapering benzodiazepines and other medications also occurs in a systematic fashion but is second in priority to opioids. Benzodiazepine tapers often need to be extended beyond the timeframe of the PRC program because of greater risk for complications compared with opioid tapers.

Daily withdrawal assessment is performed during the opioid taper and for several days after taper completion. The Clinical Opioid Withdrawal Scale[32] is used to assess blood pressure, heart rate, temperature, and withdrawal symptoms through the opioid taper. On dismissal a urine drug screen is repeated but may not be informative for confirmation because of medication clearance time.

Statistical Analyses

Before analyses, all variables were inspected for normality within each group. Outliers were defined as $z = \pm 3.29$ and were Winsorized to preserve data while reducing the influence of extreme values. Variables exceeding acceptable levels of skewness (± 1.96) included the following physical therapy variables: timed up-and-go, sit-to-stand, and loaded trunk. A square root transformation was conducted on these variables, which successfully reduced skewness. However, there were no differences in significance or interpretation of results using transformed variables. Therefore, the original variables were used. There were no violations to homogeneity of variance or sphericity. Missing data were replaced with group means and doing so did not alter the significance or interpretation of the results.[27] Data were imputed for data points in 43 cases in the pre-treatment to post-treatment data set, and 6 cases for six-month follow-up data using mean imputation.

Comparisons between groups (opioid use vs no opioid use, treatment completers vs noncompleters) for demographic and clinical characteristics were conducted using independent samples t-tests for continuous variables and χ^2 or McNemar tests for categorical variables. Treatment outcomes were assessed using a series of mixed model analyses of variance (ANOVAs), including 2 (group: opioid use, no opioid use) $\times$ 2 (period: pre-treatment, post-treatment; post-treatment, 6 months post-treatment; or pre-treatment, 6 months post-treatment) ANOVAs. Post hoc follow-up tests of simple main effects were used where significant interactions were found. ANOVAs were conducted with Bonferroni adjustments because of multiple comparisons. Effects sizes are reported as partial η^2 (ηp^2) for ANOVAs (.01 = small, .06 = medium, .14 = large). Analyses were conducted using IBM SPSS version 24.0 (Armonk, NY).

To further assess the effect of opioid use on participant treatment outcomes, groups were further stratified according to level of daily morphine equivalence as follows: no opioid use, low opioid use (<50 mg morphine equivalence), and high opioid use (≥50 equivalence), on the basis of CDC guidelines.[10] However, results indicated no between group differences comparing the low and high opioid groups, no Group $\times$ Period interactions, and this additional stratification did not alter the interpretation of the results for the analyses described in the results section. Accordingly, analyses were conducted comparing the broader categories of opioid and non-opioid use groups.

Results

Pre-Treatment Medication Use

The mean (SD) daily morphine equivalent dose in the opioid use group was 66.2 mg (4–330 mg) and the median dose was 40.0 mg. Of the patients in the opioid use cohort, 12.7% were taking opioids "as needed" but not daily; 51.5% were taking 1 to 40 mg per day; 26.3% were taking 41 to 90 mg per day; 25.3% took more than 90 mg. Patients reported taking prescription opioid medications for a mean (SD) of 5.8 (4.9) years. Of the opioid cohort, 16.3% reported taking opioid medications for a year or less; 77.3% reported taking opioids for more than 2 years; 45.5% reported using for 5 or more years; and 22.7% for 10 or more years (duration of use is on the basis of 110 patients because of missing data).

At pre-treatment, more than one-third (35.4%) of the study patients were taking benzodiazepines and 15.4% were taking a muscle relaxant. Approximately one-half (50.9%) were using acetaminophen whereas 42.5% were using nonsteroidal anti-inflammatory drugs (NSAIDs).

Additionally, more than half (51.6%) were taking an anticonvulsant medication whereas 15.4% and 9.8% were using prescription or over-the-counter sleep aid medications, respectively. Also, 6.7% of patients were using stimulant medications. Finally, study patients were taking the following medications for mood management: serotonin-norepinephrine reuptake inhibitors: 35.1%, selective serotonin reuptake inhibitors: 24.6% and tricyclic antidepressants: 14.0%.

Opioid Use Versus No-Opioid Use Differences in Demographic Characteristics and Pretreatment Outcomes Measures

At the time of pre-treatment, there were no significant differences identified between the opioid and no-opioid groups regarding sex, ethnicity, education, marital status, duration of pain, or primary pain site. However, a significant difference was detected for age, with the opioid group (mean = 52.79, SD = 13.50) being significantly older than the no-opioid group (mean = 45.3, SD = 13.91, $t_{283} = 4.71$, $P < .001$; Table 1). Age was initially added as a covariate in ANOVAs; however, the addition of age as a covariate did not change the interpretation of the results and was not included in the final analyses. Also, χ^2 analysis revealed no significant difference in rates of program completion between the opioid users and non-opioid users ($\chi^2 = .37$, $P = .57$).

Pre-Treatment to Post-Treatment Changes in Outcome Measures

A series of mixed-design ANOVAs were performed for all outcomes measured. These were treatment group (opioid, no opioid) × period (pre-treatment; post-treatment) analyses. See Table 2 for means and SDs. For PS, PI, MHQOL, PHQOL, CES-D, and PCS, period effects were significant for all outcomes in directions indicating that patients improved on all indexes ($F_{1,283} > 248$, Ps $< .001$; $\eta p^2 > .466$). There was an overall group effect for PI ($F_{1,283} = 3.07$, $P = .04$, $\eta p^2 = .01$), indicating that patients using opioids on admission reported overall worse pain-related life interference. All Opioid group × Period interactions were nonsignificant ($F_{1,283} < 3.08$, Ps $> .08$, $\eta p^2 < .011$), indicating that patients improved irrespective of groups status.

For our functional outcomes, the 5-minute walk, 50-foot walk, timed up-and-go test, repeated sit-to-stand, repeated trunk flexion, and loaded reach, all period effects were significant ($F_{1,283} > 151.58$, Ps $< .001$, $\eta p^2 > .349$) in directions indicating that patients improved at the end of treatment. There was a significant group effect for the 50-foot walk test ($F_{1,283} = 2.18$, $P = .01$, $\eta p^2 = .02$) and for the timed up-and-go test ($F_{1,283} = 8.86$, $P = .003$, $\eta p^2 = .01$), with patients using opioids having worse overall performance on both tests. However, all Opioid group × Period interactions were nonsignificant ($F_{1,283} < 3.85$, Ps $> .06$, $\eta p^2 < .014$), indicating that treatment-related improvements occurred irrespective of group status.

For the COPM performance outcome, a significant Group × Period interaction was detected ($F_{1,283} = 5.27$, $P = .02$, $\eta_p^2 = .018$). However, follow-up tests of simple main effects indicated no differences between groups at admission ($P = .09$) or discharge ($P = .16$). There was, however, a significant period effect, ($F_{1,283} = 2{,}734.62$, $P < .001$, $\eta p^2 = .91$), indicating improvement across treatment for both groups.

Medication Taper

At discharge from the IPRP, all patients in the opioid group had completed the taper and discontinued opioid medication. Compared with pre-treatment, a significant number of patients had also tapered from benzodiazepines (McNemar test, $P < .001$), acetaminophen ($P < .001$), NSAIDs ($P < .001$), muscle relaxants ($P < .001$), anticonvulsants ($P < .001$), stimulants ($P < .001$), prescription sleep medications ($P < .001$), and tricyclic antidepressants ($P < .002$). Compared with pre-treatment, use of over-the-counter sleep medications remained the same ($P = .25$; Table 3).

At post-treatment, there were no significant differences between the non-opioid group and opioid group in the proportion of patients taking acetaminophen, NSAIDs, muscle relaxants, stimulants, over-the-counter sleep medications, or tricyclic antidepressants ($\chi^2 < 2.70$, df = 1, Ps $> .10$). Conversely, significant difference did exist between the opioid and non-opioid groups in the proportion of patients taking benzodiazepines, anticonvulsants, and prescription sleep medications with a higher proportion of opioid users finishing treatment still receiving each of these medications ($\chi^2 > 4.87$, Ps $< .03$; Table 3).

Six-Month Follow-Up

One hundred nineteen (41.8%) of the 285 patients who completed treatment completed questionnaire measures at the 6-month follow-up. Comparisons of those who completed and did not complete the follow-up survey revealed no group differences in gender, pain site, marital status, education, opioid use status at admission, depressive symptoms, or pain catastrophizing. Patients who completed the 6-month survey were more likely to be older ($t_{283} = 4.55$, $P < .001$) and have longer duration of pain ($t_{283} = 2.10$, $P < .05$) than patients who did not complete the survey.

Regarding opioid use at 6 months post-treatment, 12 (10.1%) of the 119 patients who completed the rehabilitation program and returned the questionnaire reported using opioids. Of those reporting opioid use at 6 months post-treatment, most (n = 11, 91.6%) of these patients had been taking opioids at pre-treatment. Also, 11 patients (9.2%) did not answer if they were using opioids or not on the 6-month questionnaire. Of those not answering the opioid use question, 5 (45.5%) were taking opioids at pre-treatment.

For our self-report data, ANOVAs were repeated to compare pretreatment with the 6-month time period, to assess whether patients had significant improvements at

Table 2. Sample Pre-Treatment and Post-Treatment Values for all Pain Outcome Variables

	Pre-Treatment		*Post-Treatment*			
Outcome Variable	*Patients Taking Opioids, Mean (SD)*	*Patients Not Taking Opioids, Mean (SD)*	*Patients Taking Opioids, Mean (SD)*	*Patients Not Taking Opioids, Mean (SD)*	*Within-Subjects Effect F Value*	*Effect Size* η_p^2
PS†	4.31 (.99)	4.10 (.97)	3.02 (1.38)	2.84 (1.21)	248.23*	.467
PI†	4.61 (.97)	4.50 (1.07)	3.49 (1.19)	3.12 (1.33)	280.35*	.498
Mental health quality of life‡	38.71 (21.47)	41.15 (20.18)	69.21 (19.44)	72.32 (19.75)	451.68*	.615
Physical health quality of life‡	30.35 (14.47)	32.20 (14.63)	57.24 (20.74)	60.58 (20.48)	559.65*	.664
Depressive symptoms§	25.28 (12.76)	23.31 (12.05)	12.00 (9.72)	10.80 (9.41)	332.22*	.541
Pain catastrophizing¶	26.17 (11.57)	24.22 (12.06)	13.13 (9.87)	11.36 (9.24)	349.65*	.553
5-Minute Walk‖	1,170.12 (371.61)	1,254.18 (356.92)	1,404.80 (328.30)	1,491.15 (280.99)	242.29*	.461
50-Foot Walk‖	12.64 (4.23)	11.39 (4.24)	10.06 (2.57)	9.36 (2.43)	151.98*	.349
Timed Up-and-Go‖	12.93 (4.86)	11.46 (3.99)	9.35 (2.24)	8.71 (2.02)	225.94*	.444
Repeated Sit-to-Stand‖	17.38 (8.22)	15.79 (8.22)	11.99 (5.47)	11.40 (4.78)	166.60*	.371
Repeated trunk flexion‖	14.05 (5.08)	13.92 (7.11)	9.97 (2.83)	9.56 (3.16)	190.91*	.403
Loaded reach‖	55.09 (12.91)	56.25 (13.80)	62.95 (11.11)	64.37 (11.44)	158.68*	.359
Occupational functioning performance**	2.75 (.87)	2.94 (.97)	7.56 (1.22)	7.34 (1.37)	2,743.62*	.906

NOTE. η_p^2 = effect size, admission to immediately post-treatment (.01 = small, .06 = medium, .14 = large).
*$P < .001$; period effect, admission to immediately posttreatment.
†Multidimensional Pain Inventory.
‡Medical Outcomes Study, 36-Item Short Form Health Survey.
§Center for Epidemiological Studies-Depression Scale.
¶PCS.
‖Simmonds Physical Performance Test Battery.
**COPM.

Table 3. Pre-Treatment and Post-Treatment Group Differences in Frequency of Medication Use

	Pre-Treatment			*Post-Treatment*			
Outcome Variable	*Patients Taking Opioids (n = 142), n (%)*	*Patients Not Taking Opioids (n = 143), n (%)*	x^2 *df = 1*	*Patients Taking Opioids, n (%)*	*Patients Not Taking Opioids, n (%)*	x^2 *df = 1*	*Within Subjects Change,† x^2 df = 1*
Opioids	142 (100)	0 (.0)	285.0**	0 (0)	0 (0)	.00**	142.00**
Benzodiazepines	58 (40.8)	43 (30.1)	3.62	38 (26.8)	20 (14)	7.17*	43.00**
Acetaminophen	94 (66.2)	51 (35.7)	26.58**	35 (24.6)	24 (16.8)	2.69	86.00**
NSAIDs	63 (44.4)	58 (40.6)	.42	32 (22.5)	35 (22.5)	.15	54.00**
Muscle relaxants	29 (20.4)	15 (10.5)	5.39*	6 (4.2)	2 (1.4)	2.09	36.00**
Anticonvulsants	85 (59.9)	62 (43.4)	7.78**	69 (48.6)	44 (30.8)	9.46**	28.90**
Stimulants	8 (5.6)	11 (7.7)	.49	4 (2.8)	4 (2.8)	.01	11.00**
Prescription sleep medications	25 (17.6)	19 (13.3)	1.02	11 (7.7)	3 (2.1)	4.87*	30.00**
Over-the-counter sleep medications	18 (12.7)	10 (7.0)	2.60	15 (10.6)	10 (7.0)	1.14	3.00
Tricyclic antidepressants	20 (14.1)	20 (14.0)	.01	17 (12.0)	13 (9.1)	.63	10.00**

NOTE. Effect size, admission to immediately posttreatment (.01 = small, .06 = medium, .14 = large).
*$P < .05$.
**$P < .01$.
†Cochran Q test used for within subjects test.

follow-up. For PS, PI, MHQOL, PHQOL, CES-D, and PCS, Opioid group × Period (pre-treatment, 6-month) interactions were nonsignificant ($F_{1,117} < 2.13$, $Ps > .14$, $\eta p^2 < .03$). There were no group effects. Period effects were again significant for all outcomes in directions indicating that patients improved on all indexes, irrespective of group status ($F_{1,117} > 44.01$, $Ps < .001$, $\eta p^2 > .26$; Table 4).

Loss of Treatment Gains

In comparing outcomes at post-treatment with 6 months post-treatment, there were some losses in treatment gains. To examine these differences, a series of mixed models ANOVAs were performed. These analyses were Treatment group (opioid, no opioid) × Period (post-treatment, 6-month follow-up) analyses. For PS, PI, MHQOL, PHQOL, CES-D, and PCS, all Opioid group × Period interactions were nonsignificant ($F_{1,117} < .98$, $Ps > .33$, $\eta p^2 < .008$). Period effects were significant for all outcomes in directions indicating treatment losses on all indexes, irrespective of group status ($F_{1,117} > 6.02$, $Ps < .02$, $\eta p^2 > .049$) with the exception of PI where there was no significant losses from post-treatment to 6- months post-treatment ($F_{1,117} = .02$, $P = .90$, $\eta p^2 = .001$; Table 5).

Discussion

Findings of the present study replicate and expand upon the current literature to demonstrate treatment effectiveness of interdisciplinary pain rehabilitation with opioid cessation for patients with CNP, using patient self-report as well as performance-based measures of functioning. Patients who were tapered off opioids showed gains comparable with their non–opioid-using counterparts and experienced sustained improvements in functioning 6 months after rehabilitative treatment. These findings suggest that regardless of previous opioid use status, rehabilitative treatment effectively leads to sustained functional restoration for chronic pain patients well beyond treatment completion for an enhanced degree of daily functioning.

At pre-treatment, there were no group differences between opioid and non–opioid-using patients across most demographic variables or measures of pain, quality of life, depressive symptoms, pain catastrophizing, or performance of activities of daily living. This lack of group difference challenges the widely used suggestion that chronic pain patients taking opioids may have more disruptive pain experiences than those who are not taking opioid medications. However, there was an overall group difference in pain-related interference, with patients taking opioids reporting greater levels of interference. Patients using opioids on admission also showed significantly slower completion times for 2 domains of performance-based functional outcomes (50-foot walk; timed up-and-go); however, there were no treatment-related differences, indicating that patients in both groups improved to similar extents. At the end of 3 weeks of interdisciplinary pain rehabilitation, there were no treatment-related opioid group differences across any of the patient self-report or performance-based measures of functioning, replicating previous findings.[14,20,28] These results suggest that patients initiating treatment while taking opioids are able to benefit comparably from rehabilitative treatment even while undergoing the additional task of tapering off opioids. Additionally, although the median opioid dose was 40 MME per day on program admission, the range included doses as high as 330 MME per day indicating this treatment modality may be effective in patients taking higher opioid doses. Results also suggest integrating performance-based functional outcome measures is feasible and allows for more objective assessment of patients' progress in treatment.

Polypharmacy is another problematic issue in patients with CNP. Patients receiving care in IPRPs often suffer with comorbid problems such as fatigue, mood, and poor sleep, and rely primarily on pharmacological treatment modalities to treat these issues. In this study we found that a significantly greater proportion of patients in the opioid group were taking acetaminophen, muscle relaxants, and anticonvulsants at the time of admission compared with the no-opioid group. Similar to the outcomes related to opioid cessation, significant improvements in functional status and mood occurred despite reduction in these medications.

Maintenance of gains at 6 months post-treatment confirm robust treatment effects over time regardless of opioid group, while also highlighting the importance of appropriate follow-up care. Patients responding to the 6-month follow-up survey reported outcomes significantly better than pre-treatment outcome variables across all self-report measures. Notably, although positive gains were maintained overall (ie, pre-treatment compared with follow-up), there was a demonstration of treatment effect loss across these domains between the post-treatment and 6-month follow-up. When patients leave the structured environment of an intensive program, they are tasked with applying their self-management strategies within the context of real-life stressors back home. Although program components do specifically assist patients in preparing for their return home, including prevention of relapse to past pain behaviors, applying new skills in familiar environments in which pain behaviors were likely reinforced can be a legitimate challenge. Our previous research shows that at post-treatment, patients identify relaxation strategies, moderation/modification, physical therapy/exercise, cognitive-behavioral therapy strategies (including self-talk, challenging thoughts), and use of distraction as the most important strategies learned.[7] However, the extent to which patients actively and consistently apply such strategies after treatment remains unclear.

The ultimate aim of IPRPs is not to alleviate pain or produce short-term functional gains, but rather to foster sustained benefits that patients can continue for the remainder of their lives. This suggests that an important component of active pain rehabilitation treatment is assisting the chronic pain patient in generating an appropriate plan for follow-up care. This plan may include ongoing cognitive-behavioral therapy, attending aftercare pain rehabilitation sessions to reinforce gains made in treatment, and attention to reducing reliance on

Table 4. Pre-Treatment and Follow-up Values for Pain Outcome Variables

	Pre-Treatment		*6-Month Follow-up*		*Within Subjects Effect, F*	*Effect Size, η_p^2*
Outcome Variable	*Patients Taking Opioids, Mean (SD)*	*Patients Not Taking Opioids, Mean (SD)*	*Patients Taking Opioids, Mean (SD)*	*Patients Not Taking Opioids, Mean (SD)*		
PS†	4.05 (1.01)	4.06 (1.02)	3.24 (1.35)	3.00 (1.42)	53.27*	.31
PI†	4.49 (.93)	4.53 (.98)	3.29 (1.45)	2.92 (1.60)	100.17*	.46
Physical Health QOL‡	30.88 (14.54)	32.61 (14.83)	44.50 (23.05)	48.85 (24.59)	56.72*	.33
Mental Health QOL‡	41.09 (21.59)	38.71 (19.74)	60.93 (23.76)	57.35 (24.73)	63.33*	.35
Depressive Symptoms§	23.34 (12.73)	24.42 (12.62)	15.79 (11.78)	17.16 (11.55)	44.02*	.27
Pain Catastrophizing¶	24.61 (9.94)	25.63 (11.91)	15.76 (10.88)	14.82 (11.06)	77.85*	.40

Abbreviation: QOL, quality of life.
NOTE. η_p^2 = Effect size, admission to immediately posttreatment (.01 = small, .06 = medium, .14 = large).
*$P < .001$; period effect, admission to 6-month follow up.
†Multidimensional Pain Inventory.
‡Medical Outcomes Study, 36-Item Short Form Health Survey.
§Center for Epidemiological Studies-Depression Scale.
¶PCS.

Table 5. Sample Post-Treatment and 6-Month Follow-up Values for Self-Report Pain Outcome Variables

	Post-Treatment		*6-Month Follow-up*			
Outcome Variable	*Patients Taking Opioids, Mean (SD)*	*Patients Not Taking Opioids, Mean (SD)*	*Patients Taking Opioids, Mean (SD)*	*Patients Not Taking Opioids, Mean (SD)*	*Within-Subjects Effect, F*	*Effect Size, η_p^2*
PS†	2.93 (1.25)	2.76 (1.30)	3.24 (1.35)	3.00 (1.42)	6.63*	.049
PI†	3.28 (1.22)	2.97 (1.47)	3.29 (1.45)	2.92 (1.60)	.02	.001
Mental health quality of life‡	71.57 (18.55)	71.73 (20.73)	60.93 (23.76)	57.35 (24.73)	43.88**	.273
Physical health quality of life‡	59.05 (19.76)	63.14 (22.30)	44.50 (23.05)	48.85 (24.59)	78.57**	.402
Depressive symptoms§	10.16 (8.00)	10.95 (9.32)	15.79 (11.78)	17.16 (11.55)	44.14**	.274
Pain catastrophizing¶	12.08 (8.75)	12.25 (10.26)	15.76 (10.88)	14.82 (11.06)	14.47**	.110

NOTE. η_p^2 = effect size, admission to immediately post-treatment (.01 = small, .06 = medium, .14 = large).
*$P < .05$; period effect, admission to immediately post-treatment.
**$P < .01$; period effect, admission to immediately post-treatment.
†Multidimensional Pain Inventory.
‡Medical Outcomes Study, 36-Item Short Form Health Survey.
§Center for Epidemiological Studies-Depression Scale.
¶PCS.

medications and health care utilization to address chronic symptom concerns. One important component of this planning process would be to identify facilitators (eg, social support) and anticipate barriers (eg, finances, time limitations, regional access to resources including opioid medication, psychosocial stressors) to ongoing application of skills, in service of optimizing patient success over the long term.

We also found a low rate of return to opioids at 6-month post-treatment regardless of opioid use status at the time of admission. These data are consistent with previous studies showing relatively low return to opioid use in patients who completed opioid taper in the course of IPRP focused on functional[14,20,28] compared with the reported >90% relapse rates associated with 8 weeks of restoration opioid detoxification alone.[31] These findings suggest an important role of IPRP in reducing return to prescription opioids in patients with CNP.

Several study limitations should be considered when interpreting these results. First, because this was an observational cohort study, patients were not randomly assigned to a control condition. Randomized control studies are needed to address issues of selection bias and to compare outcomes with patients who complete IPRP without opioid withdrawal. Second, the applicability of these findings to all patients with CNP taking opioids may be limited because of selection bias in the study sample. Patients in our study were referred specifically for pain rehabilitation with opioid weaning and expressed willingness to pursue this treatment approach. Also, 17% of our sample did not complete the full course of treatment. This may distinguish our study sample from other patients unwilling to engage in functional restoration as well as opioid weaning, in concert. Of particular importance are patients' motivation and ability to tolerate opioid withdrawal. It seems likely that IPRP with rapid opioid weaning may not be appropriate for some patients, and alternatives to tapering strategies, such as maintenance treatment options in the form of medication-assisted treatment (eg, buprenorphine/naloxone) may be considered. The potential benefit from this practice is supported by growing evidence.[1] Additional research is needed to assess treatment outcomes for IPRP programs with opioid replacement therapies and to understand patient characteristics that may affect the success of different treatment approaches (eg, patients with opioid use disorder symptoms, patients receiving very high opioid doses). Third, patient follow-up response is another source of potential bias. Of the 285 patients included in this study, 119 (42%) were successfully contacted and completed questionnaire data assessing functional status and opioid use status 6 months after treatment leaving the status of a large number of patients unknown. This limits our ability to speak to the long-term durability of IPRP and introduces the potential for selection bias that needs to be taken into consideration. Also, because a significant percentage of study participants reside out of state or internationally, it was not feasible for us to collect 6-month follow-up data on the performance-based functional outcomes, further limiting our ability to speak to treatment durability. Finally, our sample lacked ethnic/racial diversity, which limits the generalizability of our findings to other chronic pain populations and prohibited our ability to examine ethnic/racial group differences.

Conclusions

Overall, the results of this study lend further support to interdisciplinary pain rehabilitation as an effective treatment for chronic pain. Not only do these programs contribute to significant functional gains and symptom reduction among patients with chronic pain, results also indicate that patients can be successfully tapered off opioid pain medications during treatment. Future research should explore ways to optimize treatment for patients who are reluctant to withdraw from opioid medications and to explore novel methods for service delivery (eg, stepped treatment approaches for primary care patients) to improve patient access to such programs.

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