Postoperative Psychological Predictors for Chronic Postsurgical Pain After a Knee Arthroplasty: A Prospective Observational Study

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Objective. Chronic postsurgical pain is a significant adverse effect shown in around 20% of people who had undergone a knee arthroplasty. Psychological risk factors emerged as significant and potentially modifiable risk factors for its development. However, there is still little evidence when assessing these factors during the acute postoperative period. This study aimed to assess the predictive value of postoperative pain catastrophizing, pain-related fear of movement, anxiety, depression, and pain attitudes in developing chronic postsurgical pain after knee arthroplasty.

Methods. A 6-month follow-up prospective observational study design was used. The study sample comprised 115 people who underwent a knee arthroplasty due to painful primary osteoarthritis. Measures of pain catastrophizing, pain-related fear of movement, anxiety, depression, and pain attitudes were obtained 1 week after surgery. Chronic postsurgical pain was set at an intensity of ≥30 using a 100-mm visual analog scale 3 and 6 months after surgery.

Results. Analysis revealed that baseline pain intensity, pain catastrophizing, pain-related fear of movement, anxiety, depression, and maladaptive pain attitudes were significant predictors of chronic pain at 3 and 6 months after surgery in a univariate analysis. However, at 3 months after surgery, only pain intensity and pain catastrophizing were predictors in the final multivariate model forecasting disturbing pain. Moreover, 6 months after surgery, pain intensity and distrust in medical procedures remained independent predictors. Most of the psychological factors can be grouped into a single dimension defined as pain-related psychological distress.

Conclusion. The results suggest that postoperative pain intensity, pain catastrophizing, and pain attitudes are independent predictors for chronic postsurgical pain after knee arthroplasty.

Impact. Postoperative cognitive and emotional factors should be considered alongside pain intensity during postoperative rehabilitation after knee arthroplasty since they could influence the development of chronic postsurgical pain.

Keywords: knee arthroplasty, orthopedic procedures, rehabilitation, chronic postsurgical pain, psychological factors, pain catastrophizing

Running Head: Psychologic Predictors for Knee Arthroplasty Pain

1. Introduction

Chronic postsurgical pain (CPSP) is defined as chronic pain that develops or increases in intensity after a surgical procedure and persists beyond the healing process.[1] Despite the difficulty in deciding when acute or subacute postsurgical pain becomes chronic,[2] the International Classification of Disease opted to establish the cutoff point at 3 months after the surgery.[1] Although pain-related outcomes after a knee arthroplasty can significantly improve up to 1 year after surgery,[3] the main improvements can be observed during the first 3 months.[4] After that point, the improvement dramatically decelerates, becoming nonsignificant; therefore, setting CPSP after a knee arthroplasty at a minimum of 3 months after surgery seems reasonable.[4,5] Knee arthroplasty (KA) is a successful treatment for end-stage symptomatic knee osteoarthritis.[6] However, CPSP has become a significant adverse effect in around 20% of the patients.[7] Besides, chronic pain after KA has been shown to have a tremendous socioeconomic impact and influence on every dimension of health-related quality of life.[8,9] For this reason, there is a need for more evidence regarding the prevention and treatment of CPSP after KA.[5]

In order to prevent the development of CPSP, numerous authors suggest that screening for risk factors and providing appropriate and targeted interventions during perioperative management could improve pain intensity, quality of life and health functioning.[4,5,10,11] In this regard, clinicians and researchers are increasingly aware that any attempt to screen for people at risk for developing chronic pain after KA would require an individualized assessment with a biopsychosocial view of the patient.[12] However, the complex multidimensional nature of pain represents a challenge when trying to estimate a reliable predictive model.[13] Preoperative psychological factors such as pain catastrophizing emerged as strong and potentially modifiable risk factors which could be worth trying to target in specific individuals for better outcomes.[11,14-17] As a result, few studies have assessed the influence of targeted interventions in people with high pain catastrophizing.[18-20] Such studies successfully decreased pain catastrophizing,[18] but no effect on postoperative pain outcomes was observed when compared with usual care.[18-20]

While the potential value for identifying at-risk patients and the evaluation of complex interventions using a biopsychosocial framework is clear, further research on risk factors is needed.[5,21] Most of the research evaluating the influence of risk factors on KA outcomes has focused on the preoperative period.[16] However, the assessment of postoperative risk factors is also recommended since an ideal model for studying the development of CPSP should include both preoperative and postoperative risk factors.[22] Previous research suggests that psychological factors such as self-efficacy might be more associated with outcomes when measured in the acute postoperative period.[23] Besides, postoperative pain-related psychologic distress has been shown to influence health functioning and quality of life independently,[4] but there is little evidence of its influence on CPSP.[16] Regardless, postoperatively assessed risk factors are still under-researched, although the postoperative is a relevant period in which such factors could be addressed during the KA rehabilitation. Therefore, the present study aimed to assess the predictive value of postoperative pain catastrophizing, pain-related fear of movement, anxiety, depression, and pain attitudes in developing CPSP 3 and 6 months after KA.

2. Methods

This research was conducted according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement,[24] and following the declaration of Helsinki. The study protocol received approval from The Research Ethics Committee of the University of Vic–Central University of Catalonia (59/2018). The protocol was registered at clinicaltrials.gov (NCT03378440). All the participants agreed to participate and signed an informed consent form.

2.1 Study Design and Participants

A 6-month follow-up prospective observational study design was used. The participants' recruitment occurred between December 2018 and April 2020 and was carried out using a consecutive (nonrandom) strategy through a postoperative domiciliary rehabilitation service. The data collection and follow-up were carried out between December 2018 and October 2020. Pain intensity was assessed through the postoperative rehabilitation process, including 1 week, 3 months, and 6 months after surgery. Eligible participants were women and men who were at least 18 years old and had undergone total or unicompartmental KA due to primary osteoarthritis. Exclusion criteria were assessed by a general practitioner and included participants who had undergone revision surgery, had undergone surgery due to secondary osteoarthritis, could not read or speak in Spanish, and had a diagnosis of inflammatory arthritis or major depression. Also, few people were admitted to the domiciliary physical therapy service in the second or third week after surgery. Therefore, baseline assessment (1 week after surgery) was unavailable, and they were not included in the present study.

2.2 Measures

Data collection was carried out by 3 physical therapists, and the same physical therapist assessed the same participant at each follow-up encounter (1 week, 3 months, and 6 months after surgery). All the measurements were performed at the participants' homes. Most outcome variables consisted of self-administered questionnaires and required no or minimal interaction with the interviewer. Due to the advanced age of some participants, if needed, the interviewer gave support by reading the questionnaires during the assessments.

2.2.1 Pain Intensity

Pain intensity was assessed during rest using a 100-mm visual analog scale (VAS) (where 0 = no pain and 100 = worst imaginable pain).[25] Patients were asked to rate their experienced pain intensity during the last week.

2.3 Covariates

2.3.1 Demographic and Procedure Data

The following demographic data were collected at baseline: age, sex, body mass index, Charlson Comorbidity Index (CCI),[26] smoking habit, alcohol habit, type of surgery (total or unicompartmental), and education level.

2.3.2 Psychological Measures

Pain catastrophizing. The Spanish version of the Pain Catastrophizing Scale (PCS) was used to assess thoughts and feelings related to pain experiences.[27] The PCS is a 13-item self-administered questionnaire composed of 3 subscales: rumination, magnification, and helplessness. The Spanish version of the PCS has shown an acceptable internal consistency (total Cronbach α = 0.79, rumination = 0.82, magnification = 0.72, and helplessness = 0.80).[27]

Pain-related fear of movement. The Spanish version of the Tampa Scale for Kinesiophobia (TSK-11) was used to measure pain-related fear of movement. The TSK-11 is an 11-item self-administered questionnaire. The scores range from 11 to 44, and higher scores indicate a higher degree of kinesiophobia. This assessment tool has shown an acceptable internal consistency (Cronbach α = 0.79).[28]

Anxiety and depression. The Spanish version of the Hospital Anxiety and Depression Scale (HADS) was used to measure depression and anxiety. The total scores range from 0 to 42 points, and higher scores indicate a higher degree of depression and anxiety. This assessment tool has shown excellent internal consistency (Cronbach α = 0.90).[29]

Pain attitudes. The brief Spanish version of the Survey of Pain Attitudes (SOPA) was used to assess participants' attitudes when they feel pain.[30] The SOPA includes 30 items that assess 6 pain-related beliefs, gauging the extent to which patients believe that they can control their pain (Pain Control); that they are unable to function because of pain (Disability); that pain means they are doing exercise that is damaging themselves and, therefore, they should avoid such activity (Harm); that their emotions affect their pain (Emotion); and that others should be solicitous in response to their experience of pain (Solicitude); in addition, the SOPA assesses the extent to which patients believe that medical procedures are appropriate and can cure their pain problem (Medical Procedures). Each dimension scores from 0 to 4, with higher scores meaning stronger beliefs.

2.4 Sample Size Calculation

The sample size was estimated using the preliminary results of 55 participants. The proportion of individuals who presented the health condition of interest (CPSP) was assessed in relation to the exposure factor (individuals with high pain catastrophizing were considered exposed). The exposure was determined using the median score of the Spanish version of the PCS (14 points out of 52).[27] The analysis revealed that the proportion of individuals with CPSP among the exposed individuals was 56.7%. At the same time, the proportion of unexposed individuals was 16%. On the basis of these data, the sample size was computed on the basis of assumptions of a logistic regression model with an expected odds ratio (OR) of 6.87, with P(y = 1/x = 1) = 0.567 and P(y = 1/x = 0) = 0.16 (where P = probability), a nominal significance alpha of .01, a test power beta of 0.95, a correlation between predictors of 0.4, and a 2-tailed test. Such assumptions yielded a proposed sample size of 96 participants. Since the logistic model is computed at a specific moment in time using baseline information as predictors, a cross-sectional observational design was assumed. The sample size was oversized, assuming a possible 20% loss of participants due to incomplete information, yielding a proposed sample size of 115 participants. G*Power 3 software was used to obtain sample size estimates.[31,32]

2.5 Data Analysis

The outcome variable was CPSP at 3 and 6 months after surgery (CPSP3 and CPSP6, respectively). CPSP was set as a dichotomous variable according to the pain intensity at 3 and 6 months (CPSP3 and CPSP6, respectively). Patients with a VAS score of <3 were considered to have no pain or mild pain intensity, whereas those with a VAS score of ≥3 were considered to have moderate to severe pain intensity. The cutoff point was set according to previous studies.[33-36]

Continuous variables were described using medians and interquartile ranges. Categorical variables were summarized using raw frequencies and percentages. Continuous variables were tested for normality using the Kolmogorov-Smirnov test. A nonparametric Mann-Whitney *U* test (for continuous variables) and chi-square tests (for categorical variables) were performed to compare baseline demographic, clinical, and psychological variables between individuals with and those without CPSP3 and CPSP6.

Logistic regression analysis was performed to determine risk factors for both CPSP3 and CPSP6 outcomes. First, a univariate analysis was performed using the demographic and clinical variables to assess them as possible controlling variables. Since intake pain ratings have a strong potential to influence longitudinal pain ratings, baseline pain intensity was included as a clinical covariate. Second, each of the proposed psychological risk factors was assessed separately to estimate the individual isolated effect. Third, a multivariate analysis was performed using a backward method to estimate the final multivariate model and accounting for multicollinearity effects. The OR, 95% CIs, and *P* values were reported, along with the percentage of cases correctly classified across all predicted categories. To quantify the predictive value of our model, pseudo-R^2 and odds ratios were estimated, and receiver operating characteristic curves on sensitivity and specificity were constructed. The sensitivity was plotted against the 1 − specificity for each given cutoff value of the predictive variable; this approach allowed us to determine the optimal classification cutoff, where sensitivity (true-positive rate) is more balanced with 1 − specificity (false-negative rate), adding up to 1, also named the Youden Index. The area under the receiver operating characteristic curve was determined with an area of 1 representing a perfect prediction and an area of 0.5 representing a complete random guess. Areas in the interval from 0.9 to 1 represent excellent prediction, those in the interval from 0.8 to 0.9 represent good prediction, those in the interval from 0.7 to 0.8 represent fair prediction, and those in the interval from 0.6 to 0.7 represent poor prediction.[37]

Finally, exploratory factor analysis was used (with principal axis factoring as the extraction method and promax with Kaiser normalization as the rotation method) to identify the number of dimensions underlying the group of psychological measurements. The number of factors was assessed using the Kaiser-Guttman rule considering the number of eigenvalues larger than 1, along with the amount of variance accounted for by each dimension. The factor correlation matrix was also displayed.

For all analyses, *P* values of <.01 were considered statistically significant results. All statistical analyses were performed with IBM SPSS, version 28 (IBM, Chicago, IL, USA).

2.6 Role of the Funding Source

This study was partially funded by The Catalan Board of Physical Therapists. The funder played no role in the design, conduct, or reporting of this study.

3. Results

3.1 Descriptive Analysis

One hundred fifty-nine people were assessed for eligibility. A total of 115 participants met the inclusion criteria and agreed to participate in the study (Fig. 1). Seven participants were lost at the 3-months follow-up. The 115 participants in the study had a median age of 70.5, and most of them were women (66.1%). At the 3-month follow-up, 28.7% of the participants showed moderate to severe CPSP (CPSP3). Patients with CPSP3 achieved higher scores in baseline VAS pain at rest ($P < .001$), pain catastrophizing ($P < .001$), anxiety ($P < .001$), and depression ($P < .001$) and showed statistically significant differences in pain attitudes related to emotion ($P = 0.007$). At the 6-month follow-up, CPSP6 was present in 19.4% of the cohort. Patients with CPSP6 also showed higher scores in baseline VAS pain at rest ($P < .001$), pain catastrophizing ($P < .001$), anxiety ($P < .001$), and depression ($P < .001$) and showed statistically significant differences in pain attitudes related to emotion ($P < .001$) and medical procedures ($P < .001$). No differences were found between groups in any demographic or clinical variable (Tab. 1).

3.2 Univariate Analysis

Among the assessed baseline demographic and clinical factors, only VAS pain at rest emerged as a significant predictor for CPSP3 (OR = 1.810; 95% CI = 1.408–2.328) and CPSP6 (OR = 2.130; 95% CI = 1.530–2.964) (Tab. 2). Therefore, it was retained as the controlling variable for further models. In the case of psychological factors, univariate analysis showed that many of them were significant predictors for CPSP3 and CPSP6. For the CPSP3 model, pain catastrophizing (OR = 1.092; 95% CI = 1.051–1.134), anxiety (OR = 1.198; 95% CI = 1.088–1.318), and depression (OR = 1.324; 95% CI = 1.159–1.513) were significant predictors (Tab. 3). For the CPSP6 model, pain catastrophizing (OR = 1.100; 95% CI = 1.054–1.148), kinesiophobia (OR = 1.173; 95% CI = 1.063–1.295), anxiety (OR = 1.248; 95% CI = 1.120–1.392), depression (OR = 1.379; 95% CI = 1.183–1.608), SOPA Emotion (OR = 2.950; 95% CI = 1.644–5.296), and SOPA Medical Procedures (OR = 0.155; 95% CI = 0.054–0.444) were significant predictors (Tab. 3).

3.3 Multivariate Analysis

In the final multivariate regression analysis for CPSP3, baseline VAS pain at rest (*P* = 0.001; OR = 1.611; 95% CI = 1.207–2.150) and pain catastrophizing (*P* = 0.006; OR = 1.079; 95% CI = 1.022–1.140) remained independent predictors. Also, kinesiophobia (*P* = 0.104; OR = 0.903; 95% CI = 0.799–1.021) was maintained in the final model, although it did not reach significance. These results show that an increase of 1 point in VAS pain at rest increased the odds of CPSP3 by 1.611, an increase of 1 point in the PCS increased the odds of CPSP3 by 1.079, and an increase of 1 point in the TSK-11 decreased the odds of CPSP3 by 0.903. The R^2 for dependency was 0.316, indicating that 31.6% of the variance was explained by the included explanatory variables. However, the overall model correctly classified 75.9% of the CPSP3 cases (Tab. 4).

For CPSP6, baseline VAS pain at rest (*P* < .001; OR = 2.144; 95% CI = 1.505–3.055) and SOPA Medical Procedures (*P* = 0.004; OR = 0.170; 95% CI = 0.023–0.497) remained in the final model, both being significant independent predictors. An increase of 1 point in the baseline VAS pain at rest increased the odds of CPSP6 by 2.144, and an increase of 1 point in the SOPA Medical Procedures decreased the odds of CPSP6 by 0.107. The R^2 was 0.347, and the final model correctly classified 83.3% of the CPSP6 cases (Tab. 4).

3.4 Receiver Operating Characteristic Analysis

The receiver operating characteristic curves for both CPSP3 and CPSP6 final multivariate models are shown in Figure 2. In the CPSP3 model, the area under the curve was 0.865 (95% CI = 0.786–0.944), resulting in a good predictive model with a sensitivity of 77.4% and a specificity of 75.3%, along with a cutoff value of 0.287. This cutoff value is the decision value at which the true-positive rate will better match the true-negative rate, similar to minimizing the false-positive and false-negative probabilities jointly. In the CPSP6 model, the area under the curve was 0.904 (95% CI = 0.862–0.983), resulting in an excellent predictive model with a sensitivity of 85.3% and a specificity of 82.9%, along with a cutoff value of 0.194.

3.5 Exploratory Factor Analysis

Exploratory factor analysis results showed that pain-related psychological variables were highly correlated and could be gathered in 2 dimensions. The first dimension was associated with patients' pain-related psychological distress, comprising pain catastrophizing, depression, anxiety, kinesiophobia, baseline VAS pain at rest, SOPA Disability, SOPA Emotion, SOPA Harm, and SOPA Medical Procedures (Suppl. Table). The variables SOPA Pain Control and SOPA Solicitude did not manage to load in the pain-related psychological distress dimension, and they were gathered in a separate one. This highly correlated structure explains the reduced number of predictors admitted in the multivariate logistic model.

4. Discussion

The present study aimed to assess the predictive value of postoperative pain catastrophizing, pain-related fear of movement, anxiety, depression, and pain attitudes in developing CPSP3 and 6 months after KA. The cutoff for CPSP was set at an intensity of ≥3 during rest on a visual analog scale. This cutoff corresponds to moderate to severe pain with a potential impact on physical or emotional functioning.[36] In a univariate analysis, the results showed that baseline pain intensity, pain catastrophizing, anxiety, depression, and maladaptive pain attitudes are significant predictors of CPSP3 and CPSP6. However, at 3 months after surgery, only pain intensity and pain catastrophizing would be needed as a predictors in the final multivariate model forecasting disturbing pain. Moreover, at 6 months after surgery, pain intensity and distrust in medical procedures remained independent predictors.

The proportions of participants with CPSP in the present study were 28.7% and 19.4% at 3 and 6 months after surgery, respectively. Those figures are in accordance with previous studies, which show that at least 10% to 34% of patients experience pain 3 months to 5 years after surgery.[38] Demographic and clinical factors such as female sex,[12,39] younger age,[12,39] and medical comorbidities[40] are commonly accepted as significant, nonmodifiable risk factors for poor outcomes after KA. These factors were also assessed in the present study, and the analysis revealed that none of the measured demographic and clinical factors predicted the development of CPSP at rest.

Nevertheless, identifying potentially modifiable risk factors, such as postoperative acute pain and psychological factors, seems more appropriate since they could be screened and addressed during the perioperative process. Systematic reviews and meta-analyses identify preoperative psychological factors such as anxiety, depression, and pain catastrophizing as independent predictors for developing CPSP after KA.[11,14-17] Despite that, few studies have assessed them in the postoperative period,[16] and they suggest that postoperative anxiety, fear of movement, self-efficacy, and pain catastrophizing might also influence pain outcomes after KA.[23,41,42] The results of the present research support these findings.

There are many studies recognizing that psychological factors affect how individuals adjust to chronic pain.[43] In addition, maladaptive cognitions (ie, pain catastrophizing or kinesiophobia) and emotional factors (ie, anxiety or depression) appear to play a significant role in chronic pain development and persistence after KA.[11,16,17] Within the most significant psychological factors, pain catastrophizing seems the most widely investigated.[13] Through different brain imaging modalities, pain catastrophizing has evidenced a significant association with enhanced intensity and affective processing, along with a weakened modulation of pain. Besides, it has also been shown to influence salience detection, motor activity, pain processing, and modulate top-down attentional processes, which could result in a deficit in attentional disengagement from pain-related information.[13,44,45] From a clinical point of view, it is important to note that pain catastrophizing has also shown to be a significant mediator in pain-related outcomes.[46] It can mediate pain reduction through cognitive-behavioral therapy, pain education, and pharmacological and psychosocial treatments in patients with chronic pain.[47-50] According to our results, postoperative pain catastrophizing could also be involved in maintaining pain after KA. Therefore, it should be considered during the KA rehabilitation period.

Studies such as the present one help to improve the clinicians' understanding when attempting to develop interventions to prevent the transition between acute and chronic postoperative pain states. In this regard, it should be noted that the influence of pain catastrophizing on pain perception might be modulated by the perceived threat value of the stimulus.[45] Consequently, the interventions designed to modify the perceived threat of clinical pain are expected to be beneficial among patients who catastrophize about their pain.[45] Pain neuroscience education,[51,52] cognitive behavioral therapy,[18] pain coping skills,[53] or multimodal physical therapy are some of the apparently effective interventions in reducing pain catastrophizing in patients who had KA.[54] Nevertheless, the influence of reducing pain catastrophizing in patients who had KA on developing CPSP remains unclear.[19,20] Future studies should clarify if reducing pain catastrophizing in patients scheduled for KA who catastrophize about their pain influences the development of CPSP.

Despite focusing on pain catastrophizing, previous studies have displayed that it could overlap with other psychological constructs such as anxiety and depression.[55] Such findings are consistent with our results since the exploratory factor analysis revealed that during the acute postoperative period, most of the psychologic factors could be gathered into 1 dimension. The same event was observed in a previous study, which defined this dimension as "pain-related psychologic distress" and showed to influence the quality of life and health functioning after KA.[4] These results could justify that, despite many other psychologic factors being significant in the univariate analysis, only pain catastrophizing appeared as an independent predictor of CPSP (at 3 months after surgery), with SOPA Medical Procedures (at 6 months after surgery). In conclusion, pain-related psychologic factors are strongly correlated during intense pain situations, such as the early postoperative period. This reinforces the concept of the biopsychosocial model of pain, suggesting that pain experience entails a complex interaction between psychological factors.[56] Therefore, cognitive, and emotional factors should be considered during acute postoperative pain management since they could influence the development of CPSP.

To our knowledge, this is the first study that examined the role of pain attitudes in chronic pain after KA. The results showed that distrust in medical procedures could lead to CPSP6. Such belief relates to the patient's outcome expectancies, and in a previous study performed by Sullivan M. et al. (2011), expected outcomes appeared to partially mediate the effects of pain catastrophizing on recovery outcomes after KA.[57] Besides, expected outcomes toward pain and function improvements have been suggested by Ghomrawi H et al (2022) as a determining factor for KA appropriateness;[58] and Carriere J et al (2022) recommend targeting negative expectancies to prevent prolonged recovery trajectories.[59] In that regard, healthcare providers should consider pain attitudes during KA recovery and rehabilitation.

6.1 Limitations

This study has limitations that should be considered when interpreting the results. Sample size estimation was based on the proportion of individuals with CPSP in relation to pain catastrophizing, but it did not account for other psychological factors. This should be considered a limitation since other psychological factors were added to predictive models. Preoperative information on patients who had KA was unavailable for this study since the individuals were assessed once they were admitted to the postoperative domiciliary rehabilitation service. Also, potentially significant variables such as self-efficacy, socioeconomic status, social support, or mental health might influence the results.[21,23,60-62] Therefore, they should be considered in future studies. Furthermore, every patient had different physical therapists during their postoperative period, and treatment was not monitored during the study duration. Therefore, the authors do not know if different treatment approaches might have influenced postoperative pain outcomes. Finally, the physical therapists who collected the data were the same as the authors and were not blinded to intake pain intensity ratings. This should be considered a major limitation since it could induce a detection bias**.**

5. Conclusion

Postoperatively assessed pain intensity and psychological factors of pain catastrophizing, anxiety, depression, and pain attitudes might influence the development of CPSP3 and CPSP6 after KA. Postoperative pain intensity and pain catastrophizing were independent predictors for CPSP3 after KA. In addition, pain intensity and the patient's attitude toward medical procedures' effectiveness in pain reduction were independent predictors for CPSP6 after KA. Postoperative pain intensity, pain catastrophizing, and pain attitudes should be considered during KA postoperative management.

Author Contributions

Marc Terradas-Monllor: Conceptualization, Methodology, Formal analysis, Investigation, Writing – Original Draft, Funding acquisition.

Miguel A Ruiz: Methodology, Formal analysis, Writing – Reviewing and editing.

Mirari Ochandorena-Acha: Conceptualization, Methodology, Formal analysis, Investigation, Writing – Reviewing and editing, Funding acquisition.

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Ethics Approval

This study received approval from The Research Ethics Committee of University of Vic – Central University of Catalonia (59/2018).

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Clinical Trial Registration

This study was registered at clinicaltrials.gov (NCT03378440).

Disclosures

The authors completed the ICMJE Form for Disclosure of Potential Conflicts of Interest and reported no conflicts of interest.

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Table 1.

Sample Characteristics at Baseline[a]

Variable	Total Sample (N = 115)	Participants With CPSP at 3 mo			Participants With CPSP at 6 mo		
		Participants With VAS Scores of <3 (n = 77)	**Participants With VAS Scores of ≥3 (n = 31)**	***P*[b]**	**Participants With VAS Scores of <3 (n = 87)**	**Participants With VAS Scores of ≥3 (n = 21)**	***P*[b]**
Age, y	70.50 (10.70)	71.11 (10.30)	70.94 (12.80)	.504	71.00 (10.40)	70.48 (14.40)	.739
No. (%) women	76 (66.1)	51 (66.2)	22 (71)	.634	56 (64.4)	16 (76.2)	.302
Body mass index classification, no. (%) of participants				.580			.907
Normal weight	31 (27)	23 (29.9)	4 (12.9)		25 (28.7)	3 (14.3)	
Overweight	42 (36.5)	26 (33.8)	14 (45.2)		29 (33.3)	11 (52.4)	
Obesity	42 (36.5)	28 (36.4)	13 (41.9)		33 (37.9)	7 (33.3)	
Charlson Comorbidity Index	3 (2)	3 (2)	3 (2)	.598	3 (2)	3 (1)	.672
Smoking habit, no. (%) of participants				.502			.545

Never smoked	81 (70.4)	51 (66.2)	24 (77.4)		59 (67.8)	16 (76.2)	
Quit smoking	25 (21.7)	20 (26)	5 (16.1)		22 (25.3)	3 (14.3)	
Smoker	9 (7.8)	6 (7.8)	2 (6.5)		6 (6.9)	2 (9.5)	
Alcohol habit, no. (%) of participants				.158			.770
Never	49 (42.6)	30 (39)	15 (48.4)		35 (40.2)	10 (47.6)	
Minimal consumption	58 (50.4)	39 (50.6)	16 (51.6)		45 (51.7)	10 (47.6)	
Usual consumption	8 (7)	8 (10.4)	0 (0)		7 (8)	1 (4.8)	
Type of surgery, no. (%) of participants				.739			.514
TKA	51 (44.3)	35 (45.5)	13 (41.9)		40 (46)	8 (38.1)	
UKA	64 (55.7)	42 (54.5)	18 (58.1)		47 (54)	13 (61.9)	
Education level, no. (%) of participants				.322			.212
Read and write	39 (33.9)	23 (29.9)	15 (48.4)		27 (31)	11 (52.4)	
Elementary, intermediate	48 (41.7)	35 (45.5)	10 (32.3)		38 (43.7)	7 (33.3)	

Secondary, vocational	24 (20.9)	17 (22.1)	5 /16.1)		20 (23)	2 (9.5)	
University	4 (3.5)	2 (2.6)	1 (3.2)		2 (2.3)	1 (4.8)	
Baseline VAS pain at rest, scored from 0 to 10	4 (4)	3 (3.8)	6 (2.5)	<.001	4 (3.5)	7 (2.8)	<.001
PCS, scored from 0 to 52	14 (23)	11 (13)	31 (20)	<.001	12 (15)	36 (26)	<.001
TSK-11, scored from 11 to 44	29 (7)	29 (8)	31 (7)	.060	29 (7)	32 (8)	<.001
HADS							
Anxiety, scored from 0 to 21	5 (7)	4 (5)	8 (8)	<.001	4 (5)	10 (10)	<.001
Depression, scored from 0 to 21	4 (6)	3 (5)	7 (6)	<.001	3 (5)	9 (7)	<.001
SOPA, all scored from 0 to 4							
Solicitude	1.40 (1.20)	1.40 (1.10)	1.40 (1.80)	.846	1.40 (1.20)	1.80 (2.00)	.019
Emotion	1.50 (1.75)	1.50 (1.50)	2.50 (1.50)	.007	1.50 (1.25)	3.00 (1.25)	<.001
Pain control	2.20 (1.00)	2.40 (1.00)	1.80 (1.00)	.017	2.20 (0.80)	1.80 (1.50)	.341

Harm	1.40 (0.60)	1.40 (0.50)	1.60 (0.60)	.031	1.40 (0.80)	1.60 (0.60)	.020
Disability	2.33 (1.33)	2.33 (1.50)	2.67 (0.67)	.014	2.33 (1.33)	2.67 (0.83)	.061
Medical procedures	2.40 (0.60)	2.40 (0.40)	2.40 (0.40)	.203	2.40 (0.40)	2.20 (0.90)	<.001

[a]Data are reported as median (interquartile range) unless otherwise indicated. CPSP = chronic postsurgical pain; HADS = Hospital Anxiety and Depression Scale; PCS = Pain Catastrophizing Scale; SOPA = Survey of Pain Attitudes; TKA = total knee arthroplasty; TSK-11 = Tampa Scale for Kinesiophobia; UKA = unicompartmental knee arthroplasty; VAS = visual analog scale.

[b]Mann-Whitney *U* or χ^2 test.

Table 2.

Univariate Logistic Regression for Demographic and Clinical Factors Related to CPSP at 3 and 6 Months After Knee Arthroplasty[a]

Parameter	B	SE	Wald Value	*P*	OR	OR 95% CI	%CC
CPSP at 3 mo							
Sex	0.220	0.463	0.226	.635	1.246	0.503–3.090	44.4
Age	−0.021	0.028	0.574	.449	0.979	0.927–1.034	54.6
Type of surgery	0.143	0.430	0.111	.739	1.154	0.497–2.680	49.1
BMI	0.014	0.041	0.118	.732	1.014	0.936–1.099	53.7
CCI	0.020	0.190	0.012	.914	1.021	0.704–1.480	60.2
VAS pain at rest	0.594	0.128	21.376	<.001	1.810	1.408–2.328	75.0
CPSP at 6 mo							
Sex	0.572	0.559	1.046	.306	1.771	0.592–5.300	43.5
Age	−0.014	0.031	0.196	.658	0.986	0.927–1.049	54.6
Type of surgery	0.324	0.498	0.498	.515	1.383	0.521–3.672	49.1
BMI	−0.025	0.048	0.270	.603	0.975	0.887–1.072	47.2
CCI	−0.114	0.222	0.263	.608	0.892	0.577–1.379	60.2
VAS pain at rest	0.756	0.169	20.093	<.001	2.130	1.530–2.964	81.5

[a]%CC = percentage of cases correctly classified; BMI = body mass index; CCI = Charlson Comorbidity Index; CPSP = chronic postsurgical pain; OR = odds ratio; VAS = visual analog scale.

Table 3.

Univariate Logistic Regression for Psychological Factors Related to CPSP at 3 and 6 Months After Knee Arthroplasty[a]

Parameter	B	SE	Wald Value	*P*	OR	OR 95% CI	%CC
CPSP at 3 mo							
PCS	0.088	0.019	20.563	<.001	1.092	1.051–1.134	73.1
TSK-11	0.085	0.040	4.440	.035	1.089	1.006–1.178	60.2
HADS anxiety	0.180	0.049	13.657	<.001	1.198	1.088–1.318	69.4
HADS depression	0.281	0.068	16.990	<.001	1.324	1.159–1.513	69.4
SOPA solicitude	0.071	0.234	0.092	.762	1.073	0.679–1.698	53.7
SOPA emotion	0.584	0.228	6.586	.010	1.793	1.148–2.802	62.0
SOPA pain control	−0.511	0.269	3.604	.058	0.600	0.354–1.017	63.9
SOPA harm	0.704	0.387	3.314	.069	2.022	0.947–4.315	60.2
SOPA disability	0.539	0.256	4.445	.035	1.715	1.039–2.832	67.6
SOPA medical procedures	−0.485	0.431	1.265	.261	0.615	0.264–1.434	59.3
CPSP at 6 mo							
PCS	0.095	0.022	19.212	<.001	1.100	1.054–1.148	77.8

TSK-11	0.160	0.050	10.044	.002	1.173	1.063–1.295	68.5
HADS anxiety	0.222	0.056	15.975	<.001	1.248	1.120–1.392	74.1
HADS depression	0.322	0.078	16.913	<.001	1.379	1.183–1.608	75.9
SOPA solicitude	0.684	0.276	6.132	.013	1.982	1.153–3.407	63.0
SOPA emotion	1.082	0.298	13.140	<.001	2.950	1.644–5.296	71.3
SOPA pain control	−0.244	0.298	0.673	.412	0.783	0.437–1.404	60.2
SOPA harm	0.917	0.425	4.647	.031	2.501	1.087–5.757	62.0
SOPA disability	0.491	0.288	2.918	.088	1.634	0.930–2.872	63.9
SOPA medical procedures	−1.865	0.573	12.051	<.001	0.155	0.054–0.444	75.0

[a]%CC = percentage of cases correctly classified; CPSP = chronic postsurgical pain; HADS = Hospital Anxiety and Depression Scale; OR = odds ratio; PCS = Pain Catastrophizing Scale; SOPA = Survey of Pain Attitudes; TSK-11 = Tampa Scale for Kinesiophobia.

Table 4.

Final Multivariate Logistic Regression Model for Psychological Factors Related to CPSP at 3 and 6 Months After Knee Arthroplasty[a]

Parameter	**B**	**SE**	**Wald Value**	***P***	**OR**	**OR 95% CI**	**%CC**
CPSP at 3 mo							
Baseline VAS for pain at rest	0.477	0.147	10.497	.001	1.611	1.207–2.150	75.9
PCS	0.076	0.028	7.639	.006	1.079	1.022–1.140	
TSK-11	−0.102	0.062	2.638	.104	0.903	0.799–1.021	
Constant	−1.792	1.551	1.335	.248	0.167		
CPSP at 6 mo							
Baseline VAS for pain at rest	0.763	0.181	17.825	<.001	2.144	1.505–3.055	83.3
SOPA Medical procedures	−2.230	0.781	8.153	.004	0.107	0.023–0.497	
Constant	−0.568	1.759	0.104	.747	0.567		

[a]%CC = percentage of cases correctly classified; CPSP = chronic postsurgical pain; OR = odds ratio; PCS = Pain Catastrophizing Scale; SOPA = Survey of Pain Attitudes; TSK-11 = Tampa Scale for Kinesiophobia; VAS = visual analog scale.

Figure 1: Flow diagram of patients in the study

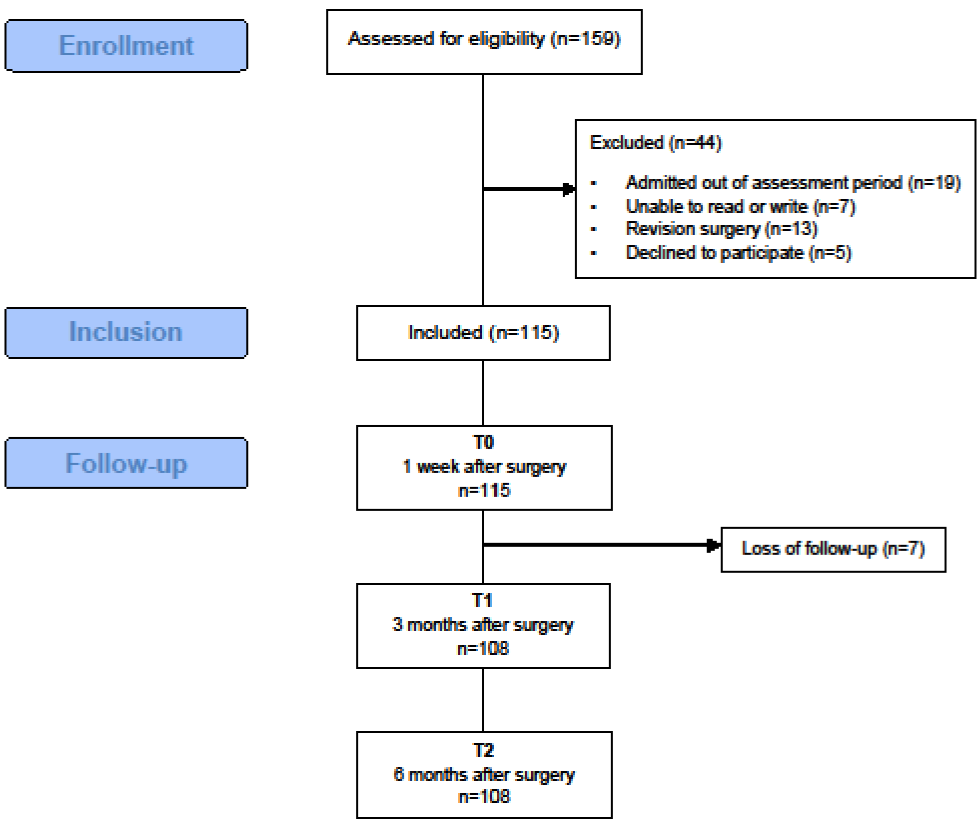

Figure 1. Flow diagram of participants in the study.

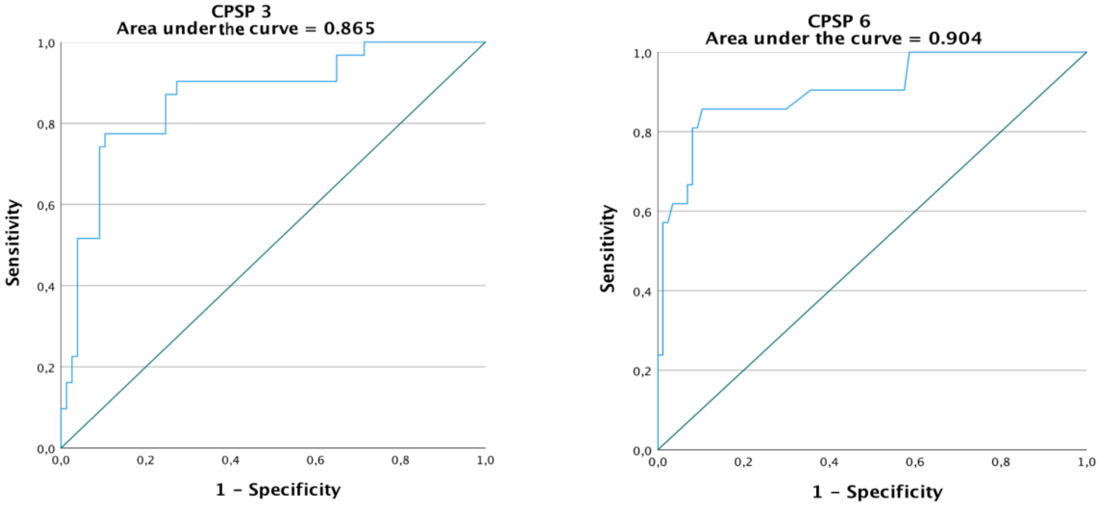

Figure 2. Receiver operating characteristic curves for chronic postsurgical pain prediction at 3 mo (CPSP3) and 6 mo (CPSP6) after surgery.