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Changes in catastrophizing and kinesiophobia are predictive of changes in disability and pain after treatment in patients with anterior knee pain

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Abstract

Purpose   The purpose of the study was to investigate if changes in psychological variables are related to the outcome in pain and disability in patients with chronic anterior knee pain.

Methods   A longitudinal observational study on 47 patients with chronic anterior knee pain was performed in a secondary healthcare setting. Pain was measured with the visual analogue scale and disability with the Lysholm scale. The psychological variables, such as anxiety, depression, pain coping strategies, catastrophizing and fear to movement beliefs, were studied by using self-administered questionnaires.

Results   Among the pain coping strategies, only the catastrophizing subscale showed a significant reduction. Similarly, anxiety, depression and kinesiophobia were significantly reduced after treatment. Those patients who decreased the catastrophizing, kinesiophobia, anxiety and depression showed a greater improvement in pain and disability after a purely biomedical treatment. A multiple regression analysis revealed that changes in catastrophizing predicted the amount of improvement in pain severity and that changes in both catastrophizing and anxiety predicted changes in disability after treatment.

Conclusion   What has been found suggests that clinical improvement in pain and disability is associated with a reduction in catastrophizing and kinesiophobia. Therefore, co-interventions to reduce catastrophizing thinking and kinesiophobia may enhance the results.

Level of evidence   Prospective Cohort Study, Level I for prognosis.

Keywords   Anterior knee pain · Patellofemoral pain · Kinesiophobia · Catastrophizing · Anxiety · Depression

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Introduction

Anterior knee pain is one of the most frequent reasons for consultation within knee conditions in adolescents and young adults [25]. However, despite the high prevalence of this disorder, its pathogenesis and therefore its treatment are not clearly understood [30]. In fact, the results of the treatment, both conservative and surgical, are unpredictable, and many patients may continue to experience significant pain and disability following a correct treatment.

To date, it is well accepted that anatomical alterations (severe patellofemoral malalignment, severe patellar chondropathy) cannot fully account for pain and disability in anterior knee pain patients [30]. Biopsychosocial models of pain suggest that a complete understanding of chronic pain requires consideration of anatomical, psychological and social factors [18]. A cross-sectional study in anterior knee pain patients showed that an excessively negative orientation towards pain, that is, the belief that pain will get

worse and that one is helpless to deal with it (catastrophization) and the belief that movement will create additional injury or re-injury and pain (kinesiophobia), is associated with pain intensity and disability in these patients [8] as occurs in other chronic pain patients [38]. Riddle et al. [27] have demonstrated that high levels of pain catastrophizing have been shown to predict post-surgical pain and poor function in patients with a knee arthroplasty. In a longitudinal study by Piva et al. [24] fear-avoidance beliefs turned out to be the strongest predictor of functional outcome in a series of anterior knee pain patients, even greater than biomechanical and structural variables. Chmielewski et al. [5] have shown that the decrease in fear of movement or reinjury may have potential to improve short-term outcomes for knee pain and function after anterior cruciate ligament reconstruction. On the basis of these observations, we believe that psychological factors (catastrophization, kinesiophobia, anxiety and depressive symptoms) may be overlapping or unique risk factors for poor results in the treatment of anterior knee pain patients. We hypothesize that after treatment, a change in pain and disability will be correlated with a change in pain coping strategies, cognitions and emotions about pain that can explain the amount of change in the functional outcome.

To our knowledge, there are no previous studies in anterior knee pain patients that analyse changes in pre-treatment measures of pain, disability, kinesiophobia, catastrophization, anxiety and depressive symptoms after traditional biomedical treatment. The objective of the present study is to investigate if changes in psychological variables are related to the outcome in pain and disability in patients with chronic anterior knee pain.

Materials and methods

During a 1-year period, all consecutive patients with anterior knee pain referred to our orthopaedic surgery consultation were invited to participate in the study. Inclusion criteria were age from 18 to 50 years, pain perceived in the anterior aspect of the knee following exclusion of other objective causes of pain for at least 6 month of duration, and acceptance to complete the questionnaires at baseline and at 6 months of follow-up. Exclusion criteria included incomprehension of the contents of the questionnaires, history of fracture around the knee, tumour, infection, torn meniscus and anterior cruciate ligament injury. All patients underwent radiograph and MRI exams to rule out these conditions.

The following socio-demographic variables were recorded for all patients: sex, age, educational level and employment. After accepting to participate, the participants completed a booklet with the questionnaires at two moments: at baseline before treatment (physical therapy or surgery) and at 6 months after treatment completion. All the questionnaires were filled out by the patients themselves without assistance from any investigator. Self-reporting of clinical pain intensity was obtained by asking subjects to rate their pain during the past month on a Visual Analogue Scale (VAS) [1, 14]. The Lysholm Knee Scale was used to evaluate disability [34]. The frequency of patients' use of pain coping strategies was assessed with the Coping Strategies Questionnaire (CSQ) [28, 29]. Anxiety and depression were evaluated using the Hospital Anxiety and Depression Subscale (HAD) [13, 40]. Pain-related fear associated with avoidance behaviours and the avoidance of movement and physical activity was measured with the Tampa Scale for Kinesiophobia (TSK) [8, 17] and catastrophizing by means of the Pain Catastrophizing Scale (PCS) [11, 32].

The institutional review board (Hospital Arnau de Vilanova, ID number IC 2012/11) approved the protocol, and all patients gave their informed consent to participate in the study.

Statistical analysis

Descriptive statistics were calculated for the study sample, and scatter plots were used to detect outliers. Continuous variables were expressed with mean and standard deviation and categorical variables with raw number and percentage. Spearman correlation coefficients were used to explore the association between variables. For comparisons at each time point, pre- and post-treatment, repeated measures t test were used. Finally, two multiple regression analyses were used to predict 6-month changes in the average pain intensity and disability after treatment. In each separate model, changes in pain and disability were the dependant variables, and age, sex, and changes in catastrophizing, kinesiophobia, anxiety and depression were the independent variables. Finally, the sensitivity of the changes in psychometric variables to detect changes was obtained by reporting the regression coefficients with 95 % confidence intervals for those variables given by the model. The amount of change that predicts a change of 20 mm in pain and a change of 8.9 in disability were calculated, as these are the clinically relevant changes reported previously for VAS [37] and for Lysholm scale [2]. All statistical analyses were performed using SPSS software (SPSS Inc., Chicago, IL, USA), and statistical significance was determined using an α level of 0.05.

Results

Of the 50 patients who began the study, 47 completed all the questionnaires at follow-up. Three patients had more

Table 1 Demographic characteristics of the sample and variables before and after treatment

Age	32.1 (10.9)
Gender (no., % of female)	42 (89.4 %)
Studies	
University	17 (36.1 %)
Secondary studies	19 (40.4 %)
Basic studies	11 (23.4 %)

	Initial	Follow-up	
Examination characteristics			
Pain (VAS)	7.7 (1.6)	3.2 (2.6)	$p < 0.001$
Disability (Lysholm)	43.9 (20.9)	73.5 (20.6)	$p < 0.001$
Pain coping strategies (CSQ)			
Diverting attention	20.8 (6.5)	22.2 (6.7)	n.s.
Reinterpreting pain	14.9 (6.6)	16.9 (7.7)	n.s.
Ignoring pain	19.7 (5.6)	23.6 (6.6)	$p < 0.01$
Coping self-statements	24.3 (5.8)	24.3 (6.6)	n.s.
Praying or hoping	21.1 (7.2)	20.0 (7.1)	n.s.
Catastrophizing	18.2 (8.4)	11.3 (5.8)	$p < 0.001$
Increasing activity level	26.1 (5.4)	28.7 (7.2)	n.s.
Kinesiophobia (TSK)	45.2 (6.1)	41.1 (5.9)	$p < 0.001$
Catastrophizing (PCS)	20.7 (13.1)	7.5 (10.2)	$p < 0.001$
Anxiety (HAD)	8.5 (4.5)	5.2 (3.8)	$p < 0.001$
Depression (HAD)	5.7 (4.3)	2.8 (3.1)	$p < 0.001$

than two unanswered items in one of the questionnaires and were excluded from the analysis. Five patients had only one item that went unanswered in one questionnaire, and they were not excluded because the unanswered item was in the middle value of the scale. Visual inspection of the scatter plot of each variable revealed no obvious outliers. Descriptive data for the sample are summarized in Table 1. After treatment there is a significant improvement in pain and disability levels. Among the pain coping strategies, as measured by the CSQ, only the subscale catastrophizing showed a significant reduction that was also shown with the specific questionnaire PCS. Similarly, anxiety, depression and kinesiophobia were significantly reduced after treatment.

Table 2 displays the Spearman rho correlations between both pain intensity and disability level with all the explored psychometric variables. After treatment, only anxiety, depression, catastrophizing and kinesiophobia correlated with residual pain and disability. The improvement changes in pain and disability after treatment significantly correlated with changes in anxiety, depression, kinesiophobia and catastrophizing, but not simultaneously with the other pain coping strategies. Change in catastrophizing turned out to be the strongest predictor of changes in both pain and disability after treatment.

Table 2 Spearman correlation coefficients of pain intensity and disability level with the psychometric variables before and after treatment

	Anxiety	Depression	Pain coping strategies (CSQ)							Kinesiophobia	Catastrophizing
			Diverting attention	Reinterpreting pain	Ignoring pain	Coping self-statements	Praying or hoping	Catastrophizing	Increasing activity level		
Pain pre-treatment	0.39**	0.30*	0.02	−0.02	−0.21	−0.19	0.40**	0.48**	−0.41**	0.35*	0.47**
Disability pre-treatment	−0.49**	−0.59**	0.19	0.12	0.44**	0.25	−0.38**	−0.62**	0.33*	−0.55**	−0.49**
Pain post-treatment	0.41**	0.54**	−0.12	−0.04	−0.25	0.15	0.01	0.50**	−0.26	0.35*	0.59**
Disability post-treatment	−0.43**	−0.59**	0.24	−0.03	0.28	0.02	0.08	−0.50**	0.30*	−0.41**	−0.57**

$* p < 0.05$; $** p < 0.001$

Table 3 Hierarchical regression explaining pain and disability

Explanatory variables (change scores)	R^2	Corrected R^2	B (95 % CI)	p value
Model predicting pain intensity	0.49	0.48		
Catastrophizing (PCS)			0.13 (0.09, 0.17)	0.001
Model predicting disability	0.58	0.56		
Catastrophizing (PCS)			−0.92 (−1.42, −0.41)	0.001
Anxiety			−2.26 (−3.85, −0.67)	0.006

Two separate regression analyses were performed for pain and disability as dependant variables. Only changes in catastrophizing significantly predicted changes in pain level. Changes in catastrophizing accounted for 48 % of the explained variance in changes in pain. Regarding disability, changes in catastrophizing and anxiety accounted for 56 % of the variance. There were no colinearity problems in any of the coefficients obtained (Table 3).

Based on the non-standardized coefficients of the model, we calculated the clinically relevant changes in explanatory variables. A change of 15 points (95 % CI 12, 22) in catastrophizing measured with PCS predicts a clinically relevant change of two in pain intensity measured with VAS. Also, a change of 10 points (95 % CI 6, 22) in catastrophizing suggest a clinically meaningful change of nine in disability as measured by Lysholm scale.

Discussion

The most important finding of this study was that the changes in catastrophizing after treatment predict the changes in both pain and disability. As expected, on the basis of previous studies in chronic pain [7, 8, 16, 22, 23, 33], we found that catastrophizing was positively related to present pain intensity and disability among patients with anterior knee pain at the two time points of the study. After treatment, patients referred to a significant improvement in pain and disability, but most patients still had residual symptoms. This cross-sectional association between catastrophizing and pain is consistent with several prior investigations in other bone and joint conditions such as low back pain [22, 23], osteoarthritis of the knee [33], rheumatoid arthritis [16] and upper extremity conditions [7]. Thomeé et al. [36] observed in a sample of 50 patients with anterior knee pain that the catastrophizing subscale of the CSQ showed a very high score, more than double the score found in other series of rheumatoid arthritis patients.

In this study, the participation of changes in psychological variables on the changes in pain intensity and disability after treatment are also explored longitudinally. To our knowledge, this is the first study to address this issue in anterior knee pain patients. Changes in catastrophizing turned out to be the strongest predictor of change in

referred pain intensity. After adjusting for sex, age, type of treatment, catastrophizing alone accounted for 48 % of the explained pain variance. This finding is consistent with previous research that found an association between catastrophizing cognitions and the development of chronic pain in several musculoskeletal conditions and after an orthopaedic surgery [35].

Although the exact mechanisms by which catastrophizing affects the experience of pain and disability are not well known, it has been suggested that it influences pain perception and associated behaviour. People who catastrophize have difficulties in not focusing on the painful or threatening stimulus [6, 22]. This intensifies fear of pain, which increases attention paid to the stimulus. Also, an excessively emotional evaluation of pain is associated with catastrophizing, which causes a higher perception of the experience of pain [9]. In a study with functional MRI in patients with chronic pain, it was seen that ideas of catastrophizing were not only associated with a higher degree of activity in the brain's pain processing areas, but also in the cortical areas related to attention, the anticipation of pain, and emotional aspects of pain [12]. In a study performed in healthy subjects in whom pain was caused by heat, higher levels of pain catastrophization were related to a higher degree of pain as well as higher duration of the heat-related pain. This suggests that catastrophization plays a facilitator role in the pain perception process [9].

The observed reduction in catastrophizing levels after treatment is consistent with previous findings in patients having a total knee arthroplasty. Wade et al. [39] observed that as pain subsides after surgery for knee osteoarthritis, catastrophizing does as well. This observation challenges the notion of catastrophizing as a stable trait like a personality component. Pain is a multidimensional phenomenon composed of sensitive, cognitive-evaluative and affective-motivational domains. Catastrophizing modulates the perception of pain, and this relationship seems to be bidirectional in a dynamic manner. Our results suggest that anterior knee pain patients tend to catastrophize when pain is more intense. Conversely, some studies have shown in other chronic pain conditions that this relationship may occur in the opposite direction; as catastrophizing is primarily decreased, pain sensation and function improve [4, 31].

In this study, the reduction in kinesiophobia showed a moderate correlation with improvement in disability and a low correlation with improvement in pain. These findings are consistent with a research by Piva et al. [24] who found that change in fear-avoidance beliefs about physical activity was the strongest predictor of function and pain outcome after rehabilitation in patients with anterior knee pain. In the study by Piva et al. [24] and also in ours, there was no specific treatment focused on modifying beliefs and attitudes, and the observed changes in fear beliefs were insignificant. It seems that the improvement in symptoms helped patients to overcome their fear of physical activity. Greater reduction in fear of movement beliefs have been reported in chronic low back pain using cognitive-behavioural treatments along with conventional biomedical treatment [19, 26].

This study has some limitations. An observational correlation design has been used, and therefore, causal inferences have to be made with caution. The sample was recruited from a specialized clinic in knee surgery which presumably treats the most severe cases. The average pain level of this sample was 7.7 in VAS from 0 to 10, and the patient's symptoms persisted for more than 6 months. Maybe the associations found are lower in a sample with milder symptoms. Another weakness that may limit external validity of this study is that most of participants had high educational levels. Previous research has identified education and social function as potential moderators of catastrophizing's relationships with pain severity [10]. Additionally, we did not study the influence of structural abnormalities in the results after treatment. All patients were examined with MRI to rule out other causes of knee pain such as torn meniscus, ligamentous injury or osteoarthritis. However, the structural abnormalities that have been proposed to cause anterior knee pain such as spin, tilt, lateral translation and malalignment of the patella have been observed in many people with no knee pain or disease [15, 21]. Patients underwent either physiotherapy or surgical treatment by the same clinical team and with an homogeneous protocol. To prevent any potential interaction of the type of treatment received, this variable was entered in the regression model and failed to be predictive of the outcome. Further research is needed to specifically investigate the different impact of changes in beliefs and attitudes on the clinical outcome after physical therapy or surgery.

This study may have some clinical implications. As the clinical improvement in pain and disability has been shown to be associated with a reduction in catastrophizing and kinesiophobia, co-interventions to reduce catastrophizing thinking and kinesiophobia may improve the results of a purely biomedical treatment (physiotherapy or surgery). Studies performed in chronic low back pain have shown that interventions to decrease catastrophizing, fear of movement and anxiety help to improve functional status. Effective management of these maladaptive cognitions has been demonstrated with specific cognitive-behavioural strategies [3, 20, 27]. This study has provided preliminary evidence that reduction in catastrophizing may be an appropriate outcome measure, as it was sensitive to changes in pain intensity and disability. This study has also provided the amount of changes in catastrophizing necessary to observe a clinically meaningful change in pain intensity and disability that may help to calculate sample size in further interventional studies.

Conclusion

Clinical improvement in pain and disability has been shown to be associated with a reduction in catastrophizing and kinesiophobia. These findings suggest that co-interventions to reduce maladaptive beliefs and attitudes may improve the results.

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