The Association Between Fear of Movement, Pain Catastrophizing, Pain Anxiety, and Protective Motor Behavior in Persons With Peripheral Joint Conditions of a Musculoskeletal Origin A Systematic Review

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The association between fear of movement, pain catastrophizing, pain anxiety and protective motor behavior in persons with peripheral joint conditions of a musculoskeletal origin: a systematic review

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Abstract

Objective: to investigate alterations in motor behavior related to pain-related beliefs in persons with peripheral joint conditions.

Design: Systematic Review

Results: Our database search (Pubmed, Web of Science, Embase, PsycINFO) identified 7390 articles (until September 2019) and nine papers (344 participants) were selected based on the eligibility criteria for selecting studies, i.e. studies in adults with primary peripheral joint conditions, assessing the influence of fear of movement, catastrophizing or anxiety on motor behavior in terms of kinematics, kinetics and muscle activity during active movements.

In the acute stage after knee or radius surgery, more catastrophizing and fear were associated with less active joint motion in the operated and adjacent joints. In knee patients in the chronic stage after surgery, increased hip adduction and knee valgus were linked to increased fear of movement during the performance of challenging tasks. Similar results were found in persons with non-surgical chronic knee pain. During gait, no relation between lower limb kinematics and fear of movement was observed.

Conclusion: Kinematic alterations appear in tandem with pain-related perceptions in acute stages after surgery. Altered kinematics influenced by pain-related beliefs are also seen in persons with chronic non-surgical and surgical knee pain, when challenging tasks are performed.

Keywords: movement; kinematics; fear; catastrophizing; beliefs

What is Known: Fear of movement, based on inappropriate catastrophic thoughts about pain, is an important contributor to perceived pain and disability in musculoskeletal conditions.

What is New: This systematic review shows that pain-related beliefs are furthermore related to alterations in motor behavior at the painful/injured and adjacent joints. Given that pain-related beliefs and movement are inter-related in persons with peripheral joint conditions, it would be valuable to add a measure of pain-related beliefs to the assessment of motor behavior in persons with peripheral joint conditions.

Introduction

Chronic musculoskeletal pain conditions are the leading cause of disability worldwide.[1] Due to a complex interaction between many factors involved in the development and maintenance of musculoskeletal pain, defining an optimal care plan is challenging.[2] The identification of the factors underlying the transition from acute to chronic pain or disability and the persistence of pain and disability, is indispensable to adequately tailor management programs. In this context, it is well known that psychological factors are important contributors to perceived pain, disability and performance in musculoskeletal conditions.[3,4]

Within the fear-avoidance model, inappropriate catastrophic thoughts about pain following an injury or pain experience might initiate fear of movement and lead to avoidance behavior, in an attempt to decrease pain or to prevent further injury.[5] This avoidance behavior can be overt, meaning that a person completely avoids a certain activity. However, avoidance behavior is often more subtle, resulting in distinct motor adaptations, such as muscle guarding, alterations in muscular and movement timing, decreased regional range of motion, decreased movement variability, or altered spatiotemporal movement characteristics.[6,7] In the acute stage following pain or injury, motor adaptations to avoid further tissue damage is adaptive because it enhance the recovery of damaged tissues.[8] However, protective motor behavior is inappropriate when it persists based on pain-related beliefs even when the tissues are healed.[9] It is theorized that such persistent protective motor behavior can initiate a vicious circle of aberrant joint loading, increased pain and increased fear, which might lead to disability on the long term.[9]

Numerous studies have identified motor adaptations in persons with peripheral joint pain or following peripheral joint injuries.[10-12] These adaptations are diverse and vary within and between individuals. Recognizing the association between maladaptive beliefs and the adapted motor behavior in persons with peripheral joint conditions, might explain the variable motor responses to pain or injury. Gaining insights in these associations can improve the understanding of the transition from acute to chronic pain, the persistence of pain, the development of long-lasting functional limitations or the occurrence of re-injuries. This information is therefore essential to further optimize care plans for peripheral joint conditions within a biopsychosocial context.

The aim of this systematic review is to identify whether motor behavior is related to or predicted by pain-related beliefs, defined as fear of movement, pain catastrophizing or pain anxiety, in persons with peripheral joint pain or after peripheral joint surgery. Based on this review, we aim to formulate specifications on the parameter selection and the task-requirements recommended to identify a potential relation between motor behavior and pain-related beliefs. We also aim to give recommendations for the optimization of physiotherapy assessment and management plans in case of peripheral joint conditions.

Methods

Protocol details were registered in the international prospective register of systematic reviews (PROSPERO, registration number CRD42018112931). Furthermore, this study conforms to all PRISMA guidelines and reports the required information accordingly (see Supplementary Checklist).[13]

Papers were selected until September 2019 from following electronic databases: PubMed, Web of Science, Embase and PsycINFO. A combination of search terms for (1) the peripheral joint, (2) fear of movement, catastrophizing and anxiety and (3) motor behavior were used. The search terms and the used strategies can be found in Appendix 1 and 2.

Papers were included when they met the eligibility criteria as described in Table 1. The title and the abstract of all studies retrieved from the database search were screened independently by two assessors (LDB and TM). Full texts were read from all eligible studies based on title and abstract and from those studies in which the abstract did not provide enough information for eligibility. To finalize the selection process, reference lists of included papers were manually screened by both reviewers for additional eligible papers. Furthermore, experts were contacted to ensure that no relevant papers for inclusion were missed. In case of disagreement on study-selection between the two assessors, a third assessor (AT) was consulted to reach consensus.

Risk of bias assessment of selected studies was done using the Quality In Prognosis Studies tool.[14] The Quality In Prognosis Studies tool is recommended by the Cochrane Prognosis Methods Group to assess risk of bias for prognosis studies.[14] Questions related to six domains are included to consider when evaluating risk of bias in studies of prognostic factors: participation, attrition, prognostic factor measurement, confounding measurement and account, outcome measurement and analysis and reporting. According to responses to items, risk of bias for each of the six domains was determined as high (score 2 points), moderate (score 1 point) or low (score 0 points). The mean scores of the six domains per study were used to determine the overall risk of bias rating. Mean scores from 0 to 0.65, from 0.66 to 1.32 and from 1.33 to 2 were considered low, moderate and high risk of bias respectively. Although specifically developed for prognostic research, the tool was also used in case that cross-sectional correlational studies were selected for inclusion, given that most items are relevant for those studies as well.

The risk of bias of the included papers was independently rated by two reviewers (LDB and TM). Reviewers were blinded to each other's results. In case of disagreement, consensus was reached after discussion with a third reviewer (AT).

The following data was extracted from the included papers: (1) author, year of publication; (2) characteristics of the study population; (3) specifications on the assessment of motor behavior; (4) specifications on the assessment of fear of movement, catastrophizing and/or anxiety; and (5) key findings related to the association between fear of movement, pain catastrophizing and/or pain anxiety and parameters of motor behavior. Data was extracted by one person (LDB) and verified by a second person (TM).

No meta-analysis could be performed due to study-heterogeneity in study populations and assessed motor behavior parameters. Therefore, a best-evidence synthesis was performed, classified studies into research on persons with non-surgical chronic peripheral pain and persons in the acute, subacute or chronic stage after surgery. For this systematic review, non-surgical chronic peripheral pain was defined as pain lasting for 3 months or longer. The acute, subacute and chronic stage after surgery were defined as within the first two weeks after surgery, from the second week till the third month after surgery and from third month after surgery, respectively.

Results

Database search and risk of bias

Our database search identified 7390 articles, of which 38 papers were selected for full-text screening. Nine papers, with a total of 344 participants, were included in this review based on the predefined eligibility criteria. The selection process is visualized in the flow-diagram in Figure 1.

The overall risk of bias score per study and the scores on the different items of the QUIPS per study are shown in Table 2. Three studies had a low risk of bias,[15-17] and six a moderate risk of bias.[18-23] As no studies showed high risk of bias, all studies were used for study results' interpretation.

Study characteristics

Seven studies included persons with knee pain or after knee surgery.[15,16,18-21,23] In one study, persons with shoulder pain were included,[22] and another study recruited persons after surgery for a distal radius fracture.[17]

Associations between motor behavior and fear of movement, catastrophizing or anxiety were reported in persons with non-surgical chronic knee or shoulder pain,[15,18,22] in the acute stage after knee or radius surgery,[17,19] in the subacute stage after knee or radius surgery [17,21] and in the chronic stage after knee surgery.[16,20,21,23]

Motor behavior assessment entailed the assessment of joint angles (kinematics) in nine studies,[15-23] muscle activity in one study,[23] kinetics in three studies,[16,20,21] and spatiotemporal movement parameters in two studies.[15,16] Movement tasks were analytical active joint movements in three studies,[17,19,22] and functional movement tasks in seven studies.[15,16,18,20-23] From these functional tasks, four were considered challenging tasks (i.e. tasks requiring higher joint loading or tasks resembling typical injury-mechanism, such as a jump-landing task).[15,18,21,23]

Fear of movement was assessed in eight studies using the Tampa Scale for Kinesiophobia (TSK),[15,16,19-21,23] and The Fear-avoidance Beliefs Questionnaire (FAB-Q).[18,22] In one study pain catastrophizing was investigated by means of the Pain Catastrophizing Scale (PCS).[17]

In five studies, the relation between motor behavior and pain-related beliefs was assessed using correlation analyses.[15,18,20,21,23] In four studies, regression analyses were used to determine the predicting role of pain-related beliefs on motor behavior.[16,17,19,22]

In Table 3, more details on patients' characteristics, motor behavior assessment and assessed psychological factors are described.

Association between pain-related beliefs and motor behavior

Relations between pain-related beliefs and kinematics, muscle activity and spatiotemporal parameters were reported. No relations between pain-related beliefs and kinetics were found. Details on the association between pain-related beliefs and motor behavior are described in Table 3.

Non-surgical chronic peripheral joint pain

In persons with chronic knee pain, a relation between pain-related beliefs and motor behavior was identified. In case of chronic patellofemoral pain, an increase in fear of movement was significantly correlated with increased hip adduction during single leg squat and jogging, an increased knee abduction during step-down and jogging, and a decreased peak knee flexion and cadence during stair descent (range r=0.48 -

0.76).[15,18] In persons with chronic shoulder pain, there was no association between fear of movement and shoulder joint motion during a forward flexion and a hand behind back motion.[22]

Acute stage after surgery

After total knee arthroplasty, knee range of motion during analytical active knee flexion measured at the day of discharge was predicted by fear of movement at discharge day, i.e. higher fear was associated with less flexion range of motion (R^2 = 0.47).[19] In persons who had undergone distal radius fracture surgery, greater pain catastrophizing was a predictor for increased finger stiffness (increased distance to palmar crease, decreased finger range of motion) at suture removal (partial R^2 = 0.021-0.38).[17]

Subacute stage after surgery

In persons after a distal radius fracture surgery, greater pain catastrophizing was a predictor for increased finger stiffness (increased distance to palmar crease, decreased finger range of motion) at six weeks after surgery (partial R^2 = 0.039-0.14).[17]

At six weeks after arthroscopic meniscectomy, peak knee flexion, knee joint moments and ground reaction forces during single leg hop landing were not related to fear of movement.[21]

Chronic stage after surgery

Results regarding the relation between fear of movement and motor behavior at the chronic stage after knee surgery are conflicting.

In persons who received anterior cruciate ligament (ACL) reconstruction, results seem to be dependent on task-demands. At one-year after surgery, a significant negative correlation between fear of movement and knee, hip and trunk flexion (r range = -0.48 - -0.41), and a positive correlation between fear of movement and hip adduction and gluteus maximus preparatory activation was found during a jump-landing task (r range = 0.45-0.52).[23] During gait however, higher fear of movement was only related to higher trunk peak flexion in persons with lateral knee osteoarthritis 12 year after ACL reconstruction (r = 0.52).[20] In this study, no associations between hip, knee and ankle joint kinematics and trunk, hip, knee and ankle joint moments on the one hand and fear of movement on the other hand were reported.[20] This is in line with the results from Luc-Harley et al. (2018), who also did not observe a relation between fear of movement and gait knee kinematics, knee kinetics or velocity in persons two years post-ACL reconstruction.[16]

At one year after arthroscopic meniscectomy following a traumatic meniscus tear, peak knee flexion angles, knee extension moments and peak ground reaction forces during single leg hop landing were also not related to fear of movement.[21]

Discussion

With this systematic review, we extend the knowledge on how an injury or pain experience relates to altered motor behavior, by investigating the role of pain-related beliefs with regard to adaptations in motor behavior in persons with peripheral joint conditions.

In persons with chronic nonsurgical knee pain, increased fear of movement is related to protective movement patterns at the pain site and in adjacent joints, when challenging movement tasks are performed.[15,18] [15,18] Fear of movement relates thus to the often reported adaptive movement strategy of increased hip adduction together with increased knee abduction. [24] These insights add to the debatable and variable results in literature on the association between the dynamic knee valgus and the reduction in gluteal muscular strength as reported in persons with chronic patellofemoral joint pain.[25]

In the acute stage after surgery, higher levels of fear of movement and catastrophizing are predictive for less joint motion at the pain site and in adjacent regions.[17,19] Avoidance of movements that might negatively affect tissue recovery in this acute stage after surgery can be interpreted as a normal reaction to an injury, surgery or pain experience, as it may enhance recovery.[8] In contrast, the persistence of avoidance behavior in stages when tissues are healed, is inappropriate. In the subacute and chronic stage after surgery, contradictory results were found regarding the relation between fear of movement and motor behavior. Our results suggest that in these stages after surgery, the reported differences between studies in the adaptations in motor behavior related to pain-related beliefs may be clarified by various factors, such as the assessment specifications with regard to motor behavior, the measure of pain-related beliefs or the factors controlled for in the interpretation of the relation between motor behavior and pain-related beliefs, such as personal factors (age, occupation), duration of symptoms or pain severity, amongst others.

First, results indicate that it is important to use joint specific measures of motor behavior and to perform a complete movement assessment when studying the relation to fear. In the study of Satpute et al (2018) in chronic shoulder pain patients, a range of ‘total upper extremity movement’ instead of a separate analysis of shoulder ROM and adjacent joints’ movement was assessed.[22] Furthermore, also frozen shoulder patients, who obviously have less range of motion, were included in this study. These facts might explain why no relation between upper extremity range of motion and fear of movement was observed in chronic shoulder pain patients. These results should thus be interpreted with care.[22] In addition, in persons after arthroscopic meniscectomy, only sagittal plane knee kinematics were assessed. Relevant data from the frontal plane and from adjacent joints was thereby potentially missed. This study-limitation may contribute to the fact that no association between fear of movement and kinematics were found.[21]

Second, the task that participants had to perform may explain why inconsistent results were found. Results seem to indicate that it is important to challenge the participant by letting him/her perform a movement task which could be perceived harmful as it resembles the injury-mechanism or which could elicit pain. This is supported by studies in chronic low back pain. In persons with chronic low back pain, the perceived harmfulness score on the picture showing a person lifting an object with a bent back (item of Photograph Series of Daily Activities – PHODA, Series of pictures of daily life activities that patients have to rate for perceived harmfulness)[26] significantly predicted lumbar range of motion while lifting a box with a bent back. In contrast, other items of the PHODA which did not show an activity performed with a bent back were not related to lumbar ROM while lifting.[7] The fact that no relation between fear of movement and lower limb motor behavior during level walking was found in persons at 2 and 12 years after an ACL repair, is thus not that surprising, as this activity is unlikely to be perceived as harmful.[16,20]

Third, the injury mechanism and the measure of fear might be important. More information regarding the injury mechanism and the task-related fear of movement/re-injury that participants experienced during the performance of the studies movement protocol would be valuable. Similarly to research in low back pain, mixed results on the relation between the TSK and motor behavior are reported. The TSK, which is a general measure of the "beliefs that painful activity will result in damage and/or increased suffering and/or functional loss",[27] is potentially not sensitive enough to capture pain-related beliefs associated with specific pain-provocative or fear-provocative activities (for example, activities resembling the injury mechanism). Similarly like the TSK,[28] the FAB-Q is a scale which focuses on patients' beliefs about how physical activity in general and work might affect pain.[29] It is already shown in persons with low back pain that only task-specific, but not general measures of pain-related fear predicted lumbar ROM during lifting.[7] These results support the idea that not general fear of movement/(re)injury as assessed by a general scale such as the TSK or the FABQ, but the fear for performing specific activities is a key factor that should be more systematically addressed in patients with peripheral joint conditions. No study included in this review specifically examined the fear of performing the study's movement task, and whether this movement task resembled the injury-mechanism. This could lead to an underestimation of the extent to which fear of movement was apparent in the studied populations.

Finally, the absence of information regarding the pain that participants experienced during the performance of the assessed movement task is a major concern for the correct interpretation of the data, especially for the studies reporting on the subacute and chronic stages after surgery. Since pain might directly (i.e. loading painful tissues) or indirectly (e.g. by the enhancement of fear, the decrease in force development, …) play an important role in the avoidance of movement,[6] this is a major shortcoming. From the five studies that used a correlation analysis to investigate the relation between pain-related beliefs and motor behavior, none additionally assessed a potential relation between pain and pain-related beliefs. In the four studies using regression analysis, no study controlled for level of pain.

Besides the reported methodological limitations of the included studies, this review might also have limitations regarding the search strategy. Although a large systematic search in different databases was performed together with consulting experts, it is possible that suitable studies for inclusion in this review were not identified. Furthermore, given that only 344 participants were included in this review, one must be careful to draw conclusions based on the reported results. The fact that no eligible studies before 2015 were detected by the database search, might rely to the fact that the fear-avoidance model of pain, and the scales assessing the different construct related to the fear-avoidance model (i.e. TSK, FAB-Q, PCS) were originally developed for and applied in persons with low back pain.[28-30] The knowledge acquired in persons with spinal pain is often only in a later stadium translated to persons with peripheral pain problems, although underlying mechanisms might be similar.

Based on the specific limitations of the included studies, several highlights for future research can be formulated.

Highlights for future research

The results of this review also highlight that in future research the link between inappropriate pain-related beliefs and altered motor behavior should be assessed in more peripheral joint conditions than the ones that have been assessed so far (i.e. mainly knee joint disorders). Furthermore, prospective research monitoring the processes that lead to altered motor behavior in persons with peripheral joint conditions would enhance the understanding of why and how motor behavior changes. This can be done by assessing the mediating effect of pain-related beliefs and other relevant psychological factors (i.e. controllability, anxiety sensitivity) on the relation between a pain experience or injury and altered motor behavior. Further investigation of the effect of this altered motor behavior on aberrant joint loading, the level of return to activity, return to performance, chance for re-injury and the persistence of pain is essential. The assessment of motor behavior must include the assessment of muscle activity (redistribution of activity within and between muscles); movement patterns at the painful/injured joint and adjacent regions, including single joint kinematics and intersegmental joint coupling to well document the alterations in motor behavior. The task during which motor behavior is assessed, best resembles an activity which is perceived as painful, harmful or which elicits a fear-response. Potentially, tasks resembling the injury mechanism are most appropriate.[7] Therefore, it is essential to record a task-specific fear of movement score. Lastly, it is suggested to control for the level of pain experienced during task-performance.

Preliminary implications for clinical practice

The results of this review provide preliminary recommendations for clinical practice, as they imply that neither mechanical output nor psychological factors should be considered in isolation in persons with peripheral joint conditions. Physiotherapists should be aware of the potential influence of fear of movement and catastrophizing on changes in motor behavior at the painful site and adjacent regions, especially in patients with high levels of fear and catastrophizing. It is suggested to include the assessment of fear of movement or (re)injury in the regular patient assessment in physiotherapy practice. However, based on the results of this review, it is suggested to additionally apply a task-specific measure of fear.

In the management of persons with high levels of fear of movement or re-injury, it might therefore be important to target these feared activities by educational approaches and exposing patients to their feared activities. The results of the assessment of fear of movement can be used to elaborate on the beliefs about harmful consequences of activities, and how these relate to alterations in region-specific motor behavior.

Conclusion

Both peripheral and central factors co-exist in peripheral joint conditions, and are inter-related. The assessment of motor behavior in persons with peripheral joint conditions might thus additionally be interpreted as a convenient, potentially implicit measure to capture fear of movement or re-injury, or the catastrophizing of pain. In persons with chronic non-surgical knee pain, fear of movement is associated with altered lower limb kinematics. Altered movement behavior due to pain-related beliefs is also seen in persons in the acute stage after surgery, and this behavior persists into the chronic stage after surgery when challenging movement tasks are performed. However, the link between this altered movement behavior and the persistence of pain or reduction in function is not well studied so far.

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Figure Legends section

Figure 1. Flowchart visualizing the selection process