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Masterclass

Unraveling the role of fear and avoidance behavior in chronic musculoskeletal pain: from theory to physical therapy clinical practice

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ABSTRACT

Background: Protective behaviors in the context of pain fostered by fear are helpful in acute traumatic pain to enable a person to protect their body from further injury and promote healing in the short term. However, protective behavior that is ongoing in the absence of tissue damage may contribute to the persistence of disability in people with musculoskeletal pain. Current evidence highlights the importance of addressing pain-related fear, fear of movement-related pain, and avoidance behavior in the management of people with chronic musculoskeletal pain. But, physical therapists find it challenging to make sense of and implement the evidence in their clinical practice. This issue partly stems from the pervasiveness of the biomedical model, which fails to address important psychological factors such as fear of movement-related pain and avoidance behavior and their role in chronic musculoskeletal pain. Despite a wider acceptance of the biopsychosocial model of care, physical therapists lack confidence and guidance on how to implement this model into practice.

Objective: The aims of this masterclass are twofold: (1) to describe how the concepts/theory of fear learning can be applied in physical therapy practice for people with chronic musculoskeletal pain, (2) to illustrate the implementation of these concepts in clinical practice using an example of the management of a person with a chronic musculoskeletal pain condition.

Discussion: We discuss how clinicians may identify and target fear of movement-related pain and avoidance behavior in clinical practice, with examples of how to understand and manage individuals with chronic musculoskeletal pain using an associative learning and behavioral framework.

Introduction

In the last two decades, our understanding about pain has shifted from a purely nociceptive perspective (e.g., pain = tissue damage) to an individual experience shaped by multidimensional factors.[1,2] Pain has emotional aspects, and the relationship between pain and emotions (especially fear) has gained attention.[3–8] Pain and fear are crucial for survival, with pain signaling that the body's integrity might be in danger.[9–11] Here, we considered fear as the output of threat processing involved in behaviors and other protective responses, which evolved from reflexive to cognitive neural systems.[12] Thus, pain serves as a key signal of bodily threat, triggering protective physiological and

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Table 1
Developing fear and avoidance in the context of pain.

"The patient is a 40-year-old individual, who worked as a housekeeper in two houses to support their family. Some years ago, they were hanging a heavy blanket on a higher shelf in the wardrobe when they experienced an intense pain in their right shoulder. Initially, they froze, afraid that something really bad happened in their shoulder, which made them use a shoulder sling during the next two days. The pain lasted for one week. They reported that every time they tried to raise their shoulder, pain would occur or increase. They were very worried about the cause of their pain and were concerned whether they would be able continuing doing their job. As a consequence, they became overprotective of their shoulder in many daily activities such as combing their hair and washing their face and even in activities that did not require them to raise their arm (e.g., carrying bags or pushing a supermarket trolley). They went to a specialist physician who told them that their pain was caused by many years of heavy labor, which commonly leads to tendon ruptures of the shoulders, especially in people of their age. Although the absence of a traumatic mechanism of pain onset in their shoulder, the doctor reinforced that they did a great job in avoiding certain activities, prescribed anti-inflammatory medication, and instructed them to avoid overhead movements with their right shoulder in the future. The patient became highly avoidant of using their right arm. After four weeks their pain had reduced, but so had their shoulder function."

behavioral responses associated with fear.[13]

In acute traumatic pain, short-term protective behaviors prevent further injury and promote healing. However, when these behaviors persist without tissue damage, they may contribute to ongoing disability and chronic pain.[4,5,14,15] The fear-avoidance model (FAM) explains the interplay of pain, fear, and disability. It suggests that perceiving pain as a threat leads to a focus on pain management over life goals, triggering a cycle of fear, catastrophizing, hypervigilance, and avoidance, resulting in disuse, disability, and negative emotions.[4]

Musculoskeletal conditions affect 1.71 billion people globally, representing 17 % of disability years. Chronic musculoskeletal pain (CMP), a major public health issue, contributes to disability across all ages.[16] It is classified as chronic primary (formerly 'nonspecific') or chronic secondary musculoskeletal pain, linked to an underlying disease and chronic nociception from the spine, joints, bones, muscles, tendons, or soft tissues.[17,18]

Current evidence highlights the importance of addressing pain-related fear and avoidance for effective CMP management.[19,20] A major challenge for clinicians is how to translate theoretical models into clinical practice. This masterclass has two aims: (1) to describe the application of fear learning concepts in physical therapy for CMP, and (2) to illustrate these concepts in clinical practice using shoulder pain as an example, chosen for its high prevalence and significant impact on patient activities. While chronic musculoskeletal conditions may differ in their specific characteristics, the principles of fear learning and avoidance behaviors are fundamentally similar across conditions, enabling broader application of these concepts in clinical practice.

Fear of movement-related pain and avoidance: what we have learned so far?

Several terms are used interchangeably in the pain literature to describe fear in the context of pain including pain-related fear (i.e., fear of pain, fear of (re-)injury, fear of physical activity and so forth),[21] fear-avoidance beliefs (i.e., fear of physical and work activities that may elicit pain),[22] fear of movement-related pain (i.e., fear of performing a particular movement or physical activity that is [wrongfully] assumed to worsen a tissue damage or cause reinjury),[4] and kinesiophobia (i.e., an excessive and debilitating fear to abnormal situations, such as physical movement and activities).[23] However, these terms should not be considered synonyms.

In this masterclass, we focus on explaining how fear of movement-related pain develops and contributes to disability in CMP. We also address other types of pain-related fear, including fear of pain, kinesiophobia, and fear-avoidance beliefs, as they play a significant role in the persistence of pain and disability. We discuss the development of fear in the context of pain, its link to disability, and provide examples of assessment and intervention strategies in clinical practice. For this purpose, we present a patient's case to illustrate how key concepts (described in Table 1 below) such as fear learning (acquisition), inhibitory learning (extinction), and the acquisition and reinforcement of avoidance behavior may take place after an episode of acute musculoskeletal pain.

Fear learning

A glossary of common terms in fear conditioning literature is presented in Table 2, as well as a description about how the patient's history should be considered through the lens of a behavioral approach.

In the patient's story, their belief that their shoulder was injured led to worry after the pain onset, prompting protective behaviors in daily life (e.g., using a sling, avoiding carrying bags or pushing a trolley) to prevent further harm.[24]

Most of our understanding of fear learning comes from studies on Pavlovian fear conditioning, a type of associative learning.[25] Fear conditioning is a valuable behavioral paradigm for studying emotional learning and memory because the learning occurs rapidly (within a single trial under some circumstances) and the memory is persistent.[26] In experimental fear conditioning procedures, a neutral stimulus (conditioned stimulus; CS) such as a light, tone, or movement, is paired with an aversive and biologically relevant unconditioned stimulus (US; e.g., pain). After repeated pairings, the neutral stimulus (CS) (e.g., movement) starts to predict threat and gains "excitatory" properties (CS+) and comes to elicit protective responses even in the absence of the US (conditioned fear responses, CR), such as fear of movement-related pain.[27,28]

A particular feature of associative learning is that novel stimuli sharing characteristics with the original fear-provoking CS, i.e., generalization stimuli, may start eliciting similar responses (known as "stimulus generalization").[29] Stimulus generalization allows us to generate protective responses to potential threats in complex, dynamic environments without needing to learn anew.[29] Fear generalization is adaptive and occurs when people show conditioned fear responses in the face of a stimulus that was never paired with the US itself (e.g., pain), but that share perceptual resemblances with the original CS, such as when an individual extrapolates the threat value from one condition (e.g., pain while hanging clothes on the clothesline) to novel conditions (e.g., reaching for an object). Fear generalization can become maladaptive, often termed "overgeneralization", when a novel stimulus resembling a previously learned safe one (e.g., a non-painful movement) or one that does not resemble the fear-evoking CS+ still elicits conditioned fear. This maladaptive fear generalization can lead to sustained anxiety, excessive avoidance behavior, and disability.[30,31]

In humans, fear can be learned through direct experience, i.e., experiential learning/conditioning, but also by verbal instructions, and observing others, i.e., observational learning.[32,33] Emotional information from verbal instructions can contribute to fear learning by directly instilling fear and moderating fear acquired through experience,[34] as seen in the patient's doctor's advice to avoid overhead movements with their painful shoulder. Fear is often acquired indirectly through social transmission (e.g., observational or social fear learning).[35] Observational learning theory suggests that seeing another person express pain contributes to the development of pain-related fear and avoidance behaviors.[36]

The FAM proposes that some individuals gradually return to activity through confrontation/approach behavior after acute pain, while others, due to increased threat perception (perceiving pain as a bodily threat), persist in avoidance, leading to a cycle of fear, avoidance, and disability. This inflated threat perception can evolve due to negative

Table 2
Glossary of terms and clinical examples.

Term	Definition	Clinical Example (the patient's case)
Fear acquisition	Acquisition of conditioned fear is achieved by presenting an initially neutral conditioned stimulus (CS) such as a light, tone, or movement, with an aversive and biologically significant unconditioned stimulus that intrinsically elicits fear (US; e.g., pain). After (repeated) pairing with the US, the CS (e.g., movement) will start to elicit conditioned responses (CR) in absence of the US.	The neutral movement/ activity (CS) (*hanging a heavy blanket on a higher shelf)* started to elicit fear after being paired with an aversive US (*shoulder pain)*. Pain elicited defensive behavior and physiological unconditioned fear responses (UR). After a few movement-pain pairings (*She reported that every time she tried to raise her shoulder, pain arose)* (CS+). The CS+ (raising shoulder) alone was capable of eliciting a conditioned fear response (CR) (*After four weeks the patient reported that pain was not the main complaint; however, they became fearful of raising their arm*).
Fear generalization	The spreading of conditioned fear responses to novel stimuli that are perceptually (or conceptually) similar to the original CS+.	Conditioned fear to a specific movement (raising shoulder) generalized to similar movements that were never paired with pain themselves (*The patient began to move their shoulder with extreme caution in many daily activities such as combing their hair and washing their face*).
Fear overgeneralization	The excessive spreading of conditioned fear e.g., towards novel stimuli that are more similar to the original CS- or dissimilar to the original CS+.	Although there is no clear instance of fear overgeneralization in the patient's story, a hypothetical scenario could illustrate this phenomenon. Suppose the patient's fear of pain in their shoulder became so generalized that they began to avoid all kinds of household chores, not only those requiring them to raise their arm. For instance, even sweeping the floor, which does not require raising the arm like hanging a heavy blanket, could become a feared activity. In this scenario, the patient would be operating under the fear that any physical activity, regardless of the actual demand on their shoulder, could potentially lead to a recurrence of the intense pain they once felt.
Category-based or Conceptual fear generalization	The ability to abstract conceptual information during a learning episode, which allows fear generalization to physically dissimilar stimuli that are semantically related or belong to the same category.	In this patient's story, it is clear that given their understanding that their shoulder was injured/ damaged, they became worried about their shoulder after the pain onset, adopting protective behaviors in their daily life to task that they thought might be equally dangerous, such as avoiding carrying bags or pushing a supermarket trolley.
Fear Extinction	Progressive decrease of the expression of conditioned fear responses (CR). Extinction happens when fear decreases during repeated exposure to a previously CS+ which is now presented in the absence of the unconditioned stimulus. Extinction learning involves the formation of a novel stimulus-outcome association (extinction memory). Extinction associations are fragile compared to the original fear memory because they are context-dependent.	*After a few sessions, the patient was able to move their arm with minimal discomfort and no longer avoided or feared shoulder movements.*
Reinstatement	Reinstatement refers to a reappearance of extinguished fear responses following exposure to unsignaled presentations of the US after the completion of extinction training. This reappearance may be non-differential, in which the CR reappear to both CS+ and CS-. In addition, an unsignaled US that was not involved in fear acquisition can also make extinguished CRs reemerge (i.e., cross-US reinstatement).	*A few months later, the patient experienced shoulder pain again during their work, and their fear and the tendency to avoid raising their arm was renewed.*
Renewal	Renewal refers to a reappearance of extinguished CRs when in a different context from the one in which extinction training took place.	
Spontaneous recovery	Spontaneous recovery refers to a reappearance of extinguished CRs with the passage of time following extinction training in the absence of any further explicit training.	
Operant conditioning	The process in which behavioral change (i.e., learning) occurs as a function of the consequences of one's own behavior.	After the initial shoulder pain incident, the patient began to avoid using their right arm in many daily activities (negative reinforcement, as avoidance reduced pain). However, this led to severe limitations in their daily living activities (a form of negative punishment as they lost the ability to engage fully in daily tasks). When they felt pain in their shoulder during work, they started to adapt their work-related activities to protect the shoulder, again demonstrating negative reinforcement. Furthermore, their regular use of analgesics to cope with the

(*continued on next page*)

Table 2 (*continued*)

Term	Definition	Clinical Example (the patient's case)
		pain can be considered positive reinforcement, as the medication provided temporary pain relief, encouraging its continued use.

The definitions described above were adapted from the American Psychology Association dictionary of Psychology, available at https://dictionary.apa.org/.

appraisal of the pain (e.g., catastrophic thoughts), resulting in pain-related fear and excessive protective behaviors such as escape, avoidance, and hypervigilance.[4,5] Pain catastrophizing can reinforce this vicious cycle, as it fosters disability by facilitating the acquisition of fear and avoidance behaviors.[37]

Acquisition and reinforcement of avoidance behaviors

Operant conditioning is a powerful pathway for acquiring and reinforcing avoidance behaviors.[11] Unlike classical conditioning, operant conditioning explains how (pain) behaviors are shaped by their consequences (e.g., fear reduction and pain relief after avoiding a movement) rather than their antecedents, i.e., cues that precede pain episodes, such as specific movements. Operant conditioning involves one's own behavioral responses, not merely a pairing of two external stimuli. The likelihood of a behavior (e.g., pain-related avoidance) decreases when followed by positive punishment (adding an aversive outcome/stimulus; e.g., being stigmatized when avoiding activity) or negative punishment (removing a positive outcome/stimulus; like missing a social event because of avoidance behavior). Conversely, positive reinforcement (adding a positive outcome/stimulus, like attention of others) or negative reinforcement (removing a negative outcome/stimulus; like pain relief from avoidance) will increase or maintain the behavior.[11,38] In the patient's story, the maintenance of protective behaviors, such as using a shoulder sling or avoiding using their painful shoulder while combing their hair and washing their face, are examples of behaviors sustained through negative reinforcement. Conversely, behaviors that relieve pain, such as pressing a tender area, are sustained through positive reinforcement.[39]

In the context of pain, reinforcers can also act upon new types of voluntary behaviors that individuals may engage in to reduce suffering. Examples of these behaviors include consulting doctors or taking pain medication. Reinforcers can also act on pain reports, communicative pain behaviors (e.g., facial expressions) and social behavior, increasing their frequency through positive or negative reinforcement.[21] One example is the regular use of analgesics to cope with the pain, described in the second part of the patient's story. Avoidance behaviors maintained by negative reinforcement can lead to significant disability, prompting individuals to avoid movements and tasks previously associated with pain, or even beyond, due to stimulus generalization.

Inhibitory learning model of fear extinction

We continue the patient's story (Table 3) to illustrate how fear extinction can occur when people with chronic pain confront their fears and engage in movements and exercises, even unintentionally, as the patient experienced through a supervised exercise program. We also discuss how fear renewal or reinstatement can happen during flare-ups if fear and avoidance are not properly addressed during rehabilitation

Inhibitory learning is the hypothesized principle underlying exposure-based treatments for various clinical conditions, including disability in people with CMP.[40] Crucial for this inhibitory learning process during exposure therapy is expectancy violation.[39] This can be achieved through a "behavioral experiment", where harm expectations (e.g., "if I hang up clothes, my shoulder will be damaged") following specific feared movements are challenged and corrected. According to the inhibitory learning model of fear extinction, the original "excitatory" memory, where a CS+ (e.g., movement) predicts an US (e.g., harm/-pain), is not erased by extinction. Instead, extinction forms a new "inhibitory" memory where the CS+ predicts the non-occurrence of the US (e.g., "if I hang up clothes, my shoulder will not be damaged").[41] This was evident in the patient's story, as after a few sessions, they could move their arm with minimal discomfort and no longer feared shoulder movements. The core idea of the inhibitory learning model of extinction is that the original fear memory is not erased but coexists with a new inhibitory memory, creating competition between the two. As a result, the CS+ becomes an ambiguous stimulus, and which memory will be retrieved and expressed, i.e. whether the stimulus will trigger fear or not, will depend largely on the context.[41] Therefore, inhibitory associations are more fragile compared to the original fear memories.[41]

Reinstatement was also evident in the patient's story, as they became fearful again after an unexpected episode of shoulder pain a few months later.

Assessing fear of movement-related pain and avoidance behaviors in clinical practice

What is clear in the patient's story is that, although their physical therapist offered an evidence-based intervention, i.e., exercises, that led to a short-term improvement in pain and disability, the factors that led the patient to fear and avoid (e.g., limiting beliefs about pain, catastrophic thoughts about the prognosis of her condition) were not properly addressed during the rehabilitation process. This underscores the importance of helping people with CMP learn to self-manage pain flare-ups, fear, and harm expectations.

Although many physical therapists struggle with addressing psychological factors and are concerned about professional boundaries,[42] evidence suggests that fear-avoidance beliefs in people with CMP are associated with poor treatment outcomes.[43,44,45] The patient's story is common in musculoskeletal clinical practice. Clinicians must recognize protective responses, assess whether they are helpful or unhelpful, and know how to address them in patients with CMP. We will briefly suggest how the patient's rehabilitation could have been improved by addressing their fear of movement-related pain and avoidance behaviors.

Table 3
Fear Extinction and Reinstatement.

"*With severe limitations on daily living activities, the patient decided to seek help from a physical therapist. The patient's physical therapist proposed a supervised exercise treatment plan based on exercises to increase shoulder/scapular mobility and strength. After a few sessions, the patient was able to move their arm with minimal discomfort and no longer avoided shoulder movements. Both the therapist and patient were very satisfied with these results and concluded that no further treatment was necessary. A few months later, the patient experienced shoulder pain again during their work, and their tendency to avoid raising their arm reemerged. Subsequently, the patient avoided any shoulder movement, which led to limitations in daily activities again. They became worried that the physical nature of their job would cause more degeneration in their shoulder, so they started to adapt their work-related activities to protect the shoulder. Over the months, the patient's pain was getting worse and interfering more in their daily life, despite the efforts to protect the shoulder. They consulted another specialist physician, which referred them to surgery. However, they did not want to get surgery because they were starting to feel pain in their left shoulder and were afraid not to be able to take care of their kids and continue working during the healing process. Therefore, they started using analgesics regularly to cope with the pain.*"

Interview

The patient's physical therapist could have explored their negative and catastrophizing thoughts, limiting beliefs about pain (e.g., pain equals tissue damage), and related behaviors.[46,47] Open-ended and reflective questions like 'Where did it all begin?', 'Do you have any explanation for your pain?', 'Is there any activity/movement you believe could harm your body? Why?', and 'Is there any activity/-movement you avoid because it seems too harmful?' could help identify limiting beliefs and avoided activities. More robust guides to carrying out a qualitative interview for physical therapists can be found elsewhere.[48–50]

Clinical tools

The patient's physical therapist could have used pictorial instruments to identify feared or avoided activities/movements to establish with the patient a hierarchy of activities perceived as threatening. Several pictorial instruments have been developed to assess avoidance behavior or to determine the perceived harmfulness of physical activities and movement including The Photograph Series of Daily Activities (PHODA),[51] the Pictorial Fear of Activity Scale-Cervical (PFActS-C),[52] and the Avoidance Daily Activities Photo Scale (ADAP-Shoulder).[53]

Regardless of the instrument used to assess the hierarchy of activities perceived as threatening, the patient's physical therapist could have asked them which activities or movements from the hierarchy they would like to recover first or those that are the most valued activities that they are avoiding, which therefore contribute most to their disability. By discussing with the patient which activities they would like to recover first or those that are most important to them, the physical therapist could have helped them identify the activities that would be crucial to overcome fear in a motivational and goal-oriented perspective, which would provide a better guide for exposure therapy and disability improvement.

The use of self-administered questionnaires also plays a role in the assessment of people with pain. The patient's physical therapist could have used a series of questionnaires that have been developed to assess pain-related fear, fear of movement-related pain and avoidance behaviors, such as the Fear-Avoidance Beliefs Questionnaire (FABQ), Tampa Kinesiophobia Scale, and Pain Catastrophizing Scale (PCS).[54–56] However, these measures should be used with consideration to their limitations. Mean scores can occasionally conceal high levels of fear and avoidance linked to specific tasks. As a result, patients may receive misleadingly low scores, potentially preventing them from obtaining the appropriate treatment. This highlights the importance of a thorough interview to facilitate disclosure of relevant information.

Therefore, utilizing clinical tools could have granted the patient's physical therapist a more person-centered understanding about existing limiting beliefs and protective behaviors associated with their disability. Directly discussing the patient's responses to these tools might have provided deeper insights into their perspectives on their condition. However, a true grasp of the patient's emotional reactions to the feared activities can only emerge when they confront these activities. This underscores the imperative need for a behavioral assessment.[57,58]

Behavioral assessment

The assessment of behaviors of a person with pain may not be fully revealed in the interview or even with questionnaires. People can say that they do not fear pain or movements, but implicitly hold limiting beliefs and worries about certain movements, that may only be revealed if the person is exposed to them.[58–60] Thus, during behavioral assessment, the patient's physical therapist could have asked to perform the feared activities identified by the patient, such as hanging something on a higher shelf in the wardrobe or on a clothesline, searching for protective behaviors (e.g., compensatory movements, increased muscle co-contraction, decreased speed).

Behavior experiments are crucial for assessing protective behaviors. After identifying the main factors associated with fear and avoidance behavior, it is essential that the clinician and the client collaboratively establish goals (e.g., defining activities that are more important to be recovered). This cooperative approach is crucial in aligning expectations and fostering shared responsibility and decision-making in functional recovery.

Cognitive-behavioral interventions and exposure-based therapy

As stated above, some individuals with CMP are hampered by limiting pain beliefs, fear of certain body movements/activities and avoidance behaviors. To address this debilitating aspect of the chronic pain experience, the patient's physical therapist could have offered treatment approaches such as pain education and exposure-based approaches.[61–64] The main goal of these interventions is to help people overcome their fears, cease avoiding feared activities, and re-engage with valued life activities, thereby increasing overall participation. Additionally, within the context of physical therapy, these interventions aim to foster a more active lifestyle and empower patients to perform their daily tasks or exercises with greater security and self-efficacy. By doing so, these therapies aim to integrate into physical therapy practice, supporting the performance of physical activities, which are considered the first line of treatment in this population.

The patient's physical therapist could have integrated pain education concepts during the whole process of interview and behavioral assessment to help the patient to make sense of their pain and minimize the threat value of pain.[65–67] Pain education can be described as a cognitive intervention that aims at reconceptualizing pain by increasing the understanding the neurophysiology of multifactorial aspects of pain.[68] This way, it can be seen as an intervention that directly targets catastrophic thinking and fear-avoidance beliefs. Pain neuroscience education combined with self-motivated coping strategies has consistently yielded positive outcomes.[69,70] Current evidence suggests that pain education provides positive effects on fear of movement-related pain and pain catastrophizing.[66] Although pain education might be a valuable and effective intervention for several pain-related outcomes in different chronic pain conditions, the educational process does not necessarily need to be based on explicit pain neurophysiology education.[49] By using communication skills and a non-judgmental approach, clinicians can help clients to make sense of their story, identify gaps, discrepancies, and misconceptions about how their pain experience in a more person-centered way.[71]

To help someone make sense of their story, it usually takes more than educating them about pain. Pain education should be offered in combination with active approaches. Exposure-based approaches are grounded in expectancy violation. Putting it simply, exposure therapy may facilitate individuals in forming a new CS-noUS association (e.g., movement-no harm) that inhibits the original CS-US association (e.g., movement-harm). This is achieved by repeatedly exposing the client to the previous feared movements or tasks without protective behaviors through behavioral experiments.[72,73] Behavioral experiments can elicit protective responses that clients may not be aware. For example, the patient's physical therapist could have exposed the patient to the feared movement/task in a controlled way by asking "What do you think will happen when you raise your arm?" (assessing harm expectancy), then ask them to perform the movement and to reappraise (e.g., "How was that? What actually happened?") and repeat exposure in a new context (i.e., gradually progress the task towards M's needs and goals"). Repeated exposures strengthen new associations so that they will be more easily retrieved when the individual is confronted with the feared situation.

Exposure can be planned considering the most relevant feared/avoided activities of the client. Although the main aim of exposure treatment for chronic pain is to reduce fear and disability, not pain

Table 4
Definitions of Cognitive-behavioral approaches and its application on the case.

Interventions	Description	Example based on the case
Graded activity	Improving exercise and activity tolerance by positively reinforcing the client's activity levels. Programs include individual exercises according to functional capacity and observed individual physical work demands. Activities are progressed in a time-contingent rather than in a pain-contingent approach. The goal is to assist clients to increase their level of activity, not only on feared and avoided movements.	Based on the patient's preferences and motivations, a program of exercise/activities could be established to increase their overall activity level using the painful limb. The program progression should be time-contingent and follow S.M.A.R.T. goals (specific, measurable, achievable, relevant and time-bounded).
Exposure Therapy	Exposes clients to fear-provoking daily-life movements and activities. It is considered as a cognitive-behavioral approach during which fear is activated and catastrophic expectations are being challenged and disconfirmed, resulting in reductions of the threat value of the originally feared stimuli. The goal is to decrease disability through fear and avoidance reduction.	The patient could have been exposed to the most relevant feared movements and activities in a controlled manner, through behavioral experiments. The patient's physical therapist should continuously assess and challenge the patient's cognitions and perceptions about the pain and the anticipated outcome of each behavioral experiment to disconfirm/violate maladaptive cognitions and harm expectancies.

reduction *per se,*[5,74] exposure-based approaches have been successful in reducing pain-related fear levels and disability in several chronic musculoskeletal conditions, such as low back pain,[75–79] complex regional pain syndrome,[80–82] fibromyalgia,[83] upper extremity pain, and post-traumatic neck pain.[84] Nevertheless, it is important to consider and be sensitive to the client's levels of distress and tissue sensitivity, as an aversive experience can foster fear and reinstall avoidance behaviors. Although the individual will most likely experience pain during the first exposure exercises, it is essential to conduct the exposure therapy in a way that the individual can perceive that no harm will occur, thus weakening the perceived link between pain and tissue damage.

Furthermore, managing uncertainty is crucial in fear management within physical therapy. Patients with CMP often face diagnostic uncertainty and intolerance of uncertainty, which can worsen their pain experience and contribute to limiting beliefs and catastrophic thoughts.[85,86] Intolerance of uncertainty, a trait linked to increased pain catastrophizing, may require specific interventions like cognitive-behavioral therapy to improve coping.[87] Physical therapists should recognize these uncertainties and incorporate strategies to address them in a comprehensive treatment plan.

Table 4 presents the definition of some behavioral approaches and its application to the patient case.

It is important to highlight that CMP is associated with large inter-individual variability in symptoms and clinical manifestations,[88] making it a challenge for clinicians. Therefore, physical therapists are invited to use the knowledge presented in this paper as a starting point to bridge the gap between fear and avoidance learning mechanisms and physical therapy practice and discuss with the client the preferrable treatment approach.

Though not the primary focus of this masterclass, it is important to briefly highlight pain self-efficacy in managing CMP. Pain self-efficacy—the belief in one's ability to manage pain and maintain daily activities—significantly affects the pain experience and treatment adherence.[89,90] Strategies like cognitive-behavioral techniques, graded exposure, and patient education can enhance self-efficacy and improve outcomes. By incorporating these strategies, physical therapists can help patients build confidence in managing pain, thereby boosting engagement and adherence to rehabilitation.

Summary

In this masterclass, we presented key concepts of learning and behavioral mechanisms associated with how fear, specially fear of movement-related pain, and avoidance behavior may persist and lead to disability in individuals with musculoskeletal pain. Fear of movement-related pain and avoidance behaviors can be rapidly acquired during an acute pain episode and are associated with the development and maintenance of chronic disabling pain, and with its recovery.

Declaration of competing interest

The authors declare no competing interest.

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