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INTERNET-DELIVERED PAIN RESILIENCE THERAPY (PRT): A MULTI-SUBJECT CASE SERIES

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CASE REPORT

INTERNET-DELIVERED PAIN RESILIENCE THERAPY (PRT): A MULTI-SUBJECT CASE SERIES

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Abstract: Objective: Pain is a multifaceted phenomenon; therefore, innovative, multisystem approaches are recommended as a path to pain recovery. Pain Resilience Therapy (PRT) was developed as a novel, resilience-focused approach to pain management using intermediate to advanced physical therapist knowledge and skills. Methods: Three people with chronic pain received tele-physical therapy using PRT. The primary aim of PRT was to facilitate the development of pain resilience. Addressing vulnerability was a secondary aim. Treatment results were assessed using validated self-report measures for pain intensity, resilience, vulnerability, interference, patient outcome expectations, expectancies, and perspectives. Results: All patients demonstrated a significant reduction in pain intensity and increased pain resilience (cognitive-affective positivity or behavioral perseverance) measured by the Pain Resilience Scale (PRS), Pain Self-Efficacy Questionnaire (PSEQ), Chronic Pain Acceptance Questionnaire (CPAQ), and Self-Efficacy for Rehabilitation (SER). Pain interference improved (PROMIS®) with associated improvements in activity, sleep, mood, and stress measured by the Defense and Veterans Pain Rating Scale (DVPRS 2.0). Certain measures related to vulnerability (negative mood, fear avoidance, pain catastrophizing, kinesiophobia, depression, anxiety) also improved. The PRT intervention was safely delivered and patients reported their health as very much improved measured by the Patient Global Impression of Change (PGIC) survey. Conclusion: PRT's resilience-focused approach reduced pain and increased pain resilience while improving physical and psychological well-being. Although research is needed to elucidate change mechanisms, assisting patients in accessing resources that facilitate resilience is a valid pathway to pain recovery. This case series is a step toward integrating an understanding of resilience within the broader context of pain and disability.

Summary Box

• This is the first study to report the effectiveness of Pain Resilience Therapy. Initial outcomes indicate that Pain Resilience Therapy can significantly decrease pain intensity, improve physical and psychological factors associated with chronic pain, and enhance patients' self-reported health status.

• The importance of this study lies in its potential to inform physical therapist practice by offering an alternative telehealth intervention for chronic pain that could be accessible to those who cannot attend in-person therapy. It also emphasizes the role of resilience in pain management and could shift the focus from pain vulnerability to resilience-building, which may lead to better long-term outcomes for patients with chronic pain.

Keywords: chronic pain, resilience, PRISM, musculoskeletal pain, salutogenesis

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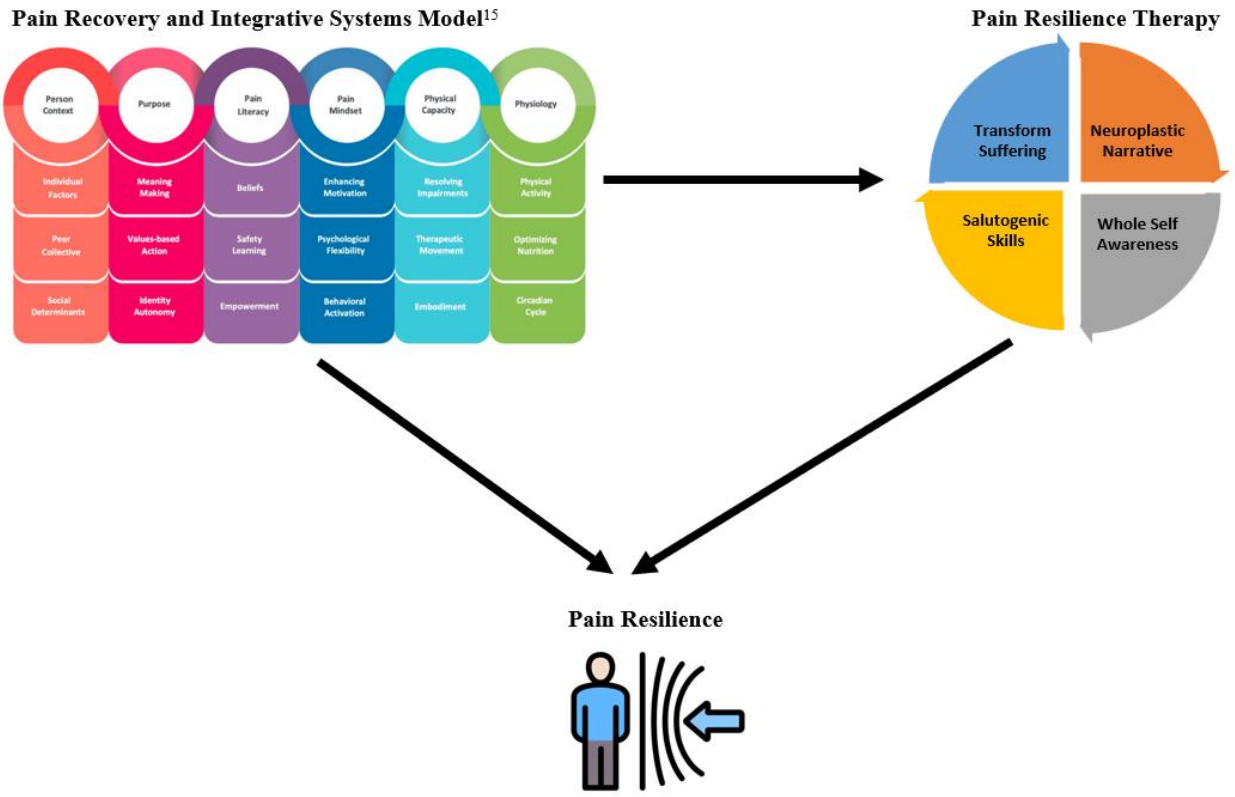
Introduction

Pain is an emergent experience arising from sensory, motor, and cognitive-emotional processing in the brain. Through learning and memory, pain is encoded and can persist.[1] Sensory alterations[2] (hyperalgesia, allodynia) cause an attentional bias resulting in cognitive-emotional distress (pain catastrophizing, kinesiophobia).[3] Poor motor performance (fatigue, reduced control, impairment) also contributes to disability.[4] Increased vigilance to bodily sensations and instability of body schema lead to disconnection, detachment, or dissociation.[5] As part of this multifaceted experience, one's sense of coherence (perceiving pain as comprehensible, manageable, and meaningful)[6] and self-efficacy may be diminished.[7] Avoidance behaviors are the embodiment of the pain experience.[8] Learning about and adapting to pain is a complex, dynamic process incorporating cognitive, affective, and physiological states.[9]

Decades of research have been devoted to factors that generate vulnerability to chronic pain, yet few studies have explored the characteristics that facilitate enhanced adaptation.[10,11] New evidence suggests a salient role of resilience in adapting to pain and achieving successful function (in human terms, well-being).[12,13] Resilience first emerged as a construct from positive psychology, shifting the emphasis away from negative psychological factors and toward positive aims, promotive and protective factors, and adaptive capacities.[14] Recently, the Pain Recovery and Integrative Systems Model (PRISM) introduced a broader, multi-process and multisystem construct of pain-specific resilience in physical therapy. This new model centers on learning healthy behaviors that promote relatively stable levels of physical, physiological, and psychosocial functioning.[15] These positive, asset-based processes are contingent upon individualized behavior change and are person context-dependent (Figure 1). Personal contextual factors may include beliefs, safety learning, embodiment, therapeutic movement, and psychological flexibility.[15] Health-promoting behaviors (physical activity, sleep, nutrition, avoidance of risky substances) also build resilience and adaptive plasticity.[15,16] Resilience may act as a protective factor in the face of pain symptomatology, disability, and psychosocial distress to promote beneficial outcomes and/or buffer vulnerability toward negative outcomes.[17] Assessing and addressing the resilience gap may strengthen outcomes in people facing the adversity of chronic pain.[18] While many physical therapists are familiar with resilience as a factor in pain management, we were unable to identify previous investigations concerning a specific, multi-system approach toward enhancing

Figure 1: Clinical Decision-Making Process



resilience and chronic pain recovery. Likewise, we were unable to locate research that detailed changes in pain-specific resilience as a process outcome across an episode of physical therapy care.

The purpose of this case series is to describe the initial development of a novel intervention called Pain Resilience Therapy (PRT) and demonstrate its effects in three individuals experiencing chronic pain. Innovative aspects of PRT include a resilience-focused approach to reduce pain, improve pain interference, and enhance quality of life. We hypothesized that PRT would be safely tolerated, facilitate pain recovery, enhance physical and psychological resilience, and significantly improve patients' self-perceived health.

Case Presentation

Case 1

A 44-year-old male (white, college educated, married, employed, no current opioid use) with an 8-year history of chronic low back pain (CLBP) was referred by his physical therapist due to a noticeable plateau in progress and difficulty coping with pain. He previously received 8 years of intermittent impairment-based

physical therapy that centered on lumbar stabilization exercises, spinal mobility, and manual therapy. He also received 8 months of psychodynamic psychotherapy and 8 weeks of Pain Reprocessing Therapy[19] with no relief. His pain was localized to the base of the spine and above the right posterior superior iliac spine. The patient reported no leg pain, numbness, or paresthesia. His primary complaint was pain exacerbated by work-related stress, sitting for prolonged periods, and a loss of recreational activities such as running and skiing. He was motivated to return to running and believed a body-mind approach to treatment would be beneficial.

Case 2

A 66-year-old female (white, college-educated, married, lightly employed, no current opioid use) presented with an 8-month history of left-sided neck pain and bilateral shoulder pain. She reported an adverse incident during a massage therapy session where the practitioner suddenly and forcefully distracted and pulled both upper extremities at 180 degrees of flexion without her consent or warning. This incident was described as traumatic and reminiscent of an acceleration–deceleration injury. Approximately 24 hours after the incident, the patient reported feeling 'numb all over my body' and then progressively developed pain. She reported diffuse paresthesia in both upper extremities that did not follow a dermatomal pattern. Throughout 8 months, the patient consulted and/or received treatment from one neurologist, three chiropractors, two physical therapists, three orthopedists, a physiatrist, and an acupuncturist. She underwent three imaging studies indicating cervicalgia and mild rotator cuff tendinosis but no rotator cuff tear. The patient was motivated to resume activities such as returning to the gym and Pilates classes; however, she was very concerned about movements that would exacerbate pain and described confusion regarding the cause of and unpredictability of her symptoms. The patient reported that these symptoms resulted in significant disruption to her daily life.

Case 3

A 74-year-old female (white, college-educated, unmarried, retired, no current opioid use) presented with a history of childhood trauma, Hashimoto's thyroiditis, and previous CLBP with a new episode that began 6 months earlier. Her primary care physician prescribed a gabapentinoid (300mg/4x/day) to manage her pain. Three months into the medication regime, the patient began to experience drug-related side effects that included rebound pain between doses, intense dermatomal itching in her trunk and arms, anxiety, and

difficulty sleeping. Her primary care physician provided education on tapering down the gabapentinoid and recommended physical therapy for pain management. The patient reported localized pain at the base of the lumbar spine and at various points throughout the thoracic spine. She reported no leg pain, numbness, or paresthesia. The patient believed conservative treatment would support the medication taper and help manage her pain. However, she was uncertain and fearful about tapering the medication due to its potential analgesic effects. The patient was having difficulty completing her daily routine.

Diagnostic Evaluation

For each of the three patients featured in this case series, the treating physical therapist employed a diagnostic evaluation process based on the biopsychosocial model of pain. Physical examination followed consensus-based multispecialty guidelines and best practices in telemedicine for orthopedic and neurologic pain.[20] This included visual observation, verbally guided self-palpation, lumbar and hip active range of motion (ROM), functional strength testing, gait assessment, and special clinical tests. Physical examination findings for each patient are provided in Table 1. The treating physical therapist used the 10-item Optimal Screening for Prediction of Referral and Outcome-Yellow Flag (OSPRO-YF)[21] to evaluate pain-related psychosocial factors shown in Table 2. The OSPRO-YF is a valid and reliable multidimensional psychological measure for individuals with chronic pain.21 Functioning and disability reflect a complex interaction among individual health conditions, as well as contextual environmental and personal factors. Therefore, the treating therapist used the International Association for the Study of Pain (IASP)[22] and the World Health Organization's International Classification of Functioning, Disability, and Health (ICF-11)[23] new classifications for chronic pain to formulate a diagnosis. This reflects the International Classification of Diseases (ICD) 11th Revision (ICD-11) which regards chronic pain as a biopsychosocial phenomenon and includes the diagnosis of chronic primary pain and six types of chronic secondary pain.[23] Empirical studies have demonstrated the integrity of these diagnostic categories, reliability, clinical utility, international applicability, and superiority over the previous 10th edition (ICD-10).[23] For reliability and diagnosis, a classification algorithm and coding tool for the ICD-11 are available for clinician use.[23]

Table 1: Evaluation Findings

	Case 1	Case 2	Case 3
ICD-11 Diagnosis	• MG30.02 Chronic primary low back pain • XS7G Psychosocial factors present • XS2E Severe pain intensity • XS7N Severe distress • XT5T Continuous with additional flare-ups	• NA6Z Injury to neck/neck trauma • XS7G Psychosocial factors present • XS2E Severe pain intensity • XS7C Moderate distress • XT5T Continuous with additional flare-ups	• MG30.02 Chronic primary musculoskeletal pain • PL13.2 Drug-related injury or harm in the context of correct administration or dosage • XS7G Psychosocial factors present • XS2E Severe pain intensity • XS7C Moderate distress • XT5T Continuous with additional flare-ups
Key Examination Findings	• Posture revealed no scoliosis, abnormal kyphosis, or lordosis. • Lumbar range of motion (ROM) assessed while standing. The patient was instructed to move to end range of flexion, extension, lateral flexion, and rotation. Although lumbar ROM was within normal limits, pain was noted at the end ranges of forward flexion and left rotation. • Lower extremity muscle strength was WNL as assessed by the following functional movement patterns; a *double leg squat and rise* to test L3 and L4 quadriceps and lower extremity strength, heel-toe walking for L5 and S1 radiculopathy–related weakness, and repetitive toe raises for S1-related related weakness. • Faber's test was negative for sacroiliac joint dysfunction. • Seated straight leg raise and slump test were negative for neural tension/L4 to L5 or L5 to S1 disc herniation. • Prone stork test was negative for posterior facet pain. • Gait pattern was normal, the patient was able to heel walk, toe walk, and, tandem walk.	• Posture revealed no cervical lordosis, forward head posture, or abnormal head tilt. • Cervical ROM assessment included flexion, extension, lateral flexion, and rotation. Left lateral flexion and right rotation were painful and limited by 10 degrees. • Bilateral shoulder flexion and abduction ROM was WNL yet pain was noted in a diffuse pattern throughout the upper quarter at the end range. • The Spurling Maneuver was negative for cervical radiculopathy. • Roos Stress Test was negative for Thoracic outlet syndrome. • Empty can test was negative for shoulder impingement.	• Posture revealed no scoliosis, abnormal kyphosis, or lordosis. • Lumbar ROM was assessed while standing. The patient was instructed to move to end range of flexion, extension, lateral flexion, and rotation. Lumbar ROM was limited in all directions by about 20 degrees due to reports of pain and/or tension. • Lower extremity muscle strength was WNL as assessed by the following functional movement patterns; a *double leg squat and rise* to test L3 and L4 quadriceps and lower extremity strength, heel-toe walking for L5 and S1 radiculopathy–related weakness, and repetitive toe raises for S1-related related weakness. • Faber's test was negative for sacroiliac joint dysfunction. • Seated straight leg raise and slump test were negative for neural tension/L4 to L5 or L5 to S1 disc herniation. • Prone stork test was negative for posterior facet pain. • Gait pattern was normal, the patient was able to heel walk, toe walk, and, tandem walk.

Outcomes

Each patient completed five standardized outcome measures to assess psychosocial factors and patient status before treatment and at 90 days post-treatment (Table 2).

Table 2: Outcome Measures

	Case 1		Case 2		Case 3	
	Pretreatment	**90-Days Posttreatment**	**Pretreatment**	**90-Days Posttreatment**	**Pretreatment**	**90-Days Posttreatment**
OSPRO-Yellow Flag **+Yellow Flag** **- Yellow Flag**	**Resilience** +PSEQ 22.591 +SER 89.952 +CPAQ 37.943 **Vulnerability** +FABQ-W 23.293 +FABQ-PA 21.01 +TSK-11 28.293 +PCS 30.742 +STAI 50.682 +STAXI 21.119 +PHQ-9 10.123 +PASS-20 51.118	**Resilience** -PSEQ 45.242 -SER 111.986 -CPAQ 75.547 **Vulnerability** -FABQ-W 7.111 -FABQ- PA 14.031 -TSK 19.246 -PCS 16.086 +STAI 36.382 +STAIX 18.92 -PHQ-9 3.43 -PASS-20 23.675	**Resilience** +PSEQ 30.822 +CPAQ 48.889 **Vulnerability** +FABQ-W 27.876 +FABQ- PA 21.107 +TSK-11 31.545 +STAIX 14.323 +PCS 29.968 +PASS-20 52.635	**Resilience** -PSEQ 42.906 -CPAQ 71.406 **Vulnerability** -FABQ-W 6.159 -FABQ- PA 13.919 -TSK-11 18.691 -STAIX 34.422 -PCS 9.743 -PASS-20 17.37	**Resilience** +PSEQ 38.627 +CPAQ 61.05 **Vulnerability** +FABQ-W 22.758 +TSK-11 29.037 +PCS 29.791 +PASS-20 47.354	**Resilience** -PSEQ 38.627 -CPAQ 61.05 **Vulnerability** +FABQ-W 26.82 +TSK-11 28.2 +PCS 21.261 +PASS-20 38.023
Pain Resilience Scale	Behavioral Perseverance = 15 Cognitive/Affective Positivity = 9 Total Score = 24	Behavioral Perseverance = 15 Cognitive/Affective Positivity = 21 Total Score = 36	Behavioral Perseverance = 15 Cognitive/Affective Positivity = 13 Total Score = 28	Behavioral Perseverance = 18 Cognitive/Affective Positivity = 28 Total Score = 46	Behavioral Perseverance = 16 Cognitive/Affective Positivity = 16 Total Score = 32	Behavioral Perseverance = 16 Cognitive/Affective Positivity = 22 Total Score = 38
Pain Intensity	5/10: Interrupts some activities	1/10; Hardly notice pain	7/10: Focus of attention prevents doing daily activities	2/10; notice pain, doesn't interfere with activity	5/10; interrupts some activities	2/10; notice pain, doesn't interfere with activity
DVPRS Pain Interference	Activity 8/10 Sleep 7/10 Mood 9/10 Stress 9/10	Activity 0/10 Sleep 0/10 Mood 0/10 Stress 1/10	Activity 8/10 Sleep 8/10 Mood 9/10 Stress 9/10	Activity 2 /10 Sleep 2/10 Mood 0/10 Stress 0/10	Activity 7/10 Sleep 5/10 Mood 6/10 Stress 6/10	Activity 2/10 Sleep 3/10 Mood 3/10 Stress 3/10
PROMIS® Pain Interference	Raw Score 26 T Score 69.6	Raw Score 6 T Score 41	Raw Score 28 T Score 72.4	Raw Score 7 T Score 48	Raw Score 13 T Score 57.1	Raw Score 10 T Score 53.8
Patient Global Impression of Change		7- Very Much Improved		7- Very Much Improved		6- Much Improved

Abbreviations: OSPRO-YF, Optimal Screening for Prediction of Referral Outcomes-Yellow Flag, DVPRS, Defense and Veterans Pain Rating Scale, PROMIS®, Patient-Reported Outcomes Measurement Information System; **Vulnerability Measures:** FABQ-W, Fear-Avoidance Beliefs Questionnaire work subscale, FABQ-PA, Fear-Avoidance Beliefs Questionnaire physical activity subscale, TSK-11, Tampa Scale of Kinesiophobia, PCS, Pain Catastrophizing Scale, STAI, State-Trait Anxiety Inventory, STAXI, State-Trait Anger Expression Inventory, Patient Health Questionnaire-9, PHQ-9, PASS-20, Pain Anxiety Symptoms Scale. **Resilience Measures:** PSEQ, Pain Self-Efficacy Questionnaire, SER, Self-Efficacy for Rehabilitation, CPAQ, Chronic Pain Acceptance Questionnaire.

The Pain Resilience Scale (PRS) was used to measure pain resilience.[24] The PRS was developed as a pain-specific measure of resilience, and its validity within the chronic pain population is superior to general resilience scales. It has high internal consistency (*Cronbach's* α = .94) and high *test*-retest reliability (r = .79). The PRS provides a total score, along with two distinct subscales for cognitive/affective positivity and behavioral perseverance.[24] Higher scores indicate greater pain resilience.

The 10-item OSPRO-YF tool was used to measure pain resilience and pain vulnerability. The OSPRO-YF is a valid and reliable multidimensional psychological measure for individuals with chronic pain and accurately estimates scores of 10 full-length psychological questionnaires (FABQ, TSK-11, PCS, STAI, STAXI, PHQ-9, PASS-20, PSEQ, SER, CPAQ) found in Table 2.[21] It includes 1 domain related to resilience (positive affect/coping) and 2 domains related to vulnerability (negative mood and fear avoidance). The Cronbach's α for the 2 domains ranges from 0.88 to 0.94. The presence of a positive yellow flag indicates

pain-associated psychological distress. The absence of a yellow flag after treatment indicates a statistically significant improvement in pain-associated psychological distress.[21]

The Defense and Veterans Pain Rating Scale (DVPRS 2.0) was used to measure pain intensity and pain interference with activity, sleep, mood, and stress.[25] The DVPRS is a reliable (Cronbach's α = 0.871) and valid instrument that provides standard language and metrics to communicate pain and related outcomes.[25] Lower scores indicate less pain intensity and pain interference.

Patient-Reported Outcomes Measurement Information System (PROMIS)® Pain Interference Short Form 6b was also used to measure pain interference.[26] The PROMIS® is a reliable (Cronbach's α = 0.88 to 0.97) self-report measure of the consequences of pain on relevant aspects of a person's life and how pain hinders social, cognitive, emotional, physical, and recreational engagement. The minimally important difference (MID) is 3.0 T-score points for pain samples.[26] Lower scores indicate less pain interference.

Patient Global Impression of Change (PGIC) is a valid measure[27] regarding a patient's perspective on the efficacy of treatment. Patients rate their change on a 7-point scale of: "7- very much improved," "6- much improved," "5- minimally improved," "4- no change," "3- minimally worse," "2- much worse," or "1- very much worse." Higher scores are associated with greater improvements in pain.

Therapeutic Intervention

In all three cases, one physical therapist who developed PRT provided treatment for chronic pain. PRT is a health behavior change approach developed from the recently published PRISM for physical therapist practice.[15] The physical therapist and patient collaborated to create each individualized treatment plan using evidence-informed methods for shared decision-making. The PRISM framework (Figure 1) served as a patient decision aid to enhance shared knowledge about treatment options and adherence.[28] PRISM processes are supported by Level I or II evidence.[15] Second, the physical therapist considered objective data from the OSPRO-YF (Table 2), which is a validated guide for psychologically informed practice.[21] A description of each treatment intervention is found in Table 3. The primary aim of treatment was to facilitate pain resilience. A secondary aim was to address pain vulnerability. It should be noted that many of the processes involved in PRT exceed entry-level physical therapist education and represent intermediate to advanced clinical skills. PRT's approach to resilience can be summarized in four ways:

1. The Transformation of Suffering:[29] The core emotional experience of chronic pain is one of anxiety,[21] fear without solution,[30] guilt,[31] and shame.[32] These states cause emotional dysregulation and pain persistence. Therefore, the initiation of PRT is based upon individual factors and relational processes to support empathic attunement that validates, reassures, and provides a corrective pain experience that opens the person to new possibilities.
2. A Neuroplastic Narrative: Pain education and comprehending how the brain works helps the patient to develop a non-pathologizing understanding that the body is not damaged. In this way, patients can develop insights about the ways the brain produces pain, how neural networks can adapt, and how the brain can change the way it perceives and responds to pain, reducing its intensity and impact on daily life. Clinically, a pathoanatomic cause of pain is reconstructed for a new neuroplastic narrative.[33]
3. Whole Self Awareness: In conjunction with a neuroplastic narrative, patients can build awareness of the integration of sensory, motor, and emotional aspects that influence pain and the understanding that managing pain extends beyond the brain. Embodied experiential exercises are used to address interactions among the brain, mind, body, and behavior.[34]
4. Salutogenic Skills: Building skills for better health and the role of health-promoting behaviors, including physical activity, sleep hygiene, and nutrition, enhance physiological systems that drive plasticity and support well-being.[35]

PRT helps the patient understand how the brain works, and how to use it to modulate pain, and build resilience. Improving pain literacy and the capacity to use it effectively, promotes patients' motivation for behavior change.[36] Behavior change processes and techniques support pain self-management. To achieve these objectives, a HIPPA-compliant Zoom for Healthcare was used to deliver a 60-minute tele-physical therapy session once per week.[37] Case #1 received 8 weeks of care, Case #2 received 10 weeks of care, and Case #3 received 12 weeks of care (Table 3).

Table 3: Description of Pain Resilience Therapy

Case 1		
Session	**Process**	**Description of the Intervention**
1	• Individual factors • Relational processes	A Corrective Pain Experience: The initiation of care is based upon individual factors and relational processes to support empathic attunement that validates, reassures, and provides a corrective pain experience that opens the person to new possibilities. The therapist invites the patient to tell their story of pain, of searching for a solution, and potentially being misunderstood and/or mismanaged by the medicolegal system. The therapist explicitly demonstrates a deep understanding and empathy towards the person's experiences of pain and associated emotional distress. Allowing the person's experience to be heard and seen is foundational for safety and trust. Affirming the person's pain and emotional experiences as real and significant helps counteract feelings of shame or disbelief they may have encountered in their healing journey. This experience is important for moving through vulnerable emotional states (suffering) that maintain pain (fear, shame, guilt, frustration, sadness, etc.) and as a precursor to discussing the sensitive topic of the brain as the cause of pain.
2	• Beliefs	The Brain and Pain: the cause of chronic pain is reconceptualized from bodily damage to a central brain-generated false alarm. Pain education is provided on the role of the brain in the generation and maintenance of pain. Pain was explained so that the patient understands that pain is generated by the brain and that pain can be triggered by either physical damage/injury, anticipated injury, or by difficult emotions/distress. It was emphasized that all pain is real and not due to the patient's imagination, and that no blame or stigma should be associated with having centralized chronic pain. Neural pathways in the brain generate all pain, and centralized pain is driven by a cycle of pain leading to a focus on pain, which leads to increased pain. Understanding pain lowers fear-avoidance behaviors so that people can move again.
3	• Resolving impairments	Therapeutic Exercise was prescribed to normalize spinal ROM deficits. This includes movement prescribed to correct impairments, restore muscular and skeletal function, and/or maintain a state of well-being.
4	• Therapeutic movement	Graded Exercise Therapy: a program was developed to improve physical function and increase physical activity levels so that the person could return to running 2-miles twice a week.
5	• Psychological flexibility • Physical activity	Noticing Thoughts with Movement: this is a foundational psychological flexibility technique and skill. This skill and perspective help people gain some distance from thoughts and the impact they are having on pain and function. The exercise helps people to step back from thoughts so that people can relate differently toward thoughts about pain. (e.g. I'm noticing that I'm having the thought that…) It may include and be combined with education on how to apply this skill to increasing levels of potentially threatening movement where negative thoughts or emotions may naturally arise.
6	• Safety learning	Window of Tolerance: safety learning is important for people who live with chronic pain, toxic stress, or have a trauma history. Ongoing pain and stress can narrow the window of tolerance (the zone in which a person is able to function most effectively) making it difficult for people to remain in a state of optimal arousal. They may more easily slip into states of hyperarousal or hypoarousal in response to stressors or pain. Education here helps to build resilience by learning to identify and cultivate a sense of safety, where individuals can better manage their reactions to potential triggers, staying within their window of tolerance.
7	• Embodiment	Interoceptive Awareness: embodiment exercises help people consciously identify a variety of bodily sensations. This is achieved via interoception exercises that promote body awareness. This technique increases awareness of heart and breathing rate, body temperature, muscle tension/tightness, pain, feelings of emotion moving through the body and the 5 senses. Body awareness encompasses the sensitivity to bodily signals and the ability to recognize subtle body cues and the sense of bodily self.
8	• Embodiment	Shifting States: embodiment exercises help people consciously control the transition from sympathetic to the parasympathetic mediated states. This is achieved by various relaxation and breathing techniques and exposure to pleasant, unpleasant and neutral bodily sensations. These techniques can stimulate the parasympathetic nervous system and thus prevent stress mechanisms from developing harmful effects on physical and mental health.
Case 2		
Session	**Process**	**Description of the Intervention**
1	• Individual factors • Relational processes	A Corrective Pain Experience: The initiation of care is based upon individual factors and relational processes to support empathic attunement that validates, reassures, and provides a corrective pain experience that opens the person to new possibilities. The therapist invites the patient to tell their story of pain, of searching for a solution, and potentially being misunderstood and/or mismanaged by the medicolegal system. The therapist explicitly demonstrates a deep understanding and

		empathy towards the person's experiences of pain and associated emotional distress. Allowing the person's experience to be heard and seen is foundational for safety and trust. Affirming the person's pain and emotional experiences as real and significant helps counteract feelings of shame or disbelief they may have encountered in their healing journey. This experience is important for moving through vulnerable emotional states (suffering) that maintain pain (fear, shame, guilt, frustration, sadness, etc.) and as a precursor to discussing the sensitive topic of the brain as the cause of pain.
2	• Beliefs	The Brain and Pain: the cause of chronic pain is reconceptualized from bodily damage to a central brain-generated false alarm. Pain education is provided on the role of the brain in the generation and maintenance of pain. Pain was explained so that the patient understands that pain is generated by the brain and that pain can be triggered by either physical damage/injury, anticipated injury, or by difficult emotions/distress. It was emphasized that all pain is real and not due to the patient's imagination, and that no blame or stigma should be associated with having centralized chronic pain. Neural pathways in the brain generate all pain, and centralized pain is driven by a cycle of pain leading to a focus on pain, which leads to increased pain. Understanding pain lowers fear-avoidance behaviors so that people can move again.
3	• Psychological flexibility	Noticing Thoughts: this is a foundational psychological flexibility technique and skill. This skill and perspective help people gain some distance from thoughts and the impact they are having on pain and function. The exercise helps people to step back from thoughts so that people can relate differently toward thoughts about pain. (e.g. I'm noticing that I'm having the thought that…)
4	• Psychological flexibility	Naming The Mind: when beliefs about pain don't readily change psychological flexibility skills can help people manage thoughts and emotions. The "Naming the Mind" exercise is a psychological technique that helps individuals create a healthier distance between their sense of self and their thoughts, thereby reducing the impact of negative or unhelpful thinking patterns. This practice is grounded in mindfulness principles emphasizing the observation of thoughts without immediate identification or judgment. The person assigns a name to their mind or to specific thought patterns. This is conceptualized as a protector within that has become overprotective due to the persistence of pain.
5	• Resolving impairments • Therapeutic movement	Therapeutic Exercise was provided to normalize spinal ROM deficits. This includes movement prescribed to correct impairments and restore muscular and skeletal function.
6	• Resolving impairments • Therapeutic movement	Therapeutic Exercise was prescribed to normalize spinal ROM deficits. This includes movement prescribed to correct impairments, restore muscular and skeletal function., and/or maintain a state of well-being.
7	• Resolving impairments • Therapeutic movement	Therapeutic Exercise was prescribed to normalize spinal ROM deficits. This includes movement prescribed to correct impairments, restore muscular and skeletal function., and/or maintain a state of well-being.
8	• Circadian Cycle	Sleep Hygiene Behaviors: lifestyle factors impact nervous system function, pain modulation, as well as mental and physical health. Education as delivered with information about sleep in general and/or sleep hygiene behaviors.
9	• Physical activity	Graded Walking Program: was created with education on a structured plan to gradually increases the duration, distance, and intensity of walking sessions over time. This approach is beneficial for individuals looking to improve their fitness, manage chronic pain, or simply increase their physical activity in a safe and sustainable manner. Education was provided about the safe return to Pilates class twice a week.
10	Values-based action	Trying On a Value: A life lived according to values is described as rewarding, meaningful, and active. It can also feel liberating, joyous and free. People are provided with a list of values-based words. They choose a value they are willing to try for one week. Common values people find important are fun, spontaneity, reliability, risk, compassion, connection, and vitality. This list is by no means exhaustive.
Case 3		
Session	**Process**	**Description of the Intervention**
1	• Individual factors • Relational processes	A Corrective Pain Experience: The initiation of care is based upon individual factors and relational processes to support empathic attunement that validates, reassures, and provides a corrective pain experience that opens the person to new possibilities. The therapist invites the patient to tell their story of pain, of searching for a solution, and potentially being misunderstood and/or mismanaged by the medicolegal system. The therapist explicitly demonstrates a deep understanding and

		empathy towards the person's experiences of pain and associated emotional distress. Allowing the person's experience to be heard and seen is foundational for safety and trust. Affirming the person's pain and emotional experiences as real and significant helps counteract feelings of shame or disbelief they may have encountered in their healing journey. This experience is important for moving through vulnerable emotional states (suffering) that maintain pain (fear, shame, guilt, frustration, sadness, etc.) and as a precursor to discussing the sensitive topic of the brain as the cause of pain.
	• Beliefs	The Brain and Pain: the cause of chronic pain is reconceptualized from bodily damage to a central brain-generated false alarm. Pain education is provided on the role of the brain in the generation and maintenance of pain. Pain was explained so that the patient understands that pain is generated by the brain and that pain can be triggered by either physical damage/injury, anticipated injury, or by difficult emotions/distress. It was emphasized that all pain is real and not due to the patient's imagination, and that no blame or stigma should be associated with having centralized chronic pain. Neural pathways in the brain generate all pain, and centralized pain is driven by a cycle of pain leading to a focus on pain, which leads to increased pain. Understanding pain lowers fear-avoidance behaviors so that people can move again.
2	• Beliefs • Meaning making	Medication-Related Beliefs: some patients may believe that medication is the only way to control pain. Addressing beliefs and exploring broader meaning-making was utilized to develop a more holistic narrative to pain management. Medication-related beliefs were reconstructed. Medication, in the right dose, was reframed as one potential modifier of neuroplasticity (e.g. 'it helps the nervous system change and adapt in a good way') alongside lifestyle interventions. A change in belief shifts the meaning about the relative importance of medication as just one part of an overall pain management program and how it improves movement.
3	• Motivational enhancement	Decisional Balance: the patient was ambivalent about tapering down the medication. Decisional balance was explored with regard to tapering. Support to weigh the pros and cons of continuing versus tapering off the medication was discussed. The patient was prompted to make arguments for change themselves. (e.g. 'What benefits do you think you might find if you were to reduce the medication?' 'What do you stand to gain and what concerns do you have about reducing the medication?')
4	• Therapeutic movement	Six Movements of the Spine: this exercise was taught as a daily sequence to improve spinal joint mobility through the fundamental movements of flexion, extension, lateral flexion, and rotation. The movements engage and relax the supporting muscles of the spine. Combined with deep diaphragmatic breathing it supports the activation of the parasympathetic nervous system and relaxes spinal muscles.
5	• Circadian cycle	Sleep Hygiene Behaviors: lifestyle factors impact nervous system function, pain modulation, as well as mental and physical health. Education was delivered with information about sleep in general and/or sleep hygiene behaviors.
6	• Circadian cycle	Sleep Hygiene Behaviors: lifestyle factors impact nervous system function, pain modulation, as well as mental and physical health. Education as delivered with information about adding progressive muscle relaxation to the patient's nightly bedtime routine.
7	• Optimizing nutrition	Ultra-Processed Foods: the role of nutrition was discussed with regard to inflammation, autoimmunity (Hashimoto's), pain, and body function. The adoption of healthy eating habits was encouraged. The distinction between highly processed foods versus whole foods was explored and discussed.
8	• Optimizing nutrition	Food Triggers: nutrition education was provided regarding nutritional triggers and pain. This centered on reading food labels and identifying added sugar, refined carbohydrates, food additives (MSG, Aspartame) and saturated or trans fats.
9	• Psychological flexibility	Noticing Thoughts: this is a foundational psychological flexibility technique and skill. This skill and perspective help people gain some distance from thoughts and the impact they are having on pain and function. The exercise helps people to step back from thoughts so that people can relate differently toward thoughts about pain. (e.g. I'm noticing that I'm having the thought that…)
10	• Behavioral activation	Activity Scheduling: helping patients return to and schedule activities that are likely to be enjoyable or provide a sense of accomplishment. These activities are chosen based on their potential to disrupt the cycle of depressive symptoms. The scheduling is gradual, starting with simpler tasks and progressively incorporating more complex or challenging activities.
11	• Values-based Action	Trying On a Value: A life lived according to values is described as rewarding, meaningful, and active. It can also feel liberating, joyous and free. People are provided with a list of values-based words. They choose a value they are willing to try for one week. Common values people find important are fun, spontaneity, reliability, compassion, connection, vitality. This list is by no means exhaustive.

12	• Values-based Action	Taking Action: people can learn how to make room for painful sensations in service of the way they want to live. This exercise explores values-based activities in which they are committed to engage and the unpleasant thoughts, emotions, or sensations they are willing to make room for while completing this activity. (e.g. 'I'm willing to make room for some back pain and feeling sweaty when I exercise. I also notice that I'm having thoughts that too much exercise will damage my back and I'm going to have to use medication for the rest of my life. I'm willing to move with these thoughts because I value my health and I see the contribution of physical activity to health.')

Results

This case series describes the effect of PRT, a novel resilience-focused approach used in the treatment of 3 people with chronic pain (Table 2).

Case 1 pain score decreased by 4 points from 5/10 to 1/10 by the end of 8 sessions. The patient experienced a significant improvement in all pain-specific resilience factors as demonstrated by increased cognitive-affective positivity (PRS), pain self-efficacy, pain acceptance, and self-efficacy in rehabilitation (OSPRO-YF). Vulnerability factors of fear avoidance, kinesiophobia, pain catastrophizing, pain-related anxiety, and depression also significantly improved (OSPRO-YF). The patient's depressive symptoms indicated by the PHQ-9 decreased from moderate (10.12) to none-minimal (3.43) by the end of the treatment. Vulnerability factors of state-trait anxiety and state-trait anger improved but did not reach significance. Positive changes were reflected in pain interference (DVRPS). Pain no longer interfered with activity, sleep, or mood (0/10), and was hardly noticed with stress (1/10). The change in pain interference surpassed the minimally important difference (MID) of 3.0 T-score points for pain samples (PROMIS)®.[26] The patient no longer had pain with lumbar ROM. He was able to sit for prolonged periods and returned to the recreational activity of running twice a week for 2 miles. By the end of the care, he was skiing intermediate slopes with his family on the weekends. The patient self-reported his condition as very much improved as measured by the PGIC.

Case 2 pain score decreased 5 points from 7/10 to 2/10 which did not interfere with activity by the end of 10 sessions. The patient experienced a significant improvement in all pain-specific resilience factors as demonstrated by improvements in cognitive-affective positivity and behavioral perseverance (PRS), pain self-efficacy and pain acceptance (OSPRO-YF). This patient also experienced a significant improvement in all vulnerability factors of fear avoidance, kinesiophobia, state-trait anxiety, pain catastrophizing, and pain-related anxiety (OSPRO-YF). Positive changes were reflected in pain interference (DVRPS). Pain did not

interfere with mood or stress (0/10), and was minimal with activity and sleep (2/10). The change in pain interference surpassed the minimally important difference (MID) of 3.0 T-score points for pain samples (PROMIS)®.[26] The patient no longer had cervical ROM limitations. She was able to return to all daily activities pain-free. By the end of care, she returned to the gym and Pilates classes, reporting minimal 2/10 pain. The patient self-reported her condition as very much improved as measured by the PGIC.

Case 3 pain score decreased 3 points from 5/10 to 2/10 which did not interfere with activity by the end of 12 sessions. All pain-specific resilience factors improved as demonstrated by cognitive-affective positivity (PRS) and pain self-efficacy and pain acceptance (OSPRO-YF). Vulnerability factors of fear avoidance, kinesiophobia, pain catastrophizing, and pain-related anxiety improved but did not reach significance (OSPRO-YF). Positive changes were reflected in pain interference with activity (2/10) and sleep, mood, and stress (3/10) (DVRPS). The change in pain interference surpassed the minimally important difference (MID) of 3.0 T-score points for pain samples (PROMIS)®. [26] Lumbar ROM was within normal limits. By the end of care, she was able to return to all daily activities. The patient self-reported her condition as much improved as measured by the PGIC.

Discussion

This case series describes the initial development and use of a new intervention called Pain Resilience Therapy (PRT). All participants reported substantial reductions in pain intensity and improvements in pain-specific resilience post-treatment. There were also significant improvements in pain interference with enhanced social, cognitive, emotional, physical, and recreational activities. Self-perceived health was very much improved.

All three cases also demonstrated improvement in vulnerability factors. Case 1 and Case 2 reached statistically significant improvements in certain vulnerability factors, but Case 3 did not. This may be because PRT does not target vulnerability. It may be that the initial development of PRT focused on psychological flexibility as a resilience factor.[38] Participants may benefit from positive psychology interventions that cultivate optimism, joy, hope, gratitude, or self-compassion.[10] It may be that psychosocial factors such as state and trait anxiety and anger are less impacted by pain resilience-focused approaches. The role of perceived injustice should also be considered as higher levels of injustice are associated with less

optimal pain outcomes.[39] Feelings of injustice and associated anxiety and anger may arise when a patient receives unsatisfactory treatment and/or pain relief. All participants reported challenges negotiating the healthcare system and consulting multiple healthcare providers throughout their pain management journey with unsatisfactory outcomes. The assessment of injustice alongside resilience is warranted. Also, Case 3 was still tapering down from a gabapentinoid, which may have contributed to an increased level of anxiety, a known symptom of dependence and withdrawal that impacts reward centers in the brain.[40] This phenomenon is similar to other drugs (opioids) affecting neuroplasticity and the ability of the nervous system to downregulate.[41] Specific to this case gabapentinoid use is associated with a high risk for adverse events.[40]

Researchers have suggested the valuable contribution of both resilience and vulnerability factors in chronic pain and physical disability, with the additional caveat that resilience factors uniquely impact specific aspects of the pain experience.[42] In a sample of 188 patients with chronic pain and disability both resilience and vulnerability factors impacted pain outcomes, yet the resilience factors uniquely impacted psychosocially focused outcomes – above and beyond vulnerability factors.[42] In a survey of 249 women with chronic pain, those with higher resilience exhibited more participation in moderate-vigorous activity.[43] In a study of 220 adults with chronic pain, pain resilience mediated the relationship between pain intensity and activity patterns.[44] In sixty adults with low back pain, resilience moderated the influence of negative pain beliefs on movement-evoked pain.[45] Resilience-focused treatments also share common elements used in integrative approaches. A recent single-arm trial (n=16) of integrated cognitive behavioral therapy for chronic pain reported significant reductions in pain catastrophizing but not pain intensity.[46] The intervention was not resilience-focused but rather focused on shifting attention, working on memory, and mental practice alongside video feedback.

Pain resilience and pain catastrophizing combine to predict functional outcomes and quality of life.[11] The three participants who received PRT in this case series experienced a significant reduction in pain catastrophizing and pain intensity. Indeed, resilience can act as a protective factor in the face of pain symptomatology, disability, and psychological sequelae.[17] Multisystem resiliency approaches such as PRT have been identified as a predictor of improved physical and psychological functioning.[47] Such an approach may help physical therapists understand how the whole human body, embedded in a context, shapes the

brain and behavior. Broadening the scope of resilience in chronic pain has been recommended by pain researchers and clinicians.[10] Finally, randomized controlled trials suggest that internet-delivered care can be as effective as in-person care in pain management, and in the cases presented in this paper, internet-delivered care was effective in improving patient outcomes in meaningful ways.[48] The use of tele-physical therapy is a valuable intervention that may enhance access to pain management.

The primary limitation of PRT is the need for empirical support (efficacy/effectiveness) for its application. There was no control group, and due to the small sample size and individualized nature of chronic pain, external validity is limited. In addition, case series may be subject to various biases, including selection bias. To gain insight into what leads to resilience, it is important to explore the potential causal factors and mechanisms in further detail. For example, all participants in this study were white, college-educated, and did not report recent exposure to social determinants known to negatively impact pain. Resilience is a multidimensional construct that impacts the brain and behavior differently based on sociodemographics.[49] Future research should consider the combined and independent contributions of pain resilience and vulnerability.[50] This case series provides a structure for generating new knowledge and testing through cohort studies and randomized-controlled trials.

Conclusion

PRT is a novel, resilience-focused approach to pain management. Pain-specific resilience improved in all patients along with reductions in pain intensity. Improvements in pain interference enhanced social, cognitive, emotional, physical, and recreational activities. Participants' self-perceived health was very much improved suggesting PRT's use can advance pain management. Research supporting innovations like PRT is needed to reduce pain and negative sequelae that limit activity and restrict participation.[51] Further operationalization of PRT is required for efficient and effective delivery.

Informed Consent and Ethical Considerations

We invited three patients with chronic pain to participate in the study. We informed each participant of the study's purpose, procedures, potential benefits, and risks. Patients were advised that their participation was voluntary and that they could withdraw at any time without penalty or loss of benefit. The treating physical therapist reviewed each patient's rights to privacy. Patients who chose to participate signed written consent that included permission for publication of identifying material in a case report. Each patient also signed a

HIPAA (Health Insurance, Portability, and Accountability Act) acknowledgment. There were no adverse events reported during the study. Patients did not receive compensation for participation.

Patient Perspective

The PGIC (Table 2) allowed patients to objectively rate their perceived health 90 days post-intervention. Case 1 and 3 rated their overall health as "very much improved and case 3 "much improved. Improvements in PGIC correlate with pain, disability, and quality-of-life measures, and the multifaceted nature of the questions allows patients to contemplate several factors that they may consider important in their clinical situation.[27]

Equity, Diversity, and Inclusion Statement

In the design and execution of this research, we have actively embraced the principles of equity, diversity, and inclusion. The research team was constructed with a commitment to these values, ensuring a range of perspectives by including members from different backgrounds, genders, ethnicities, sexual orientations, and stages of their scientific careers.

We actively worked to mitigate bias in our recruitment and selection processes within the confines of a three-person case series. Our study population was chosen with a deliberate effort to reflect diverse demographics, ensuring that our research is relevant and accessible to a wide spectrum of people living with pain. In our research methodology, we specifically utilized self-report measures that identify various factors of mental distress, an often-overlooked contributor to the pain experience. These measures have been validated across diverse populations to ensure the reliability and validity of our results across different demographics.

The analysis and interpretation of our results were undertaken with a conscious effort to recognize and highlight diversity. We considered how the outcomes might differ by demographic factors and discussed the implications of these differences concerning EDI. In cases where disparities were evident, we engaged in a thorough exploration of potential contributing factors and their broader societal implications.

We believe that incorporating EDI principles into our research enriches the scientific process and enhances the societal impact of our findings. We are committed to continuous learning and improvement in

implementing EDI principles in our work and as we further develop Pain Resilience Therapy and test it in cohort and randomized controlled trails.

Conflict of interests

The authors report no conflicts.

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