The Puzzle of Pelvic Pain: A Rehabilitation Framework for Balancing Tissue Dysfunction and Central Sensitization II: A Review of Treatment Considerations

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ABSTRACT

Physical therapists have been instrumental in guiding the medical system away from "end-organ" focus in the assessment and treatment of persistent pelvic pain. However, for the most part physical therapists remain in a biomedical model of treatment focusing on tissue dysfunction as a framework for the assessment and treatment of persistent pelvic pain. This article proposes a framework that integrates current understanding of local tissue dysfunction with the wider context of sensitized protective mechanisms within the spinal cord and brain. Current concepts in pain science, particularly as it relates to the Neuromatrix and central sensitization, lead away from bio-medicalism towards a bio-psycho-social model of evaluation and treatment of persistent pelvic pain.

Key Words: chronic pelvic pain, graded exposure, graded imagery, neurodynamics, neuromatrix theory

INTRODUCTION

Physical therapists often speak of the concept of the short, hypertonic pelvic floor. Fitzgerald and Kotarinos[1,2] refined this idea in 2 articles in 2003. They proposed a framework for the treatment of pelvic floor dysfunction that moved away from the traditional strengthening approach of Kegel exercises. The idea that one cause of persistent pelvic pain and overactive bladder syndromes may be hypertonic muscles, instead of hypotonic muscles, has changed the treatment focus for some patient complaints of pelvic pain. In 1999, Simons et al[3] established peripheral referral patterns for hypertonic muscles and myofascial dysfunction. Physical therapists have made a compelling argument that many forms of persistent pelvic pain may have origins in myofascial dysfunction causing "end point" organ irritation, including swelling, redness, and pain in the bladder, prostate, testicles, or the vagina.[4] Emerging research demonstrates that myofascial treatment of urologically based pelvic pain is an efficacious treatment approach for these conditions.[5] Fitzgerald et al[5] demonstrated in a multicenter feasibility study that physical therapy intervention of myofascial treatment applied to the perineum, abdominal wall, and pelvic floor demonstrated a 57% response rate compared with a 21% improvement rate with general massage therapy. The treatment approach in the multicenter study is an example of a tissue-based, biomedical therapeutic intervention. In our companion article, a biopsychosocial framework for the assessment of persistent pelvic pain was proposed as an evidence-based approach founded on modern pain science.[6] This article discusses the treatment of persistent pelvic pain in a biopsychosocial framework.

STARTING AT THE "END POINT"

Butler[7] describes *biomedicalism* as a "patho-anatomical search for a singular cause for chronic problems." Waddel[8] defines a biopsychosocial approach as an "individual-centered model that considers the person, their health problem and their social context." The International Association for the Study of Pain describes pain as a "sensory and emotional experience"[9] that encompasses both tissue nociception and the interpretation of the pain experience. The current physical therapy practice pattern for the treatment of persistent pelvic pain begins with the pathoanatomic tissues in a traditional kinesiopathologic model that emphasizes treatment of the movement dysfunction with manual therapy, biofeedback, electrical stimulation, and exercise.[10,11] The treatment focus may shift to central sensitization when the treatment of the painful tissues is unsuccessful. Globally, chronic pain and stress are at epidemic levels, as history shows, epidemics are best altered by education.[7] The treatment of chronic pelvic pain has been well-recognized to have a mind (stress)-body (nociception) connection; however, education has not been widely used in this pain population to effectively link the 2 areas. Neurophysiology-based

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education provides an evidence-based biologically and physiologically plausible explanation for the patient's persistent pain experience.[12,13] This understanding allows the clinician and the patient to move effectively from biomedicalism to biopsychosocialism. Addressing tissue dysfunction and central sensitization at the beginning of the treatment process through neurophysiology-based education encourages the patient with persistent pelvic pain to address the complexity of his or her presentation from the onset of treatment. This may allow the patient to make meaningful changes in both the painful tissues and the processing of the pain experience in his or her nervous system.

The conceptual changes that need to occur for physical therapists to treat their patients in a biopsychosocial framework were reviewed in part I of this series, which was published in the 2011 September/December issue of the *Journal of Women's Health Physical Therapy*.[6] The summary of these conceptual changes is as follows:

1. Pain is an output expression of the brain in response to a perception of threat.[14,15] A therapeutic goal in persistent pain is to restore movement without triggering a protective pain response.
2. Pelvic pain is complex. Psychosocial considerations include sexuality, cultural expectations, privacy, and religious issues.
3. Chronic pain does not necessarily correlate with injury or disease, and nociception is neither necessary nor sufficient for a pain response.[15,16]
4. The nervous system slides and glides as we move.[16-18]
5. Neurophysiology-based pain education is an effective adjunct to physical therapy intervention.[12,13,19] Educating patients in the concepts of pain science, including neural plasticity, increases understanding and decreases the threat response.

In a biopsychosocial framework, the initial physical therapy assessment needs to evaluate the relative contribution of tissue dysfunction and central sensitization.[6] Central sensitization is a pathophysiological state characterized by generalized or widespread hypersensitivity.[20] Central sensitization encompasses "impaired functioning of brain-orchestrated descending anti-nociceptive (inhibitory) mechanisms and (over) activation of descending and ascending pain facilitatory pathways."[21] The pain response operates within the entire system of nociceptive input, peripheral neurogenic sensitization, and central sensitization. Intervention and treatment options are guided by the estimation of the relative contribution of each part of this dynamic system and were explored in part I of this series.[6] Specific treatment techniques for tissue dysfunction in chronic pelvic pain have been covered extensively in the literature.[2,5,22-29] The treatment of central sensitization as it pertains to persistent pelvic pain remains to be explored.

TREATMENT OF CENTRAL SENSITIZATION

Neurophysiology-Based Pain Education and Threat Identification

Neurophysiology-based pain education forms the basis of treatment in central sensitization and refers to patient education about the role of central and peripheral processes in persistent pain.[21] A patient who believes that local tissue dysfunction is the primary cause of a chronic pain state is likely to have thoughts and beliefs that limit normal mobility and function in the affected area.[30] Before beginning active mobilization, or exercise, it is helpful to educate patients in pain physiology in order to assist them in reconceptualizing their pain. Research demonstrates that patients are able to learn complex neurophysiology and that this education aids in recovery.[12,13]

There are a variety of patient education resources for the physical therapist. Some commonly used resources include the following:

- Individualized learning in the clinic using a variety of written materials. The "Explain Pain" posters can be helpful props during one-to-one education. This collection of posters summarizes the pitfalls of the recovery process in persistent pain, ideas for taking control of recovery, an explanation of graded exposure, and the role of thoughts and beliefs. The posters are generally used in conjunction with the written materials described later.[31]
- "Know Pain" is a PowerPoint presentation for therapists and patients by Patterson and Pearson.[32] This is a detailed, concise 1-hour PowerPoint presentation that enables physical therapists to pass the concepts of pain neurophysiology education to their patients.
- Written resources commercially available, including *Explain Pain*,[30] *Understand Pain, Live Well Again*,[33] and *The Pain Truth … and Nothing But*.[34] These are resources on pain neurophysiology education prepared for the patient for use in a self-directed learning style.

Psychometric questionnaires have been designed to measure maladaptive cognitions such as catastrophization and fear avoidance behaviors that have been shown to have predictive qualities in the development of central sensitization.[35,36] These questionnaires can be used to identify underlying beliefs and attitudes about movement. Clinicians must carefully assess the responses, noting which questions were rated highly during the initial evaluation. Use these responses to assist in accurate threat identification and in the development of a plan for addressing the risk factors

to aide in decreasing perceived vulnerability of fear of movement. Threat perception in the nervous system may start as fear avoidance from the memory of old injuries,[37] fear of the future ramifications of the injury ("How will I work next week?"), or may be in response to the patient's environment (coworkers, family, and third party payers).[30,34] There are a massive number of potential threats within the context of persistent pain.[30] Using educational tools in the clinic to accurately explain pain helps give contextual meaning to the patient's symptoms. Reduction of threat decreases the need for the engagement of active coping systems such as the sympathetic, immune, endocrine, and motor systems and the need for protective pain states.[16,38] Threats can be identified in a biopsychosocial framework (Table 1).

BODY MAP TRAINING

When sensitized neural states have been identified, the use of neurophysiology of pain education then flows into gentle guided exercises to normalize input into the sensory-motor cortex. Within the neuromatrix, there are sensory maps, motor maps, and maps for smell, vision, and peripersonal space to name a few.[39] The smudging of these body maps refers to a loss of normally distinctive localization and has been demonstrated in phantom limb pain,[40,41] complex regional pain syndrome (CRPS),[42] and chronic pain.[43] Smudging in the sensory-motor cortex often occurs in the painful area and can also occur in the body part adjacent to the affected area on the homunculus.[41,43] The clinical significance of body map training in the pelvic floor is untested. An understanding of current neurophysiology supports reasoning that the accurate representation of the pelvic musculature in the sensory and motor cortices will increase proprioceptive awareness. This awareness will help the patient with persistent pelvic pain to better identify the proper facilitation or downregulation of the pelvic floor muscles as dictated by the therapeutic goals.[44-46]

Patients with pelvic pain may report symptoms that could be indicative of smudging including the sensation that their pelvic anatomy is altered or missing, or they may report foot pain that began after their pelvic pain. Since the feet lie next to the genitals on the homunculus, it is postulated that this may be the result of homuncular smudging. Objective findings may also include hypersensitivity, hyposensitivity, allodynia, poor localization of touch, and decreased acuity in 2-point discrimination of the perineum and external genitalia.

In the sensory-motor cortex, sensory information drives motor activity and motor activity drives sensation.[39] Movement patterns are stored into motor programs that are activated by various sensations.[46] Gentle guided movements such as pelvic tilts, movement of the ischial tuberosities, and guided sensory training in various sitting, standing, and lying postures may be useful for increasing sensory awareness.[47,48] Sensory awareness can be further facilitated through body mechanoreceptors by using the knobbly end of a fit disc that can be placed under the feet or buttocks during exercise. Franklin[47] and Feldenkrais[48] have developed therapeutic exercises using sensation-based movement, which has been proposed as an effective basis for gentle introductory movement in the initial therapeutic phase.

Body maps are the reference point for movement and sensation; these maps are constantly changing with each experience. Movement, thought, and the context of life provide input to the central nervous system that refreshes or changes the maps and the mind.[16] The ability to undergo change is a property of the plasticity of the nervous system.[49,50] Each movement will shape the next movement as motor learning occurs and sensory awareness improves; this occurs in pelvic training just as it does for sport training or knee exercises. Body map training may be used to address the neuromatrix by modifying fear conditioning, teaching neutral alignment, reorganizing the sensorimotor cortex, and changing awareness of body parts.[39,40,51]

Table 1. Identifying Threats in a Biopsychosocial Framework[a]

Biological	Psychological	Social
Worried x-rays showing "arthritis"	Fear of pain	Withdrawn from family/joy
Worried x-rays showing disc bulges	Fear of not recovering	Withdrawn from hobbies/sports
Lack of specific diagnosis	Fear of serious injury	Legal battle stress
Multiple medications ineffective	Fear of reinjury	Family stress/anger
Doing too much without pacing	Sadness/depression	Financial stress/worries
	Hopelessness about recovery	Work stress/anger
	Attitude toward sexuality	

[a]Adapted from Jam.[34]

DOWNREGULATING THE SENSITIVE NERVOUS SYSTEM

There are approximately 200 inhibitory neurons descending from the brain that help downregulate the sensitive nervous system for every one nociceptive or danger neuron traveling up to the brain.[16] Downregulation involves the release of inhibitory chemicals into the synapses to decrease the sum of the neural response when the brain concludes that a threat exists. The activity in descending pathways is not constant and can be modulated.[52] Decreasing levels of vigilance, attention, and stress are some techniques that may enhance the activity in the descending pathways.[12,21] Decreasing a stress response may also help to decrease the sympathetic nervous system response. There are many different techniques that may improve the patient's mind-body connection by targeting the upregulated sympathetic nervous system. The majority of these techniques have not been well researched for efficacy in physical therapy treatment despite common use in the clinic. More research needs to be done on manual therapy in general and in persistent pelvic pain in particular to identify the most efficacious treatment strategies to downregulate the sensitive nervous system.

Treatment options may include the following:

- *Connective tissue mobilization*: Mobilization of the soft tissue is used to have a direct effect on tissue dysfunction, given the basic need of muscles, fascia, and neural tissue to move in order to be healthy.[3,53] Connective tissue mobilization may also directly impact the state of the autonomic nervous system, specifically by interrupting the viscera-somatic reflex arc, which is an autonomic reflex.[54] Therefore, connective tissue mobilization may affect both tissue dysfunction and sensitization through modulation of the nervous system. Clinically, treatment of the connective tissue has been shown to be an important component of tissue dysfunction-based treatment in urologically based pelvic pain.[5] It is proposed that this treatment may have an important effect not only on local tissue dysfunction but also on the sensitized nervous system.
- *Deep breathing*: Oxygen is vital for every organ in our body. People with persistent pain tend to have maladaptive breathing patterns, including shallow apical breathing.[55] Retraining deep breathing, with both lateral costal and diaphragmatic techniques, is believed to downregulate the sensitive nervous system, particularly the sympathetic nervous system.[55]
- *Relaxation training*: There are many different styles of relaxation training, including paradoxical relaxation,[24] progressive muscle relaxation, autogenic training, mindfulness training, and meditation.[56] Research shows that people who meditate have more gray matter in regions of the brain that are important for attention, emotional regulation, and mental flexibility.[55] Meditation may also decrease anxiety and improve self-esteem.[57] Mindfulness training is the skill of maintaining focus on something by choice while allowing thoughts, emotions, and sensations to come in and out of awareness, and at the same time, awareness without judgement.[56] Patients will respond to different relaxation strategies and a variety of relaxation strategies should be tried to find the best fit. Clinically, patients will gravitate to one form or another, often from personal preference. Allowing a patient to choose her or his preference may help improve compliance.[58]
- *Cardiovascular exercise*: There is evidence that aerobic exercise lowers a person's stress response and assists in mood and anxiety relief.[59,60] The American College of Sports Medicine recommends performing moderately intense cardiovascular exercise for 30 minutes per day on at least 5 days per week, or vigorously intense cardiovascular exercise for 20 minutes per day on at least 3 days a week. In addition, the recommendation is that an individual perform 8 to 12 repetitions of 8 to 10 strength training exercises at least twice per week.[61]
- *Guided imagery*: Guided imagery allows for individual exploration into belief patterns and movement patterns that may not be helpful in the goal of returning to normal movement and function. These thoughts, beliefs, and movements are often outside of conscious awareness and largely outside of one's control.[62] Imagery engages the power of the mind to reduce anxiety, depression, and stress. Carrico et al[62] conducted a pilot study, using a guided imagery CD specifically recorded and scripted for women with interstitial cystitis and pelvic pain. The study found that approximately 45% of the treatment group participants responded to guided imagery therapy, noting a moderate or marked improvement on the global response assessment. Pain scores and episodes of urgency significantly decreased in the treatment group.
- *Yoga*: The term *yoga* is derived from the Sanskrit verb *yug*, which means to bind or join. This refers to the overarching goal of yoga to unite the mind and body in a way that promotes health.[63] Comprehensive protocols have been adapted for yoga in the management of chronic pain. Yoga specifically addresses body awareness through body map training, breathing techniques, and

increased awareness of mental and physical states, which may help patients better understand their pain response. Several mechanisms could potentially explain the benefits of yoga for persistent pain conditions. Yoga can decrease sympathetic nervous system activity, reduce inflammatory markers, reduce stress markers (cortisol), and increase flexibility, strength, circulation, and cardiorespiratory capacity.[63] Yoga has also been shown to increase the frequency of positive emotions and could potentially undo the physiological effects of negative emotions, broaden cognitive processes, and build physical and psychological resources.[63] Finally, it is possible that yoga can lead to improvements in self-efficacy for pain control.[63]

- *Affirmations/positive thinking*: Patients may be able to learn to control and change their thoughts, seeking mastery in the following areas: stress inoculation, assertiveness in dealing with their situation, handling conflict that arises around their pain, and decreasing their resistance to get better.[64] Thoughts are nerve impulses, and negative thinking alone may drive persistent pain states. Moseley et al[65] demonstrated that the thought of movement alone was sufficient to increase pain and swelling in CRPS. The contribution to persistent pain states from thoughts and beliefs provides a significant possibility for therapeutic intervention. Clinicians can assist and encourage the use of positive affirmations and can demonstrate good modeling of these techniques.
- *Joy/laughter*: Ongoing stress, particularly in the absence of positive coping skills, lowers resistance, weakens the immune system, and increases susceptibility to health problems.[66] Pain is reduced while undergoing functional magnetic resonance imaging by positive pictures, beautiful music, positive expectations, enticing smells, sweet tastes, social touch, and sexual behavior.[67] Patient instruction may include choosing a positive environment for exercise, one that is interesting, novel, and fun.
- *Addressing sleep dysfunction*: A systematic review concluded that there is consistent evidence associating chronic low back pain with greater sleep disturbances and reduced sleep duration.[68] Reid et al[69] looked at the efficacy of aerobic physical activity with sleep hygiene education to improve sleep, mood, and quality of life in individuals with chronic insomnia. The study concluded that an aerobic physical exercise program (involving two 20-minute sessions 4 times per week or one 30-minute session 4 times per week) with sleep hygiene education can be very beneficial to patients with insomnia and depressive mood.[69]

NEURODYNAMICS

Once tissue dysfunction and central sensitivity are being effectively addressed, peripheral sensitivity of the nervous system needs to be assessed. The study of neurodynamics addresses the sensitivity of the peripheral nervous system that may develop following an injury.[17] Neurodynamics is the normal movement of the nerves within a body in motion. Nerves are able to slide, glide, bend, stretch, and move. Butler[16] and Shacklock[70] have established standardized tests for assessing neural mobility, sensitivity, and adverse neural tension in all parts of the body except for the pudendal nerve. In peripheral neurogenic pain, nerves are sensitized as a result of plastic changes that have occurred within the peripheral nervous system, including the development of abnormal impulse-generating sites.[16,17,71-73] Nerves may also be sensitized because of chemical processes from proinflammatory mediators including prostaglandins, serotonin, bradykinin, cytokines, and macrophages.[16,74]

Decreasing the sensitivity of the peripheral nerves may be addressed mechanically through a variety of manual therapy techniques that propose to unload the nerve by increasing the space or fluid motion in the tissues around the nerve.[2,17,18,24] With decreased tension of the soft tissues surrounding the nerves including muscles, connective tissue, scar tissue, and abnormal joint mechanics, the nerve has a better chance of moving well within the space surrounding it.

A neurodynamic assessment includes physical palpation of the nerve where possible, as well as passive and active neurodynamic tests.[16,70] For the pelvis, this involves the pudendal, ilioinguinal, iliogastric, femoral, and obturator branches of the lumbosacral nerves. The specific instructions for these tests and the specific handling skills are beyond the scope of this article but are available in texts and in continuing education courses. The pudendal nerve has not been specifically addressed in these texts and classes but has significant importance in persistent pelvic pain, especially as it pertains to pudendal nerve entrapment. Reassurance to the patient that the pudendal nerve is a mobile and resilient structure, which under normal circumstances can tolerate varying pressures including prolonged sitting postures and still perform well, may be important. Direct mobilization techniques to the branches of the pudendal nerve in the pelvic floor are used in practice, specific instructions are outside the scope of this article. Patients can be taught these techniques using a dilator or their own finger for a home exercise program. The pudendal nerve can also be mobilized through various depths of squatting with modifying the neck position to load

and unload the dura mater and the nervous system. (See Appendix A.)

To address the fear of movement seen clinically in patients with a diagnosis of pudendal nerve entrapment/irritation, it is important that patients learn to squat and sit again without eliciting fear and pain. Beginning with squatting and sitting in a pool environment may help patients practice these functional activities without creating fear and producing the pain response. With practice and creativity, it is possible to encourage progressive movements that integrate a graded exposure of nonthreatening movement in functional ways throughout the pelvic floor and trunk. It is critical that any movement technique be adapted to the individual patient and his or her beliefs about movement and not taken as a "one-size-fits-all" protocol.

GOAL SETTING AND GRADED MOTOR IMAGERY

Once tissue dysfunction, central sensitization, and neurodynamics have been addressed and are showing signs of improvement, patients need to establish short- and long-term goals to help reduce the threat of increased function. The patient may be asked to create a list of pain control strategies that they can use to pace activities. It may be helpful to follow a proposed "2 of 10" rule when progressing activity.[33] The "2 of 10" rule simply states that if pain increases more than 2 of 10 over the baseline during a functional activity, the patient is instructed to engage in one of his or her pain control strategies to reduce the threat of the activity and minimize the chance of a flare-up.[33] This will prevent the tendency for some patients to push as far as possible at one time and then have to spend days recovering, a "boom and bust" training error that should be avoided. Table 2 provides an example of some of the strategies that patients might find helpful. Blyth and colleagues[75] carried out a large study (n = 474) in Australia with patients with chronic pain who had not sought treatment. The study showed that "use of active strategies was associated with lower levels of disability, less distress, less reliance on medication and less use of formal health care."

Once pain control strategies are identified, goal setting will occur in a straightforward manner. It is important to set activity goals that are easy and manageable at the start in order to avoid triggering a protective pain response.[16,30] In his text, Jam[34] describes a simple 3-step exercise in goal setting. The steps included guiding patients to find their "easy" activity, such as walking, and informing patients that they should perform this activity several times per day.

If patients are unable to progress through a traditional graded exposure program, then a graded motor imagery program can be used. Graded motor imagery is a sequential process of rehabilitation that targets the brain to normalize cognitive processing and cortical representation.[76-78] There is growing evidence that the sensory-motor cortex is reorganized and the involved peripheral tissues are less precisely represented (smudged) in chronic pain states.[43,46] The therapeutic focus should be the brain and the cognitive functions rather than the specific tissues that are in pain when using these interventions in patients who have increased central sensitization. Imagined movement fires the same sensory and motor patterns in the brain as actual movement.[78] Mulder[78] concluded that imagining movement creates similar processing of sensory information as physically practicing the movement, which leads to the reacquisition of motor skills.

Clinicians can take advantage of this knowledge to allow the patient to practice a threatening activity in a sequential, nonthreatening format. Sequential processes have been shown to be effective in CRPS, a clinical syndrome that shares many similarities to persistent pelvic pain.[79] Sequential processes that are used therapeutically are as follows:

1. Laterality reconstruction
2. Motor imagery
3. Mirror therapy

Laterality is the ability to discriminate left/right judgments and is important in proprioception. It has been well studied and documented in the trunk, neck, and extremities.[42,80,81] Laterality must be addressed before graded motor imagery occurs because imagining movement requires the ability to correctly visualize the image in the brain; otherwise, increased synaptic stress could occur if graded motor imagery is attempted without accurate left/right discrimination.[42] Clinically, it has been observed that patients with pelvic pain with significant central sensitization have difficulty identifying right and left pelvic wall palpation. The presentation may be subtle and varies widely between patients. The clinical significance of laterality in the pelvic floor is speculative and based on the neurophysiology and laterality studies that have been completed on other parts of the body.

Table 2. Examples of Possible Pain Control Strategies

Heat	Music	Specific stretches	Affirmations	Deep breathing	Distraction
Ice	Change of position	Positive visualizations	Progressive relaxation exercises	Self-trigger point release	Activities with friends

The foot and back are next to the genitals on the homunculus, the sensory-motor maps of the body in the brain.[82] It is possible that a lack of proprioceptive awareness and corresponding cortical somatosensory smudging may cause laterality deficits in the feet or the low back.[83,84] In highly sensitized states, working with the feet or low back for sensory/motor awareness may be a nonthreatening starting point. Tactile discrimination training with highly sensitized patients becomes the focus of treatment in the initial stages. An example of a brain-targeted home exercise program is for a partner to stimulate the left/right pelvic floor with the purpose of accurate identification of touch. Graphesthesia may also be practiced for tactile discrimination; a partner may draw letters or shapes on the perineum and surrounding tissue for the patient to identify. Two-point discrimination in the external genitalia may also be used to train to assist with the improvement of cortical sensory and motor representation. This type of sensory training has supportive evidence when treating patients with CRPS.[85] Adaptation of these techniques to the pelvic floor is pre-evidence but follows logical reasoning. Improving sensory awareness may also help with neglect and lack of ownership issues that often occur in central sensitization.[81,84]

Once laterality recognition has been restored and tactile acuity/awareness has improved, grading motor activity of the intended action, such as the use of a dilator, can be progressed from imagining a movement, then watching the movement, and finally actively engaging in the movement. Creativity needs to be used when addressing the fears of a patient with persistent pelvic pain. Can the patient imagine using the dilator without exciting the protective pain response? If so, can the patient watch someone else use a dilator without exciting the protective pain response? There is a commercially available video that demonstrates the use of a dilator that can be incorporated as part of a graded imagery program.[86]

Once imagining the activity or watching the video no longer produces a pain response, the patient may be ready to start using the dilator herself. A consideration might be to change the context of the activity by using different scents or music while practicing the dilation. Monitoring heart rate and breathing rate as a biofeedback tool for self-regulation during these types of activities may be helpful. The therapist and the patient may need creativity and patience to move toward nonthreatening activity and normalized sensory-motor function. Each patient presents an individual, complex history and unique context of their pain experience, which must be taken into consideration when designing a treatment activity. The therapist and the patient need creativity and patience to move toward nonthreating activity and normalized sensory-motor function.

Mirror box exercises are used in CRPS rehabilitation to create visual input for the brain to "normalize" movement and activity of the affected side.[87-89] Since left/right functioning of the pelvic floor occurs simultaneously in activity, mirror work cannot be used in this traditional way with persistent pelvic pain. Instead, in persistent pelvic pain, mirror work can be used to provide feedback about the patient's disrupted body awareness and acceptance of "this is mine, and this is how it works."[90] Mirror work may be used throughout treatment to help with visualization, sensory-motor mapping, and acceptance. Many patients have a withdrawal reflex upon the approach of a finger, dilator, or penis toward the vagina. This is a protective reflex that is often subconscious. Michael Graziano, the neuroscientist who discovered flinch cells in the monkey brain, states that these flinch cells fire in the polysensory zone for thwarting threats within peripersonal space.[91,92] Using a mirror to practice relaxing the "space" around the perineum and the vulva may be important when dealing with neglect and ownership problems. Peripersonal space is perceived within the neuromatrix and may be a significant part of the treatment of persistent pain states.[51] Male patients with pelvic pain can also benefit from mirror work to increase and restore sensory awareness.

Hebb[93] described the neurologic basis of motor learning as "Neurons that fire together, wire together. Neurons that fire apart, stay apart." This is the key concept in using graded motor imagery in retraining the sensitive nervous system. By practicing the skill first through imagery and then progressing to actual movement, there is a change in the representation of the movement and the involved body parts in the sensory and motor cortices.[46,94] Notably, this can be done without triggering a protective pain response that will help restore normal sensitivity to the nervous system.

CONCLUSION

Pelvic pain is complex, involving multiple systems in a biopsychosocial context. Therefore, a multidisciplinary approach may be required. There is emerging evidence that treatment of soft tissue dysfunction in urologically based chronic pelvic pain is an effective treatment strategy. However, in persistent pelvic pain, there must be a clear integration of the sensitized nervous system within existing treatment strategies to address this complex pain process effectively. Physical therapy plays an integral role in the management of these patients with complex pain through careful assessment and treatment of the sensitized nervous system as well as local tissue dysfunction. The framework that we have proposed looks at balancing local tissue dysfunction and neuromatrix

involvement based on each patient's individualized presentation and connects the mind-body approach through the neurophysiology of pain education. See Appendix B for a graphic representation of this treatment framework.

Pearson[33] presents a well-formed explanation of the ability of patients with persistent pain to return to normal function:

> Remember, all these things that the nervous system has learned can be changed back. Neurons can become less sensitive; they can stop paying attention to and stop misinterpreting normal sensation as dangerous. Sensors can change back to the way they were; the map of the body on the brain can go back to its normal state and the muscles can regain their normal coordinated action. All it took was the wrong circumstances and lots of practice to get them to act the way they are. Now the patient has to practice new things. With *Patience, Persistence, Compassion and Practice* the patient will find ways to change them back, instead of just covering up the pain. ❍

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APPENDIX A: Pudendal Nerve Mobilizing Teachniques

Active Pudendal Nerve Gliding

- When you can, sink into a deeper squat. You may need to lift your chin to take the tension off your nerves if you are uncomfortable. Experiment.
- Do not force—remember this is a gliding and sliding motion.
- Play with leg position, and sink as low as you can. Let the legs roll a bit in and out.
- Aim those ischeal tuberosities *wide*.

Progressive Options for Home Program

- Start in a comfortable stance, with your legs wide apart.
- Drop your rear toward the ground, aiming your tailbone straight to the floor.
- Notice how the ischeal tuberosities move apart as you sink into a gentle squat.
- Options for getting specific to your body include head position, legs rolled in or out, feet turned in or out.
- Stay comfortable, don't force! Seek those positions that feel gently stretchy.

- As you get more tolerance and become more flexible, sink even further into a squat.
- Play with head, leg, and arm position, aiming for a gentle glide and stretch.
- Feel the ischeal tuberosities and the pelvic floor being open and wide.
- Do not force any motion: no pain is necessary, you are gliding nerves, so be gentle!

Appendix B
Treatment Framework for Persistent Pelvic Pain