New Frontiers in the Matrix of Neuromusculoskeletal Pain:

Integrating Pain Mechanisms with Objective Physical Findings and Needling Strategies

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Background and Purpose:

Chronic pain states are characterized by profound changes in neuronal excitability and architecture in the pain matrix. These neuroplastic changes occur in the spinal cord, thalamic nuclei, cortical and limbic areas and may alter the threshold, intensity and affect of one's pain experience. Moreover, the dynamic changes that occur during the initiation, amplification and perpetuation of chronic pain syndromes may provide explanations for some of the effects observed following dry needling and other physical medicine modalities.

In this workshop, participants will learn important palpation skills and how to identify objective physical findings suggestive of spinal segmental sensitization (SSS) in their patients with chronic pain. Participants will also practice specific needling techniques and physical medicine modalities to desensitize the involved spinal segment, as well as learning how to objectively determine whether the physical manifestations of SSS were resolved following their treatment selection.

Spinal Segmental Sensitization is a hyperactive state of the dorsal horn caused by bombardment of nociceptive impulses from sensitized and/or damaged tissue (somatic, visceral, etc.). Manifestations in the sensitized spinal segment include dermatomal allodynia and hyperalgesia, sclerotomal tenderness and myofascial trigger points (MTrPs) within the involved myotomes.

This workshop will integrate emerging knowledge from the pain sciences in a clinically accessible way. For example, participants will learn how novel micronalytical techniques provide unique insight into the local biochemical milieu of human muscle. These techniques have confirmed that ***active*** MTrPs have elevated levels of a variety of biochemicals, including inflammatory mediators, neuropeptides, cytokines and catecholamines. Not only are these substances are known to be associated with persistent pain states and inflammation, they are also very effective at sensitizing peripheral nociceptors, leading to peripheral sensitization. Furthermore, persistent noxious input from peripheral nociceptors can then lead to central sensitization. The results of these processes are local pain and muscle tenderness, allodynia, hyperalgesia and referred pain, among other symptoms.

Course participants will also learn how innovative applications of ultrasound techniques are being used to visualize MTrPs and measure their stiffness properties and local blood flow. These office-based techniques demonstrate that MTrPs in the upper trapezius are

stiffer than the surrounding tissue and that ***active*** MTrPs can be distinguished from latent MTrPs by their high resistance blood flow.

Participants will also learn *objective* and *quantitative* examination techniques that help identify the tissues and likely pain mechanisms involved in the patient with chronic pain. These easy-to-learn examination skills are fundamental to the evaluation and management of chronic pain. Furthermore, their application *before* and *after* treatments aimed at desensitizing the involved spinal segment provides the clinician and patient meaningful, objective and *reproducible* physical findings to guide treatment outcomes.

There has been a fundamental change in our understanding of the factors involved in the initiation, amplification and perpetuation of persistent musculoskeletal pain states. For example, prolonged noxious input, especially from muscle (from an ***active*** MTrP, for example), may lead to long-term changes in gene expression, somatosensory processing and synaptic structure in dorsal horn neurons and other CNS structures. Under normal circumstances, neurons carrying nociceptive information are controlled by inhibitory interneurons—structures in the dorsal horn critically involved in preventing the transition from acute to chronic pain. However, continuous noxious input, particularly that coming from muscle nociceptors, results in the co-release of glutamate and substance P (SP).

Together, these two biochemicals bind to their respective receptors on post-synaptic neurons, and induce sensitization of wide dynamic range (WDR) dorsal horn neurons (i.e., central sensitization). Furthermore, sustained release of SP and glutamate will cause inhibitory neurons to undergo apoptosis (i.e., programmed cell death), leading to a persistent sensitized state. This lowers the neurons' activation threshold and opens previously ineffective synapses, causing an expansion of the receptive field of pain, referral of pain, allodynia and hyperalgesia.

The purpose of this workshop is for participants to learn about the exciting and important advances in the pain sciences and immediately integrate this information in their clinical practice to determine the objective, reproducible physical manifestations of peripheral and central sensitization and how to properly evaluate and treat these aspects of chronic neuro-musculoskeletal pain.

Learning objectives:

- Analyze the dynamic relationship between primary afferent nociceptors and surrounding tissues and the concept of peripheral sensitization
- Integrate the concept of polysensory synaptic convergence, activity-dependent neuroplasticity and central sensitization of dorsal horn neurons
- Understand the concept of "afferent drive"
- Discuss the unique characteristics of muscle pain compared to cutaneous pain
- Understand the mechanisms of muscle pain underlying pain referral patterns, development of hyperalgesia and expansion of the receptive field of pain
- Discuss the critical role of dorsal horn synaptic connections in the development of allodynia, hyperalgesia and amplification of chronic musculoskeletal pain

- Analyze a mechanism for the loss of spinal inhibitory neurons and the creation of an uninhibited segment
- Understand the components of spinal facilitation and how it is generated and amplified
- Discuss the mechanisms by which even Aβ fiber stimulation can perpetuate spinal facilitation and maintain chronic pain states
- Understand the roles of sensitization and neuroplasticity in generating, amplifying and perpetuating chronic musculoskeletal pain
- Discuss the interplay of somatovisceral/viscerosomatic integration and spinal facilitation
- Review the pathophysiology, diagnosis and referral patterns for common myofascial trigger points
- Learn palpation techniques to identify common myofascial trigger points (MTrPs)
- Discuss treatment techniques for myofascial pain
- Introduce a novel microdialysis needle able to (1) sample the *in-vivo* biochemical milieu (e.g., inflammatory mediators, neuropeptides, cytokines, etc.) of muscle and (2) distinguish subjects who have clinically distinct soft tissue findings
- Demonstrate that ***active*** myofascial trigger points in the upper trapezius have a unique biochemical milieu of substances known to be associated with pain states and inflammation
- Discuss how subjects with an ***active*** MTrP in the upper trapezius have elevated levels of inflammatory mediators, neuropeptides, and cytokines, etc. in a remote, uninvolved muscle compared to latent and normal subjects.
- Demonstrate how the concentration of specific analytes dramatically changes in response to initial acupuncture needle insertion and also following a local twitch response with dry needling, particularly in ***active*** MTrPs
- Introduce novel applications of ultrasound techniques to visualize MTrPs, measure their stiffness properties and local blood flow
- Demonstrate that MTrPs in the upper trapezius are stiffer than surrounding tissue and that ***active*** MTrPs can be distinguished from latent MTrPs by their high-resistance blood flow
- Determine the reproducible physical manifestations of sensitization in chronic myofascial pain
- How to integrate palpation techniques in your clinical practice in order to determine the affected dermatomes, myotomes and sclerotomes in chronic neuromusculoskeletal pain
- Demonstrate needling techniques and physical medicine modalities used to desensitize the involved segments, eliminate chronic MTrPs and alleviate chronic neuromusculoskeletal pain
- Understand the critical role of sensitization and neuroplasticity in generating and perpetuating neuromusculoskeletal pain
- Determine objectively whether the physical manifestations of segmental sensitization were eliminated following your treatment selection