

PASIG PERFORMING ARTS

SPECIAL INTEREST GROUP



PASIG MONTHLY CITATION BLAST: No.61

June 2011

Dear PASIG members:

CSM abstract and programming submission is now closed and reviewers are at work evaluating them. Acceptances should go out in September. In the meantime, PASIG Vice President, Lisa Shoaf, has been hard at work planning our PASIG programming. The 2012 Combined Sections Meeting will be held in Chicago, February 8 –11, 2011.

Don't forget, the PASIG sponsors an annual student research scholarship. This award is to recognize students, who have had an abstract accepted to CSM, for their contribution to performing arts medicine and research. For more information on the research award please check our webpage (www.orthopt.org/sig_pa.php). Students with additional questions can contact Amy Humphrey (ahumphrey@bodydynamicsinc.com).

PERFORMING ARTS CONTINUING EDUCATION AND CONFERENCES

****Performing Arts Independent Study Courses****

Orthopaedic Section Independent Study Course. *20.3 Physical Therapy for the Performing Artist.*

Monographs are available for:

- Figure Skating (J. Flug, J. Schneider, E. Greenberg),
- Artistic Gymnastics (A. Hunter-Giordano, Pongetti-Angeletti, S. Voelker, TJ Manal), and
- Instrumentalist Musicians (J. Dommerholt, B. Collier).

Contact: Orthopaedic Section at: www.orthopt.org

Orthopaedic Section Independent Study Course. *Dance Medicine: Strategies for the Prevention and Care of Injuries to Dancers.*

This is a 6-monograph course and includes many PASIG members as authors.

- Epidemiology of Dance Injuries: Biopsychosocial Considerations in the Management of Dancer Health (MJ Liederbach),
- Nutrition, Hydration, Metabolism, and Thinness (B Glace),
- The Dancer's Hip: Anatomic, Biomechanical, and Rehabilitation Considerations (G. Grossman),
- Common Knee Injuries in Dance (MJ Liederbach),
- Foot and Ankle Injuries in the Dancer: Examination and Treatment Strategies (M. Molnar, R. Bernstein, M. Hartog, L. Henry, M. Rodriguez, J. Smith, A. Zujko),

- Developing Expert Physical Therapy Practice in Dance Medicine – (J. Gamboa, S. Bronner, TJ Manal).
Contact: Orthopaedic Section at: www.orthopt.org

PAMA: Medical Problems of Performing Artists
July 21 – 24, 2011, Snowmass, CO

International Association for Dance Medicine and Science (IADMS) 21st Annual Meeting
October 13 – 16, 2011, Washington DC
Contact: www.iadms.org

Please send information about other courses of interest to our membership to: Amy Humphrey PT, DPT, OCS, MTC; ahumphrey@Bodydynamicsinc.com

For this June Citation BLAST, Michelle Finnegan and Mandy Blackmon have put together abstracts on the topic “*Myofascial trigger points and trigger point dry needling related to pain—Part I.*” Part II, in July, will focus on the treatment of trigger points in different areas of the body, and on nutritional aspects that can perpetuate trigger points. The format is an annotated bibliography of articles generally from the last decade. The PASIG Research Committee initiated this monthly Citation BLAST on performing arts-related topics in June 2005 in the hopes of encouraging our members to stay current in the literature and, perhaps, consider conducting research themselves. Each month we send a new list of performing arts (PA) citations to members of the PASIG to further the pursuit of PA-related scholarship. (Information about EndNote referencing software can be found at <http://www.endnote.com>, including a 30-day free trial).

As always, your comments, suggestions, and entry contributions to these Citation BLASTs are welcome. Please drop me an e-mail anytime.

Regards,
Shaw

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Myofascial trigger points and trigger point dry needling related to pain—Part 1

The purpose of this blast is to educate readers on the benefits of a treatment approach, called trigger point dry needling. This is used in the treatment of myofascial conditions that are due to trigger points. In this section, Part 1, the references below offer insight into the foundational sciences of this treatment approach, so you will better understand how the trigger points come about, their effects on the body, and how treatment

generally works. In a follow up blast, Part 2, it will cover pain syndromes according to body regions and how the treatment has worked in other patient populations, so readers will understand when it can work. Because at this time there is no specific research on the treatment of myofascial trigger points with dry needling in dancers, we understand that you cannot assume that the treatment will be effective across other populations until there is research to support it. However, if as a clinician you are not considering muscle as a source of pain, specifically trigger points, then a piece of the picture is being ignored. This may be especially true in dancers, where they tend to have greater than average joint mobility and significant demands on their muscles. If muscles are not working efficiently, there can be a breakdown at some point in the kinetic chain. As a result, a multitude of problems can occur. We hope the information provided here will stimulate the thinking process to further consider adding this into the clinical examination process, as both of us have seen some great results in patients who have failed other treatments in physical therapy.

As stated above, though there are no articles dealing specifically with the treatment of myofascial trigger points in dancers with dry needling, there are, however, several articles published that recognized myofascial pain can be present in performing artists.

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Although there are no articles dealing specifically with the treatment of myofascial trigger points in dancers with dry needling, there are several articles published that recognized myofascial pain can be present in performing artists.

Dommerholt J (2010). Performing arts medicine - instrumentalist musicians: part III - case histories. J Bodyw Mov Ther **14**(2): 127-138.

In parts I and II of this article series, the basic principles of examining musicians in a healthcare setting were reviewed [Dommerholt, J. Performing arts medicine - instrumentalist musicians: part I: general considerations. J. Bodyw. Mov. Ther., in press-a; Dommerholt, J. Performing arts medicine – instrumentalist musicians: part II: the examination. J. Bodyw. Mov. Ther., in press-b]. Part III describes three case reports of musicians with hand pain, interfering with their ability to play their instruments. The musicians consulted with a performing arts physiotherapist. Neither musician had a correct medical diagnosis if at all, when they first contacted the physiotherapist. Each musician required an individualized approach not only to establish the correct diagnosis, but also to develop a specific treatment program. The treatment programs included ergonomic interventions, manual therapy, trigger point therapy, and patient education. All musicians returned to playing their instruments without any residual pain or dysfunction.

Rosen NB (1993). Myofascial pain: the great mimicker and potentiator of other diseases in the performing artist. Maryland Med J **42**(3): 261-266.

The performing artist often sustains a variety of neuromusculoskeletal problems that interfere with the ability to play or perform. Although many of these conditions occur as a result of overuse or misuse; other causes should be kept in mind--particularly when pain problems persist, recur, or do not respond to usual therapeutic measures. Chief among these are myofascial pain syndromes. These are quite common but are often overlooked, despite the fact that they can cause, potentiate the dysfunction of, and mimic other conditions. This article presents an overview of myofascial pain and dysfunction--particularly as it pertains to neuromusculoskeletal pain and disability in musicians and performing artists.

In order to understand the treatment approach of using trigger point dry needling there first has to be an understanding of what myofascial trigger points are and how are they are thought to form. The articles below will detail some of the information in this area.

Ge HY, Arendt-Nielsen L (2011). Latent Myofascial Trigger Points. Current Pain Headache Reports.

A latent myofascial trigger point (MTP) is defined as a focus of hyperirritability in a muscle taut band that is clinically associated with local twitch response and tenderness and/or referred pain upon manual examination. Current evidence suggests that the temporal profile of the spontaneous electrical activity at an MTP is similar to focal muscle fiber contraction and/or muscle cramp potentials, which contribute significantly to the induction of local tenderness and pain and motor dysfunctions. This review highlights the potential mechanisms underlying the sensory-motor dysfunctions associated with latent MTPs and discusses the contribution of central sensitization associated with latent MTPs and the MTP network to the spatial propagation of pain and motor dysfunctions. Treating latent MTPs in patients with musculoskeletal pain may not only decrease pain sensitivity and improve motor functions, but also prevent latent MTPs from transforming into active MTPs, and hence, prevent the development of myofascial pain syndrome.

Ge H-Y, Fernandez-de-Las-Penas C, et al. (2011). Myofascial trigger points: spontaneous electrical activity and its consequences for pain induction and propagation. Chinese Med 6: 13. ABSTRACT: Active myofascial trigger points are one of the major peripheral pain generators for regional and generalized musculoskeletal pain conditions. Myofascial trigger points are also the targets for acupuncture and/or dry needling therapies. Recent evidence in the understanding of the pathophysiology of myofascial trigger points supports The Integrated Hypothesis for the trigger point formation; however unanswered questions remain. Current evidence shows that spontaneous electrical activity at myofascial trigger point originates from the extrafusal motor endplate. The spontaneous electrical activity represents focal muscle fiber contraction and/or muscle cramp potentials depending on trigger point sensitivity. Local pain and tenderness at myofascial trigger points are largely due to nociceptor sensitization with a lesser contribution from non-nociceptor sensitization. Nociceptor and non-nociceptor sensitization at myofascial trigger points may be part of the process of muscle ischemia associated with sustained focal muscle contraction and/or muscle cramps. Referred pain is dependent on the sensitivity of myofascial trigger points. Active myofascial trigger points may play an important role in the transition from localized pain to generalized pain conditions via the enhanced central sensitization, decreased descending inhibition and dysfunctional motor control strategy.

Gerwin RD, Dommerholt J, et al. (2004). An expansion of Simons' integrated hypothesis of trigger point formation. Current Pain Headache Reports 8(6): 468-475.

Simons' integrated hypothesis proposed a model of trigger point (TrP) activation to explain known TrP phenomena, particularly endplate noise. We propose an expansion of this hypothesis to account for new experimental data and established muscle pathophysiology.

Mense S (2011). [Differences between myofascial trigger points and tender points]. Schmerz 25(1): 93-103; quiz 104.

The article describes and compares the characteristics of myofascial trigger points (MTrPs) of the myofascial pain syndrome and the tender points (TePs) of the fibromyalgia syndrome. Many statements are hypothetical, because not all aspects of the disorders have been clarified in solid studies. Signs and symptoms of MTrPs: (1) palpable nodule, often located close to the muscle belly, (2) often single, (3) allodynia and hyperalgesia at the MTrP, (4) referral of the MTrP pain, (5) normal pain sensitivity outside the MTrPs, (6) local twitch response, (7) local contracture in biopsy material, (8) peripheral mechanism probable. Signs and symptoms of TePs: (1) no palpable nodule, (2) location often close to the muscle attachments, (3) multiple by definition, (4) allodynia and hyperalgesia also outside the TePs, (5) enhanced pain under psychic stress, (6) unspecific histological changes in biopsy material, (7) central nervous mechanism probable. The multitude of differences speak against a common aetiology and pathophysiology.

Simons DG, Mense S (2003). [Diagnosis and therapy of myofascial trigger points]. Schmerz 17(6): 419-424.

AIM: Myofascial trigger points (MTrPs) are hyperirritable tender spots in palpable tense bands of skeletal muscle. Muscle is an orphan organ, no medical specialty claims muscle as its organ. The article aims at filling some of the gaps in the current knowledge of MTrPs. METHODS: The presented findings were partly obtained in experiments on anaesthetised rabbits, partly they are the result of ample experience with patients suffering from MTrPs. DIAGNOSIS: Each muscle has a characteristic elicited referred pain pattern that, for active MTrPs, is familiar to the patient. Without a laboratory test or imaging method, diagnosis of MTrPs depends entirely on history and physical examination. MTrP symptoms follow muscle overload, are activated acutely by sudden overload, or develop gradually with prolonged contractions or repetitive activity. The diagnostic skill required depends on considerable innate palpation ability, authoritative training, and extensive clinical experience. THERAPY: Effective treatment methods include manual stretching by trigger-point pressure release, contract-relax, vapo coolant spray-and-stretch, and dry needling or injection of MTrPs. CONCLUSIONS: The integrated hypothesis presents an explanation for the pathophysiology of MTrPs and begins with excessive release of acetylcholine from involved motor endplates. It depends on a new understanding of the abnormality of endplate noise. Biopsies demonstrate segmental shortening of groups of sarcomeres in individual muscle fibres and possibly waves of contracted sarcomeres to account for palpable taut bands.

There is research to support that there are chemical and vascular changes associated in the area of the trigger points, which resultantly can be feeding into the pain mechanism associated with them.

Shah JP, Danoff JV, et al. (2008). Biochemicals associated with pain and inflammation are elevated in sites near to and remote from active myofascial trigger points. Archives Phys Med Rehabil 89(1): 16-23.

OBJECTIVES: To investigate the biochemical milieu of the upper trapezius muscle in subjects with active, latent, or absent myofascial trigger points (MTPs) and to contrast this with that of the noninvolved gastrocnemius muscle. DESIGN: We used a microanalytic technique, including needle insertions at standardized locations in subjects identified as active (having neck pain and MTP), latent (no neck pain but with MTP), or normal (no neck pain, no MTP). We followed a predetermined sampling schedule; first in the trapezius muscle and then in normal gastrocnemius muscle, to measure pH, bradykinin, substance P, calcitonin gene-related peptide, tumor necrosis factor alpha, interleukin 1beta (IL-1beta), IL-6, IL-8, serotonin, and norepinephrine, using immunocapillary electrophoresis and capillary

electrochromatography. Pressure algometry was obtained. We compared analyte concentrations among groups with 2-way repeated-measures analysis of variance. SETTING: A biomedical research facility. PARTICIPANTS: Nine healthy volunteer subjects. INTERVENTIONS: Not applicable. MAIN OUTCOME MEASURES: Preselected analyte concentrations. RESULTS: Within the trapezius muscle, concentrations for all analytes were higher in active subjects than in latent or normal subjects ($P < .002$); pH was lower ($P < .03$). At needle insertion, analyte concentrations in the trapezius for the active group were always higher (pH not different) than concentrations in the gastrocnemius muscle. At all times within the gastrocnemius, the active group had higher concentrations of all analytes than did subjects in the latent and normal groups ($P < .05$); pH was lower ($P < .01$). CONCLUSIONS: We have shown the feasibility of continuous, in vivo recovery of small molecules from soft tissue without harmful effects. Subjects with active MTPs in the trapezius muscle have a biochemical milieu of selected inflammatory mediators, neuropeptides, cytokines, and catecholamines different from subjects with latent or absent MTPs in their trapezius. These concentrations also differ quantitatively from a remote, uninvolved site in the gastrocnemius muscle. The milieu of the gastrocnemius in subjects with active MTPs in the trapezius differs from subjects without active MTPs.

Shah JP, Gilliams EA (2008). Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome. J Bodywork Movement Therap **12**(4): 371-384.

This article discusses muscle pain concepts in the context of myofascial pain syndrome (MPS) and summarizes microdialysis studies that have surveyed the biochemical basis of this musculoskeletal pain condition. Though MPS is a common type of non-articular pain, its pathophysiology is only beginning to be understood due to its enormous complexity. MPS is characterized by the presence of myofascial trigger points (MTrPs), which are defined as hyperirritable nodules located within a taut band of skeletal muscle. MTrPs may be active (spontaneously painful and symptomatic) or latent (non-spontaneously painful). Painful MTrPs activate muscle nociceptors that, upon sustained noxious stimulation, initiate motor and sensory changes in the peripheral and central nervous systems. This process is called sensitization. In order to investigate the peripheral factors that influence the sensitization process, a microdialysis technique was developed to quantitatively measure the biochemical milieu of skeletal muscle. Biochemical differences were found between active and latent MTrPs, as well as in comparison with healthy muscle tissue. In this paper we relate the findings of elevated levels of sensitizing substances within painful muscle to the current theoretical framework of muscle pain and MTrP development.

Shah JP, Phillips TM, et al. (2005). An in vivo microanalytical technique for measuring the local biochemical milieu of human skeletal muscle. J Applied Physiol **99**(5): 1977-1984.

Myofascial pain associated with myofascial trigger points (MTrPs) is a common cause of nonarticular musculoskeletal pain. Although the presence of MTrPs can be determined by soft tissue palpation, little is known about the mechanisms and biochemical milieu associated with persistent muscle pain. A microanalytical system was developed to measure the in vivo biochemical milieu of muscle in near real time at the subnanogram level of concentration. The system includes a microdialysis needle capable of continuously collecting extremely small samples (approximately 0.5 microl) of physiological saline after exposure to the internal tissue milieu across a 105-microm-thick semi-permeable membrane. This membrane is positioned 200 microm from the tip of the needle and permits solutes of <75 kDa to diffuse across it. Three subjects were selected from each of three groups (total 9 subjects): normal (no neck pain, no MTrP); latent (no neck pain, MTrP present); active (neck pain, MTrP present). The microdialysis needle was inserted in a standardized location in the upper trapezius muscle. Due to the extremely small sample size collected by the microdialysis system, an established microanalytical laboratory, employing

immunoaffinity capillary electrophoresis and capillary electrochromatography, performed analysis of selected analytes. Concentrations of protons, bradykinin, calcitonin gene-related peptide, substance P, tumor necrosis factor-alpha, interleukin-1beta, serotonin, and norepinephrine were found to be significantly higher in the active group than either of the other two groups ($P < 0.01$). pH was significantly lower in the active group than the other two groups ($P < 0.03$). In conclusion, the described microanalytical technique enables continuous sampling of extremely small quantities of substances directly from soft tissue, with minimal system perturbation and without harmful effects on subjects. The measured levels of analytes can be used to distinguish clinically distinct groups.

Sikdar S, Ortiz R, et al. (2010). Understanding the vascular environment of myofascial trigger points using ultrasonic imaging and computational modeling. Conference proceedings : ... Annual Int Conference IEEE Engineering in Med Biology Society. **2010**: 5302-5305.

Myofascial pain syndrome (MPS) is a common, yet poorly understood, acute and chronic pain condition. MPS is characterized by local and referred pain associated with hyperirritable nodules known as myofascial trigger points (MTrPs) that are stiff, localized spots of exquisite tenderness in a palpable taut band of skeletal muscle. Recently, our research group has developed new ultrasound imaging methods to visualize and characterize MTrPs and their surrounding soft tissue. The goal of this paper was to quantitatively analyze Doppler velocity waveforms in blood vessels in the neighborhood of MTrPs to characterize their vascular environment. A lumped parameter compartment model was then used to understand the physiological origin of the flow velocity waveforms. 16 patients with acute neck pain were recruited for the study and the blood vessels in the upper trapezius muscle in the neighborhood of palpable MTrPs were imaged using Doppler ultrasound. Preliminary findings show that symptomatic MTrPs have significantly higher peak systolic velocities and negative diastolic velocities compared to latent MTrPs and normal muscle sites. Using compartment modeling, we show that a constricted vascular bed and an enlarged vascular volume could explain the observed flow waveforms with retrograde diastolic flow.

There is also research on the reliability of finding trigger points. Granted, the reliability is not assessed in every area of the body, but research on this topic, and most areas, is still relatively new.

Bron C, Franssen J, et al. (2007). Interrater reliability of palpation of myofascial trigger points in three shoulder muscles. J Manual Manipulative Ther **15**(4): 203-215.

This observational study included both asymptomatic subjects ($n=8$) and patients with unilateral or bilateral shoulder pain ($n=32$). Patient diagnoses provided by the referring medical physicians included subacromial impingement, rotator cuff disease, tendonitis, tendinopathy, and chronic subdeltoid-subacromial bursitis. Three raters bilaterally palpated the infraspinatus, the anterior deltoid, and the biceps brachii muscles for clinical characteristics of a total of 12 myofascial trigger points (MTrPs) as described by Simons et al. The raters were blinded to whether the shoulder of the subject was painful. In this study, the most reliable features of trigger points were the referred pain sensation and the jump sign. Percentage of pair-wise agreement (PA) was $\geq 70\%$ (range 63-93%) in all but 3 instances for the referred pain sensation. For the jump sign, PA was $\geq 70\%$ (range 67-77%) in 21 instances. Finding a nodule in a taut band (PA = 45-90%) and eliciting a local twitch response (PA = 33-100%) were shown to be least reliable. The best agreement about the presence or absence of MTrPs was found for the infraspinatus muscle (PA = 69-80%). This study provides preliminary evidence that MTrP palpation is a reliable and, therefore, potentially useful diagnostic tool in the diagnosis of myofascial pain in patients with non-traumatic shoulder pain.

Gerwin RD, Shannon S, et al. (1997). Interrater reliability in myofascial trigger point examination. Pain **69**(1-2): 65-73.

The myofascial trigger point (MTrP) is the hallmark physical finding of the myofascial pain syndrome (MPS). The MTrP itself is characterized by distinctive physical features that include a tender point in a taut band of muscle, a local twitch response (LTR) to mechanical stimulation, a pain referral pattern characteristic of trigger points of specific areas in each muscle, and the reproduction of the patient's usual pain. No prior study has demonstrated that these physical features are reproducible among different examiners, thereby establishing the reliability of the physical examination in the diagnosis of the MPS. This paper reports an initial attempt to establish the interrater reliability of the trigger point examination that failed, and a second study by the same examiners that included a training period and that successfully established interrater reliability in the diagnosis of the MTrP. The study also showed that the interrater reliability of different features varies, the LTR being the most difficult, and that the interrater reliability of the identification of MTrP features among different muscles also varies.

Trigger points can also affect the tissues, joints, and structures around them in several different ways. The articles below highlight their potential on different structures and physiological mechanisms, further demonstrating the need to be able to evaluate and effectively treat myofascial trigger points.

Andrzejewski, W., K. Kassolik, et al. (2010). The influence of age and physical activity on the pressure sensitivity of soft tissues of the musculoskeletal system. J Bodywork Movement Ther **14**(4): 382-390.

SUMMARY BACKGROUND: The pressure sensitivity of soft tissues is defined as the slightest pressure causing pain. Sex, movement system illnesses, pain ailments may influence the pressure sensitivity. However, there have been few studies on factors determining the level of pressure sensitivity of skeletal muscles. **OBJECTIVE:** The authors have determined to study the influence of age and physical activity on the pressure sensitivity of skeletal muscles. **METHODS:** The examination of pressure sensitivity of trigger points and muscle insertions was carried out using algometry. **RESULTS:** 76 volunteers (38 students and 38 individuals aged 50-75) participated in the study. The differences in pressure sensitivity between students and people aged 50-75 were not statistically significant. Pressure sensitivity of students differed depending on their level of physical activity. **CONCLUSIONS:** The level of physical activity influenced the pressure sensitivity of skeletal muscles. Age did not significantly influence pressure sensitivity.

Fernandez-Carnero J, Ge HY, et al. (2010). Increased spontaneous electrical activity at a latent myofascial trigger point after nociceptive stimulation of another latent trigger point. Clin J Pain **26**(2): 138-143.

OBJECTIVE: To investigate the changes in surface and intramuscular electromyographic (EMG) activity at latent trigger points (TrPs) in the extensor carpi radialis brevis muscle after injection of either glutamate or isotonic saline into latent TrPs in the infraspinatus muscle. **METHOD:** Nociceptive muscle stimulation was obtained by a bolus injection of glutamate (0.2 mL, 0.5 M) into a latent TrP located in the right infraspinatus muscle in 12 healthy volunteers. A bolus of isotonic saline (0.9%, 0.2 mL) injection served as control. Injections were guided by intramuscular EMG showing resting spontaneous electrical activity at the latent myofascial TrP in the infraspinatus muscle. Intramuscular (at the TrP) and surface EMG activities of both infraspinatus and extensor carpi radialis brevis muscles were recorded before, during, and after injection for a period of 6 minutes to monitor changes produced in EMG activity. **RESULTS:** Glutamate injection into latent TrPs induced higher pain intensity than isotonic saline injection ($P < 0.001$). The analysis of variance showed a significant increase in root mean square score of intramuscular EMG activity at TrP in the

extensor carpi radialis brevis after glutamate (mean \pm -SD: 212.0 \pm -215.6 microV) but not isotonic saline (mean \pm -SD: 74.2 \pm -72.2 microV) injections ($P < 0.001$). No changes in surface EMG activity were found. No significant changes in root mean square of intramuscular and surface EMG activity in the infraspinatus muscle were found.

CONCLUSIONS: Our results show that an increased nociceptive activity at latent TrPs in the infraspinatus muscle may increase motor activity and sensitivity of a TrP in distant muscles at a same segmental level.

Fernandez-de-Las-Penas C (2009). Interaction between Trigger Points and Joint Hypomobility: A Clinical Perspective. *J Manual & Manipulative Ther* 17(2): 74-77.

The relationship between muscle trigger points (TrPs) and joint hypomobility is frequently recognized by clinicians. Among different manual therapies aimed at inactivating muscle TrPs, ischemic compression and spinal manipulation have shown moderately strong evidence for immediate pain relief. Reduction of joint mobility appears related to local muscles innervated from the segment, which suggests that muscle and joint impairments may be indivisible and related disorders in pain patients. Two clinical studies have investigated the relationship between the presence of muscle TrPs and joint hypomobility in patients with neck pain. Both studies reported that all patients exhibited segmental hypomobility at C3-C4 zygapophyseal joint and TrPs in the upper trapezius, sternocleidomastoid, or levator scapulae muscles. There are several theories that have discussed the relationship between TrP and joint hypomobility. First, increased tension of the taut muscular bands associated with a TrP and facilitation of motor activity can maintain displacement stress on the joint. Alternatively, it may be that the abnormal sensory input from the joint hypomobility may reflexively activate TrPs. It is also conceivable that TrPs provide a nociceptive barrage to the dorsal horn neurons and facilitate joint hypomobility. There is scientific evidence showing change in muscle sensitivity in muscle TrP after spinal manipulation, which suggests that clinicians should include treatment of joint hypomobility in the management of TrPs. Nevertheless, the order in which these muscle and joint impairments should be treated is not known and requires further investigation.

Ge HY, Zhang Y, et al. (2008). Induction of muscle cramps by nociceptive stimulation of latent myofascial trigger points. *Exp Brain Res*. 187(4): 623-629.

The aim of this present study is to test the hypothesis that nociceptive stimulation of latent myofascial trigger points (MTrPs) increases the occurrence of local muscle cramps. Nociceptive muscle stimulation was obtained by a bolus injection of glutamate (0.1 ml, 0.5 M) into a latent MTrP and a control point (a non-MTrP) located in the right or left gastrocnemius medialis muscles in 14 healthy subjects. A bolus of isotonic saline (0.9%, 0.1 ml) injection served as a control. The injections were guided by intramuscular electromyography (EMG) showing resting spontaneous electrical activity at a latent MTrP and no such activity at a non-MTrP. Intramuscular and surface EMG activities in the gastrocnemius medialis muscle were recorded pre-, during-, and post-injection for a period of 8 min to monitor the occurrence of muscle cramps, which are characterized by a brief episodic burst of high levels of EMG activity. The results showed that glutamate and isotonic saline injections into the latent MTrPs induced higher peak pain intensity than into the non-MTrPs (both $P < 0.05$). Glutamate injection induced higher peak pain intensity than isotonic saline injection into either latent MTrPs or non-MTrPs (both $P < 0.05$). Muscle cramps were observed in 92.86% of the subjects following glutamate injection into the latent MTrPs, but not into the non-MTrPs ($P < 0.001$). No muscle cramps were recorded following isotonic saline injection into either the latent MTrPs or the non-MTrPs. These results suggest that latent MTrPs could be involved in the genesis of muscle cramps. Focal increase in nociceptive sensitivity at MTrPs constitutes one of the mechanisms underlying muscle cramps.

Li LT, Ge HY, et al. (2009). Nociceptive and non-nociceptive hypersensitivity at latent myofascial trigger points. Clinical J Pain **25**(2): 132-137.

OBJECTIVE: The aim of the study was to evaluate whether or not there exists nociceptive and non-nociceptive hypersensitivity at latent myofascial trigger points (MTrPs). **METHODS:** Eleven healthy volunteers participated in this study, which consisted of 3 sessions of electromyography-guided intramuscular injection with a minimum of a week interval in between. In each session, a bolus of either hypertonic saline (6%, 0.1 mL, each), glutamate (0.1 mL, 0.5 M, each), or isotonic saline (0.9%, 0.1 mL, each) was randomly injected into a latent MTrP and a non-MTrP located in the right or left gastrocnemius medialis muscles. After each injection, participants were asked to rate the perceived pain intensity on an electronic visual analog scale (VAS) and to mark the pain areas on pain drawings. Maximal pain intensity (VAS(peak)), the area under the curve (VAS(auc)), and local and referred pain areas were extracted. **RESULTS:** Injections of either hypertonic saline, glutamate, or isotonic saline into the latent MTrPs induced a higher VAS(peak) and larger VAS(auc) than the non-MTrPs (all, $P < 0.05$). Furthermore, the MTrPs with referred pain after painful injections were found to show higher VAS(peak) and larger VAS(auc) than those without referred pain (both, $P < 0.001$). **CONCLUSIONS:** These results confirm the existence of nociceptive hypersensitivity at latent MTrPs and provide the first evidence that there exists non-nociceptive hypersensitivity (allodynia) at latent MTrPs. Finally, the occurrence of referred muscle pain is associated with higher pain sensitivity at latent MTrPs.

Lucas KR, Rich PA, et al. (2010). Muscle activation patterns in the scapular positioning muscles during loaded scapular plane elevation: the effects of Latent Myofascial Trigger Points. Clin Biomech **25**(8): 765-770.

BACKGROUND: Latent Myofascial Trigger Points are pain-free neuromuscular lesions that have been found to affect muscle activation patterns in the unloaded state. The aim was to extend these observations to loaded motion by investigating muscle activation patterns in upward scapular rotator muscles (upper and lower trapezius and serratus anterior) hosting Latent Myofascial Trigger Points simultaneously with lesion-free synergists for shoulder abduction (infraspinatus and middle deltoid). This approach allowed examination of the effects of these lesions on both their hosts and their lesion-free synergists in order to understand their effects on the performance of shoulder abduction. **METHODS:** Surface electromyography was employed to measure the timing of onset of muscle activation of the upper and lower trapezius and serratus anterior (upward scapular rotators), infraspinatus (rotator cuff) and middle deltoid (abductor of the arm) initially without load and then with light (1-4 kg) dumbbells. Comparisons were made between control (no Latent Trigger Points; $n=14$) and Latent Trigger Point ($n=28$) groups. **FINDINGS:** The control group displayed a relatively stable sequence of muscle activation that was significantly different in timing and variability to that of the Latent Trigger Point group in all muscles except middle deltoid (all $P < 0.05$). The Latent Trigger Point group muscle activation pattern under load was inconsistent, with the only common feature being the early activation of the infraspinatus. **INTERPRETATION:** The presence of Latent Trigger Points in upward scapular rotators alters the muscle activation pattern during scapular plane elevation, potentially predisposing to overuse conditions including impingement syndrome, rotator cuff pathology and myofascial pain.

Niddam DM, Chan RC, et al. (2007). Central modulation of pain evoked from myofascial trigger point. Clin J Pain **23**(5): 440-448.

OBJECTIVES: Low-intensity low-frequency electrostimulation delivered within a myofascial trigger point (MTP) has been used as intervention to deactivate MTPs. The therapeutic effect has been suggested to be due to peripheral mechanisms. However, nonpainful stimuli are also known to reduce simultaneous pain through central effects. The primary objective of the present study was to assess if central pain modulation occurs after intervention with

low-intensity electrostimulation within an MTP. We hypothesized that intervention induces pain inhibition via the periaqueductal gray (PAG). **METHODS:** Twenty-four patients with myofascial pain syndrome participated in the study. During functional magnetic resonance scanning, painful (high-intensity) intramuscular electrostimulation was delivered at random intervals (mean interstimulus interval=10.2 s) within an MTP of the upper left trapezius muscle. In-between scanning sessions, intervention (intramuscular electrostimulation, low-intensity, interstimulus interval=0.5 s) was applied to the same area. Patients were divided into responders and nonresponders according to their change in pressure pain thresholds relative to intervention. In addition to a whole brain search, a region of interest approach was also implemented to test the effect of intervention on PAG signal change. **RESULTS:** The main findings were: (1) intervention modulated PAG activity to painful stimuli more in responders than in nonresponders, (2) change in PAG activity from the whole patient population correlated with change in pressure pain threshold, and (3) a network known to regulate affective qualities of the pain experience was (subsignificantly) engaged more in responders than in nonresponders. **DISCUSSION:** The applied intervention most likely involves supraspinal pain control mechanisms related to both antinociception and regulation of pain affect.

The last aspect of this covers the effects of dry needling on myofascial trigger points, which is a rapidly growing technique among physical therapists in the states.

Ga H, Koh HJ, et al. (2007). Intramuscular and nerve root stimulation vs lidocaine injection to trigger points in myofascial pain syndrome. *J Rehabil Med*: **39**(5): 374-378.

OBJECTIVES: To compare the efficacies of an intramuscular stimulation technique and 0.5% lidocaine injection to trigger points in myofascial pain syndrome. **PARTICIPANTS:** Forty-three people with myofascial pain syndrome of the upper trapezius muscle. **INTERVENTIONS:** Twenty-two subjects were treated with intramuscular stimulation and another 21 with 0.5% lidocaine injection at all the trigger points on days 0, 7 and 14. **RESULTS:** Intramuscular stimulation resulted in a significant reduction in Wong-Baker FACES pain scale scores at all visits and was more effective than trigger point injection. Intramuscular stimulation also resulted in significant improvement on the Geriatric Depression Scale - Short Form. Local twitch responses occurred in 97.7% (42/43) of patients. All the passive cervical ranges of motion were significantly increased. Post-treatment soreness was noted in 54.6% of patients in the intramuscular stimulation group and 38.1% in the trigger point injection group, respectively, and gross subcutaneous haemorrhage (> 4 cm²) was seen in only one patient in the trigger point injection group. **CONCLUSION:** In managing myofascial pain syndrome, after one month intramuscular stimulation resulted in more significant improvements in pain intensity, cervical range of motion and depression scales than did 0.5% lidocaine injection of trigger points. Intramuscular stimulation is therefore recommended for myofascial pain syndrome.

Hsieh Y-L, Kao M-J, et al. (2007). Dry needling to a key myofascial trigger point may reduce the irritability of satellite MTrPs. *Am J Physical Med Rehabil*: **86**(5): 397-403.

OBJECTIVE: To investigate the changes in pressure pain threshold of the secondary (satellite) myofascial trigger points (MTrPs) after dry needling of a primary (key) active MTrP. **DESIGN:** Single blinded within-subject design, with the same subjects serving as their own controls (randomized). Fourteen patients with bilateral shoulder pain and active MTrPs in bilateral infraspinatus muscles were involved. An MTrP in the infraspinatus muscle on a randomly selected side was dry needled, and the MTrP on the contralateral side was not (control). Shoulder pain intensity, range of motion (ROM) of shoulder internal rotation, and pressure pain threshold of the MTrPs in the infraspinatus, anterior deltoid, and extensor carpi radialis longus muscles were measured in both sides before and immediately after dry needling. **RESULTS:** Both active and passive ROM of shoulder internal rotation, and the

pressure pain threshold of MTrPs on the treated side, were significantly increased ($P < 0.01$), and the pain intensity of the treated shoulder was significantly reduced ($P < 0.001$) after dry needling. However, there were no significant changes in all parameters in the control (untreated) side. Percent changes in the data after needling were also analyzed. For every parameter, the percent change was significantly higher in the treated side than in the control side. **CONCLUSIONS:** This study provides evidence that dry needle-evoked inactivation of a primary (key) MTrP inhibits the activity in satellite MTrPs situated in its zone of pain referral. This supports the concept that activity in a primary MTrP leads to the development of activity in satellite MTrPs and the suggested spinal cord mechanism responsible for this phenomenon.

Tsai C-T, Hsieh L-F, et al. (2010). Remote effects of dry needling on the irritability of the myofascial trigger point in the upper trapezius muscle. Am J Phys Med Rehabil: **89**(2): 133-140. **OBJECTIVE:** To investigate the remote effect of dry needling on the irritability of a myofascial trigger point in the upper trapezius muscle. **DESIGN:** Thirty-five patients with active myofascial trigger points in upper trapezius muscles were randomly divided into two groups: 18 patients in the control group received sham needling, and 17 patients in the dry-needling group received dry needling into the myofascial trigger point in the extensor carpi radialis longus muscle. The subjective pain intensity, pressure pain threshold, and range of motion of the neck were assessed before and immediately after the treatment. **RESULTS:** Immediately after dry needling in the experimental group, the mean pain intensity was significantly reduced, but the mean pressure threshold and the mean range of motion of cervical spine were significantly increased. There were significantly larger changes in all three parameters of measurement in the dry-needling group than that in the control group. **CONCLUSIONS:** This study demonstrated the remote effectiveness of dry needling. Dry needling of a distal myofascial trigger point can provide a remote effect to reduce the irritability of a proximal myofascial trigger point.
