Journal of Bodywork & Movement Therapies 22 (2018) 673–684

Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

MYOFASCIAL PAIN AND TREATMENT: EDITORIAL

A critical overview of the current myofascial pain literature – July 2018

Jan Dommerholt [a, b, *], Michelle Finnegan [a, b], Todd Hooks [c], Li-Wei Chou [d]

[a] Bethesda Physiocare, Bethesda, MD, USA
[b] Myopain Seminars, Bethesda, MD, USA
[c] New Orleans Pelicans, New Orleans, LA, USA
[d] China Medical University, Taichung, Taiwan

ARTICLE INFO

Article history:
Received 22 June 2018
Accepted 25 June 2018

Keywords:
Myofascial pain syndrome
Trigger points
Dry needling
Manual therapy

ABSTRACT

In the current issue of this clinical overview, we are pleased to include several basic research studies ranging from the differentiation of radicular and non-radicular low back pain based on the presence of trigger points (TrPs) to the role of TrPs in patients with osteoarthritis, the diagnostic criteria of TrP, the accurate placement of needles in the piriformis muscle with dry needling (DN), and the reliability of TrP identification, among others. As usual, there are many new DN studies, but also several review papers, and manual TrP research. Contributing authors come from as many as 15 different countries!

1. Basic research

Adelmanesh, F, Jalali, A, Shirvani, A, Pakmanesh, K, Pourafkari, M, Raissi, GR, Shir Y. 2016. The diagnostic accuracy of gluteal trigger points to differentiate radicular from nonradicular low back pain. Clinical Journal of Pain. 32(8):666–672.

This innovative study is a joint project between researchers from McGill University in Montreal, Canada, Tehran University of Medical Sciences, Shahid Beheshti University of Medical Sciences, and Iran University of Medical Sciences in Tehran, Iran. They conducted a prospective, diagnostic accuracy study to predict nerve root involvement among 325 consecutive patients with low back pain (LBP). Patients over 18 years old with any type of LBP, defined as pain between the thoraco-lumbar and lumbosacral junctions for any duration, were included in the study. Patients with a history of lumbar spine surgery, rheumatologic diseases, peripheral neuropathy, or fibromyalgia were excluded. After examining each subject for the presence of a gluteal TrP, a different examiner obtained a detailed history and performed a physical examination. Next, the subjects were evaluated with magnetic resonance imaging of the lumbar spine and electrodiagnostic tests were used when the clinical evaluation and MRI findings were discordant, borderline or ambiguous. The subjects were assigned to a “radicular” or a “non-radicular” LBP group.

The researchers determined the agreement between the presence of a gluteal TrP as a diagnostic test for radicular pain and they concluded that the specificity of the TrP test was 91.4% with a sensitivity of 74.1%. The presence of TrPs in the superior-lateral gluteal region was highly specific as an indicator for radicular LBP, but not useful as a diagnostic test. As the authors noted, the TrP evaluation may be superior to MRI for diagnosing radiculopathy in patients with LBP. They recommended incorporating TrPs evaluations in routine physical examination of patients with LBP to decrease the need for more costly, time-consuming, and invasive diagnostic tests.

While this is certainly an interesting notion, which potentially could assist in identifying patients appropriate for surgery or conservative therapy, the authors did not really explain why gluteal TrPs would have predictive value other than being epiphenomena of radicular symptoms. The authors acknowledged, that “it is still premature to consider the gluteal TrP test as pathognomonic for patients with radicular LBP.

Calvo-Lobo C, Diez-Vega I, Martínez-Pascual B, Fernández-Martínez S, de la Cueva-Reguera M, Garrosa-Martín G, Rodríguez-Sanz D. 2017. Tensiomyography, sonoelastography, and mechanosensitivity differences between active, latent, and control low back

* Corresponding author. Bethesda Physiocare, 4405 East West Highway, Suite 403, Bethesda, MD, 20814-4535, USA.
E-mail addresses: jan@bpcemail.com (J. Dommerholt), mbfpt77@gmail.com (M. Finnegan), trhooks@hotmail.com (T. Hooks), chouliwe@gmail.com (L.-W. Chou).

https://doi.org/10.1016/j.jbmt.2018.06.005
1360-8592/

myofascial trigger points: A cross-sectional study. Medicine (Baltimore), 96(10):e6287.

Researchers from Spain examined the differences between tensiomyography, sonoelastography, and pressure pain threshold (PPT) of active and latent TrPs in patients with low back pain. The main objective of this study was to determine the tensiomyography differences between the palpation area of active and latent TrPs. A recent case report showed a decrease in the level of local muscle stiffness for spastic muscles (Calvo et al., 2016). In the current study, the researchers used a convenience sample of 20 active TrPs, 20 latent TrPs, and 20 control points. The outcome measurements order for each point was the sonoelastography manual strain index, tensiomyography, and PPT with a 15-min rest period in between measurements. The researchers identified five objective contractile parameters, including the maximal radial displacement (Dm), contraction time (Tc), sustain time (Ts), delay time (Td), and half-relaxation time (Tr).

The results were interesting as both PPT and sonoelastography showed statistically significant differences between the various points, except for active and latent TrPs, while tensiomyography did not show any statistically significant difference between points. There was a moderate positive correlation between PPT and Dm for active TrPs and between sonoelastography and Td for control points. In other words, the sonoelastography and mechanosensitivity showed a higher stiffness and a lower PPT, between the palpation area of active and latent TrPs. The authors described several potential limitations to the study. This is a valuable first step in quantifying the differences between TrPs, but clearly much more research will be needed.

Cheng, WM, Fan, YH & Lin, ATL, 2018. Urodynamic characteristics might be variable in bladder pain syndrome/interstitial cystitis patients with different non-bladder co-morbid conditions. Journal of the Chinese Medical Association, 81:248-254.

Bladder pain syndrome/interstitial cystitis (BPS/IC) is a clinical diagnosis characterized by complaints of supra-pubic pain related to urinary bladder filling with other symptoms, like urgency of urination, increased daytime frequency, and nocturia. BPS/IC patients have been reported to be co-morbid with other non-bladder conditions, including irritable bowel syndrome (IBS), fibromyalgia (FM), and chronic fatigue syndrome (CFS). Previous studies found that patients with BPS/IC may have certain urodynamic characteristics, such as smaller bladder volume on the first desire, smaller cystometric capacity, lower bladder compliance, and slower catheter-free maximum flow rate.

Urologists from Taiwan conducted this study to identify the impact of non-bladder co-morbid conditions on the urodynamic characteristics of BPS/IC patients, and they found that patients with BPS/IC, especially females, are more likely to have non-bladder related conditions, especially tension/migraine headache and localized myofascial pain disorder (LMP). BPS/IC Patients and co-morbid IBS are younger and are more likely to have abnormal urodynamic findings, especially higher prevalence of dysfunctional voiding. The authors hypothesized that patients may present with a regional pain syndrome that develops initially in the pelvis and progresses bi-directionally between adjacent organs (bowel or urinary bladder), then advances to systemic symptoms such as CFS or FM. The age differences may hint at the pathophysiology of BPS/IC.

The authors found that patients with BPS/IC and LMP present with larger catheter-free voided volume and lower pressure at maximum flow, and they speculated that TrPs in these patients are located in muscles other than the pelvic floor, such as the gluteus and piriformis muscles. In previous research, BPS/IC symptoms and irritating voiding symptoms improved or resolved after treatments for TrPs in the pelvic floor muscles, as well as the gluteus, piriformis, infraspinatus, and supraspinatus muscles (Doggweiler-Wiygul and Wiygul, 2002). BPS/IC patients have moderate-to-marked improvement after manual physical therapy to the pelvic floor (Weiss, 2001).

Dor A, Kalichman L. 2017. A myofascial component of pain in knee osteoarthritis. Journal of Bodywork and Movement Therapies, 21(3):642–647.

Researchers from Israel published a critical review of the role of myofascial pain in patients with osteoarthritis by performing a search of the PubMed, Google Scholar, Scopus, and PEDro databases with keywords “myofascial pain”, “osteoarthritis”, “trigger points”, “knee” or any combination of these words. They identified six interventional studies describing the treatment of myofascial pain in osteoarthritis patients and two observational studies, which showed various treatment options and some evidence that TrPs seem to play a role in knee osteoarthritis, although a causal relationship could not be established. The results are partially in line with previous studies by Bajaj et al., who showed that treating TrP in hip and lower extremity muscles reduced pain attributed to osteoarthritis (Bajaj et al., 2001).

Fernández-De-Las-Peñas, C. & Dommerholt, J, 2018. International consensus on diagnostic criteria and clinical considerations of myofascial trigger points: a Delphi study. Pain Medicine, 19:142-150.

Investigators from Spain and the USA performed a Delphi study to obtain an international consensus on the diagnostic criteria of TrPs and the definition of an active and latent TrP, and to clarify different clinical considerations about myofascial pain syndrome (MPS). A total of 60 of the 65 experts on TrPs and MPS who were contacted completed the study. Three rounds of questions were performed. The first round addressed the question which palpatory findings and signs/symptoms of a TrP are essential or confirmatory for the diagnosis of a TrP. Participants also had to choose a maximum of three options for the diagnosis of an active or latent TrP. Additional closed questions regarding active TrPs were addressed. In the second round, the responses expressed by at least 70% of the participants were used for additional refinement. The same topics from round one were covered with an additional open-ended question describing the difference between active and latent TrPs on clinical examination. For the final round of the study, the responses of less than 70% of the participants in the second round were used, especially whether the presence of referred pain is an essential criterion for active or latent TrPs.

The results of the study revealed that 60 experts considered three important diagnostic criteria for the identification of a TrP: a taut band, a hypersensitive spot, and referred pain. According to the experts, at least two of the three criteria must be present. Referred pain was thought to include more than just the sensation of pain. The most common sensations included pain spreading to a distant area, deep pain, and dull pain. Tingling and burning pain were reported by more than 50% of the participants, but less frequent than the first three symptoms. The definitions of active and latent TrPs were further clarified. This study was well-organized and designed, asking appropriate questions at each level to come to a consensus on several aspects of TrPs that are not used consistently in the literature. As the authors stated, there is a large variation in the definition of a TrP in research studies, which likely will have an impact on outcomes. The addition of this paper to the literature will hopefully standardize some of these concerns for more consistency and possibly better outcomes.

Kearns G, Gilbert, KK, Allen B, Sizer,PS, Brismee JM, Pendergrass T, Lierly M, York, D. 2018. Accuracy and safety of dry needle placement in the piriformis muscle in cadavers. Journal of Manual & Manipulative Therapy, 26:89-96.

A cadaveric study was conducted to establish guidelines for needle length selection and to determine the accuracy of needle placement with DN into the medial third of the piriformis muscle, while avoiding the sciatic nerve. Nineteen unembalmed cadaveric hips were utilized in this study as the principal investigator (PI) used surface anatomy as described by Reichert (2011) to identify the location of the piriformis muscle. The PT selected the needle length based on the size of the cadaver and the estimated depth required to penetrate the piriformis muscle. The needle was inserted immediately lateral to the lateral border of the sacrum, where the piriformis muscle exists the greater sciatic notch and angled toward the pubic symphysis (Dommerholt and Fernández De Las Peñas, 2013). The needle was advanced until the PI estimated the depth to be sufficient to reach the piriformis muscle or ceased once 10 mm of the needle remained exposed outside the buttock. Dissection was then performed to expose the piriformis muscle and sciatic nerve to examine whether the needle was accurately placed in the medial third of the piriformis muscle and if neural puncture had occurred.

The PT utilized a 0.35×75 mm in 15 specimens and a 0.35×100 mm in 4 specimens. The authors reported the needle reached the medial third of the piriformis muscle in 16 of the 19 hips. The authors noted all three failed attempts were performed using a 75 mm needle. Two of the needles were not inserted to a sufficient depth, while the final needle was of appropriate depth however missed the piriformis cranially. Although only the tip of the needle was visible and palpable on the deep surface of the piriformis, the needle did penetrate through the piriformis muscle in three hips. A 100 mm needle was utilized in two of these cases while a 75 mm needle was used in the third specimen. The authors reported there was no puncture of the sciatica nerve in any of the 19 specimens.

The piriformis muscle is often implicated as a source of buttock pain and non-discogenic sciatica (Jankovic et al., 2013; Michel et al 2013a, 2013b). Dry needling has been described in the treatment of this condition, however, there has not been a study investigating the accuracy and safety of DN targeting the medial third of the piriformis muscle. Dalmau-Carolà described injecting the piriformis muscle under video fluoroscopy (Dalmau-Carola, 2005). The authors of the current paper demonstrated that the piriformis muscle can be treated accurately and safely. In addition although the sciatica nerve was not punctured in this study, as noted by the authors if a needle is advanced slowly a patient would note neural symptoms prior to puncture of the nerve. One additional issue needs to be addressed with DN of the piriformis muscle: the sample size of this study is too small to take various anatomical variations in consideration. Although in 89% of cases the sciatic nerve is underneath the piriformis muscle, Lewis et al. established that in almost 9% the common fibular branch of the sciatic nerve passes through the piriformis and in nerly 3% the common fibular branch crosses over the piriformis (Lewis et al., 2016). Nevertheless, this is a well-designed study that confirms a previously described technique for DN of the piriformis muscle and aids the reader in needle length selection.

Lv, H, Li, Z, Hu, T, Wang, Y, Wu, J & Li, Y, 2018. The shear wave elastic modulus and the increased nuclear factor kappa B (NF-kB/p65) and cyclooxygenase-2 (COX-2) expression in the area of myofascial trigger points activated in a rat model by blunt trauma to the vastus medialis. Journal of Biomechanics, 66, 44–50.

The ability to diagnose of a taut band, that may harbor TrPs, depends on the clinician's examination skills and experience. Locating a taut band is important for the diagnosis of myofascial pain syndrome (MPS). Shear-wave elastography (SWE) is a relatively novel noninvasive dynamic and real-time ultrasound (US) imaging technology, that provides an opportunity to objectively quantify muscle stiffness of TrPs. Researchers from China conducted an experimentally controlled animal study to elucidate increased inflammatory cytokines expression, such as nuclear factor kappa B (NF-kB/p65), cyclooxygenase-2 (COX-2), and voltage-gated calcium channels (VGCC) involved in the activation of TrPs using SWE in a rat model, and to evaluate the feasibility of a quantitative analysis of the muscle elastic modulus.

Rats in the experimental group received blunt trauma to the vastus medialis muscle. The authors found that the elastic modulus and electromyography (EMG) data of TrPs in the experimental group were significantly increased. The muscle was harder in the region of the TrPs compared with surrounding muscle, which suggests that ultrasound SWE may be as effective as EMG to detect the elastic modulus in evaluating MPS. SWE may be more convenient and efficient given its non-intrusive manner.

In addition, they found increased levels of NFkB/p65, COX-2, and VGCC expression in the focal area in the experimental group compared to the control group, which provides additional evidence in support of Simon's Integrated TrP Hypothesis (Simons et al., 1999).

Palacios-Ceña M, Ferracini GN, Florencio LL, Ruíz M, Guerrero ÁL, Arendt-Nielsen L, Fernández-de-Las-Peñas C. 2017. The number of active but not latent trigger points associated with widespread pressure pain hypersensitivity in women with episodic migraines, 18(12):2485–2491.

Active TrPs may precipitate migraine attacks (Giamberardino et al., 2007), but to date, no study has investigated the relationship between the presence of TrPs and widespread pressure hypersensitivity in individuals with migraines. The authors from Spain and Denmark conducted a study to investigate the possible association between the number of TrPs and widespread pressure pain sensitivity in women with episodic migraines.

In this study, TrPs were considered to be active when the referred pain elicited during the examination mimicked pain features experienced during a migraine attack. TrPs were considered to be latent when there were no migraine pain features. The authors found that a greater number of active but not latent TrPs in various head, neck and shoulder muscles was associated with widespread pressure hypersensitivity in women with episodic migraines. The temporalis and upper trapezius muscles featured the most active TrPs. The authors hypothesized that it is conceivable that peripheral nociception from active TrPs in muscles innervated by the upper cervical spine nerves (C1-C3) or the trigeminal nerve may contribute as a nociceptive trigger to the trigeminocervical nucleus caudalis by facilitating and contributing to the sensitization process. Furthermore, it is important to consider that peripheral nociception from active TrPs may contribute to the development of more sensitization, and, therefore, contribute to chronicity. Early treatment of active TrPs in individuals with episodic migraines may prevent or postpone the development of widespread pressure pain sensitivity.

Sales do Nascimento, JD, Alburquerque-Sendín, F, Vigolvino, LP, Fortunato de Oliveira, W & De Oliveira Sousa, C, 2018. Inter- and intraexaminer reliability in identifying and classifying myofascial trigger points in shoulder muscles. Archives of Physical Medicine and Rehabilitation, 99:49-56.

Investigators from Spain and Brazil examined both the inter- and intrarater reliability of examiners without clinical experience in several muscles of the shoulder. Furthermore, they assessed the reliability of classifying TrPs in subjects with subacromial impact syndrome (SIS). A total of 52 subjects with SIS and asymptomatic controls were included in the study with the groups being equally divided. Two examiners, a third-year physical therapy student and a recent graduate, performed the assessments on the same day. They received five hours of training by a clinician with six years of experience. The criteria to determine the presence of a TrP were adopted from Simons et al. (1999). The examiners were trained palpating the same muscles of three symptomatic and three asymptomatic volunteers that were included in the study, including the upper and lower trapezius, supraspinatus, infraspinatus, pectoralis minor, and middle deltoid. After one examiner assessed all muscles, the second examiner assessed the same muscles after a rest period of five minutes. The procedure was repeated once.

Results revealed that the intra-examiner reliability for the symptomatic and asymptomatic groups ranged from moderate to perfect. The inter-examiner reliability ranged from moderate to almost perfect in the two groups, except for a few muscles of the symptomatic group on the affected side, which were poor to fair. These results suggest the intra-examiner reliability is acceptable in those without experience; however, the inter-examiner reliability was less reliable.

Considering the increased number of papers being published on DN and TrPs, there is a limited but growing number of recent studies examining the reliability of locating TrPs in muscles (De Groef et al., 2018, Mayoral del Moral et al., 2018, Sales Do Nascimento et al., 2018; Rozenfeld et al., 2017; Sanz et al., 2016; Mora-Relucio et al., 2016; Barbero et al., 2012; Bron et al., 2007; Al-Shenqiti and Oldham, 2005; Hsieh et al., 2000; Lew et al., 1997; Gerwin et al., 1997; Walsh et al., 2017; Njoo and Van Der Does, 1994; Nice et al., 1992). Only a few other studies have considered the reliability with less experienced clinicians (Mora-Relucio et al., 2016; Myburgh et al., 2011; Holsgaard-Larsen et al., 2010). As a result, this paper is a nice contribution to the literature. It would be interesting to perform a similar study, but with an experienced examiner in addition to several inexperienced examiners and see how the results may change.

Tornero-Caballero MC, Salom-Moreno J, Cigarán-Méndez M, Morales-Cabezas M, Madeleine P, Fernández-de-Las-Peñas C. 2016. Muscle trigger points and pressure pain sensitivity maps of the feet in women with fibromyalgia syndrome. Pain Medicine, 17(10):1923-1932

Clinically, referred pain from active TrPs reproduces symptoms experienced by the patient. The authors from Spain conducted a study to investigate whether referred pain patterns from active TrPs in the foot muscles reproduced the symptoms experienced by women with fibromyalgia syndrome (FMS). The authors found that the presence of active TrPs in the foot musculature was not related to a diagnosis of FMS without the presence of foot pain. Women with FMS without foot pain did not have active TrPs in their foot muscles.

The highest number of active TrPs was observed in the flexor hallucis brevis and adductor halluces muscles in women with FMS and foot pain. The authors included the first topographical pressure pain sensitivity maps of the plantar area in women with FMS. Generalized lower pressure pain thresholds (PPTs) in both FMS groups compared with healthy women were observed, but FMS women with foot pain exhibited a larger extent of pressure pain hyperalgesia than those without foot pain.

The results from this study have several potential clinical implications in relation to walking patterns in FMS women and may support the hypothesis that interventions aimed at reducing FMS pain should focus on TrPs. Proper management of foot pain can lead to improvements in walking patterns, so suitable foot orthotics resulting in increased comfort, lower pain intensity, and increased PPT should be considered in foot pain patients.

Zhang H, Lü J-J, Huang Q-M, Liu L, Liu Q-G, Eric, O-A. 2017. Histopathological nature of myofascial trigger points at different stages of recovery from injury in a rat model. Acupuncture in Medicine, 35:445–451.

How TrPs are formed and evolve throughout different stages after injury has not been explored sufficiently in the scientific literature. Researchers from China conducted a research study to investigate the histopathology of TrPs under a transmission electron microscope (TEM) and an optical microscope building on their previously validated animal model. In Huang's previous studies, a rat model of active TrPs was examined after a combination of blunt trauma and eccentric loading a taut band, contracture knots, a local twitch response, spontaneous electrical activity, and abnormal electrical potentials (Huang et al., 2013).

In the current histopathological study, the authors found that TrPs featured contracture knots visible with an optical microscope. The study showed that active TrPs following blunt injury may gradually develop chronic pain with contracture knots. TrPs with fewer contracture knots were similar in nature to latent TrPs, while TrPs with more contracture knots were analogous to active TrPs. Furthermore, the researchers observed fewer and more deformed mitochondria with fewer or vanishing ridge-like mitochondrial structures under the TEM, which are consistent with the ATP energy crisis found within muscle fibers associated with TrPs. They concluded that chronic TrPs may represent a type of chronic myopathy caused by disturbances of local energy supplementation secondary to acute tissue damage. This is an interesting study that expands the knowledge base of TrPs in a rat model.

2. Reviews

Chaudhry FA. 2017. Effectiveness of dry needling and high-volume image-guided injection in the management of chronic mid-portion Achilles tendinopathy in adult population: a literature review. European Journal of Orthopaedic Surgery & Traumatology, 27(4):441-448

Dry needling for tendinopathy is increasingly used even though the literature is inconclusive about the optimal treatment parameters, such as dosage, frequency, and intensity (Krey et al., 2015; Settergren, 2013; Wheeler et al., 2016; Nagraba et al., 2013). This study from the UK explored the effectiveness of DN and high-volume image-guided injection in the management of midportion chronic Achilles tendinopathy. Achilles tendinopathy is a common overuse condition with an incidence of 2.35 per 1000 people (De Jonge et al., 2011). There are only a few papers suggesting that DN may beneficial. High-volume image-guided injections, usually performed with a local anesthetic, normal saline, and corticosteroids, may also improve pain and function. Outcome measures were pain and function, using, for example, the Victorian Institute of Sports Assessment for Achilles Tendon (VISA-A). The author searched Embase, Pubmed, and Medline with the Ovid search engine and keywords Achilles tendinopathy, Achilles tendonitis, high-volume image-guided injection, and dry needling. Only four articles were identified with three case reports of high-volume image-guided injections without a control group. The fourth paper compared high-volume image-guided injection with and without DN.

Although only one paper included DN and concluded that high-volume image-guided injections without DN were more effective than with DN, the author concluded that "ultrasound-guided dry needling with high-volume injection provides good short-to medium-term relief of symptoms in the management of chronic mid-substance Achilles tendinopathy," which does not appear to be supported by the included papers. Case reports cannot really be used to draw any substantial conclusions, and the fourth paper did not provide much evidence for adding DN, which the author readily acknowledged. It is not clear why the author seemed ambiguous about the conclusions as it seemed quite clear that the included studies in this paper do not provide any support for adding DN for Achilles tendinopathy.

Eloqayli, H, 2018. Subcutaneous accessory pain system (SAPS): A novel pain pathway for myofascial trigger points. Medical Hypotheses, 111:55-57.

Myofascial pain syndrome (MPS) is one of the most common forms of musculoskeletal pain with TrPs and somatic referred pain being its hallmark signs. The presentation, initiation, referred pain, and the role of central and peripheral centralization in MPS is complex. Although various theories for the formation of TrPs and referred pain have been described, no single theory can explain all of these components and a causal relationship and a mechanism linking these two components of a TrP are missing. This article explores the questions as to why TrPs behave differently as compared to surrounding muscle tissue and whether TrPs are a primary or secondary dysfunction.

The author proposes the Subcutaneous Accessory Pain System (SAPS) theory in this article to describe the formation of TrPs and presentation of referred pain. Based on preliminary unpublished data of the suppression of TrP local and referred pain following a subcutaneous injection of local anesthetics, the author postulates that the location of this accessory pain system appears to be located in the subcutaneous tissue. The author proposes that "trigger points have an extra-innervation system that connect it with other spinal structures such as the facet, annulus, and may be other trigger points with the subcutaneous fascia playing a role in the pathogenesis or forming a passage for the extra-innervation." This accessory pain system extends from TrPs to the spinal cord segment directly or indirectly via dorsal rami. The author has not published this prior data; therefore, information regarding study design or outcomes is unknown. In addition, although the author reports that individuals in which the SAPS exists are prone to MPS whereas those devoid of this system can sustain the same risk factors without the formation of TrPs or referred pain, there is no discussion as to why the SAPS is present in some individuals and absent in other individuals.

Liu, L, Huang, QM, Liu, QG, Thitham, N, Li, LH, Ma, YT & Zhao, JM, 2018. Evidence for dry needling in the management of myofascial trigger points associated with low back pain: a systematic review and meta-analysis. Archives of Physical Medicine and Rehabilitation, 99: 144–152 e142.

Liu and her colleagues from China conducted a systematic review and meta-analysis to evaluate the current evidence of the effectiveness of DN of TrPs associated with low back pain (LBP) to provide a comprehensive and quantitative evaluation of the post-intervention and follow-up effectiveness compared with other treatments, including laser therapy, tender point needling, superficial dry needling, acupoint acupuncture, sham dry needling, and other physical therapies. A total of 11 randomized controlled trials (RCTs) involving 802 patients were included in the meta-analysis. The low-to-moderate-quality evidence showed that compared with other treatments, DN of TrPs was more effective in alleviating the intensity of LBP and functional disability. The significant effects of DN plus other treatments on pain intensity was superior to DN alone for LBP at post-intervention, but the quality of evidence was low. To date, the data remain insufficient to draw conclusions regarding the follow-up effects of DN compared with other treatments in treating LBP. More multiple-center RCTs with high-quality, large samples, and adequate follow-up, should be conducted to provide high-quality evidence that could suggest the best clinical therapeutic method.

Martin, RL, Chimenti, R, Cuddeford, T, Houck, J, Matheson, JW, Mcdonough, CM, Paulseth, S, Wukich, DK & Carcia, CR, 2018. Achilles pain, stiffness, and muscle power deficits: Midportion Achilles tendinopathy revision 2018. Journal of Orthopaedic and Sports Physical Therapy, 48:A1-A38.

The Orthopaedic Section of the American Physical Therapy Association (APTA) publishes evidence-based clinical practice guidelines for management of patients with musculoskeletal conditions. Content experts were appointed by the Orthopaedic Section of the APTA to provide an update from the original guideline in 2010. Databases for MEDLINE, CINAHL, Cochrane Library and PEDro were searched from 2009 to November 2017 for articles associated with classification, examination, and intervention for Achilles pain, stiffness, muscle power deficits, and midportion Achilles tendinopathy. This article is concisely divided into the following sections that also include a synopsis of the 2010 summary: prevalence, pathoanatomical features, risk factors, clinical course, diagnosis/classification, differential diagnosis, imaging, examination, and intervention. For each topic, a synthesis of the recent literature with the corresponding level of evidence level I–V was given. In addition, a 2018 recommendation grade was given based on the strength of evidence found within the literature.

The article includes numerous interventions as described in the literature including exercise, stretching, manual therapy, patient education, orthoses, iontophoresis, and DN. Two studies were reviewed concerning DN. Wheeler et al. performed a prospective cohort study comparing the outcomes of high-volume image-guided injection (HVIGI) with and without DN (Wheeler et al., 2016). Outcome assessments showed that HVIGI without DN compared to individuals receiving DN resulted in a greater improvement; however, as noted by the authors, confounding factors mean it is not possible to categorically state that this difference was solely due to different injection techniques. In a prospective case series by Yeo et al., subjects received tendon injection of marcaine followed by ultrasound-guided DN combined with a 4-week eccentric exercise program (Yeo et al., 2016). Pain scores at rest and during activity decreased and over 75% of subjects had high or very high satisfaction levels at 12 and 24 months follow-up. The previous 2010 guidelines did not recommend DN, and a 2018 recommendation for the utilization of DN was graded an "F", which was based upon evidence from a Level IV study. Of interest is that several recent DN articles pertaining to the Achilles tendon were not included in these guidelines, such as Settergren (2013) and Krey et al. (2015), among others. Good quality studies are needed to further expand or knowledge and understanding of utilization of DN for Achilles tendinopathy.

3. Dry needling, acupuncture, and injections

Blasco-Bonora PM, Martín-Pintado-Zugasti A. 2017. Effects of myofascial trigger point dry needling in patients with sleep bruxism and temporomandibular disorders: a prospective case series. Acupuncture in Medicine, 35(1):69-74

Investigators from Spain examined the results of DN to the masseter and temporalis TrPs on pain-free maximum mouth opening, pressure pain threshold (PPT) testing, pain intensity, and temporomandibular disorder (TMD) related disability in patients who were diagnosed with sleep bruxism and myofascial TMD. Twenty-three subjects were screened for the study, with 17 of them meeting the inclusion and exclusion criteria. All subjects received one session of DN to the masseter and temporalis muscles. Outcome measures assessed included pain intensity with the Visual Analog Scale (VAS), PPT with a mechanical algometer, pain free maximum mouth opening with a millimeter ruler, and the Jaw Disability Checklist (JDC). All outcome measures were assessed before treatment, immediately after, and one week after treatment except for the JDC, which was not assessed immediately after treatment. Results of the study showed that there was a significant decrease in pain immediately after and one week after compared to baseline. Similarly, a significant increase in pain free maximum mouth opening was found. There was a significant increase in PPT of both the masseter and temporalis muscles immediately and 1 week after treatment compared to baseline. Finally, the JDC showed a large decrease in JDC scores from baseline to one week after treatment, suggesting a significant improvement in jaw functioning. Based on these results the authors concluded that DN of TrPs in the masseter and temporalis muscles with sleep bruxism and myofascial TMD can improve pain, sensitivity, mouth opening and TMD related disability. This is the first paper of its type looking to help manage the symptoms of sleep bruxism and myofascial TMD with DN; however, even though the results are positive, several factors need to be considered, many of which the authors do recognize. This includes a lack of a control group, a small sample size, a short-term follow-up period, other muscles besides the masseter and temporalis were not considered, and the diagnosis of sleep bruxism was not made with a polysomnographic recording. Another factor to consider is that it was only a single treatment, which is not typically reflective of clinical practice. Additionally, it is interesting that part of the inclusion criteria for a TrP in the included muscles was elicitation of a local twitch response. Although this strongly correlates to the presence of a TrP, it is also the least reliable and in these muscles can be more difficult to elicit (Gerwin et al., 1997; Al-Shenqiti and Oldham, 2005).

Castro-Sanchez AM, Garcia-Lopez H, Mataran-Penarrocha GA, Fernandez-Sanchez M, Fernandez-Sola C, Granero-Molina J, Aguilar-Ferrandiz ME. 2017. Effects of dry needling on spinal mobility and trigger points in patients with fibromyalgia syndrome. Pain Physician, 20(2):37-52

Dry needling and joint mobilizations cannot only diminish local pain in patients with fibromyalgia, but can also reduce pain from central sensitization, which is a key feature of fibromyalgia (Affaitati et al., 2011). Staud realized that nociceptive input from muscles is a key component in maintaining the pain patients with fibromyalgia experience (Staud et al., 2006; Staud, 2011), and therefore, this Spanish single-blind randomized controlled trial adds to our understanding of peripheral aspects of fibromyalgia pain. The inclusion criteria were having a diagnosis of fibromyalgia, being in between 18 and 65 years of age, and having limitation of usual activities due to pain, among others. Exclusion criteria focused mostly on having other medical diagnoses. Sixty-four patients diagnosed with fibromyalgia were randomly assigned to an experimental group receiving DN or to a control group for cross tape therapy addressing TrPs in the latissimus dorsi, iliocostalis, multifidus, and quadratus lumbourum muscles. Outcome measures included spinal mobility, measured with the Spinal Mouse and TrP algometry recorded at baseline and after 5 weeks of treatment. The validity and reliability of Spinal Mouse measurements in children with adolescent idiopathic scoliosis was established recently (Livanelioglu et al., 2016). Dry needling reduced the pressure sensitivity of TrPs and the number of TrPs significantly. Subjects in both groups increased their spinal mobility, but the effect size ranged from negligible to small. The study did not determine long-term outcomes and did not include a control group. In clinical practice multiple interventions are commonly used and in that sense, the study is a bit artificial.

Dernek, B, Adiyeke, L, Duymus, TM, Gokcedag, A, Kesiktas, FN & Aksoy, C, 2018. Efficacy of trigger point injections in patients with lumbar disc hernia without indication for surgery. Asian Spine Journal, 12L232-237.

Low back pain (LBP), a common problem treated by primary and specialty physicians, is usually associated with muscular components, among several etiologies and other factors. Intervertebral disc herniation, which can affect the nerve roots and lead to lumbosacral radiculopathy, is one of the most common causes of LBP. Trigger points may develop in specific muscle groups following trauma or overload. Repetitive strain injuries can cause the formation of chronic TPs as well.

Researchers from Turkey conducted a prospective comparative study to investigate the efficacy of gluteal TrP injections with prilocaine in patients with lumbosacral radiculopathy complaining of gluteal pain. Subjects in Group 1 were given TrP injections, a home exercise program, and oral medications, and subjects in group 2 were only treated with a home exercise program and oral medications. They found that patients with radiculopathy, which possibly was due to TrPs in the gluteal region, have favorable results with TrP injections. A previous study by Mahmoudzadeh et al. showed similar results with DN (Mahmoudzadeh et al., 2016).

TrPs in the lumbar area and hip muscles are particularly important sources of nonspecific LBP. TrPs located in the gluteus minimus muscle can mimic sciatica during the chronic phase of radiculopathy. TrP injections may be used when other conservative methods fail. In Dernek et al.'s study, patients undergoing medical therapy and an exercise program comprised the control group. The group receiving TrP injections had significantly reduced pain and improved functional status compared with the controls. The authors believe that the mechanism of action and features of the anesthetic are also important determinants of TrP injection success without providing any evidence of this assumption. Although few studies have used prilocaine, the authors prefer its use for TrP injections.

Espí-López GV, Serra-Añó P, Vicent-Ferrando J, Sánchez-Moreno-Giner M, Arias-Buría JL, Cleland J, Fernández-de-Las-Peñas C. 2017. Effectiveness of inclusion of dry needling in a multimodal therapy program for patellofemoral pain: a randomized parallel-group trial. Journal of Orthopaedic and Sports Physical Therapy, 47(6):392-401

Thirty patients with patellofemoral pain were treated with manual therapy and exercises, while another 30 received additional TrP DN for the vastus medialis and lateralis muscles for a total of 3 sessions once a week for 3 weeks. Outcome measures included the Knee injury and Osteoarthritis Outcome Score (KOOS; 0–100 scale) the Knee Society Score, the International Knee Documentation Committee Subjective Knee Evaluation Form (IKDC), and the numeric pain-rating scale. Measurements were taken at baseline, and at 15 days and 3 months following the treatments. Twee subjects dropped out at the 3-month follow-up. The researchers did not find any significant between-group differences for any outcome, which suggests that including 3 sessions of DN did not effect the outcomes. The study did not include a control group, which means that the within-group changes could be solely due to having received treatments.

Geist K, Bradley C, Hofman A, Koester R, Roche F, Shields A, Frierson E, Rossi A, Johanson M. 2016. Clinical effects of dry needling among asymptomatic individuals with hamstring tightness: a randomized controlled trial. Journal of Sport Rehabilitation, 26(6):507-517

Investigators from the USA performed a randomized controlled trial to determine the effects of DN and stretching on the extensibility of hamstring muscles and functional performance in asymptomatic individuals. Subjects were randomly assigned to either a DN group or a blunt needle group. The patients and investigators were blinded to the assignment of groups. Inclusion criteria included a hamstring flexibility deficit of greater than 20° with 90/90 passive knee extension and being between the age of 18 and 65. The exclusion criteria were thorough and did include not having any other prior DN treatments, which was important to blind the subjects from treatment. Three treatments were performed over a 6–8 week period, followed by the second visit 3–5 days later and the third visit 4–6 weeks after the second visit. During the initial visit hamstring extensibility was assessed along with several unilateral hop tests and dominance testing of the lower extremity. Dry needling was performed at the end of the session. All subjects were instructed in a home stretching program of the hamstrings. During the second and third sessions the hamstring extensibility and single leg hop testing were assessed and DN was performed. The DN technique utilized was a pistoning approach followed by the needles being left in situ for 5 min. This approach was chosen based on a pilot study the investigators performed prior to this study. The needles were inserted at three different locations: 2 cm distal to the ischial tuberosity and in the medial and lateral hamstring bellies half way between the ischial tuberosity and popliteal crease. For the blunt needle group, the handle of a 100 mm needle (with the needle removed) was utilized with the plastic tube of a 50 mm needle. A total of 27 of the 28 subjects who met all criteria completed the study. Results of the study revealed a significant increase in hamstring extensibility on the treated side between the first and second visits and on the untreated side between the second and third visits. There was also a significant increase in hamstring extensibility on both the treated and untreated side between the first and third visits. Both the treated and untreated sides demonstrated a significant increase in performance of the triple hop for the DN group between the first and second visits. There was also a significant effect of time for the single hop for distance, the timed 6 m hop, and crossover hop. Based on these findings the authors concluded that DN of the hamstring muscles does not increase the extensibility any greater than stretching alone but it may have an impact on functional performance.

Overall this is a well-designed study that utilized appropriate ways to measure flexibility and function of the lower extremity. Their findings did not support their original hypothesis, which is in line with a previous study reporting that two sessions of DN did not improve hamstring flexibility (Mason et al., 2016). Similarly, in both studies, there were a limited number of treatments, which may have had an impact on the results. Furthermore, the investigators of this study had designated areas to needle in the hamstring muscles versus needling an area that feels tighter with palpation. It would be interesting to repeat this study with a greater number of DN treatments and a control group to see if the results would be any different.

George, A, Vanetten, L & Briggs, M, 2018. Dry needling for female chronic pelvic pain: a case series. Journal of Women's Health Physical Therapy, 42, 8–16.

Common clinical findings of Chronic Pelvic Pain (CPP) are hypertonicity with a greater degree of tension in the pelvic floor muscles and notable TrPs in the various layers of the deep hip rotators, levator ani, and coccygeus. CPP patients often have difficulty with pelvic muscle relaxation and contraction, abnormal voiding, and maintaining continence. Conservative interventions for CPP include internal and external soft tissue mobilization, electrical stimulation with biofeedback, and therapeutic exercise, however, with mixed results.

The authors presented two case series involving CPP patients who had received previous physical therapy interventions to their lumbar spine, sacroiliac joints, hip joints, and surrounding musculature without noticeable relief. They reported substantial functional limitations secondary to pelvic pain elicited with palpation of pelvic floor muscles, particularly the obturator internus. They demonstrated the powerful impact of adding focused DN to the obturator internus, pelvic floor, and gluteal muscles. These cases illustrate the importance of appropriate pelvic screening for recalcitrant lumbopelvic pain and the potential benefits of utilizing DN interventions to treat a challenging condition and region.

Jin GY, Jin LL, Jin BX. 2016. Dry needling: a de-meridian style of acupuncture. World Journal of Acupuncture-Moxibustion, 26(2):1-5

In this paper, the authors listed their reasons why DN should be considered a form of contemporary acupuncture, or TrP acupuncture. They mentioned that the needles and techniques used in DN are no different than those used in acupuncture. According to the authors, TrPs targeted with DN are the same as acupoints or Ashi points, and lastly, the mechanisms of DN and acupuncture are the same.

Although the development of modern DN theory and its application may appear to be closely associated with the clinical trials and research of acupuncture, in fact, they are based on a totally different medical theory. DN is a needling therapy to stimulate TrPs for the treatment of musculoskeletal and nervous system disease and dysfunction using an injection needle or solid filament needle based on Western neuroanatomy and modern scientific study. Acupuncture is a traditional Chinese management approach to stimulate acupoints or Ashi points primarily for the treatment of internal medicine disease. Acupuncture can also address pain problems following Chinese meridian theories, acupuncture clinical trials, and experimental research.

In 1977, Melzack et al. found a remarkably 71% degree of topographical overlap between TrPs and acupoints (Melzack et al., 1977). In 2000, Hong CZ correlated the “tender points” to acupuncture's Ashi points, and the “local twitch response” to acupuncture's Deqi based on the works of Melzack et al. (Hong, 2000). Both authors attempted to figure out similar phenomena, but they did not address whether DN is equivalent to acupuncture. As we have mentioned previously in this review column, Melzack et al. compared acupuncture point locations to the locations of the crosses in Travell and Simons' referred pain illustrations, which by definition makes the comparison invalid.

Acupuncture practice can be regarded a holistic approach, while DN practitioners typically apply needling only to TrPs and fascial restrictions, which is not to suggest that they could not also be holistic providers. The needling training required for DN practitioners is considerably less involved than the training for acupuncturists, but DN practitioners have completed other graduate education prior to learning DN, such as chiropractic or physiotherapy. In the USA, physical therapists already master 86% of the competencies required for DN practice when they graduate from their entry-level physical therapy education (Caramagno et al., 2015). Obviously, DN practitioners should not claim that they are practicing acupuncture unless they have completed acupuncture training.

Núñez-Cortés R, Cruz-Montecinos C, Vásquez-Rosel Á, Paredes-Molina O, Cuesta-Vargas A. 2017. Dry needling combined with physical therapy in patients with chronic postsurgical pain following total knee arthroplasty: a case series. Journal of Orthopaedic and Sports Physical Therapy, 47(3):209-216

Chronic postsurgical pain (CPSP), defined as moderate to severe pain lasting at least 3 months following surgery, is reported in 6%–10% of post-total knee arthroplasty (TKA) patients. Myofascial pain may contribute to CPSP as has been reported in previous studies. Researchers from Chile conducted a study to determine the short-term clinical and functional effects of DN in combination with therapeutic physical exercises on pain perception, knee joint range of motion, and function. Fourteen patients who after a TKA continued to have with persistent postsurgical pain and TrPs participated in this study. Active and latent TrPs were examined in all operated limbs. Targeted muscles included the tensor fascia latae, hip adductors, hamstrings, quadriceps, and gastrocnemius containing at least one TrP. The patients received weekly DN treatments for 4 weeks combined with therapeutic exercises. They had clinically significant improvements in pain, range of motion, function, and TrPs.

The authors suggested that the positive changes could be because DN can decrease muscle fatigue, which is a common feature of chronic musculoskeletal pain. The presence of TrPs is associated with an increase in muscle fatigue and inactivating TrPs could possible reduce muscle fatigue and improve patients' tolerance to exercise. The combination of DN and therapeutic exercises could be a cost-effective alternative for treating patients with CPSP and associated TrPs following TKA. After all, only 4 DN sessions were needed to obtain significant clinical and functional improvements.

Puentedura EJ, Buckingham SJ, Morton D, Montoya C, Fernandez de Las Penas C. 2017. Immediate changes in resting and contracted thickness of transversus abdominis after dry needling of lumbar multifidus in healthy participants: a randomized controlled cross-over trial. Journal of Manipulative and Physiological Therapeutics, 40:615-623.

The lumbar multifidus (LM) and transversus abdominis (TrA) muscles can play an important role in low back pain (LBP). The muscles act synergistically and in clinical practice, it is common to observe a decreased ability to contract the LM and TrA muscles. The authors conducted a study to investigate whether DN of the LM would change the thickness of the TrA muscle using real-time ultrasound imaging after DN of the LM in asymptomatic participants.

DN of the LM at the level of L4 decreased the resting thickness and increased the thickness during a maximal concentric contraction of the TrA muscle. The authors hypothesized that an increase in the contraction thickness of the TrA muscle may indicate that the muscle has an improved ability to contract. The result of this study partially supports the hypothesis that the TrA muscle may function better after DN of the LM. It is well known that LBP is associated with changes in the activation and strength of the LM and TrA; therefore, DN of the LM may reduce LBP by increasing the contractile ability of the TrA.

Ranoux D, Martiné G, Espagne-Dubreuilh G, Amilhaud-Bordier M, Caire F, Magy L. 2017. OnabotulinumtoxinA injections in chronic migraine, targeted to sites of pericranial myofascial pain: an observational, open label, real-life cohort study. Journal of Headache and Pain, 18(1):75

Sixty-three consecutive patients with chronic migraine participated in this observational, open label, real-life cohort study of the effects of onabotulinumtoxinA injections in the corrugator, temporalis, or trapezius muscles. The total injected dose dependent on the number of muscles that were treated and ranged from 70 to 150 U per session. The researchers looked for muscle tenderness and the presence of TrPs and considered the referred pain patterns from Travell and Simons in determining which muscles to inject. The muscles were injected without making any effort to target TrPs. Instead, the researchers assumed that the onabotulinumtoxinA would disperse sufficiently throughout the muscle. The primary outcome measure was the decrease in the number of days with a headache for a two-month period. Patients were considered responders if they had a greater than 50% decrease in headache day frequency. The secondary outcome measures were the proportion of patients with a greater than 70% decrease in headache day frequency, the decrease in triptan consumption, the time to efficacy onset, the duration of therapeutic effect, and the assessment of patient satisfaction. The injections had a high response rate of 65.1%, with 70.7% of the responders exhibiting a greater than 70% decrease in headache day frequency in at least two consecutive sessions of injections, and 22% being virtually headache-free. The latency of the therapeutic effect was also long-lasting with a mean of 14.8 days. The authors had an interesting speculation and proposed that, in patients with chronic migraines, drug abuse may be a consequence of ancillary myofascial pain rather than the cause of chronicization. of the migraine, which is an idea worthy of further study.

Salom-Moreno J, Jiménez-Gómez L, Gómez-Ahufinger V, Palacios-Ceña M, Arias-Buría JL, Koppenhaver SL, Fernández-de-Las-Peñas

C. 2017. Effects of low-load exercise on postneedling-induced pain after dry needling of active trigger point in individuals with subacromial pain syndrome. PM R, 2017 Dec;9(12):1208–1216.

Postneedling-induced pain or soreness is reported as one of the most common side effects of TrP-DN and is thought to be a consequence of neuromuscular damage generated by the repetitive needle insertions into muscles. Therefore, it is relevant to determine whether clinicians are able to reduce postneedling-induced pain by post-intervention strategies. Salom-Moreno et al. from Spain hypothesized that subjects receiving low-load exercise following TrP-DN would exhibit greater reduction of postneedling-induced pain and greater improvements in pain and disability than those receiving sham ultrasound or no intervention.

The researchers conducted a randomized, parallel-group, controlled trial for subjects with a diagnosis of subacromial pain syndrome with at least one active TrP in the infraspinatus muscle reproducing their shoulder symptoms. Participants assigned to the experimental group received a session of low-load exercise of the shoulder musculature that focused on the infraspinatus muscle with the patient supine. Individuals assigned to the placebo group received 10 min of sham ultrasound on the area of a TrP-DN in the infraspinatus muscle. An application of 1 set of 12 repetitions of low-load contractions was more effective for reducing postneedling-induced pain from active TrPs in the infraspinatus muscle immediately after, 24 h, and 48 h after TrP-DN in subacromial pain syndrome compared to placebo or control interventions. This method is helpful for clinician managing postneedling-induced pain or soreness.

Velázquez-Saornil J, Ruíz-Ruíz B, Rodríguez-Sanz D, Romero-Morales C, López-López D, Calvo-Lobo C. 2017. Efficacy of quadriceps vastus medialis dry needling in a rehabilitation protocol after surgical reconstruction of complete anterior cruciate ligament rupture. Medicine (Baltimore), 96(17):e6726

This study from Spain looked at whether adding DN of TrPs in the vastus medialis muscle to an ACL rehabilitation protocol would improve the pain intensity, range of motion (ROM), stability, and functionality improvements. Forty-four 44 subacute patients with surgical reconstruction of a complete ACL rupture were included in the study. They were randomized into one of two groups with DN being the only difference between the two groups. Outcome measures were determined at baseline, immediately after the first treatment, and than after 24 h, 1 week, and 5 weeks. Pain intensity was increased immediately after DN. ROM improved in the short-term and functionality improved in the short to midterm. Dry needling did not influence stability. The authors identified several limitations to this study, such as small sample size and a lack of analgesic medication monitoring. Post-needling soreness was not assessed. Since DN was the only difference between the two groups, it is conceivable that this may have contributed to the observed outcome. The increased pain immediately after DN is not surprising and has been found in many other studies. This study does provide support for adding DN to an ACL rehabilitation protocol.

4. Manual therapy

Jafari, M, Bahrpeyma, F & Togha, M, 2017. Effect of ischemic compression for cervicogenic headache and elastic behavior of active trigger point in the sternocleidomastoid muscle using ultrasound imaging. Journal of Bodywork and Movement Therapies, 21:933-939.

Iranian researchers explored the effect of ischemic compression of the sternocleidomastoid (SCM) muscle in subjects with cervicogenic headache (CeH) and on the elastic behavior of TrPs with ultrasound imaging. A total of 19 subjects were randomly assigned to the treatment group ($n = 9$) or the control group ($n = 10$) after meeting the inclusion and exclusion criteria. Several outcome measures were assessed including pressure pain threshold (PPT) with a digital algometer, pressure tolerance via maintaining a constant pressure of 2.5 kg/cm^2 to a SCM TrP and then measuring pain on a Visual Analog Scale, TrP modulus, and a headache questionnaire that assessed the frequency, intensity, and duration of headaches. Over a two-week period prior to the baseline and two weeks after the final session the headache questionnaire was completed. All other outcome measures were assessed at the initial and final visit. A total of four treatments were completed within an 8-day period. The treatment group received ischemic compression to an active TrP in the SCM muscle.

Results of the study showed that the treatment group had reduced intensity and frequency of headaches and a shorter duration of headaches compared to the control group. Furthermore, compared to the control group, the treatment group had a significantly decreased pressure tolerance and significant increased PPT. There were no significant changes with the ultrasound measurements including the TrP modulus and TrP area, nor was there a correlation between headache intensity, frequency, and duration with the TrP modulus or TrP area. The topic of this paper is quite interesting and unique since it aimed to assess changes of the TrP with manual techniques, which previously has only been done with DN (Maher et al., 2013). Although the results of this paper suggest that ischemic compression of the SCM muscle can improve symptoms associated with CeH, they should be interpreted with caution. First, the sample size is small. Second, the length of treatment and follow-up are not very long. Additionally, the "expert" physiotherapist and sonographer are not clearly described. There was no mention as to the extent of their training or how many years they have been practicing in their respective content areas. Someone with 2 years of training versus 20 could yield different results. It is also interesting that one of the exclusion criteria was having more than one active TrP in the SCM muscle. From a clinical perspective it is unlikely that there is only one spot in a muscle that will reproduce a patient's familiar pain. Finally, for the pressure tolerance testing there was no time frame discussed for maintaining pressure on the SCM muscle with the algometer. It also was not clearly stated if this was performed before or after the PPT testing or if there was a set rest period between the testing of these two outcome measures, both of which can have an impact on results of both of these. There is also no discussion regarding the reliability or validity of pressure tolerance. As a side note, Simons, Travell and Simons abandoned the term "ischemic compression" in 1999 with the publication of the second edition of the first volume of the Trigger Point Manual (Simons et al., 1999). Since TrPs are already hypoxic, it is highly questionable whether ischemic compression would yield the desired results.

Lee M, Kim M, Oh S, Choi YJ, Lee D, Lee SH, Yoon B. 2017. A self-determination theory-based self-myofascial release program in older adults with myofascial trigger points in the neck and back: A pilot study. Physiotherapy Theory and Practice, 33(9):681-694

Korean investigators performed an interesting study looking at the effectiveness and adherence to a self-determination theory (SDT) based self-myofascial release (SMR) program in older adults with TrPs. They also looked at factors that influenced their behavioral changes while completing the program in the home setting. Of the 44 subjects who were assessed for study eligibility, twenty completed the program. Five were excluded from final analysis due to too many absences, leaving total of 15 subjects who completed the study. All subjects completed both the SMR program and the SDT-based SMR program; there was no control group. For the SMR program two different size inflatable balls were utilized to treat TrPs in the sternocleidomastoid, upper trapezius, pectoralis major, iliopsoas, quadratus lumborum, gluteus maximus, and gluteus medius muscles. The ball was held on the respective muscle for 60 s, twice on each muscle, with a 30-s rest in between. The SDT-based SMR program was divided into two phases. In phase 1 (EP phase), subjects received four weeks of group-based education and practice in a designated room for exercise twice per week for 45 min each. During phase 2 (SM phase), subjects completed an 8-week home-based self-management program. Outcome measures included pain intensity with the Visual Analog Scale (VAS) and pain pressure threshold (PPT) testing of the upper trapezius and quadratus lumborum assessed at baseline, immediately after the EP phase, and 4 and 8 weeks after the SM phase. Cognition and depression were also assessed at baseline with the Mini-Mental State Examination and Geriatric Depression Scale respectively; however, there was no discussion of a post-treatment assessment for these measures. Interviews of the participants were performed in order to investigate factors that influenced participant behavioral changes. There was a significant decrease in pain intensity for the upper trapezius and quadratus lumborum muscles. The upper trapezius had improvements 8 weeks post the SM phase compared to baseline and the post-EP phase. The quadratus lumborum had improvements 4 weeks post the SM phase compared to baseline and post EP phase. For PPT, the upper trapezius showed improvements in the post EP phase, 4 weeks post SM phase, and 8 weeks post SM phase compared to baseline. The quadratus lumborum muscle showed a significant decrease 4 weeks post the SM phase compared to baseline. Interestingly, adherence was greater during the SM phase than during the EP phase. Awareness of the effectiveness, sense of duty to perform the exercise, obedience to expert instruction, and lack of friendship appeared to influence the adherence. Based on these findings the authors concluded that an SDT-based SMR program is effective for the treatment of TrPs and motivating older adults to participate in the program. This is an interesting study that is overall fairly well organized; however, limited conclusions can be drawn from this since the sample size was very small and there was no control group.

5. Other clinical studies and case reports

Chang SH. 2017. Complex regional pain syndrome is a manifestation of the worsened myofascial pain syndrome: case review. Journal of Pain & Relief, 6: 294

The author from Korea described three cases diagnosed with complex regional pain syndrome (CRPS) of the upper or lower extremities using the criteria of the International Association for the Study of Pain. The patients had multiple TrPs in muscles of the involved extremities. According to the author, TrPs injections and DN combined with a sympathetic nerve block are the most effective method for the management of CRPS. Perpetuating factors may cause the onset of myofascial pain syndrome, which, if those perpetuating factors are not eliminated, may result in continuous spontaneous burning pain, allodynia, hyperalgesia in the involved hand or foot with changes in autonomic responses. Chang suggested that CRPS is the manifestation of the symptoms of myofascial pain syndrome through central sensitization. Although the author seems confident in his conclusions, his conclusions do not necessarily match the more common points of view. CRPS is a severe pain condition, and multiple medications and modalities have been suggested however, their effects remain controversial and unpredictable. Further research is needed to substantiate the conclusions of the author.

Dibai-Filho AV, de Oliveira AK, Girasol CE, Dias FR, Guirro RR. 2017. Additional effect of static ultrasound and diadynamic currents on myofascial trigger points in a manual therapy program for patients with chronic neck pain: a randomized clinical trial. American Journal of Physical Medicine & Rehabilitation, 96(4):243–252.

Researches from Brazil performed a single-blinded clinical trial to investigate the additional effects of static ultrasound and diadynamic currents in a manual therapy program in individuals with chronic neck pain. Sixty subjects between the ages of 18 and 45 with chronic mechanical neck pain lasting more than 90 days were included in this study. Subjects were randomly assigned to 3 treatment groups: group 1 ($n = 20$) manual therapy; group 2 ($n = 20$) was treated with manual therapy and static ultrasound; group 3 ($n = 20$) was treated with manual therapy and diadynamic currents. Manual therapy consisted of manual cervical traction, grade III posterior-to-anterior mobilization of C2-C7 spinous processes, myofascial release of the upper trapezius muscle, and static stretching of the upper trapezius muscle. Each subject received 10 treatment sessions, twice a week for 5 weeks. Assessments were performed before and 48 h after the first session, 48 h after the final session for Numeric Rating Scale (NRS), Neck Disability Index (NDI) and Pain-Related Self-Statement (PRSS), pressure pain threshold (PPT), cervical range of motion (ROM), skin temperature over a TrP, and electromyographic activity of upper trapezius. A follow-up was also conducted via telephone or e-mail 4 weeks following the last session for NRS, NDI, and PRSS.

There was no group-versus-time interaction for NRS, NDI, PRSS, PPT, cervical ROM, and skin temperature. The authors reported similar results in all 3 groups: a significant reduction in pain, disability, and catastrophizing, and a significant increase in PPT. The authors also found no significant differences between groups for electromyographic activity of the upper trapezius muscle. Improved outcomes were not observed in individuals that received either static ultrasound or diadynamic current in addition to manual therapy as compared to manual therapy alone. Therefore, clinicians treating patients with TrPs in the upper trapezius may opt for other forms of therapy including strengthening and coordination activities for the cervical spine (Childs et al., 2008).

Waldock, C, 2017. Myofascial pain masquerading as neuropathic pain. Acupuncture in Physiotherapy, 29.

This report describes the case of a 54 year-old male who presented to therapy with a sudden insidious onset of left-sided facial pain and altered sensation in his left arm and hand. The subject had initially been seen in the Emergency Department to determine if his symptoms were of cardiac origin. He was subsequently seen by his general practitioner and referred for physiotherapy assessment. Physical examination revealed normal neck and shoulder range of motion (ROM). Neurological examination and upper-limb tension testing were both negative. Palpation of the muscles of neck and shoulder girdle revealed active TrPs in the left infraspinatus and splenius cervicis and capitis muscles. External rotation weakness was also noted on the left side. The subject received treatment consisting of dry needling (DN) directed at the left infraspinatus and splenius muscles. DN was performed to achieve De Qi and muscle twitch, which was noted in both. The subject was instructed to perform a home exercise program (HEP) consisting of stretching of the splenius and infraspinatus muscles, isometric rotator cuff exercises, and mobility exercises for the neck and shoulder girdle. The subject was seen 7 days later and reported the paraesthesia had eased for approximately 1 h following treatment and requested a second session of DN to the infraspinatus and splenius muscles. The subject was then seen 9 days later and reported at least an 80% resolution of symptoms. Assessment revealed full active ROM of the neck and shoulder girdle with no tenderness noted in either the infraspinatus or splenius muscles.

This case report does highlight the importance of a thorough evaluation and understanding of TrP referral patterns and the subsequent utilization of DN in the treatment of active TrPs. However, this article is limited in the fact that it is a single case report and did not include any objective measurements or outcome measures and there is no follow-up of this subject after his last treatment.

Statement of interest

Jan Dommerholt, Michelle Finnegan and Todd Hooks are affiliated with Myopain Seminars, LLC, Bethesda, MD, USA, an organization that promotes the recognition and treatment of individuals with myofascial pain.

References

Affaitati, G., Costantini, R., Fabrizio, A., Lapenna, D., Tafuri, E., Giamberardino, M.A., 2011. Effects of treatment of peripheral pain generators in fibromyalgia patients. Eur. J. Pain 15, 61–69.

Al-Shenqiti, A.M., Oldham, J.A., 2005. Test-retest reliability of myofascial trigger point detection in patients with rotator cuff tendonitis. Clin. Rehabil. 19, 482–487.

Bajaj, P., Bajaj, P., Graven-Nielsen, T., Arendt-Nielsen, L., 2001. Trigger points in patients with lower limb osteoarthritis. J. Muscoskel. Pain 9, 17–33.

Barbero, M., Bertoli, P., Cescon, C., Macmillan, F., Coutts, F., Gatti, R., 2012. Intra-rater reliability of an experienced physiotherapist in locating myofascial trigger points in upper trapezius muscle. J. Man. Manip. Ther. 20, 171–177.

Bron, C., Franssen, J., Wensing, M., Oostendorp, RaB., 2007. Interrater reliability of palpation of myofascial trigger points in three shoulder muscles. J. Man. Manip. Ther. 15, 203–215.

Calvo, S., Quintero, I., Herrero, P., 2016. Effects of dry needling (DNHS technique) on the contractile properties of spastic muscles in a patient with stroke: a case report. Int. J. Rehabil. Res. 39, 372–376.

Caramagno, J., Adrian, L., Mueller, L., Purl, J., 2015. Analysis of Competencies for Dry Needling by Physical Therapists. Federation of State Boards of Physical Therapy, Alexandria.

Childs, J.D., Cleland, J.A., Elliott, J.M., Teyhen, D.S., Wainner, R.S., Whitman, J.M., Sopky, B.J., Godges, J.J., Flynn, T.W., American Physical Therapy, A., 2008. Neck pain: clinical practice guidelines linked to the international classification of functioning, disability, and Health from the orthopedic section of the American physical therapy association. J. Orthop. Sports Phys. Ther. 38, A1–A34.

Dalmau-Carola, J., 2005. Myofascial pain syndrome affecting the piriformis and the obturator internus muscle. Pain Pract. 5, 361–363.

De Groef, A., Van Kampen, M., Dieltjens, E., De Geyter, S., Vos, L., De Vrieze, T., Geraerts, I., Devoogdt, N., 2018. Identification of myofascial trigger points in breast cancer survivors with upper limb pain: interrater reliability. Pain Med. https://doi.org/10.1093/pm/pnx299.

De Jonge, S., Van Den Berg, C., De Vos, R.J., Van Der Heide, H.J., Weir, A., Verhaar, J.A., Bierma-Zeinstra, S.M., Tol, J.L., 2011. Incidence of midportion Achilles tendinopathy in the general population. Br. J. Sports Med. 45, 1026–1028.

Doggweiler-Wiygul, R., Wiygul, J.P., 2002. Interstitial cystitis, pelvic pain, and the relationship to myofascial pain and dysfunction: a report on four patients. World J. Urol. 20, 310–314.

Dommerholt, J., Fernández De Las Peñas, C., 2013. Trigger point Dry Needling; an Evidenced and Clinical-based Approach. Churchill Livingstone, Edinburgh.

Gerwin, R.D., Shannon, S., Hong, C.Z., Hubbard, D., Gevirtz, R., 1997. Interrater reliability in myofascial trigger point examination. Pain 69, 65–73.

Giamberardino, M.A., Tafuri, E., Savini, A., Fabrizio, A., Affaitati, G., Lerza, R., Di Ianni, L., Lapenna, D., Mezzetti, A., 2007. Contribution of myofascial trigger points to migraine symptoms. J. Pain 8, 869–878.

Holsgaard-Larsen, A., Myburgh, C., Hartvigsen, J., Rasmussen, C., Hartvig, M., Marstrand, K., Aagaard, P., 2010. Standardized simulated palpation training – development of a Palpation Trainer and assessment of palpatory skills in experienced and inexperienced clinicians. Man. Ther. 15, 254–260.

Hong, C.-Z., 2000. Myofascial trigger points: pathophysiology and correlation with acupuncture points. Acupunct. Med. J. Br. Med. Acupunct. Soc. 18, 41–47.

Hsieh, C.Y., Hong, C.Z., Adams, A.H., Platt, K.J., Danielson, C.D., Hoehler, F.K., Tobis, J.S., 2000. Interexaminer reliability of the palpation of trigger points in the trunk and lower limb muscles. Arch. Phys. Med. Rehabil. 81, 258–264.

Huang, Q.M., Ye, G., Zhao, Z.Y., Lv, J.J., Tang, L., 2013. Myoelectrical activity and muscle morphology in a rat model of myofascial trigger points induced by blunt trauma to the vastus medialis. Acupunct. Med. J. Br. Med. Acupunct. Soc. 31, 65–73.

Jankovic, D., Peng, P., Van Zundert, A., 2013. Brief review: piriformis syndrome: etiology, diagnosis, and management. Can. J. Anaesth. 60, 1003–1012.

Krey, D., Borchers, J., Mccamey, K., 2015. Tendon needling for treatment of tendinopathy: a systematic review. Physician Sportsmed. 43, 80–86.

Lew, P.C., Lewis, J., Story, I., 1997. Inter-therapist reliability in locating latent myofascial trigger points using palpation. Man. Ther. 2, 87–90.

Lewis, S., Jurak, J., Lee, C., Lewis, R., Gest, T., 2016. Anatomical variations of the sciatic nerve, in relation to the piriformis muscle. Transl. Res. Anat. 5, 15–19.

Livanelioglu, A., Kaya, F., Nabiyev, V., Demirkiran, G., Firat, T., 2016. The validity and reliability of "Spinal Mouse" assessment of spinal curvatures in the frontal plane in pediatric adolescent idiopathic thoraco-lumbar curves. Eur. Spine J. 25, 476–482.

Maher, R.M., Hayes, D.M., Shinohara, M., 2013. Quantification of dry needling and posture effects on myofascial trigger points using ultrasound shear-wave elastography. Arch. Phys. Med. Rehabil. 94, 2146–2150.

Mahmoudzadeh, A., Rezaeian, Z.S., Karimi, A., Dommerholt, J., 2016. The effect of dry needling on the radiating pain in subjects with discogenic low-back pain: a randomized control trial. J. Res. Med. Sci. 21, 86.

Mason, J.S., Crowell, M., Dolbeer, J., Morris, J., Terry, A., Koppenhaver, S., Goss, D.L., 2016. The effectiveness of dry needling and stretching vs. Stretching alone on hamstring flexibility in patients with knee pain: a randomized controlled trial. Int J Sports Phys Ther 11, 672–683.

Mayoral Del Moral, O., Torres Lacomba, M., Russell, I.J., Sánchez Méndez, A.O., Sánchez Sánchez, B., 2018. Validity and reliability of clinical examination in the diagnosis of myofascial pain syndrome and myofascial trigger points in upper quarter muscles. Pain Med. in press.

Melzack, R., Stillwell, D.M., Fox, E.J., 1977. Trigger points and acupuncture points for pain: correlations and implications. Pain 3, 3–23.

Michel, F., Decavel, P., Toussirot, E., Tatu, L., Aleton, E., Monnier, G., Garbuio, P., Parratte, B., 2013a. The piriformis muscle syndrome: an exploration of anatomical context, pathophysiological hypotheses and diagnostic criteria. Ann Phys Rehabil Med 56, 300–311.

Michel, F., Decavel, P., Toussirot, E., Tatu, L., Aleton, E., Monnier, G., Garbuio, P., Parratte, B., 2013b. Piriformis muscle syndrome: diagnostic criteria and treatment of a monocentric series of 250 patients. Ann Phys Rehabil Med 56, 371–383.

Mora-Relucio, R., Nunez-Nagy, S., Gallego-Izquierdo, T., Rus, A., Plaza-Manzano, G., Romero-Franco, N., Ferragut-Garcias, A., Pecos-Martin, D., 2016. Experienced versus inexperienced interexaminer reliability on location and classification of myofascial trigger point palpation to diagnose lateral epicondylalgia: an observational cross-sectional study. Evid Base. Compl. Alternat Med 2016, 6059719.

Myburgh, C., Lauridsen, H.H., Larsen, A.H., Hartvigsen, J., 2011. Standardized manual palpation of myofascial trigger points in relation to neck/shoulder pain; the influence of clinical experience on inter-examiner reproducibility. Man. Ther. 16, 136–140.

Nagraba, L., Tuchalska, J., Mitek, T., Stolarczyk, A., Deszczynski, J., 2013. Dry needling as a method of tendinopathy treatment. Ortop. Traumatol. Rehabil. 15, 109–116.

Nice, D.A., Riddle, D.L., Lamb, R.L., Mayhew, T.P., Rucker, K., 1992. Intertester reliability of judgments of the presence of trigger points in patients with low back pain. Arch. Phys. Med. Rehabil. 73, 893–898.

Njoo, K.H., Van Der Does, E., 1994. The occurrence and inter-rater reliability of myofascial trigger points in the quadratus lumborum and gluteus medius: a prospective study in non-specific low back pain patients and controls in general practice. Pain 58, 317–323.

Reichert, R., 2011. Palpation Techniques: Surface Anatomy for Physical Therapists. Thieme Verlag, Stuttgart.

Rozenfeld, E., Finestone, A.S., Moran, U., Damri, E., Kalichman, L., 2017. Test-retest reliability ofmyofascial trigger point detection in hip and thigh areas. J. Bodyw. Mov. Ther. (in press).

Sales Do Nascimento, J.D., Alburquerque-Sendín, F., Vigolvino, L.P., Fortunato De Oliveira, W., De Oliveira Sousa, C., 2018. Inter- and intraexaminer reliability in identifying and classifying myofascial trigger points in shoulder muscles. Arch. Phys. Med. Rehabil. 99, 49–56.

Sanz, D.R., Lobo, C.C., Lopez, D.L., Morales, C.R., Marin, C.S., Corbalan, I.S., 2016. Interrater reliability in the clinical evaluation of myofascial trigger points in three ankle muscles. J. Manipulative Physiol. Therapeut. 39, 623–634.

Settergren, R., 2013. Treatment of supraspinatus tendinopathy with ultrasound guided dry needling. J Chiropr Med 12, 26–29.

Simons, D.G., Travell, J.G., Simons, L.S., 1999. Travell and Simons' Myofascial Pain and Dysfunction; the Trigger point Manual. Williams & Wilkins, Baltimore.

Staud, R., 2011. Peripheral pain mechanisms in chronic widespread pain. Best Pract. Res. Clin. Rheumatol. 25, 155–164.

Staud, R., Vierck, Cj, Robinson, Me, Price, Dd, 2006. Overall fibromyalgia pain is predicted by ratings of local pain and pain related negative affect: possible role of peripheral tissues. Rheumatol (Oxford) 45, 1409–1415.

Walsh, R., Kinsella, S., Mcevoy, J., 2017. The intra-rater reliability of locating and

measuring the severity of latent trigger points in the quadriceps. J. Bodyw. Mov. Ther. 21, 926–932.
Weiss, J.M., 2001. Pelvic floor myofascial trigger points: manual therapy for interstitial cystitis and the urgency-frequency syndrome. J. Urol. 166, 2226–2231.
Wheeler, P.C., Mahadevan, D., Bhatt, R., Bhatia, M., 2016. A comparison of two different high-volume image-guided injection procedures for patients with chronic noninsertional Achilles tendinopathy: a pragmatic retrospective cohort study. J. Foot Ankle Surg. 55, 976–979.
Yeo, A., Kendall, N., Jayaraman, S., 2016. Ultrasound-guided dry needling with percutaneous paratenon decompression for chronic Achilles tendinopathy. Knee Surg. Sports Traumatol. Arthrosc. 24, 2112–2118.