A Literature Review on Dry Needling and Traditional Acupuncture for Treating Myofascial Pain

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Advisor Acceptance Page

To the faculty of American College of Traditional Chinese Medicine at CIIS, DAOM Program:

The undersigned find that the capstone research of Samantha Hodges is satisfactory and recommend it be accepted.

Capstone research project title:

A Literature Review on Dry Needling and Traditional Acupuncture for Treating Myofascial Pain

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Abstract

This literature review was conducted in on order to determine if dry needling (DN) is more effective that traditional acupuncture (TA) in the treatment of myofascial pain. Likewise, physiological mechanisms of DN and TA were investigated to determine if DN was superior to TA in the treatment of myofascial pain. This review is composed of peer reviewed literature evaluating the bio mechanisms theorized to achieve pain relief in DN and TA. Research specifically on TA for myofascial pain was scarce. The evidence did not prove that DN is superior to TA in the treatment of myofascial pain. Neither did it prove the mechanism of DN to be different to TA in the treatment of myofascial pain. Dry needling appear to be a derivative form of TA, yet it proves effective at treating myofascial pain. The literature does show that the impact of TA on the limbic system may improve both metrics of stress and sleep, which have been shown to be prognostic factors in the treatment outcome with DN. The research did favor specific needling technique, suggesting that rotation is more beneficial than pistoning (lifting and thrusting in TA), that shallow and deep needling may achieve similar results, and that there may be no need for a latent twitch response. Integrative language between Western medicine and Eastern medicine age may assist to translate traditional Chinese medicine (TCM) into modern physiology and anatomy. Further research should test the combination of local and distal needling to each individually and test point selection based on differential diagnosis.

Keywords: acupuncture, acupuncture therapy, traditional Chinese medicine, trigger points, myofascial pain, dry needling, pain mechanism, fMRI, traditional acupuncture, meridian acupuncture

Table of Contents

List of Tables

List of Figures

Introduction

Background

This literature review was conducted in order to determine if dry needling (DN) is more effective that traditional acupuncture (TA) in the treatment of myofascial pain. Additionally, literature was reviewed to determine if there was a difference in the physiological mechanisms of DN and TA. Sources include peer reviewed articles, randomized controlled trails, meta-analysis, case studies, and textbooks.

Myofascial trigger points (TrPs) were first discovered coincidently by Dr. Janet Travell when she began her career in cardiology and general medicine (Simons, Travell, & Simons 1999). Her interest in myofascial pain was sparked when she noticed that despite a patient's primary diagnosis, when asked how they felt, they complained more commonly about physical discomfort. She noticed that shoulder pain was a common response in her patients as well as her clinic secretary. The pain pattern reported was the same in all of those patients. These similar patterns in both her patients and her secretary inspired Dr. Travell to examine this condition. She found common isolated tender spots in the same location in these patients that reproduced their pain when compressed. Given this finding, she decided to investigate the phenomenon further. Students at Cornell Medical College, taking her pharmacology class, helped her research this new phenomenon. This led to further exploration of the functionality and therapeutic use of trigger points, leading her away from her prior concentration on cardiology towards her legacy as a pioneer in musculoskeletal pain (Simons et al., 1999).

Her most notable accomplishment is treating myofascial pain by either injecting trigger points or using a "spray and stretch" therapy to the muscles affected by trigger points (Simons et al., 1999). The respect for her work went as far as the White House. She was brought on staff to treat President John F. Kennedy for his chronic debilitating back pain. Her techniques and evaluations are actively used today by medical professionals treating myofascial pain (Simons et al., 1999).

There is substantial evidence proving that DN is indeed a form of TA. The first evidence-based publication on the topic was done by R. Melzack, Stillwell, & Fox (1977), who reviewed 56 trigger points (TrPs) and compared them to TA acupuncture points used to treat pain in the same regions of the body. They found that 71% of the TrPs have the same pain indications as the acupoints studied (R. Melzack et al., 1977).

It was not until 2004 that this theory was challenged. Birch (2004) reviewed several pieces of TCM literature, trying to correlate classical acupuncture points indicated for pain with TrPs. According to Birch's review of the literature, there was only an 18% correspondence. Birch concluded that the only correlation between TA and TrPs were ashi points (Birch, 2004).

Dorsher and Fleckenstein (2008) produced groundbreaking work when they superimposed anatomy images with 255 common TrPs and 361 classical acupuncture points. Not only did they discover a 93.3% anatomical correspondence, but 81.5% demonstrated complete or near-complete correlation to the myofascial-referred pain (Dorsher & Fleckenstein, 2008). Their findings are presented in Figure 1.

Thanks to the work of Dorsher and Fleckenstein (2008), this literature review does not report on whether a trigger pain is an acupuncture point. The focus is whether there is a difference in only treating the local trigger point, as is done in DN, versus treating myofascial pain using TA. which includes both local and distal needling. In addition to treatment outcomes, this literature review will investigate the mechanism of the two techniques.

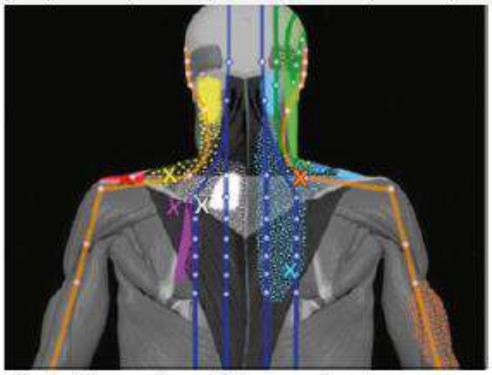

Fig. A: Three regions of the trapezius. Common trigger points in x's. Referred pain pattern are as follows: urinary bladder (UB)-blue, Large Intestine (LI)- pink, gall bladder (GB)- green, San Jiao (SJ)- orange

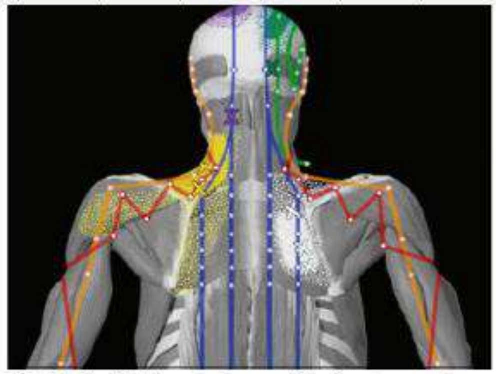

Fig. B: Occipitals, splenius capitis, levator scapulae, rhomboid major and minor. UB-blue, GB-green, Small Intestine (SI)- red, SJ- orange

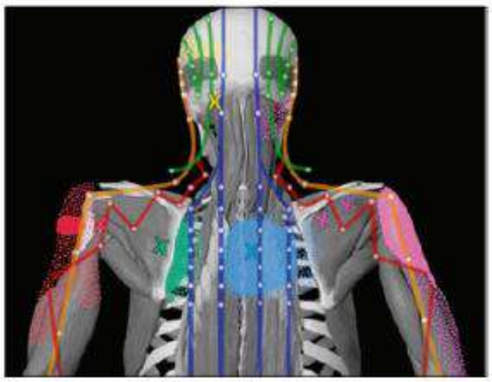

Fig. C: Semispinalis cervicis, infraspinatus, teres minor, multifidi, UB-blue, GB-green, SI-red, SJ-orange

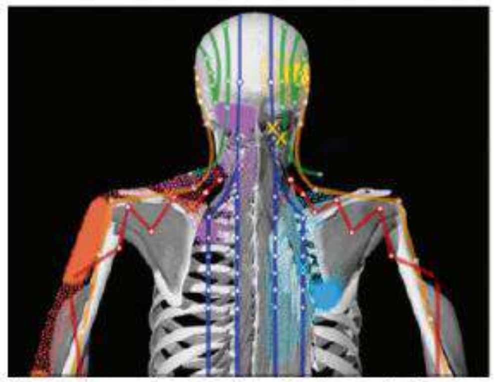

Fig. D: Supraspinatus, suboccipitals, cervical multifidi, iliocostalis, UB-blue, GB-green, SI-red, SJ-orange

Fig. E: Anterior deltoid, coracobrachialis, medial aspect of medial head of triceps, biceps brachioradialis, pronator teres, flexor digitorum superficialis, Heart (HT)- red, LI-purple, LU-pink, Pericardium (PC)-orange

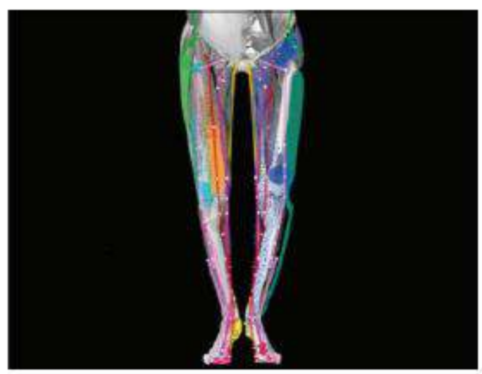

Fig. F: Gluteus minimums, tensor fasciae latae, rectus femoris, adductor brevis, adductor longus, vastus medialis, tibialis anterior, abductor hallucis, first dorsal interosseus, GB-green, Kidney (KI)-yellow, Liver (LV)- dark pink, Stomach (ST)-light pink, Spleen (SP)-red

Figure 1. Location of trigger points on meridians. From "Trigger Points and Classical Acupuncture Points Part 3: Relationships of Myofascial Referred Pain Patterns to Acupuncture Meridians," by P.T. Dorsher and J. Fleckenstein, 2008, *German Journal of Acupuncture and Related Techniques, 9,* p.12-13*.* Copyright 2008 by Springer Nature. Reprinted with permission.

Who can practice acupuncture.

According to the Center for Disease Control (CDC), as of 2016, 20.4% of U.S. adults suffer from chronic pain (Dahlhamer et al., 2018). The increased popularity of acupuncture, with over 10 million acupuncture treatments occurring annually in the US, has been attributed to its effectiveness in pain relief and the emergence of empirical research supporting its efficacy (Hao & Mittelman, 2014).

Medical professionals other than licensed acupuncturists are permitted to practice acupuncture. States that do not allow dry needling are; Washington, Orgon, California, New York, Pennsylvania, New Jersey, and Florida ("U.S. state dry needling scope of practice decisions," n.d.). Several states allow chiropractors to do dry needling. States in which chiropractors are not allowed to practice are California, Georgia, Hawaii, Kentucky, Minnesota , Mississippi, Montana, New Jersey, New York, Nevada, Organ, Pennsylvania, Rhode Island, South Carolina, Washington, and Wisconsin ("State requirements for chiropractic acupuncture," n.d.). In most states, medical doctors can practice acupuncture under their medical license; however, many states require a certain number of hours to be accredited, while Hawaii, Montana and New Mexico require a separate acupuncture license (Lin & Tung, 2017).

Although various medical professions are permitted to perform acupuncture, acupuncture techniques vary greatly with the training of the practitioner. This review will compare the techniques and results of the DN approach and the TA approach.

Method

For this literature review, the execution of keywords into databases such as EBSCO, PubMed, MEDLINE, Google Scholar, etc. was imperative. All research focused on the efficacy of dry needling and traditional acupuncture in the treatment of myofascial pain and the mechanisms. Table 1 includes the keyword searches and the articles that the author of this literature review retrieved.

Table 1. *Search Strategies*

Key Words	**Database**	**Articles found**
Myofascial pain AND Acupuncture	MEDLINE (EBSCO)	266
	PubMed	307
	Google Scholar (2009-2019)	9,860
Myofascial pain AND Dry Needling	MEDLINE (EBSCO)	193
	PubMed	235
	Google Scholar (2009-2019)	4,260
Myofascial Pain AND Traditional Acupuncture	MEDLINE (EBSCO)	12
	PubMed	31
	Google Scholar (2009-2019)	4,760
Myofascial Pain AND Meridian Acupuncture	MEDLINE (EBSCO)	2
	PubMed	79
	Google Scholar (2009-2019)	1,870
Myofascial Pain AND Acupuncture AND Mechanism	MEDLINE (EBSCO)	24
	PubMed	18
	Google Scholar (2009-2019)	6,780
acupuncture AND adenosine	MEDLINE (EBSCO)	110
	PubMed	142
	Google Scholar (2009-2019)	6,780
Acupuncture AND fMRI	MEDLINE (EBSCO)	71
	PubMed	667
	Google Scholar (2009-2019)	8,640

Several additional articles were found by scanning the references listed in formerly searched articles. The majority called for more extensive study.

The research papers were grouped according to patterns or trends found in the research. Studies that directly compared DN and TA were limited in number, but by grouping similar bodies of research, this review defines what has been published and accessible to date.

Research Question and Hypothesis

This literature review was conducted to investigate if DN is superior to TA in the treatment of myofascial pain. The literature review also reviewed literature to determine if the mechanism of DN differentiates from TA.

Literature Review

This literature review provides recent findings for pain relief via needling therapies and the impact different needling therapies have on myofascial pain, as well as subjective data from patients on pain relief.

Definitions of Therapy Terms

Acupuncture points on meridians and meridians themselves have pertinent indications that may address pain or other symptoms. Traditional acupuncture (TA) uses a filiform needle inserted in specific areas on the body based on the theoretical concept of meridians that was developed well over 2,000 years ago (Zhou, Ma, & Brogan, 2015). In an effort to bring a comprehensive understanding of Chinese medicine to the world, three International Acupuncture Training Centers where established in Beijing, Shanghai, and Nanjing starting in 1975 with the backing of the Chinese Government (Deng et al., 1999). Later texts describe that at that time, *Essentials Of Chinese Medicine* was the textbook used (Deng et al., 1999). Students of these training centers felt that the text was inadequate in discussing basic theories and there was a need for more research. The Ministry of Public health permitted these training centers to put together curriculum they deemed adequate at teaching Chinese Medicine to foreign students (. The result was *Chinese Acupuncture and Moxibustion (CAM). CAM* covers the history of Chinese medicine, the different meridians, collaterals, and points associated with Chinese medicine and the etiology, pathogenesis and diagnostic methods of which to use (Deng et al., 1999).

Dry needling (DN) is the Western medical adaptation of acupuncture. It is based on the current understanding of human anatomy and physiology as it pertains to myofascial pain and TrPs (Zhou et al., 2015). A trigger point is located in a taut band of skeletal muscle that is hyperirritable and elicits pain when stretched, compressed, overloaded, or contracted. When irritated, a corresponding referred pain typically radiates away from the site of the trigger point (Dommerholt & Fernández-de-las-Peñas, 2018).

Normal Physiology of the Muscle Motor End Plate

Skeletal muscle is composed of several structures. The skeletal muscle has muscle fascicles composed of muscle fibers containing filaments of actin proteins as well as tropomyosin and tropin proteins (I-band) and myosin proteins (Z-band) (Carroll, 2007). These filaments are positioned separately from each other at opposing ends, and they connect by the structural protein, titin (Carroll, 2007).

A muscle contraction is initiated via the upper motor neurons in the motor cortex (Carroll, 2007). Such an efferent motor axon's synapse on the spinal cord generates an action potential in the alpha motor neuron, which spreads along axons on the membrane of the muscle cell, creating a neuromuscular junction (Figure 2). Although it is negative at rest, when an action potential occurs, sodium comes in through the voltage-gated channels, and the buildup of cations begins to change the charge of the cell to a more positive charge, and hence, the cell becomes depolarized. This depolarization activates voltage-sensitive calcium channels, and allows the calcium to enter the axon terminal, docking along the membrane in the active zone. The docking of calcium causes exocytosis of acetylcholine (ACh) to initiate synaptic transmission across the cleft, binding to the receptors along the fold of the membrane. This subsequently opens sodium channels, which allows the ions to flow in, leading to further depolarization and end-plate potential rising. Open voltage-gated sodium channels lead to an action potential that travels along the muscle fiber to the T-Tubule, altering the conformation of the dihydropyridine (DHP) receptor, which releases calcium into the sarcoplasmic reticulum (SR). Calcium then binds to troponin, which frees the myosin-binding sites, permitting actin and myosin to bind, resulting in the myosin head pivoting and shortening the sarcomere (Figure 3). The contraction will continue until the motor neuron terminates the signaling, which repolarizes the sarcomere and T-tubules and closes the voltage-gated channels in the SR, causing calcium to be pumped back into the SR and tropomyosin to cover the binding sites on the actin. The contraction can also be terminated if adenosine triphosphate (ATP) stores are depleted (Carroll, 2007).

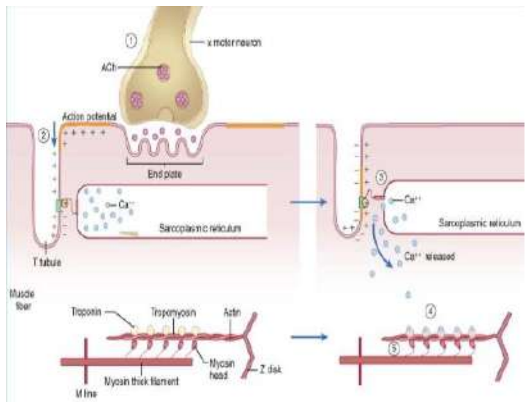

Figure 2. Motor end plate generation of action potential. The action potential begins with the release of ACh. 2. The ACh then binds to the postsynaptic receptor resulting in an action potential across the cell membrane 3. Along the T-tubule, the action potential modifies the conformation of the dihydropyridine (DHP) receptor resulting in calcium being released from the sarcoplasmic reticulum 4. Calcium binds to troponin, triggering actin-myosin binding 5. The myosin head pivots, causing the sarcomere to shorten. From "Musculoskeletal system," by R.G. Carroll, 2007, in *Elsevier's Integrated Physiology.* Retrieved from: https://www.sciencedirect.com/topics/medicine-and-dentistry/motor-end-plate. Copyright 2007 by Elsevier. Reprinted with permission.

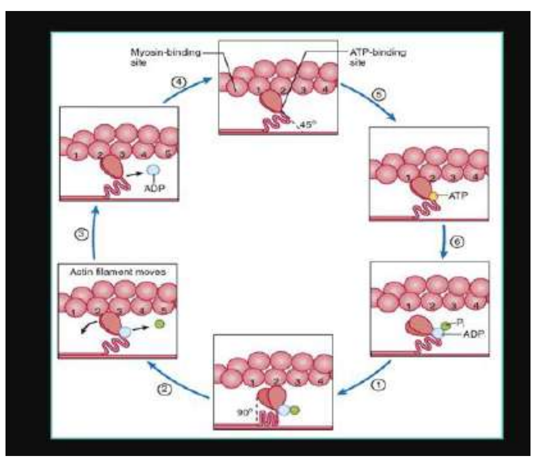

Figure 3. Contraction occurs due to changes in the position of myosin motor protein. Once the binding of the myosin head to actin occurs, inorganic phosphate is released (Pi) 2. The power stroke is initiated, and the myosin head moves to a 45-degree angle, shortening the sarcomere. 3. The initiation of the power stroke results **in** dissociation of ADP 4. Myosin is bound to actin at a 45-degree angle 5. ATP binds to myosin, breaking the bond between actin and myosin. Hydrolysis of ATM causes the myosin head to move at a 90-degree angle, allowing it to again bind to actin. This power stroke repeats as long as there is sufficient ATP and calcium. From "Musculoskeletal system," by R.G. Carroll, 2007, in *Elsevier's Integrated Physiology.* Retrieved from: https://www.sciencedirect.com/topics/medicine-and-dentistry/motor-end-plate. Copyright 2007 by Elsevier. Reprinted with permission.

Pathology at the Motor End Plate

Motor end-plate noise (EPN), found at the end-plate zone of skeletal muscle, is potentially related to acetylcholine released from nerve endings (L. Chou, Hsieh, Kao, & Hong, 2009). When a taunt band occurs, which is associated with TrPs, there is a crisis. Acetylcholine leaks from the nerve endings, resulting in a heightened ischemia-induced inflammatory reaction and an increase in pain. Theoretically, a correlation exists between pain intensity and EPN changes in the TrPs region (L. Chou et al., 2009). To test this hypothesis, L. Chou et al. (2009) used two acupuncture points, *Waiguan* (SJ-5) and *Quchi* (LI-11), to treat neck and shoulder pain and recorded the activity. The electromyogram (EMG) recordings were measured with a 2-channel portable digital miniature EMG equipment. The sham control group had a needle that touched the skin, but there was no penetration of the skin. The acupuncture group had the needle inserted and stimulated to achieve *deqi* for 15 seconds and retained the needle for three minutes. Their results showed an increase in EPN initially with the insertion of the needle then a dramatic decrease to levels below what was recorded before the needle was inserted. Along with a decrease in EPN, there was a decrease in pain intensity (L. Chou et al., 2009).

Based on ten years of research in the pathophysiology of myofascial trigger points, Ge, Fernández-de-las-Peñas , and Yue (2011) suggest that a dysfunction of the motor end plate known also as spontaneous electrical activity (SEA) contributes to local and referred pain of active TrPs. Damage to a muscle due to trauma (excessive overloading, excessive exercise, unfamiliar exercise, prolonged ischemia) results in pathological depolarization of the cell, leading to in an enormous amount of calcium and sodium flooding the cells, causing an elevation of the spontaneous action potential at the motor end plate. The authors theorize that;

If EPP (a local depolarization of the muscle fibers) exceeds a certain critical level (by summation of successive EEPs), endplate spikes are initiated, explaining the clinical phenomenon that spontaneous electrical activity associated with myofascial trigger points is registered only in a localized spot in the muscle with intramuscular needle EMG (Figure 4). (Ge, Fernández-de-las-Peñas , & Yue, 2011 p.2)

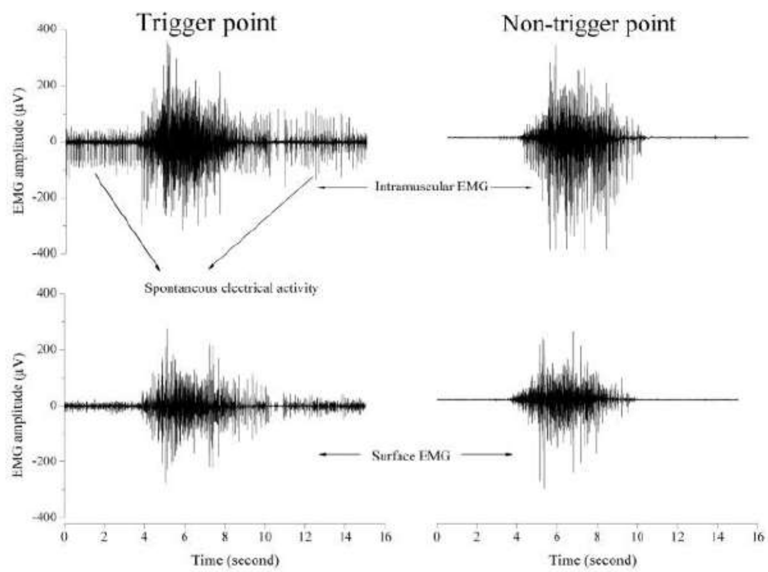

Figure 4. Electromyographic (EMG) activity of the spontaneous electrical activity (SEA) of a myofascial trigger point (MTP) (MTP) during muscle contraction of the trapezius. The surface EMG readings are similar due to needling of the MTP. From "Myofascial trigger points: spontaneous electrical activity and its consequences for pain induction and propagation," by H. Ge, C. Fernández-de-las-Peñas, and S. Yue, 2011, *Chinese Medicine Journal*, *6* (13), p. 3. Copyright 2011 by Wolters Kluwer. Reprinted with permission.

Possible Mechanisms of Acupuncture in the Treatment of Myofascial Pain

Gate control theory.

Arguably the most significant contribution to the theory of pain mechanisms was by R. Melzack and Wall in their 1965 article on the gate control system in the journal *Science*. They noted that there was not a fixed direct line of communication from skin to brain in response to a noxious stimuli resulting in pain from "pain receptors" being activated, confronting the specificity and pattern theory (R. Melzack & Wall, 1965). The specificity theory could not explain phantom limb pain or the lack of pain soldiers felt despite substantial injuries and instead they experienced joy and relief at having survived battle. They also challenged the simplicity of the pattern theory which suggested that the majority of nerve fiber endings were similar, without specificity in receptors. R. Melzack and Wall set out to prove that pain was more complex and multifaceted than previously thought (R. Melzack & Wall, 1965).

What R. Melzack and Wall (1965) came up with were three intermingling systems that regulated the phenomena of pain: cells of the substantia gelatinase in the dorsal horn of the brain stem, afferent patterns in the dorsal column system, and transmission of both large and small sensory fibers in the dorsal horn. The substantia gelatinase receives signals from the fast and heavily myelinated A-delta fibers and the slower moving lesser myelinated C-fibers. The A-delta fibers respond to mechanoreceptors while the C-fibers respond to nociceptors. Nociceptors respond to noxious stimuli resulting in pain. An example of how the "gate" works is the incidence of a boxer getting punched in the face who then massages the area after the incident. In explaining why rubbing reduces pain, R. Melzack and Wall's reported that mechanoreceptors activated by rubbing stimulate the fast-acting A-delta fibers which increase the inhibitory interneuron on the pain signals. Hence, closing the gate which keeps the pain signals from reaching the brain (R. Melzack & Wall, 1965).

The blocking of pain via the "gate" can also go the opposite direction (R. Melzack & Wall, 1965). This would explain the case mentioned earlier about the soldiers, who despite significant injuries, did not report pain as they were overcome with joy and relief from having survived the battle. Various emotions and activations of different regions of the brain are able to transform the gate control system (R. Melzack and Wall, 1964). This acknowledgement of a "mind over matter" concept was an advancement in the evolution of pain theory.

Endorphin hypothesis of acupuncture analgesia.

Scientists became perplexed as to the mechanism by which acupuncture accomplished analgesia. Pomeranz and Chiu (1976) performed one of the first studies looking at endorphin hypothesis of acupuncture analgesia. By adding naloxone to one of their studies, they determined they could block the analgesic effects of electroacupuncture (Pomeranz & Chiu, 1976). They placed mice into four groups: electroacupuncture group, sham acupuncture group, electroacupuncture acupuncture plus saline group, and electroacupuncture acupuncture plus naloxone. What they found was that the electroacupuncture produced analgesia but when combined with naloxone, the analgesic effect of acupuncture was eliminated. This suggests that there may have been a release of endorphins with electroacupuncture that where blocked by the Naloxone (Pomeranz & Chiu, 1976).

Myofascial trigger point (MTrP) circuits.

Within the dorsal horns are "MTrP-related sensory motor neurons" that provide the passage for pain information to be received by the brain, creating networks referred to as "MTrP circuits" (C.-Z. Hong 2004, 2006). These "MTrP Circuits" are founded on the gate control theory developed by R. Melzack and Wall (C.-Z. Hong, 2004).

These networks can branch out to neighboring networks and connect with once-separate MTrP (C.-Z. Hong, 2006). In the case of a severe stimulation to the peripheral sites, these "MTrP Circuits" trigger a once latent MTrP to become active as well as cause referred pain and local twitch response (LTR) (C.-Z. Hong, 2006). A similar mechanism is suspected when an MTrP is deactivated using remote needling. A possibility is that strong sensory impulses are sent to the spinal cord via nociception associated with needle stimulation which then disrupts the "neural network" associated with pain sensation (C.-Z. Hong, 2000; C.-Z. Hong & Simons, 1998)**.** The strong pressure stimulation to the MTrP loci can provide very strong neural impulses to the dorsal horn cells in the spinal cord, which may then break the vicious cycle of the MTrP circuit (C.-Z. Hong 2004, 2006).

Cholinergic Anti-inflammatory Pathway.

Another area of research supporting the mind-body connection is the cholinergic anti-inflammatory pathway which is responsible for suppression of the inflammatory response (Oke & Tracey, 2009). When a tissue is injured, there is a localized inflammatory response that involves the release of cytokines. Cytokines are proteins resulting from immune cells' efforts to regulate inflammation, either in promotion or reduction of inflammation. When the vagus nerve is stimulated, acetylcholine is released, which may then block the release of pro-inflammatory cytokines, hence reducing inflammation. It is the combination of pro- and anti-inflammatory cytokines that provide a healthy immune response. It is suggested that acupuncture may enhance the vagus nerve stimulation. It is worth having further studies to determine more clearly the role acupuncture can play in the cholinergic anti-inflammatory pathway (Oke & Tracey, 2009).

Adenosine and Analgesia.

One promising area of research into the mechanism of needling for treating myofascial pain is adenosine. Adenosine acts as an analgesic agent that suppresses pain through Gi-coupled A1-adenosine receptors (Goldman et al., 2010). According to Goldman et al. (2010):

> ATP is released in response to either mechanical and electrical stimulation or heat. Once released, ATP acts as a transmitter that binds to purinergic receptors, including P2X and

P2Y receptors. ATP cannot be transported back into the cell but is rapidly degraded to adenosine by several ectonucleotides before re-uptake. (p.883)

To determine whether adenosine is involved in the anti-nociceptive effects of acupuncture, the authors observed the extracellular concentration of adenosine during acupuncture (Goldman et al., 2010). Hypothesizing that the adenosine would increase, they needled *Zusanli* (ST 36) on mice and collected interstitial fluid by microanalysis implanted in the tibialis anterior muscle (Goldman et al., 2010).

The authors concluded,

> Our findings indicate that adenosine is central to the mechanistic actions of acupuncture. We found that insertion and manual rotation of acupuncture needle triggered a general increase in the extracellular concentration of purines, including the transmitter adenosine, which is consistent with the observation that tissue damage is associated with an increase in extra cellular nucleotides and adenosine . . . We found that the A1 receptor agonist 2-chloro-N(6)- cyclopentyl adenosine (CCPA) sharply reduced inflammatory and neurogenic pain and that suppression of pain mediated by acupuncture required adenosine A1 receptor expression (Goldman et al., 2010, p. 88).

In a test of human subjects, Takano et al. (2012) enrolled 15 male subjects to examine if the findings by Goldman et al. (2010) would be the same in humans as it was in animals (Takano et al., 2012). Patients were needled at *Zusanli* (ST 36) while a microdialysis probe was inserted inferiorly and angled toward *Zusanli*. (ST 26) The samples of interstice fluid from the microdialysis showed a significant increase in adenosine concentration that lasted at least 30 minutes after the needle was removed (Takano et al., 2012), as shown in Figure 5.

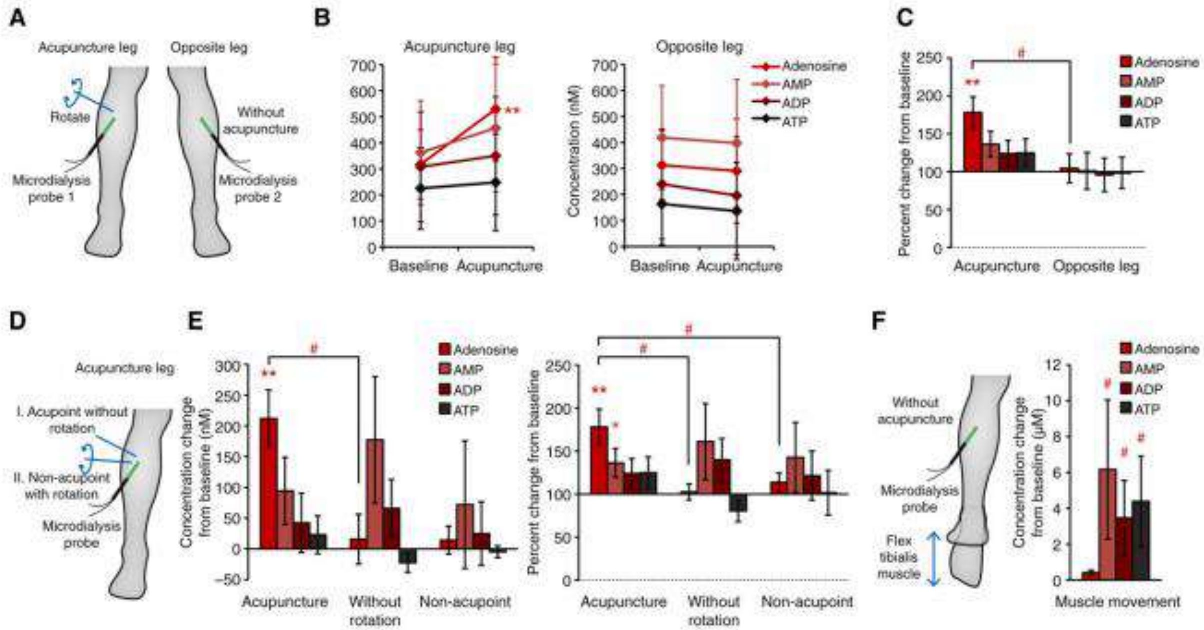

Figure 5. Comparisons of acupuncture procedures on concentrations of adenosine, AMP, ADP, and ATP. (A) Experimental design. One microdialysis probe was inserted in a leg where acupuncture was applied, and a second microdialysis probe was inserted in the opposite leg to simultaneously collect samples while the other leg received acupuncture. (B). Increase in the interstitial concentration of adenosine, AMP, ADP, and ATP before and after acupuncture simultaneously collected from acupuncture-receiving legs and untreated opposite legs (C) Changes in concentrations of purines from acupuncture-receiving legs and untreated opposite legs (D) Experimental design. Each subject received either acupuncture needle insertion, but the needle was left untouched without intermittent rotations for 30 minutes, or acupuncture needle insertion with rotations but the needle was inserted outside *Zusanli* (ST 36). (E) Comparison of effects of acupuncture with acupuncture needle insertion without rotating needle, or acupuncture needle insertion at non-acupoint. From “Traditional acupuncture triggers a local increase in adenosine in human subjects,” by T. Takano, et al., 2012, *Journal of Pain, 13*(12). p. 1219. Copyright 2012 by Elsevier. Reprinted with permission.

There was only an increase in adenosine when the needle was rotated for five minutes followed by five minutes of rest for the duration of 30 minutes (Takano et al., 2012). These findings suggest:

> that adenosine released during acupuncture binds to A1 receptors on afferent nerves that transmit pain information to the spinal cord and temporarily reduces transmission of painful input. A1 receptor activation in dorsal root ganglions, afferent nerves, and nerve terminals have previously been linked to antinociception. This study expands prior work by demonstrating that conventional acupuncture in human subjects also is linked to

significant increases in extracellular adenosine contraction. (Takano et al., 2012, pp. 1220–1221)

Is a local twitch response (LTR) necessary?

Several authors have suggested that the eliciting of an local twitch response (LTR) by employing a needle for mechanical stimulation of an MTrP within a taunt band is critical in reducing pain associated with the MTrP (L.-W. Chou, Hsieh, Kuan, & Hong, 2014; C.-Z. Hong & Simons, 1998; Hsieh et al., 2007). A common adopted technique to elicit an LTR is by “pistoning” the needle at the site of the trigger point (C.-Z. Hong, 1994a; C.-Z. Hong & Simons, 1998). It has been noted that motor end-plate activity in subjects with trapezius MTrP was normalized subsequently following DN of an MTrP that elicited an LTR (Abbaszadeh-Amirdehi, Ansari, Naghdi, Olyaei, & Nourbakhsh, 2016a, 2016b). When comparing needling that does not elicit an LTR to needling that does elicit an LTR, DeMeulemeeter, Calders, and Cagnie (2016) reported a more significant reduction in surface EMG activity of the upper trapezius when an LTR was elicited. Although the correlation of trigger point dry needling, which resulted in the eliciting of an LTR, appears to decrease motor endplate activity, and hence, decrease MTrP pain (L. Chou et al., 2011)**.** This effect may be limited to short-term relief if the MTrPs are symptomatic of conditions not related to muscle tissue (C.-Z. Hong, 2006).

In an attempt to collect biochemical substances at the site of an MTrP, it was discovered that there were several substances correlated with pain and inflammation at the site, such as substance P (SP), Calcitonin gene-related peptide (CGRP), and norepinephrine (NE) (J. Shah et al., 2008; J. Shah & Gilliams, 2008). After eliciting an LTR by needling the MTrP, these substances decreased (J. Shah et al., 2008; J. Shah & Gilliams, 2008).

These findings did not compare the results of not eliciting an LTR to eliciting an LTR. An increase in blood flow to the site of the needle insertion without an LTR has been noted (Ohkubo et al., 2009; Sandberg, Larsson, Lindberg, & Gerdle, 2005). Theoretically, this increase in blood flow can flush out the substances and stimulate opiate-producing leukocytes (J. Shah & Gilliams, 2008).

Much of the research suggesting the LTR is necessary for pain relief relies on clinical observation, and lacks a comparison to a group in which there was no LTR (Perreault, Dunning, & Butts, 2017). Although limited, six studies are most notable in the investigation of whether an LTR is necessary (Perreault et al., 2017). Three were in favor of an LTR (C.-Z. Hong 1994b; Rha et al., 2011; Tekin et al., 2013), and three stated an LTR was not a requirement for effective DN (Koppenhaver et al., 2017; Kuan et al., 2012; J. Shah et al., 2015).

A recent systematic review examined the effectiveness of DN in the treatment of MTrP and the impact of specific aspects of the technique on its effectiveness (Espejo-Antúnez et al., 2017). The authors concluded that eliciting an LTR had similar results to those studies with a total of 8-10 needle insertions or after 20 needle insertions with no mention of a twitch response (Espejo-Antúnez et al., 2017).

Prognostic Factors of Dry Needling

There are certain prognostic factors of DN. Muscle damage correlates with the pistoning technique commonly used to elicit an LTR in DN technique (Domingo, Mayoral, Monterde, & Santafé, 2013). In a prospective cohort follow-up design study, Y.-T. Huang and co-authors (2011) evaluated the outcome of patients receiving dry needling over the course of eight weeks to identify predictors of pain and disability. The patients were treated with an only-local DN that targeted the tissue with tight bands and trigger points that, when isolated and palpated, produced the patients' symptoms disability. They then needled the area using the pistoning technique until an LTR was produced and the technique was continued until the LTR ceased. At that time, the specialist passively stretched the involved muscle to its normal ROM (Y.-T. Huang et al., 2011). The patients then performed muscle-stretch exercises as recommend by Simons et al. (1999). This was done for a total of eight treatments over eight weeks (Y.-T. Huang et al., 2011). The findings were significant in reduction of pain intensity and aggregated pain. The most dramatic decrease in pain was reported from baseline to the eight-weeks of treatment, suggesting a maturation effect of DN. The study reported that several factors correlated with poor outcomes: long pain duration, high intensity of pain, poor quality of sleep, and repetitive work (Y.-T. Huang et al., 2011).

Use of fMRI to validate therapeutic response of acupuncture.

For the past twenty years, the use of fMRI has been employed to gain clarity to the mechanism of action of acupuncture. Several points have been examined over the years. To explore the effectiveness of acupuncture on the motor cortex, Jeun and co-authors (2005) used *Yanglingquan* (GB34) for its known effectiveness to improve motor function after a stroke. The run in the fMRI consisted of their control of 25 seconds of rotating the needle, followed by the control, a 25-second pause, then repeated for a total of four times (Jeun et al., 2005). They found that "*Yanglingquan* (GB 34) modulates the cortical activities of the somatomotor area in humans" (Jeun et al., 2005 p.573). Additionally, although both sides were activated, the ipsilateral side was more so (Jeun et al., 2005).

The challenge of treating myofascial pain can be due to stress and lack of sleep (Y.-T. Huang et al., 2011). In an attempt to define neural specificity of *Neiguan* (PC 6), *Daling* (PC 7), and *Guangming* (GB 37), an fMRI was used to observe neuroimaging while each of these points were needled (Bai, Yan, et al., 2010). In all points needled, *deqi* was obtained and the sensation recorded (Bai, Yan, et al., 2010). The five-minute run in the fMRI included two minutes of needling manipulations followed by one minute of rest then repeated and followed by one minute of scanning (Bai, Yan, et al., 2010). The results were:

> Distinct patters of hemodynamic responses: Negative predominantly for both *Neiguan* (PC6) and *Daling* (PC7) while positive for *Guangming* (GB 37). Acupuncture stimulation at *Neiguan* (PC6) produced extensive signal decreases in the limbic/paralimbic cerebellum and suborbital areas, such as amygdala, insula, periaqueductal gray (PAG), and flocculonodular lobe of cerebellum (nodulus and uvula). Interestingly, these remarkably decreased activities also occurred following acupuncture at *Daling* (PC7), with relatively small spatial extent and less intensive signal changes (PAG, Pons, and culmen. In contrast, acupuncture at *Guangming* (GB 37) elicited saliently increased neural responses, mainly in the occipital cortex, with a limited extent of the limbic system. (Bai, Yan, et al., 2010, p. 74)

Neiguan (PC 6) and *Daling* (PC 7) produce anti-stress and anti-anxiety effects, given that the points decreased activity in the limbic-cerebellum and suborbital areas (Bai, Yan, et al., 2010). In the discussion section of their work, the authors reported that the traditional function of *Guangming* (GB 37) is said to be that it brightens the eyes and noted their findings supported this theory seeing that *Guangming* (GB37) activates the occipital area. The authors also acknowledged in their discussion that *Xingjian* (LV 2) and *Taichong* (LV 3) both have an impact on the occipital area, although their function is not directly for vision issues. One could speculate that this would be due to the theory of Traditional Chinese medicine that mentions the liver meridian as being used in the treatment of visual disorders (W. Huang et al., 2012).

MacPherson et al. (2008) evaluated two fMRI scans of *Hegu* (LI-4) for a difference in neurological function in deep versus shallow needling. Superficial needling was defined as 1–2 mm in depth and deep 8–12 mm in depth (MacPherson et al., 2008). The subjects were all needled on the right hand. Patients received both types of needling over two 16-minute periods. Active blocks were when even technique was performed, followed by a rest period (MacPherson et al., 2008).

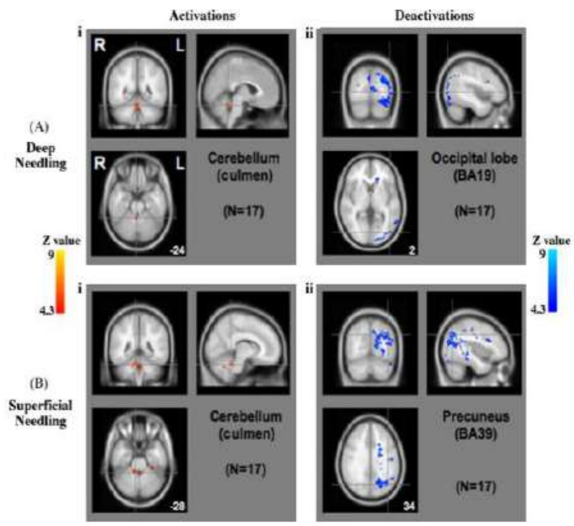

Figure 6. fMRI showing brain activation according to depth of needling. Cluster analysis shown by functional maps displaying the activations and deactivations of deep needling (A) and superficial needling (B). From "Brain imaging of acupuncture: Comparing superficial with deep needling," by H. McPherson et al., 2008, *Neuroscience Letters, 434* ,p. 148.Copyright 2015 by Elsevier. Reprinted with permission.

Activation or deactivation in blood oxygen label dependent (BOLD) responses recorded with the two different depths did not result in a significant difference (Figure 6) (MacPherson et al., 2008). The most significant limitation of this study was the lack of long term follow up. There is a possibility that over time, these techniques may result in a different outcome.

In a systematic review and meta-analysis of the literature on fMRI and the application of neural imaging to characterize acupuncture stimuli, W. Huang et al. (2012) investigated the following differences: verum and sham acupuncture, various methods of acupuncture manipulation, patients versus healthy volunteers, and differences between different acupuncture points. According to the data collected, when compared to sham, verum acupuncture had more activation in the basal ganglia, brain stem, cerebellum, and insula, and more deactivation in the "default mode network" and limbic brain areas, such as the amygdala and the hippocampus (W. Huang et al., 2012).

In the limbic brain areas, much of the data showed more brain activation with greater intensity of acupuncture stimulation (W. Huang et al., 2012). The data also showed a wider range of brain activity with higher frequency electrical acupuncture rather than low frequency**.** From this data, it is evident that acupuncture styles can likely increase or decrease activation in certain areas of the brain (W. Huang et al., 2012)**.**

Neuroimaging contributes greatly to the understanding of acupuncture. However, there are methodological problems associated with fMRI studies on acupuncture (Beissner & Henke, 2011). In fMRI studies on acupuncture, most use a block design consisting of an "active" time where the needle is stimulated followed by "rest" period, repeated, and then the scan is completed. During this time, the patient is asked to keep their eyes closed as a baseline. the researchers argue that having the subject's eyes closed does not create an accurate baseline, since closing the eyes can lead to cortical activations, especially in the visual and auditory cortices. Their research showed that the resting state of the brain has a frequency range rates that overlay with the repetitive frequency range of block design time courses of fMRI. They further argue that the results of the scan may be due to changes in attention rather than acupuncture stimulation because that stimulation may not be enough to suppress the resting state activity of the brain which creates deactivations in certain areas. They propose that a better approach would be a controlled baseline, such as creating a visual stimulus and pressing a button (Beissner & Henke, 2011). Having objective quantifiable data plays a significant role in the validation or rejection of questions or hypotheses.

Needling Techniques

Sun et al. (2010) completed a study that measured not only pain and range of motion but also quality of life. The measurement was done using the SF-36 questionnaire ("36-item Short Form Survey," n.d.) that includes multiple items such as physical function and mental health (Sun et al., 2010).

The issue with this study was the use of sham. Acupuncture points were the same for each group, but the acupuncture group received *deqi* and deeper needling, whereas the control group received shallow needling (Sun et al., 2010). Both groups saw positive results in all aspects, but the acupuncture group had greater improvement in physical functioning and emotional role according to the Short-form 36 quality of life assessment at the 12-week second follow-up. This suggests deeper needling may have longer-term effects than shallow needling. However, both groups showed improvement in all areas, suggesting that both techniques are effective (Sun et al., 2010).

C. C. Wang, Huang, Chiou, & Chang (2018) found fault in studies such as those by Sun et al. (2010) that used shallow needling as a control. Rather than a control, they designed a study that directly compared shallow needing to deep needling in the treatment of myofascial pain in the trapezius since there is strong suggestion that shallow needling does prove to have a significant impact on pain. Both groups had a reduced pain intensity, an increased pressure/pain threshold of trigger points, and an improvement in neck pain and consequent disability (measurement of the effect neck pain has in managing tasks of daily life). The authors concluded that because both had the same effect, it may be in the best interest of the patient to have shallow needling since there is less pain and minimal adverse side effects (C. C. Wang et al., 2018). A limitation of this study was the lack of follow-up in four weeks to observe the long-term effects of both.

The literature presented several needling techniques used by the various authors. Earlier studies by Hong recommended the rapid insertion and withdraw, pistoning technique, to elicit an LTR as necessary to treat TrP. Pistoning has been correlated to skeletal muscle and intramuscular nerve damage (Domingo et al., 2013). Alternative forms of needling technique include winding (H. Langevin, 2014). A rotation of 180 degrees causes the connective tissue to stick to the needle which is then followed by rotating the needle in both directions to produce immediate short-term analgesia. This method results in sustained internal stretching of fibrotic connective tissue (due to injury) and restores fibroblast response and adenosine release (H. Langevin, 2014). Other supportive findings of the use of rotation versus pistoning were a notable increase in activation of C-fibers, a distal superficial, deep mechanoreceptors and stretch receptors (Z.-J. Zhang, Wang, & McAlonan, 2012), and the release of endogenous opioids (L. Chou, Kao, & Lin, 2012; R. Zhang, Lao, Ren, & Berman, 2014). The technique of needle winding of connective tissue is shown to be more beneficial than pistoning for both short and long term pain and disability (Dunning et al., 2014)

Traditional Chinese acupuncture has several needling methods to move and regulate the qi and blood, strengthen what is deficient and draining what is excessive. Pistoning and winding are very similar to the ancient technique of raising and thrusting and rotation. In major texts, technique descriptions explain that in raising and thrusting, the needle is inserted, then raised or thrust either with a gentle or forceful technique. A strengthening technique would be to thrust forcefully and raise gently, and hence the opposite would be used to drain, thrust gently and raise forcefully. Rotation technique is accomplished by rotating the needle left (counterclockwise) to strengthen or right (clockwise) to drain. When a practitioner goes both ways in the same rotational speed, this is an even technique (O'Connor, Bensky, & Shanghai College of Traditional Medicine, 1996). From these description of TA techniques, it can be assumed that the techniques employed by DN are adaptations of TA techniques.

Other Empirical Evidence

An interesting study looked at heart rate variability (HRV) and oxygen levels associated with the trapezius (Shiro et al., 2014). The results showed that three distal acupuncture points in the Stomach meridian did not influence blood flow of the trapezius muscle, but rather reduced oxygenation of the muscle. In contrast, the three distal acupuncture points in the Large Intestine meridian increased blood flow of the trapezius muscle, and maintained oxygenation of the muscle (Shiro et al., 2014).

Frequency fluctuations in HRV in the range of 0.04–0.15Hz (low frequency, LF) are markers of sympathetic and parasympathetic nerve activity, and high frequency (HF) fluctuations in the range of 0.15–0.4Hz are markers of parasympathetic nerve activity. Thus, the LF/HF ratio is considered an index of sympathetic nerve activity (Shiro et al., 2014).

The authors concluded that acupressure at three distal acupuncture points, *Hegu* (LI 4), *Shousanli* (LI 10), and *Quchi* (LI 11), maintained higher levels of the HF components of HRV, and blood flow and oxygenation of the trapezius muscle compared with acupressure at three distal acupuncture points, *Liangqiu* (ST 34), *Zusanli* (ST 36), and *Jixi* (ST 41) (Shiro et al., 2014).

Irnich et al. (2002) used non-local acupuncture point, dry needling, and sham laser to test for neck pain. Of their 34 subjects, 79.4% suffered myofascial pain syndrome, 20.6% cervical irritation, and 29.4% whiplash injury. A problem the authors noted with their methods was that all the subjects received all three treatments and the authors considered one week to be a "washout" period. This means that the patient received non- local acupuncture one week, followed by dry needling one week later, and sham laser the following week. Despite this design flaw, they found that in the case of chronic neck pain, acupuncture improved motion-related pain. Distal points increased ROM, having more of an impact than treatment with local points and local points proved to be less effective for immediate pain relief. The authors suggested that there may be a subsequent tightening of the muscles after dry needling, caused by the twitch response and resulting in pain (Irnich et al. 2002).

In a meta-analysis and systematic reviews looking at the efficacy of acupuncture for myofascial pain, Li et al. (2017) reviewed 33 randomized controlled trails which included 22 different interventions, with dry needling and manual acupuncture being the most frequently investigated. They found that most of the acupuncture therapies, which when combined with other therapies (scraping ei. Gua sha, warming, and moxibustion), were effective in decreasing pain and increasing physical function (Li et al., 2017).

In a unique attempt to differentiate the efficacy of manual acupuncture when the number of sessions and point locations are isolated and compared, R. Wang, Li, and their coauthors (2017) conducted a meta-analysis using 16 qualified studies (R. Wang et al., 2017). Their results supported the use of MTP over acupuncture points and found that the first session and the eighth session where the most effective with sessions two to seven having a mild impact on myofascial pain (See figure 7: A, B, C) (R. Wang et al., 2017).

A systematic review of 19 studies looking at the comparative effects of local versus distal needling of acupuncture points found that either are beneficial in treating chronic musculoskeletal pain when compared to sham or no treatment (Wong Lit Wan et al., 2015). They considered local points being local acupuncture points or local tender ashi points on the local or adjacent muscle, and distal points were located at least one region away. This systematic review highlighted a gap in research as they were unable to locate a quality study comparing combined points against local or distal (Wong Lit Wan et al., 2015).

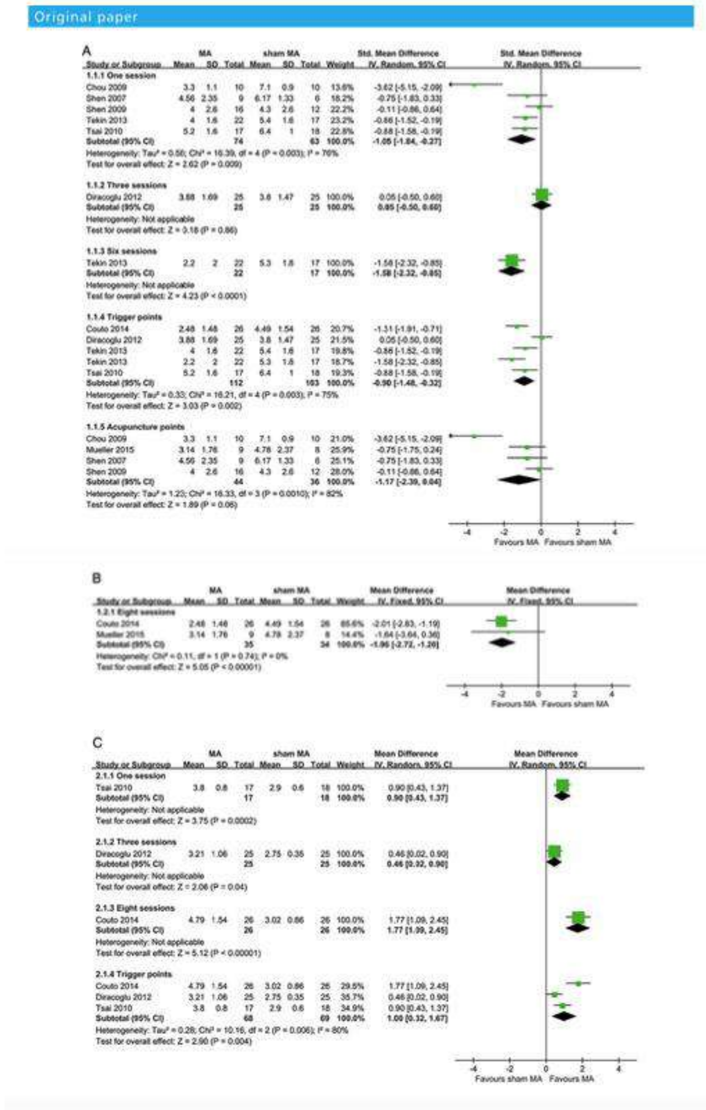

Figure 7. Forest plots of manual acupuncture (MA) in respect to sham MA for primary outcome measurements related to myofascial pain. (A) Pain intensity including subgroup analyses for number of sessions and needling location (myofascial trigger points (MTrPs) ve versus acupuncture points). (B) Pain intensity. (C) Pressure pain threshold (WMD) including subgroup analysis for number of sessions and needling location (MTrPs). From “Manual acupuncture for myofascial pain syndrome: a systematic review and meta-analysis,” by R. Wang et al., 2017, *Acupuncture Medicine, 35*(4). p.6-7. Copyright 2017 by Sage Publishing. Reprinted with permission.

A systematic review conducted by Espejo-Antúnez et al. (2017), investigated the effectiveness of dry needling in the treatment of myofascial trigger points. Of the fifteen included studies, the most common outcomes measured were pain, range of motion, disability, depression, and quality of life. The results from the studies suggested dry needling to be effective in the short term for pain relief, increased range of motion, and improved quality of life when compared to no intervention, sham, or placebo (Espejo-Antúnez et al., 2017).

A meta-analysis conducted by Li et al. (2017) included 33 trials with 1,692 patients treated with acupuncture for myofascial pain. The acupuncture techniques were comprised of manual acupuncture, electro-acupuncture, dry needling, acupuncture points injection, and fire needling with the majority treating the trapezius muscle. The meta-analyses concluded that acupuncture is effective in decreasing pain and improving physical function (Li et al., 2017), but one technique was not favored.

Kung and his coauthors (2001) conducted a study of 29 patients with chronic myofascial pain syndrome in the cervical and upper back regions with points chosen along the meridians that passed over the levator scapulae, splenius cervicis, supraspinatus, infraspinatus, and trapezius. The authors chose the following acupuncture points over trigger points: *Jianing* (GB-21) *Tianliao* (SJ-15), *Fengchi* (GB-20), *Tianzong* (*SI* 11), *Bingfeng* (SI-12), *Quyuan* (SI-13), and two distal points, *Quchi* (LI-11) and *Yanglingquan* (GB 34). The authors believed there are advantages to using acupuncture points instead of trigger points, including the ease of location and the possibility that distal acupuncture points lead to a cumulative activation of the spinal cord, midbrain, and hypothalamus-pituitary, enhancing the analgesic effect for chronic myofascial pain. Of 29 patients, 83% had a reduction in pain lasting up to 6 days after three weeks of treatment with an increase in range of motion (Kung et al., 2001).

Traditional Chinese Medicine: A Review of Different Styles

A traditional acupuncture approach to treating myofascial pain is by treating the *jingjin* (meridian sinews). In contemporary Mandarin, the definition of *jin* includes voluntary or skeletal muscles and the fascia is referred to as *jinmo* (Legge & Vance, 2010).

Legge and Vance (2010) laid out an approach to treating the myofascial pain of trigger points using the *jingjin*, otherwise referred to as channels or meridians. They grouped muscles based on yin and yang function and anatomical location and placed them into one of the 12 *jingjin*. Using this concept, they suggest that trigger points are to be treated along the same *jingjin* and selected using palpation along the *jingjin*. This approach is to be used only if the referred pain patterns stay within the *jingjin*. For example, the trapezius is listed as part of the arm *yangming* (large intestine) *jingjin*. To treat for stubborn and severe trigger points of the trapezius, Legge and Vance (2010) advise needling the local ashi point along the LI *jingjin* for up to 20 minutes. They suggest that shallow needling is not as effective; however, it is the safer approach when dealing with more sensitive structure, such as the front of the neck (Legge & Vance, 2010). Regarding distal treatment, needling the extensor carpi radials (included in the arm *yangming* (large intestine) *jingjin*) has been shown to be effective in reducing pain and increasing range of motion in patients with active trigger points in the trapezius (Legge & Vance, 2010; Tsai et al., 2010).

Traditional Chinese medicine can address chronic myofascial pain treating the underlying condition and according to the meridian layer involved. Treating the underlying condition significantly differentiates DN from TA. This involves a differential diagnosis. In Whitfield Reave’s basic four-step approach, all approaches are utilized (Reaves & Bong, 2013).

Within step one, there are four different areas that can been needled: the tendino-muscle meridians, opposite side (contra-lateral), opposite extremity (upper/lower), and empirical points (Reaves & Bong, 2013). In step one, the intention is to have an immediate improvement in pain and range of motion. The practitioner is to use palpation to monitor sensitivity and observe range of motion to determine if the patient has improved. This step may also require active range of motion by the patient in conjunction with the needling (Reaves & Bong, 2013).

In the second step, a precise diagnosis of the injury both from the Western medical perspective of the tissue that is injured and the Chinese meridian affected is required (Reaves & Bong, 2013). The importance of this step is to utilize points that will activate the meridian involved and clear the stagnation accumulated in the injured tissue (Reaves & Bong, 2013). Several studies cite the use of distal points as they apply to the meridians in the treatment of myofascial pain (Irnich et al., 2002; Kung et al., 2001; Shen & Goddard, 2007). There are several techniques that may be used to activate the affected meridian (Reaves & Bong, 2013). The practitioner can needle the *shu*-stream point of the affected meridian on the same side of the pain coupled with the *shu*-stream point of the same paired six division meridian on the opposite extremity. Alternatively, the practitioner can use traditional point categories based on actions and indications (*xi*-cleft, *luo*-connecting, back-*shu* and front *shu* points). The last two options would be to use the auricular acupuncture or the use of the extraordinary meridians (Reaves & Bong, 2013).

Auricular acupuncture is very effective in pain relief (Irnich et al., 2002; Reaves & Bong, 2013; Tsai et al., 2016). For example, Irnich et al. (2002) used ear cervical spine and ear point stellate ganglion in their study. In another example, Tsai et al. (2016) reported three emergency room cases in which battlefield auricular acupuncture was used successfully to treat pain associated with the low back, carpal tunnel, and appendicitis.

Another possibility in the third step is to address the internal organ imbalance and treat the zang-fu organs that may contribute to the pain and injury directly or indirectly (Reaves & Bong, 2013). This step encompasses the classical basis of traditional Chinese medicine. This ability to treat internally is accomplished thru the meridian system as described by O’Connor et al. (1996):

> Among the channels are major trunks and lesser branches which join internally with the vital organs, and externally with the limbs, sensory organs and orifices. The qi and blood circulate throughout the body via this network of channels. Thus, the intimate relationship between the internal viscera and the periphery of the body is primarily maintained by means of the channels. Channel theory reflects the holistic attitude of Chinese medicine, with great emphasis placed upon the interrelationships among all parts of the organism . . . In the clinic, the entire framework of diagnostics, therapeutics and point selection is based upon the theoretical framework of the channels. (p. 35)

The final step is to treat the site of the injury. This step is used to dispel stagnation of qi and blood as well as other pathogens (Reaves & Bong, 2013). In Western medicine terms, this step is an attempt to normalize the function of the soft tissue that has been damaged. In this step, acupuncture points and ashi points are chosen as they relate to myofascial trigger points (Reaves & Bong, 2013).

Although most of these approaches have been studied individually, no study, to my knowledge, encompasses all these steps. No comparative studies observe the combination of local and distal points to exclusively local or distal points (Wong Lit Wan et al., 2015). There is a lack of research in treating myofascial pain using the traditional Chinese medicine differential diagnosis system.

When seeking the solution of long-term healing, M. Callison (2012) writes exclusively on the use of motor points in his book *Motor Point Index: An Acupuncturist’s Guide to Locating and Treating Motor Points.* M. Callison (2012) describes the motor point as the place in the muscle where the motor nerve enters the muscle and thus potentially having the greatest impact on electrical activity and pain modulation. The methods employed are to treat the injured agonist muscles and the paired antagonist muscle or to use the innervating spinal segments known in TCM as Huatuojiaij (HTJJ) points. These methods aid the neural network associated with the affected muscle (M. Callison, 2012).

In a case study of the treatment of sports-related tension headaches due to myofascial pain with acupuncture, M. Callison (2008) mentions that ninety percent of patients with this type of headache report tenderness in the upper trapezius, rhomboid minor and major, gluteus medius, piriformis, splenius capitis, and cervicis when the motor point is palpated. In this case, the author determined through intake and tongue and pulse diagnosis that the patient exhibited a pattern of liver and gallbladder qi stagnation with local blood stagnation due to the trauma from a forceful collision with another soccer player. To remove obstruction in the *Tai Yang* channel, relax neck spasms, and move stagnation in the Liver and Gallbladder, the following points were used: (*Ganshu)* UB-18, (*Danshu)* UB-19, (*Qiuxu)* GB 40, (*Taichong)* LV-3, (*Zhongfeng)* LV-4, (*Kunlun)* UB-60, and (*Shenmai)* UB-62. The following motor points were used to alleviate the tension headache based the muscles involved: Paraspinals of C5, located at HTJJ (M-BW-35), the upper trapezius at (*Jiangjing)* GB-21, splenius cervicis located at extra point *Bailao* (M-HN-30), rhomboid major (also noted by the author to relax body tension and ease digestive discomfort due to LV qi stagnation) located 2.5 cun lateral to the lower border of the spinous process of T4 (between (*Jueyinshu)* UB-14 and (*Gaohuangshu)* UB-43), gluteus medius found to reduce tension in the upper trapezius and located at the junction of the medial third and lateral two-thirds of a line joining the posterior superior iliac spine and the superior border of the greater trochanter, and the piriformis found by the author to reduce sub-occipital tension, located halfway between (*Bauhuang)* UB-52 and (*Zhibian)* UB-54 (M. Callison, 2008). After the first treatment, the patient's headache was reduced to between three and four on the pain scale, where initially the pain was reported as a seven. On a one-week follow-up after three treatments, the patient reported no headache (M. Callison, 2008).

Results

The literature has not proven that TA or DN is superior in the treatment of myofascial pain. The mechanisms described in the literature suggest both TA and DN perform effectively for pain relief. Both of the hypotheses are null due to lack of specific studies comparing DN to TA and dual findings of efficacy for both TA and DN in the treatment of myofascial pain, with more literature found on DN.

From the literature, it appears that a rotation technique of needling is safer and more effective (L. Chou et al., 2012; H. Langevin, 2014; Martín-Pintado Zugasti et al., 20146; Z.-J. Zhang et al., 2012). The need for an LTR may not be necessary to gain positive results (Perreault et al., 2017). A practitioner can choose shallow or deep needling based on patient sensitivity or the safety associated with the area, such as around the intercostal area and neck. The research appears split as to which method generates more potent effects.

Neuroimaging is a promising form of observation that supports the use of multiple acupuncture points in a clinical setting. Although there are some issues with baselines (Beissner & Henke, 2011), these studies are very promising. Studies looking at particular biochemical markers give a qualitative value to the impact of needling acupuncture points. The advance in technology that allows for observation of electro physical, neurophysiological, and biochemical markers contributes significantly to the appreciation of Western medical providers who prefer a mechanistic explanation (L. Chou et al., 2012). Ideally, further research of TA will focus in these areas.

Both DN and TA have mechanisms that aid in the treatment of myofascial pain. The benefit of TA over DN according to the research could be its ability to aid in stress and relaxation, via deactivation of the limbic system (Bai, Tian, et al., 2010; W. Huang et al., 2012).

The most significant gap in the research is the ability to adequately test the meridian theory as described by O'Conner et al. (1996) and its application to treating myofascial pain, as well as individually comparing local and distal acupuncture (Wong Lit Wan et al., 2015). Lastly, there is a lack of longitudinal studies; most studies performed follow-ups for less than eight weeks.

The ability to differentiate treatment administration based on TCM differential diagnosis is what truly sets apart the application of acupuncture by acupuncturist versus PT's, chiropractors, and MDs that practice dry needling. This holistic approach may be the answer for long-term care (M. Callison, 2012).

Discussion

Dommerholt and Fernández-de-las-Peñas (2018) believe that the foundation of DN can be found in both Western and Eastern medicine and that for advancement of healthcare, DN should be implemented across all healthcare disciplines. Dommerholt and Fernández-de-las-Peñas stated,

> Within the context of acupuncture, DN may well be similar to needling of ashi points, but in the context of medicine, chiropractic, veterinary medicine, dentistry, and physical therapy, DN is nothing but a modification of trigger point injections. Nonacupuncturists need to understand the depth of contemporary acupuncture practice; acupuncturists need

> to realize that DN by other disciplines does not pose any threat to acupuncture and to the public at large. (Dommerholt & Fernández-de-las-Peñas, 2018, p. 76)

Ideally, there is mutual respect by adherents to both treatment styles. Given the findings of this literature review, both DN and TA approaches show promising results in the treatment of myofascial pain. The practice of DN by nonacupuncturists is and will continue to be a reality. Rather than debate with each other, medical practitioners should create an integrative language for both practices. To do so, it is important that both Western medicine and TCM practitioners work to understand each other and how one can benefit from the other.

In China, due mostly to financial and political reasons, hospitals offer both TCM and Western medicine (WM) (L. Wang et al., 2016). Interviews at various hospitals have shown that practitioners learn WM to integrate anatomy, physiology, pharmacology, and medical examinations with TCM in an effort to modernize it and support the TCM diagnosis. In the efforts to integrate and revolutionize TCM, the hospitals also incorporate values associated with TCM. New practitioners shadow senior practitioners of TCM as well as require the WM doctors to learn the foundations of TCM (L. Wang et al., 2016).

The problem with TCM from the perspective of peer reviewed study is the misconception of the “meridians” and that acupuncturists struggle to communicate with other health care providers due to lack of science-based training in anatomy, physiology, and pathology (Kendall, 2013). As expressed by L. Chou et al. (2012), the concept of “unblocking qi in the meridians” to establish free flow by needling at acupuncture points cannot be validated by modern medicine (L. Chou et al., 2012). These terms are foreign to the Western medical practitioner. Some literature attempts to bridge the miscommunication between the two disciples of medicine.

In an attempt to integrate the two disparate languages of WM and TCM, Kendall (2013) explains TCM as it pertains to WM. In one example, he suggests the concept of qi as energy is a poor definition, whereas understanding qi as air, breath, gases, steam, or vapor is more appropriate (Kendall, 2013). When identified as air, qi could be interpreted as oxygen from vital air that circulates in the blood represent the potential energy needed to fuel the formation of ATP, which in turn serves as the cell's energy currency (Kendall, 2002). Furthermore, *ying*, meaning nutrients, can be what glucose is derived from and is then combusted to convert adenosine diphosphate (ADP) to adenosine triphosphate (ATP) and oxygen extracted from vital air (qi) in cellular mitochondria. The grand energy potential of ATP aligns with the concept of *zhen*, true function or homeostatic balance (Kendall, 2002). Acupuncture releases adenosine and ATP, eliminating pain (Goldman et al., 2010; Takano et al., 2012). Derived from the findings of Kendall (2002), this reaction could be considered a *zhen* function.

In his book, *The Spark in the Machine,* Dr. Keown delves into how acupuncture can explain Western mysteries (Keown, 2014). In regard to referred muscle pain, he encourages the reader to stray away from the previous Western medical concept the neural circuit, or MTrP circuit, as described in this literature review, and think more of the unique fascial connection with muscles and bones as well the conductivity it may have. Fascia creates a tensegrity system: when one muscle changes, others must also adjust (Keown, 2014).

This view on fascia is supported by other research. Yang et al. (2015), suggests that fascia is innervated mostly by proprioceptive nerves and is composed mostly of collagen and is capable of transmitting electrical signals all throughout the body. It has been hypothesized that the network of acupuncture points and meridians are formed by interstitial connective tissue (H. Langevin and Yandow, 2002). The authors have proposed that the acupuncture meridians are where connective tissue planes connect and areas of convergence in the network of connective tissue that infuse the body may correspond to acupuncture points. They also purposed that stimulation of *deqi* could be the stimulation of connective tissue sensory mechanoreceptors. They suggest that the placement of the acupuncture needle anywhere in the body but especially in acupuncture points, stimulates cellular changes that proliferate along connective tissue planes (H. Langevin and Yandow, 2002)

TA is a comprehensive and holistic practice that would benefit from more rigorous scientific exploration. The approach being taken in China to integrate TCM with WM while maintaining the integrity of TCM (R. Wang et al., 2017) may be an integration from which American hospitals and medical facilities could benefit greatly.

References

36-item Short Form Survey. (n.d.). Retrieved from https://www.rand.org/health-care/surveys_tools/mos/36-item-short-form.html

Abbaszadeh-Amirdehi, M., Ansari, N. N., Naghdi, S., Olyaei, G., & Nourbakhsh, M. R. (2016a). Neurophysiological and clinical effects of dry needling in patients with upper trapezius myofascial trigger points. *Journal of Bodywork and Movement Therapies*. *(21)*1. 48-52. https://doi.org/10.1016/j.jbmt.2016.04.014

Abbaszadeh-Amirdehi, M., Ansari, N. N., Naghdi, S., Olyaei, G., & Nourbakhsh, M. R. (2016b). Therapeutic effects of dry needling in patients with upper trapezius myofascial trigger points. *Acupuncture in Medicine, (35)*2. 85-92. https://doi.org/10.1136/acupmed-2016-011082

American Board of Chiropractic Acupuncture Council of Chiropractic Acupuncture. (n.d.). State Requirements for Chiropractic Acupuncture. Retrieved from https://www.councilofchiropracticacupuncture.com/state-requirements/

Bai, L., Tian, J., Zhong, C., Xue, T., You, Y., Liu, Z., … Liu, Y. (2010). Acupuncture modulates temporal neural responses in wide brain networks: Evidence from fMRI study. *Molecular Pain*, *6*, 1–12. https://doi.org/10.1186/1744-8069-6-73

Bai, L., Yan, H., Li, N., Qin, W., Chen, P., Liu, P., . . . Tian, J. (2010). Neural specificity of acupuncture stimulation at pericardium 6: Evidence from an fMRI study. *Journal of Magnetic Resonance Imaging*, *31*(1), 71–77. https://doi.org/10.1002/jmri.22006

Beissner, F., & Henke, C. (2011). Methodological problems in fMRI studies on acupuncture: A critical review with special emphasis on visual and auditory cortex activations. *Evidence-Based Complementary and Alternative Medicine*. https://doi.org/10.1093/ecam/nep154

Birch, S. (2004). Trigger point–acupuncture point correlations revisited. *The Journal of Alternative and Complementary Medicine*, *9*(1), 91–103. https://doi.org/10.1089/107555303321222973

Callison, M. (2008). The treatment of sports-related muscle tension headaches with acupuncture and moxabustion. *The Journal of Chinese Medicine, (87),* 34-38.

Callison, M. (2012). *Motor Point Index: An Acupuncturist's guide to Locating and Treating Motor Points.* San Diego. AcuSport Seminar Series LLC.

Carroll, R. (2007). *Elsevier's Integrated Physiology*. Philadelphia. Mosby Elsevier.

Chou, L. W., Hsieh, Y. L., Chen, H. S., Hong, C. Z., Kao, M. J., & Han, T. I. (2011). Remote therapeutic effectiveness of acupuncture in treating myofascial trigger point of the upper trapezius muscle. *American Journal of Physical Medicine and Rehabilitation*, *90*(12), 1036–1049. https://doi.org/10.1097/PHM.0b013e3182328875

Chou, L. W., Hsieh, Y. L., Kao, M. J., & Hong, C. Z. (2009). Remote influences of acupuncture on the pain intensity and the amplitude changes of endplate noise in the myofascial trigger point of the upper trapezius muscle. *Archives of Physical Medicine and Rehabilitation*, *90*(6), 905–912. https://doi.org/10.1016/j.apmr.2008.12.020

Chou, L., Kao, M., & Lin, J. (2012). Probable Mechanisms of Needling Therapies For Myofascial Pain Control. *Evidence-Based Complementary and Alternative Medicine, 2012.* 1-11. https://doi.org/10.1155/2012/705327

Chou, L.-W., Hsieh, Y. L., Kuan, T. S., & Hong, C. Z. (2014). Needling therapy for myofascial pain: Recommended technique with multiple rapid needle insertion. *BioMedicine (Netherlands)*, *4*(2), 39–46. https://doi.org/10.7603/s40681-014-0013-2

Dahlhamer, J., Lucas, J., Zelaya, C., Nahin, R., Mackey, S., DeBar, L., … Helmick, C. (2018). Prevalence of chronic pain and high-impact chronic pain among adults—United States, 2016. *MMWR. Morbidity and Mortality Weekly Report*, *67*(36), 1001–1006. https://doi.org/10.15585/mmwr.mm6736a2

De Meulemetter, K., Calders, P., Cagnie, B. (2016). EMG activity before, during, and after dry needling of the upper trapezious muscle:preliminary results. *Manual Therapies. (25).* 126-127. https://doi.org/10.1016/j.math.2016.05.234

Deng, L., Gan, Y., He, S., Ji, X., Li, Y., Wang, R., … Yuan, J. (1999). *Chinese acupuncture and moxibustion* (Second ed; X. Cheng, Ed.). Beijing: Foreign Language Press.

Domingo, A., Mayoral, O., Monterde, S., & Santafé, M. M. (2013). Neuromuscular damage and repair after dry needling in mice. *Evidence-Based Complementary and Alternative Medicine*. https://doi.org/10.1155/2013/260806

Dommerholt, J. and Fernández-de-las-Peñas, C. (2018). *Trigger Point Dry Needling: An Evidence Based Approach Second Edition.* Elsevier Limitied.

Dorsher, P. and Fleckenstein, J. (2008). Trigger points and classical acupuncture points. *German Journal of Acupuncture & Related Techniques. 51*(3), 15–24. https://doi.org/10.1016/j.dza.2008.07.004

Dunning, J., Butts, R., Mourad, F., Young, I., Flannagan, S., & Perreault, T. (2014). Dry needling: A literature review with implications for clinical practice guidelines. *Physical Therapy Reviews*, *19*(4), 252–265. https://doi.org/10.1179/108331913x13844245102034

Espejo-Antúnez, L., Tejeda, J. F. H., Albornoz-Cabello, M., Rodríguez-Mansilla, J., de la Cruz-Torres, B., Ribeiro, F., & Silva, A. G. (2017). Dry needling in the management of myofascial trigger points: A systematic review of randomized controlled trials.

Complementary Therapies in Medicine, *33*(January), 46–57. https://doi.org/10.1016/j.ctim.2017.06.003

Ge, H.-Y., Fernández-de-las-Peñas, C., & Yue, S.-W. (2011). Myofascial trigger points: Spontaneous electrical activity and its consequences for pain induction and propagation. *Chinese Medicine*, *6*(1), 1–7. https://doi.org/10.1186/1749-8546-6-13

Goldman, N., Chen, M., Fujita, T., Xu, Q., Peng, W., Liu, W., … Nedergaard, M. (2010). Adenosine A1 receptors mediate local anti-nociceptive effects of acupuncture. *Nature Neuroscience*, *13*, 883. https://doi.org/10.1038/nn.2562

Hao, J. J., & Mittelman, M. (2014). Acupuncture: Past, Present, and Future. *Global Advances in Health and Medicine*, *3*(4), 6–8. https://doi.org/10.7453/gahmj.2014.042

Hong, C.-Z. (1994a). Considerations and recommendations regarding myofascial trigger point injection. *Journal of Musculoskeletal Pain*, *2*(1), 29–59. https://doi.org/10.1300/J094v02n01_03

Hong, C.-Z. (1994b). Lidocaine injection versus dry needling to myofascial trigger point: The importance of the local twitch response. *American Journal of Physical Medicine & Rehabilitation*, *73*(4), 256–263. https://doi.org/10.1097/00002060-199407000-00006

Hong, C.-Z. (2000). Myofascial trigger points: Pathophysiology and correlation with acupuncture points, *18*, 41–48. https://doi.org/10.1136/aim.18.1.41

Hong, C.-Z. (2004). Myofascial pain therapy. *Journal of Musculoskeletal Pain*, *12*(3–4), 37–43. https://doi.org/10.1300/J094v12n03_06

Hong, C.-Z. (2006). Treatment of myofascial pain syndrome. *Current Pain and Headache Reports*, *10*(5), 345–349. https://doi.org/10.1007/s11916-006-0058-3

Hong, C.-Z., & Simons, D. G. (1998). Pathophysiologic and electrophysiologic mechanisms of myofascial trigger points. *Archives of Physical Medicine and Rehabilitation*, *79*(7), 863–872. https://doi.org/10.1016/S0003-9993(98)90371-9

Hsieh, Y. L., Kao, M. J., Kuan, T. S., Chen, S. M., Chen, J. T., & Hong, C. Z. (2007). Dry needling to a key myofascial trigger point may reduce the irritability of satellite MTrPs. *American Journal of Physical Medicine and Rehabilitation*, *86*(5), 397–403. https://doi.org/10.1097/PHM.0b013e31804a554d

Huang, W., Pach, D., Napadow, V., Park, K., Long, X., Neumann, J., … Fleckenstein, J. (2012). Characterizing acupuncture stimuli using brain imaging with fMRI: A systematic review and meta-analysis of the literature. *Deutsche Zeitschrift Fur Akupunktur*, *55*(3), 26–28. https://doi.org/10.1016/j.dza.2012.08.008

Huang, Y.-T., Lin, S.-Y., Neoh, C.-A., Wang, K.-Y., Jean, Y.-H., & Shi, H.-Y. (2011). Dry needling for myofascial pain: Prognostic factors. *The Journal of Alternative and Complementary Medicine*, *17*(8), 755–762. https://doi.org/10.1089/acm.2010.0374

Irnich, D., Behrens, N., Gleditsch, J. M., Stör, W., Schreiber, M. A., Schöps, P., . . . Beyer, A. (2002). Immediate effects of dry needling and acupuncture at distant points in chronic neck pain: Results of a randomized, double-blind, sham-controlled crossover trial. *Pain*, *99*(1–2), 83–89. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12237186

Jeun, S. S., Kim, J. S., Kim, B. S., Park, S. D., Lim, E. C., Choi, G. S., & Choe, B. Y. (2005). Acupuncture stimulation for motor cortex activities: A 3T fMRI study. *American Journal of Chinese Medicine*, *33*(4), 573–578. https://doi.org/10.1142/S0192415X0500317X

Kendall, D. (2002). *Dao of ChineseMedicine: Understanding An Ancint Healing Art*. New York. Oxford Press.

Kendall, D. (2013). National Center of Complementary and Alternative Medicine (NCCAM) Introduction to Acupuncture with Disclaimer. *Swiss Journal of Integrative Medicine, (25)*, 241-246. https://doi.org/10.1159/000353908

Keown, D. (2014). *The Spark in the Machine: How the Science of Acupuncure Explains the Mysteries of Western Medicine.* London and Philadelphia: Singing Dragon.

Koppenhaver, S. L., Walker, M. J., Rettig, C., Davis, J., Nelson, C., Su, J., . . . Hebert, J. J. (2017). The association between dry needling-induced twitch response and change in pain and muscle function in patients with low back pain: A quasi-experimental study. *Physiotherapy*, *103*(2), 131–137. https://doi.org/10.1016/j.physio.2016.05.002

Kuan, T. S., Hong, C. Z., Chen, S. M., Tsai, C. T., Yen, W. C., Chen, J. T., & Feng, C. Y. (2012). Myofascial pain syndrome: Correlation between the irritability of trigger points and the prevalence of local twitch responses during trigger point injection. *Journal of Musculoskeletal Pain*, *20*(4), 250–256. https://doi.org/10.3109/10582452.2012.733804

Kung, Y.-Y., Chen, F.-P., Chaung, H.-L., Chou, C.-T., Tsai, Y.-Y., & Hwang, S.-J. (2001). Evaluation of acupuncture effect to chronic myofascial pain syndrome in the cervical and upper back regions by the concept of meridians. *Acupuncture & Electro-Therapeutics Research*, *26*(3), 195–202. https://doi.org/10.3727/036012901816355947

Langevin, H. (2014). Acupuncture, connective tissue, and peripheral sensory modulation. *Critical Reviews in Eukaryotic Gene Expression*, *24*(3), 249–253. https://doi.org/10.1615/CritRevEukaryotGeneExpr.2014008284

Langevin, H. and Yandow, J. (2001). Relationship of Acupuncture Points and Meridians to Connective Tissue Planes. *The Anatomical Record, 269*. 257-265. https://doi.org/10.1002/ar.10185

Legge, D. and Vance, K. (2010). *Jingjin: Acupuncutre treatment of the muscular system using the meridian sinews.* Australia. Sydney College Press.

Li, X., Wang, R., Xing, X., Shi, X., Tian, J., Zhang, J. J., . . . Yang, K. (2017). Acupuncture for myofascial pain syndrome: A network meta-analysis of 33 randomized controlled trials. *Pain Physician*, *20*(6), E883–E902. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/28934793

Lin, K.and Tung, C. (2017). The Regulation of the Practice of Acupuncture by Physicians in the United States. *Medical Acupuncture. (29)*3. 121-127. https://doi.org/10.1089/acu.2017.1235

MacPherson, H., Green, G., Nevado, A., Lythgoe, M. F., Lewith, G., Devlin, R., . . . Asghar, A. U. R. (2008). Brain imaging of acupuncture: Comparing superficial with deep needling. *Neuroscience Letters*, *434*(1), 144–149. https://doi.org/10.1016/j.neulet.2008.01.058

Martín-Pintado Zugasti, A., Rodríguez-Fernández, Á. L., García-Muro, F., López-López, A., Mayoral, O., Mesa-Jiménez, J., & Fernández-Carnero, J. (2014). Effects of spray and stretch on postneedling soreness and sensitivity after dry needling of a latent myofascial trigger point. *Archives of Physical Medicine and Rehabilitation*, *95*(10), 1925–1932. https://doi.org/10.1016/j.apmr.2014.05.021

Melzack, R., Stillwell, D. M., & Fox, E. J. (1977). Trigger points and acupuncture points for pain: Correlations and implications: *Pain*, *3*(1), 3–23. https://doi.org/10.1016/0304-3959(77)90032-X

Melzack, R. and Wall, P. (1964). Pain Mechanisms: A New Theory. *Science, 49*(150), 971-979. https://doi.org/10.1126/science.150.3699.971

O’Connor, J., Bensky, D., & Shanghai College of Traditional Medicine (Eds.). (1996). *Acupuncture: A comprehensive text*. Chicago: Eastland Press.

Ohkubo, M., Niwayama, M., Murase, N., Osada, T., Kime, R., Kurosawa, Y., . . . Hamaoka, T. (2009). Local increase in trapezius muscle oxygenation during and after acupuncture. *Dynamic Medicine*, *8*(1), 1–8. https://doi.org/10.1186/1476-5918-8-2

Oke, S. L., & Tracey, K. J. (2009). The inflammatory reflex and the role of complementary and alternative medical therapies. *Annals of the New York Academy of Sciences*, *1172*, 172–180. https://doi.org/10.1196/annals.1393.013

Perreault, T., Dunning, J., & Butts, R. (2017). The local twitch response during trigger point dry needling: Is it necessary for successful outcomes? *Journal of Bodywork and Movement Therapies*, *21*(4), 940–947. https://doi.org/10.1016/j.jbmt.2017.03.008

Pomeranz, B. and Chiu, D. (1976). Naloxone Blockade of Acupuncture Analgesia: Endorphins Implicated. *Life Science*, *19*. 1757-1762. https://doi.org/10.1016/0024-3205(76)90084-9

Reaves, W., & Bong, C. (2009). *The acupuncture handbook of sports injuries & pain: A four step approach to treatment* (1st ed). Boulder, Colo: Hidden Needle Press.

Rha, D., Shin, J. C., Kim, Y.-K., Jung, J. H., Kim, Y. U., & Lee, S. C. (2011). Detecting local twitch responses of myofascial trigger points in the lower-back muscles using ultrasonography. *Archives of Physical Medicine and Rehabilitation*, *92*(10), 1576-1580.e1. https://doi.org/10.1016/j.apmr.2011.05.005

Sandberg, M., Larsson, B., Lindberg, L. G., & Gerdle, B. (2005). Different patterns of blood flow response in the trapezius muscle following needle stimulation (acupuncture) between healthy subjects and patients with fibromyalgia and work-related trapezius myalgia. *European Journal of Pain*, *9*(5), 497–510.

https://doi.org/10.1016/j.ejpain.2004.11.002

Shah, J., Danoff, J. V., Desai, M. J., Parikh, S., Nakamura, L. Y., Phillips, T. M., & Gerber, L. H. (2008). Biochemicals associated with pain and inflammation are elevated in sites near to and remote from active myofascial trigger points. *Archives of Physical Medicine and Rehabilitation*, *89*(1), 16–23. https://doi.org/10.1016/j.apmr.2007.10.018

Shah, J., & Gilliams, E. A. (2008). Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: An application of muscle pain concepts to myofascial pain syndrome. *Journal of Bodywork and Movement Therapies*, *12*(4), 371–384. https://doi.org/10.1016/j.jbmt.2008.06.006

Shah, J., Thaker, N., Heimur, J., Aredo, J. V., Sikdar, S., & Gerber, L. (2015). Myofascial trigger points then and now: A historical and scientific perspective. *PM and R*, *7*(7), 746–761. https://doi.org/10.1016/j.pmrj.2015.01.024

Shen, Y. F., & Goddard, G. (2007). The short-term effects of acupuncture on myofascial pain patients after clenching. *Pain Practice*, *7*(3), 256–264. https://doi.org/10.1111/j.1533-2500.2007.00140.x

Shiro, Y., Chang, Y.-, Arai, P., Ikemoto, T., Kawai, T., Ikeuchi, M., & Ushida, T. (2014). Distal traditional acupuncture points of the large intestinal meridian and the stomach meridian differently affect heart rate variability and oxygenation of the trapezius muscle. *Evidence-Based Complementary and Alternative Medicine, (2014*). 1–5. d https://doi.org/10.1155/2014/283010

Simons, D. G., Travell, J. G., & Simons, L. S. (1999). *Travell & Simons myofascial pain and dysfunction: The trigger point manual; Volume 1: Upper half of body, Second Edition*. Baltimore: Williams & Wilkins.

Sun, M.-Y., Hsieh, C.-L., Cheng, Y.-Y., Hung, H.-C., Li, T.-C., Yen, S.-M., & Huang, I.-S. (2010). The therapeutic effects of acupuncture on patients with chronic neck myofascial pain syndrome: A single-blind randomized controlled trial. *The American Journal of Chinese Medicine*, *38*(5), 849–859. https://doi.org/10.1142/s0192415x10008299

Takano, T., Chen, X., Luo, F., Fujita, T., Ren, Z., Goldman, N., … Nedergaard, M. (2012). Traditional acupuncture triggers a local increase in adenosine in human subjects. *Journal of Pain*, *13*(12), 1215–1223. https://doi.org/10.1016/j.jpain.2012.09.012

Tekin, L., Akarsu, S., Durmuş, O., Çakar, E., Dinçer, Ü., & Kiralp, M. Z. (2013). The effect of dry needling in the treatment of myofascial pain syndrome: A randomized double-blinded placebo-controlled trial. *Clinical Rheumatology*, *32*(3), 309–315. https://doi.org/10.1007/s10067-012-2112-3

Tsai, C. T., Hsieh, L. F., Kuan, T. S., Kao, M. J., Chou, L. W., & Hong, C. Z. (2010). Remote effects of dry needling on the irritability of the myofascial trigger point in the upper trapezius muscle. *American Journal of Physical Medicine and Rehabilitation*, *89*(2), 133–140. https://doi.org/10.1097/PHM.0b013e3181a5b1bc

U.S. state dry needling scope of practice decisions. (n.d.). Retrieved December 15, 2019, from Integrative Dry Needling Institute website: https://integrativedryneedling.com/dry-needling-training/scope-of-practice/

Wang, C. C., Huang, T. H., Chiou, K. C., & Chang, Z. Y. (2018). Therapeutic effect of superficial acupuncture in treating myofascial pain of the upper trapezius muscle: A randomized controlled trial. *Evidence-Based Complementary and Alternative Medicine*, *2018*, 1–7. https://doi.org/10.1155/2018/9125746

Wang, K., Zhang, L., Lu, F., Lu, Y., & Yang, C. (2016). Can ashi points stimulation have specific effects on shoulder pain? A systematic review of randomized controlled trials. *Chinese Journal of Integrative Medicine*, *22*(6), 467–472. https://doi.org/10.1007/s11655-015-2107-4

Wang, L., Suo, S., Li, J., Hu, Y., Li, P., Wang, Y., & Hu, H. (2017). An investigation into traditional chinese medicine hospitals in China: Development trend and medical service innovation. *International Journal of Health Policy and Management*, *6*(1), 19–25. https://doi.org/10.15171/ijhpm.2016.72

Wang, R., Li, X., Zhou, S., Zhang, X., Yang, K., & Li, X. (2017). Manual acupuncture for myofascial pain syndrome: A systematic review and meta-analysis. *Acupuncture in Medicine*, *35*(4), 241–250. https://doi.org/10.1136/acupmed-2016-011176

Wong Lit Wan, D., Wang, Y., Xue, C. C. L., Wang, L. P., Liang, F. R., & Zheng, Z. (2015). Local and distant acupuncture points stimulation for chronic musculoskeletal pain: A systematic review on the comparative effects. *European Journal of Pain (United Kingdom)*, *19*(9), 1232–1247. https://doi.org/10.1002/ejp.671

Yang, C., Du, Y. K., Wu, J. Bin, Wang, J., Luan, P., Yang, Q. L., & Yuan, L. (2015). Fascia and primo vascular system. *Evidence-Based Complementary and Alternative Medicine*, *2015*. https://doi.org/10.1155/2015/303769

Zhang, R., Lao, L., Ren, K., & Berman, B. M. (2014). Mechanisms of acupuncture on persistent pain. *Anesthesiology*, *120* (2), 482–503.

Zhang, Z. J., Wang, X. M., & McAlonan, G. M. (2012). Neural acupuncture unit: A new concept for interpreting effects and mechanisms of acupuncture. *Evidence-Based Complementary and Alternative Medicine*, 2012. https://doi.org/10.1155/2012/429412

Zhou, K., Yan, M., and Brogan, M. (2015). Dry needling vs. acupuncture: the ongoing debate.

Acupuncture Medicine. 2015(33). 485-490.