Trigger Point Dry Needling as a Modality for the Promotion of Recovery and Performance

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Introduction

Myofascial trigger points have been a large focus in recent research due to their nature of causing pain and dysfunction, ultimately affecting an athlete's performance. These trigger points, despite being highly prevalent, often go undiagnosed and untreated (1). Dry needling, following suit, has emerged as a leading treatment modality for clinicians to treat myofascial trigger points (2). With this emergence of dry needling, multiple research studies and case reports have focused on the effectiveness of dry needling and whether it has any clinical significance towards an athlete's recovery from injury. Although many studies have demonstrated the benefits of this intervention for treating pain (3), there is little evidence to support that dry needling is clinically significant in improving functional outcomes (2). With this information, what is the best way to incorporate dry needling treatment to improve an athlete's recovery?

Trigger Point Pathophysiology

Myofascial trigger points (MTrPs) are defined as "hyperirritable spots in skeletal muscle that are also associated with hypersensitive palpable nodules in taut bands" (1). The tenderness associated with this pain is restricted solely to the taut band instead of the entire muscle (1). MTrPs can develop in any muscle of the body due to either "sudden injury, muscle, overload, or repetitive microtrauma" (4). Upon compression of MTrPs, pain is elicited in that point as well as along a referral pattern from that point of origin (1,3,4). Autonomic phenomena can also follow this MTrP compression, such as localized sweating, vasoconstriction or vasodilation, and pilomotor activity (1,4). These additional effects of MTrP compression are important for differentiating from other muscle tender points, which in contrast "only cause local pain upon compression" (1). Trigger points are described as being active or latent (1,3). Active MTrPs can produce spontaneous referred pain and often generate clinical symptoms as well (3,4). Latent MTrPs are usually asymptomatic but can produce referred pain due to either compression, stretch, or overload of the involved tissues (3,4). In addition to these referral patterns, latent MTrPs are believed to modify muscle activation patterns, ultimately affecting strength of the muscle as well as range of motion achieved (3).

Many factors have been associated with activating MTrPs, such as poor posture and physical or social conditions leading to vitamin deficiencies (1,4). The primary belief behind MTrP pathophysiology is that these hyperirritable spots are caused by an excessive release of acetylcholine (Ach) from the motor endplates (1). This prolonged release of Ach leads to "chronic shortening and contractures of sarcomeres, coupled with decreased circulation leading to hypoxia and local ischemia" (1). In response, inflammatory mediators – such as prostaglandins, bradykinins, and histamine – are also released, sensitizing the sensory afferent fibers of the muscle, likely causing the point tenderness of MTrPs (1). The influx of inflammatory mediators produces hypersensitivity of nociceptors, leading to both peripheral sensitization (localized at the site of injury) and central sensitization (especially at the dorsal horn neurons) (1).

Increasing Utilization of Dry Needling

Dry needling (also known as functional dry needling, intramuscular manual stimulation, or intramuscular needling) is a treatment technique used by physical therapists around the world since the 1980's (1,2). Although not typically taught in

entry-level education, many certification programs and continuing education courses have emerged to teach clinicians this innovative technique (1,3). With this increase of dry needling utilization in clinical practice, the American Physical Therapy Association (APTA) and the American Academy of Orthopaedic Manual Physical Therapists (AAOMPT) have both published position statements supporting the use of dry needling by physical therapists (1).

Dry Needling Methods

Dry needling (DN) is described as using a fine needle to penetrate the skin, subcutaneous tissues, and muscle with the purpose to "mechanically disrupt the tissue without the use of an anesthetic" (2,5). In a more expansive view, DN can be utilized to target muscles, ligaments, tendons, subcutaneous fascia, scar tissue, peripheral nerves, bones, and neurovascular bundles (3). Prior to utilizing the technique, clinicians must identify the appropriate patients and screen for absolute or relative contraindications that could lead to adverse effects (1).

Dry Needling Contraindications (1) *Note: Not an exclusive list	
Absolute Contraindications	**Relative Contraindications**
• Patient with needle phobia • An unwilling patient • Patient who is unable/unwilling to give consent • History of abnormal reaction to needling/injection • In a medical emergency • Patient on anticoagulant therapy/has thrombocytopenia • In an area/limb with lymphoedema	• Abnormal bleeding tendencies • Severely compromised immune system (e.g. HIV, cancer, hepatitis, etc.) • Vascular disease • Pregnancy • Diabetes mellitus • Epilepsy • Altered psychological status • Frail patients • Allergy to metals or latex • Children • Needling near a surgical site within 4 months of surgical procedure • Anatomic considerations (over pleura and lungs, nerves, organs, implants, etc.)

After screening for these possible eliminations, the clinician must then confirm that the patient is an ideal candidate for the DN technique. The patient should possess the following qualities: "1) a physical therapy diagnosis that will reasonably improve with DN; 2) the ability to understand what is being done and why; 3) the ability to effectively communicate his or her own response to treatment; 4) the ability to lie still during treatment; and 5) the ability to provide informed consent according to clinical guidelines" (1). It is critical to obtain signed informed consent from the patient following a discussion explaining the purpose, methods, and risks associated with DN (1).

The patient should be positioned in either supine, prone, or sidelying with the targeted tissues exposed and pillows or bolsters for assisting the patient positioning. The positioning should allow the patient to relax. Completing DN in a seated position is not recommended due to the risks of syncope occurring. Although several studies have deemed routine disinfection of visibly clean skin prior to needling unnecessary, the current standards of care recommend preparing the skin with 70% isopropyl alcohol and the clinician wearing gloves during the treatment. After disinfection of the area, the clinician identifies the MTrP using palpation and utilizes either the pincer grip to lift the skin or flat palpation to take up the slack of the skin. The sterile, disposable, solid filament needle is then inserted directly through the skin, or using a guide tube that is immediately removed, with a depth sufficient enough to penetrate the MTrP (1).

Once the needle is inserted into the MTrP, the practitioner has several technique variations to employ. The clinician may use a slow, steady pistoning motion in and out of the muscle with the needle (termed dynamic DN). The needle could also be left unbothered, also known as in situ (termed static DN). Another variation involves the needle being rotated several revolutions to draw the surrounding fascia or soft tissue around the needle as well. If the clinician decides to utilize the static technique, intramuscular electrical stimulation (IES) could augment the treatment. Since previous studies have proven IES to produce muscle relaxation and increase local blood circulation, the addition could lead to a greater decrease in muscle tone and improvements of motor recruitment, as long as contraindications of IES are ruled out (1).

Throughout the intervention, the practitioner should note the gauge, or diameter, and the length of the needles and ensure that the needle parameters are appropriate for the targeted muscles. A 0.30 x 50mm needle is appropriate for most muscles, but various other gauges and lengths are available for tissues of varying depths and sizes – such as a 0.30 x 75mm for the psoas or a 0.20 x 25 mm for the forearm muscles (1,3). If a patient is having their first experience with DN, and have given informed written consent, then treating only 1-2 muscles could be the best practice. After becoming accustomed to the intervention, the clinician could treat 3-4 muscles or more in following sessions as appropriate (1).

To gain the most benefits from DN, several authors believe that the intervention should elicit a localized twitch response (LTR) (1,4,5). This muscular response to the needle is thought to interrupt the motor end plate noise, which in turn elicits an analgesic effect (1,4). Following DN, which rarely exceeds 10 minutes, the involved tissues are then stretched and instructed through neuromuscular re-education of new movement patterns (1,4).

Physiology Behind Dry Needling

The scientific basis behind DN are summarized by several different models of thought, the most frequently utilized being the trigger point model, credited to the research of Janet Travell (1). These MTrPs are specifically targeted and inactivated by DN under the belief that the sensory, motor, and autonomic abnormalities will be relieved (1). It is suggested that DN produces both local and central nervous system responses to restore homeostasis at the MTrP site, ultimately reducing the presence of both peripheral and central sensitization (2). The DN is thought to improve the flow of acetylcholinesterase and relax the actin-myosin bonds of the taut bands (1). This cascade of events decreases the release of Ach and inflammatory mediators – such as bradykinin, calcitonin gene-related peptide, and substance P – which were responsible for the shortening of muscle, hypersensitivity and reduction of pain threshold associated with MTrP (1,4). DN also stimulates the alpha-delta nerve fibers, activating the enkephalinergic inhibitory dorsal horn interneurons as well as producing opioid-mediated pain reduction (4). Therefore, DN subsequently utilizes both the gate control theory as well as descending central mechanisms to achieve analgesia (2,4). Another theory behind DN is that it aids chronic injuries by disrupting the cyclic inflammatory process and re-stimulating the inflammatory cycle with a natural "reset" (6). This newly "injured" tissue restores the healing process and encourages new tissue formation (6).

Effects on Pain Research

Because of the invasive technique of DN, it is difficult for researchers to execute double-blinded, randomized controlled clinical trials, which severely limits the quality of evidence that can be conducted (1). Despite this limitation, Gattie et al collected several studies that compared DN to sham needling or control and examined their effects on pain, pressure pain threshold (PPT), and function outcomes immediately and long-term. Most of the studies, although being of low-quality, suggested a moderate effect of DN over control/sham in reducing pain and improving PPT immediately and after 12 weeks. In these same studies, the authors suggested a small effect in favoring DN over sham/control in reducing pain after 6 months. Gattie et al also examined studies

that compared DN to other treatments and observed their effects on pain. There was moderate-quality evidence to suggest small effect favoring DN in reducing pain and low-quality evidence support a moderate effect favoring DN in improving PPT. It is important to note that not all of these studies utilized corrective exercise in addition to the variables being observed (2).

Halle et al conducted a single-blind randomized clinical trial to determine if the addition of DN to a rehabilitation protocol after shoulder stabilization surgery was more effecting in improving range of motion (ROM), pain, and functional outcome scores. These dependent variables were assessed for the 39 enrolled patients at baseline (4 weeks post-operative) and at 8 weeks, 12 weeks, and 6 months post-operative. The 19 patients in the DN group received standard rehabilitation and weekly DN treatments between 4- and 8-weeks post-operative, while the control group received "sub-therapeutic" passive ROM during the DN treatment time. Aside from the statistically significant improvement in shoulder flexion ROM in the control group at the 6-month follow up, there were no significant differences in the outcomes between the two groups, with both groups showing improvement over time (3).

Kietrys et al conducted a systematic review and meta-analysis to explore the evidence regarding the effects of DN on pain reduction of patients with upper-quarter myofascial pain. Of the twelve studies collected and included in their analysis, three studies suggested a large effect favoring DN over sham/control having immediate effects on pain suppression, with one studying being clinically meaningful. Three studies also suggested a large effect favoring DN over sham/control in controlling pain at 4 weeks, although caution should be used due to the 95% confidence interval (CI) crossing the line of no difference. Two studies compared DN to other treatments and assessed their immediate effects on pain, suggesting a moderate effect favoring other treatment over DN. However, these studies were of questionable clinical meaningfulness due to their raw between-group effect sizes. Six studies suggested a small overall effect favoring other treatment over DN in improving pain at 4 weeks, with the 95% CI crossing the line of no difference (4).

Effects on Performance Research

Gattie et al found that there was low-quality evidence to suggest a small effect favoring DN over sham/control in improving functional outcomes both immediately and long-term. When compared to other treatments, very low-quality evidence suggested that there was no effect of DN, despite one study reporting that DN lead to functional outcome improvements (2).

Dembowski et al completed a case report on an 18-year-old collegiate pole vaulter that sustained an acute hamstring strain and had a history of multiple strains on his uninvolved extremity. In his initial examination, the athlete demonstrated limited knee active ROM, weakness, tenderness to palpation, and dysfunction according to the Selective Functional Movement Assessment (SFMA), consistent with a diagnosis of a grade 2 hamstring strain. He completed a physical therapy rehabilitation program three times per week for 3 weeks, focusing on progressive eccentric strengthening, and was instructed to perform a home exercise program as well. Due to the presence of MTrPs, he received a session of DN once per week after completing his exercises for that day without any adverse effects. The patient demonstrated improvements at every consecutive visit, completing an equal active straight leg raise, having no AROM deficits, and improving his SFMA. On day 20, at the time of his return to sport assessment, the physical examination was unremarkable, with him able to meet specific functional criteria, particularly eccentric strength within 10% of the uninvolved extremity, as well as completing several sport specific functional tests. At his follow-up examinations, there was no reported new injuries, deficits present, and he was fully participating in pole vaulting (5).

Another case report published by Patrick et al investigated a multimodal approach to conservatively manage a chronic ulnar collateral ligament (UCL) injury in a collegiate baseball pitcher. The athlete presented to outpatient physical therapy 6 weeks post-injury and platelet-rich plasma (PRP) injection. In his initial examination, he was diagnosed with a grade I and "borderline" grade II UCL sprain as well as reports of increased pain, strength deficits of both upper and lower extremities, motor recruitment deficits of scapulothoracic musculature, and significant disability measured by the Disability of the Arm, Shoulder, and Hand (DASH) outcome assessment. During the first 4 weeks, the athlete completed pain-free ROM and shoulder/scapula stabilization

exercises to strengthen the involved upper extremity (UE). Although achieving full strength in his UE at this point, he was still unable to complete a throwing program pain free. For weeks 5 and 6 after initial evaluation, he received a weekly DN session in addition to his rehabilitation exercises to initiate another acute inflammatory response, suppress pain, and promote healing of the sprained ligament. Palpation discovered MTrPs in his forearm flexor musculature, which received DN connected to IES to elicit the LTR. The injured, avascular UCL tissue received DN with the pistoning technique to reset the extracellular healing process. A follow-up MRI after the second DN session confirmed significantly decreased tears and laxity along with no edema. For weeks 7-12, the rehabilitation shifted its focus to strengthening of the kinetic chain utilized in the throwing biomechanics as well as neuromuscular reeducation to correct altered patterns in his throwing mechanics. After treatment, he reported significantly lower pain levels, displayed improvements in strength, proper pitching form, and decreased disability scores on the DASH assessment. At the start of the following season, the athlete returned to sport at 6 months post-injury with no pain at full speed (6).

Short et al also documented a case report upon a 29-year-old National Basketball Association player that sustained a contact injury during a professional game, resulting in an acute avulsion of the rectus abdominis and adductor longus from the pubic symphysis as well as partial tears of the adductor brevis and pectineus. After undergoing surgical repairs of the injuries, the athlete was led through 3 phases of rehabilitation – acute, subacute, and return-to-sport reconditioning – until he met return-to-play criteria that included a reduction in pain, normalization of ROM and strength, improvements on outcome questionnaires, reduction of movement asymmetries, and pain-free running and sport participation. The acute phase utilized various interventions – such as cryotherapy, pneumatic compression, open-kinetic-chain exercises, ROM, and progressive weight-bearing activities – to promote proper healing of the surgical repairs. The subacute phase (weeks 1 through 3 post-operative) consisted of additional manual therapy techniques, progressive strengthening, and motor control in multiple planes of movement. During this phase, on days of increased soreness, the athlete received DN in areas of increased tone and tenderness found within the adductor longus, rectus abdominis, and related regional musculature. Upon test-retest, he reported a clinically significant decrease in pain, decrease in soreness following ROM activities, and an improvement in ROM achieved according to visual observation. Phase 3 treatment implemented active mobility drills, progressive strengthening exercises in preparation for competition, and advanced plyometric and agility activities. Manual therapy and DN were reduced during this phase, only being utilized if impairments were presented possibly relating to mobility restrictions and/or increased pain. He was able to return to in-season competition at 5 weeks post-operation, with improvements observed in pain rating, the Copenhagen Hip and Groin Outcome Score, mobility, strength, the Functional Movement Screen, the Y Balance Test, and sport performance metrics. At his 2-year follow-up, he remained an active professional basketball player and had not experienced any complications or reinjuries (7).

Conclusion/Recommendations

As stated previously, it is difficult for research to conduct high-quality clinical trials to determine the effectiveness of DN due to its invasiveness. Additionally, the research that has been published is contradictory, with no true consensus on the effect size DN has on pain reduction and its effect on improving performance. However, several cases do Further evidence should still be conducted to elaborate upon the benefits of DN. But when collaborated upon with corrective exercise and analysis of movement patterns, DN could play a pivotal role in an athlete's recovery and return to peak performance.

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