Safety, effectiveness and impact of dry needling trigger points in athletes: a systematic review

Tracey Teasdale, BSc. (Hons), ND (cand)

ABSTRACT

This research will systematically review the literature on the effect and impact of dry needling of myofascial trigger points (MTrPs), and the applications of this technique to the sporting community. For athletes, proper structure and function of skeletal muscle, and enhanced recovery from injury is vital to performance. In theory, every training session, event or competition results in microtrauma to muscles[1]. Recovery from this muscle fiber damage is the basis of adaptation to training[1]. Over time, however, this repetitive microtrauma can also lead to muscle shortening and the development of MTrPs[2]. Shortened muscles and MTrPs decrease flexibility, range of motion, strength, circulation and conduction of nerve impulses[3] ultimately increasing the risk for injury. The pain associated with some MTrPs can also affect sleep quality and quantity, the ability to train effectively, and the ability to perform activities of daily living[3]. Theoretically, proper diagnosis and treatment of trigger points in the athlete has the potential to decrease post-exercise pain, and improve athletic performance. Although there has yet to be a study reporting the number of athletes affected by myofascial pain due to trigger points, the pathology quite possibly plagues most athletes. For example, in world-class badminton players, 52 % suffer from shoulder pain, 37 % have had shoulder pain in the past, and 20 % have chronic shoulder pain[4] and would likely benefit from myofascial treatments. Dry needling of trigger points with acupuncture needles is a practice used by some health care practitioners treating patients suffering from chronic musculoskeletal injuries, pain and dysfunction. The dry needling technique involves palpating for taut bands within the belly of the affected muscle, isolating the tender nodule, and inserting an acupuncture needle directly into the trigger point to cause a muscle twitch, and a reflexive relaxation and lengthening of the muscle[5]. Clinical research on the safety and effectiveness of the treatment will be shared with Sport Canada and therapists who practice trigger point therapy to ensure transfer of knowledge and ultimately improve performance of athletes across Canada.

BACKGROUND

In the realm of athletics, the ability to train, compete, and recover optimally plays a crucial role in the success of an athlete. During the 2004 Olympic Games in Athens, a survey of visits to the medical clinic in the Olympic Village found the most common presenting pathology to be myofascial pain/muscle spasm, at 32.5 %[6]. A study of elite badminton players found that 52 % suffer from shoulder pain, 37 % have had shoulder pain in the past, and 20 % have chronic shoulder pain[4]. It is probable that myofascial trigger points (MTrPs) are a major contributing factor to the pain in these athletes. Proper diagnosis and treatment would likely be beneficial to their performance, reduce pain, and improve overall quality of life. Dry needling of MTrPs, also known as trigger point acupuncture, is a simple and relatively non-invasive procedure that requires no pharmaceutical compounds. A better understanding of MTrPs and the efficacy of

dry needling is required, as this treatment may have considerable applications to the athletic population.

About myofascial trigger points

A MTrP is defined as a hyperirritable spot within a taut band in a skeletal muscle[7]. MTrPs can be either active or latent. Active MTrPs are always tender, prevent full lengthening of the muscle, decrease strength of muscle contraction, often has a predictable referred pain pattern when palpated, and will elicit a local twitch response when stimulated effectively7 above[7]. Latent MTrPs can have all of the same clinical presentations but are asymptomatic until palpated[7]. Aside from pain, MTrPs can result in autonomic dysfunctions in the affected areas, disruptions in motor coordination both local and distal to the MTrP, sleep interference, and limit the ability to carry out activities of daily living[7]. For athletes, it can affect their ability to train, perform, recover, and heal.

Formation of myofascial trigger points

According to Travell & Simons, MTrPs can be directly activated by acute trauma, or by muscles subjected to excessive repetitive contractions, or contractions sustained over a long period of time[7]. In a study of 15 healthy volunteers undergoing repetitive eccentric exercise unilaterally, MTrPs appeared on the exercised side on the second day, while the control side lacked the taut bands and tender points[8]. The MTrPs showed the sustained electrical activity consistent with other electrophysiological studies of trigger points[8,9]. During training and competition, athletes regularly subject their muscles to sustained and/or repetitive contractions that lead to microtraumas within the muscles.

Trigger point pain physiology

MTrPs are postulated to cause pain by increasing the release of acetylcholine (ACh) at motor end plates, by way of mechanical, chemical or other injurious stimuli[10]. This results in persistent sarcomere shortening and contracture, increasing local metabolism while decreasing local circulation leading to an energy crisis, hypoxia, and local ischemia[3]. Neuroactive substances and inflammatory mediators including prostaglandins, bradykinins, cytokines, and histamines are released that sensitize the afferent nerve fibres within the muscle[11,12]. This accounts for tenderness and pain of the MTrP and also stimulates the release of more ACh.

C fibres and A delta fibres within the muscles are responsible for localizing and discriminating types of pain, and sensing more diffuse aching pain, respectively[7]. The convergence of these fibres within the dorsal horn of the spinal cord supports the consistent patterns of pain referral from MTrPs[7].

Treatments for myofascial pain

Conventional treatments for myofascial pain include the application of ice, heat, physiotherapy, manual myofascial treatments, and pharmaceutical interventions such as muscle relaxants/spasmolytics, analgesics, non-steroidal anti-inflammatory drugs, and cyclo-oxygenase-2 selective inhibitors[13]. These have their limitations including side effects that can interfere with an athlete's ability to train. For example, the over-the-counter NSAID ibuprofen can result in nausea, epigastric pain, heartburn, dizziness, and skin rashes in up to 9 % of patients[14]. Clinical trials for naproxen reported adverse effects in up to 9 % of participants including heartburn,

constipation, abdominal pain, nausea, headache, dizziness, drowsiness, dyspnea, peripheral edema, tinnitus, and skin complications[14].

Needling MTrPs has a history dating back to the 7th Century AD, when Chinese physician Sun Ssu-Mo inserted needles into "a shi" points, local areas of muscle tenderness[15]. This is now referred to as dry needling of MTrPs. With the advancement of Western medicine and pharmacology, this technique has been altered from the use of acupuncture needles to the use of hypodermic needles and the injection of a local anaesthetic to decrease the pain of the injection itself, although many practitioners still use the dry needling technique. It is thought that needling directly into a MTrP relaxes the nodule by depolarizing muscle fibres, evoking small local twitches[16]. This leads to micro-stretch effects on the shortened sarcomeres and decreased traction on pain sensitive structures[3]. Needle insertion also inhibits nociceptors, releases endorphins and affects aforementioned spinal cord pathways[3]. A comprehensive review of the safety and effectiveness of this treatment for athletes will allow for a valid summation and evaluation of the evidence, which will ultimately benefit athletes, coaches, practitioners, and the sporting community.

OBJECTIVES

1. To determine the safety and effectiveness of dry needling MTrPs
2. To propose dry needling as a treatment for athletes suffering from acute and chronic myofascial pain

METHODS

Types of studies

Randomized controlled trials, clinical trials, meta-analyses, systematic reviews, and case studies were included in this review. The meta-analyses and systematic reviews were limited to the inclusion of dry needling of trigger points in comparison to another form of treatment. Studies published prior to 2000 were excluded for summary in this review.

Types of participants

Participants were limited to patients with active MTrPs in various muscles. Studies were excluded if the focal populations were too dissimilar to athletes, or if other pathologies were present. For example, those studying patients with osteoarthritis whose pain may not be solely due to MTrPs or elderly patients who may have other confounding factors associated with their pain. Articles focused on fibromyalgia were excluded as this disorder is complex, has a multifactorial and poorly understood etiology, and is not directly applicable to athletes.

Types of interventions

Dry needling of trigger points and dry needling compared to non-local acupuncture, sham treatments (acupuncture or other), wet needling with injectable substances, other active treatments, or no treatment/wait list were included in this review. Trials evaluating electro-acupuncture were not included in this review.

Types of outcome measures

Outcome measures included subjective, objective and functional scales; mainly visual analog scores (VAS), pain pressure threshold (PPT), and/or range of motion (ROM) or quality of life, respectively. Articles were excluded if the outcomes were not based on pain scores, quality of life, functionality or range of motion, as outcomes used in these studies area not applicable to athletes as a whole.

Search methods for identification of studies

A search of the National Library of Medicine database (PubMed) was undertaken using a variety of terms relating to the intervention and population to identify a comprehensive set of studies to assess for inclusion in this review. Search strings on PubMed included:

1. "trigger point" + athlete = 0
2. "trigger point" + athlete = 1 (no limits)
3. "trigger point" + needling = 21
4. Myofascial + athlete = 0
5. Myofascial + athlete = 5 (no limits)
6. Myofascial + needling = 37

Unless otherwise specified, limits were set to studies on humans that were clinical trials, randomized controlled trials, meta-analyses or reviews. Article selection was initially based on the target population of athletes. As the research on this particular population is limited, the selection was extended to presence of active trigger points in the study participants.

Selection of Studies

Titles and abstracts were examined. Irrelevant articles (not pertaining to the intervention or population) were excluded as well as those studies not meeting inclusion criteria.

Data collection and management

Data extracted included participants, interventions, outcome measures, results and main conclusions.

RESULTS

Description of studies

The studies meeting the aforementioned inclusion criteria were: 2 were systematic reviews (Cummings & White 2002, Furlan et al. 2005), one meta-analysis (Tough et al. 2008), one case summary (Ingber 2000), 4 randomized controlled clinical trials (Edwards & Knowles 2003, Irnich et al. 2002, Nabeta & Kawakita 2002, Itoh et al. 2007), and 2 clinical trials (Hsiesh et al. 2007, Kamanli et al. 2002)

Risk of bias in included studies

The main source of bias is the small sample size of the studies. The sample (n=10) may be too small to create statistically significant conclusion, which speaks to the need for more research done in this area. The other sources of biases include poor study design, lack of control groups, and lack of comparison to other forms of treatment such as physiotherapy. Articles with better study design and less risk of bias have been published; however the populations studied were quite dissimilar to athletes or had inapplicable outcome measures. As such, they were not included in this review.

Effects of interventions

Comparison 1: dry needling and dry needling vs placebo or no treatment
In a series of three case studies, Ingber found that 3 patients treated with dry needling experienced no pain or limitations in ROM in a 1-2 year follow-up period[17]. In a study of patients with bilateral infraspinatus MTrPs, where one side was treated and the other side acting as the control, no changes were noted on the untreated side[25]. The treated side resulted in significant increases in active and passive ROM and pain threshold, and a significant reduction in subjective pain scales[25]. Other studies have found dry needling to be more effective than no treatment or sham acupuncture, generally decreasing pain intensity and increasing quality of life[18,19,20,23]. A study of the modified dry needling sparrow technique involves repeated insertion of the needle into the MTrP found the intervention to result in decreased pain on the VAS and increased PPT immediately after the treatment, as well as the following day when compared with sham acupuncture[21]. Improvements lasted longer after repeated treatments, but the effects subsided after 9 days[21]. Overall, dry needling was more beneficial than sham acupuncture or no treatment, and no safety concerns were reported.

Comparison 2: dry needling vs usual care
Most studies found no difference between dry needling and usual care such as physiotherapy or physical therapy education[19,22,26]. In one study, dry needling was more effective than stretches at a 6-week follow-up, while no significant differences were found at the initial 3-week follow-up[19], suggesting that subsequent dry needling treatments have a longer-lasting effect than stretching. Minimal safety issues or adverse effects were reported. The most recent meta-analysis found 2 studies with conflicting results, 4 placebo-controlled trials with no statistically significant differences but marked statistical heterogeneity and one where dry needling to be more effective than standardized care[22]. Based on the studies included in their analysis, the authors were unable to conclude that there was a statistically significant benefit to using dry needling compared to usual care.

Comparison 3: dry needling vs standard acupuncture
Some studies found dry needling to reduce pain, increase quality of life and increase ROM beyond standard acupuncture[21,23]. A systematic review found both dry needling and standard acupuncture to be safe and more effective than sham acupuncture or no treatment, but was unable to identify the most effective type of acupuncture[18].

Comparison 4: dry needing vs wet needling
A clinical trial found a significant reduction in pain for both dry and wet needling, but found injecting lidocaine or botox provided a greater improvement in symptoms[24]. A systematic review found no difference between the two interventions[26]. The majority of the studies in the review found wet needling to be effective regardless of the substance injected[26]. There were no comments with respect to any safety concerns of wet and dry needling techniques for the general population.

DISCUSSION

Summary of main results

This literature review supports the possibility that dry needling of trigger points may have a beneficial effect and may be directly transferrable to athletes. The main limitation of the research is the number of high quality studies to provide valid evidence for athletic population. There are several case studies on athletes, however these studies do not have a control group, and therefore one cannot rule out placebo effect. The study by Hsiesh et al is the best example as patients had infraspinatus trigger points bilaterally, and only one side was treated[25]. This study had a control group, being the untreated side; however, it did not compare dry needling to any other treatment[25]. Nonetheless, athletes found a significant decrease in pain and increase in range of motion[25].

Current research supports the use of wet needling as the injection of lidocaine or botulinum toxin decreases the pain associated with the injection when compared with dry needling. There are conflicting results with respect to the efficacy of wet versus dry needling. In the meta-analysis by Cummings et al, some studies showed that wet needling is effective regardless of the substance injected, some showed no difference between wet and dry needling, while others reported dry needling to be more effective than wet needling[26]. Although most studies included within the meta-analysis were of poor quality, the general trend suggests that both wet and dry needling can be an effective treatment for trigger points[26]. Wet needling requires that the needle be wide enough to allow the passage of an injectable fluid into the trigger point. This procedure is not without possible adverse effects. Any injection or needle puncture can lead to local tenderness, bruising, and vasovagal syncope. Injection of lidocaine and other local anesthetics can result in sleepiness, lightheadedness, restlessness, visual and auditory disturbances, seizures, and hypersensitivity and allergic reactions, as well as muscle necrosis[7,27]. Local anesthetics are often injected as a hydrochloride salt, requiring the tissues to buffer the solution[27]. After repeated injections, the buffering capacity of the tissue can be depleted and decrease the effectiveness of subsequent injections[27]. Botulinum toxin injection has been associated with local weakness in 17 % of patients and dysphagia in 13 %[14]. Malaise, general weakness, upper respiratory tract infections, nausea, vomiting, headaches, drowsiness, stiffness, dizziness, falling and rhinitis were all reported in up to 10% of patients[14].

The efficacy of MTrP needling depends on the correct identification of the MTrP, accurate placement of the needle, and elicitation of the local twitch response. This can be achieved by both wet and dry needling, although the literature suggests dry needling has the advantage of fewer side effects and adverse reactions.

Applicability of evidence

Most of the studies on trigger point needling are on patients with "myofascial pain" or "myofascial pain syndrome", a poorly defined diagnosis that is not limited to a population of athletes. However, the clinical trials define within their inclusion criteria that there are active trigger points that can be isolated in the muscles of the participants. The results should therefore be applicable to any muscles with active trigger points, whether the cause of the trigger point is myofascial pain syndrome or repetitive stress from exercise and training. For athletes, every training session, event or competition should result in microtrauma to the muscles, and the recovery from this damage is the basis of adaptation to training. Over time, however, this repetitive microtrauma can also lead to muscle shortening and the development of MTrPs[2]. The

pathophysiology of an active trigger point is the same, regardless of how it is formed, and therefore can be treated the same. Addressing the physiology by increasing local blood flow and encouraging sarcomere relaxation will benefit a MTrP whether it be in a population of athletes or in the general population.

Quality of the evidence and sources of bias
An issue arises with the quality and methodology of acupuncture research. Generally, published acupuncture trials have had a relatively small sample size. The comparison groups tend to be no treatment/wait list, sham acupuncture, or standard treatment. Sham acupuncture is supposed to act as a control group, and usually is performed by improper placement or superficial insertion of the needle. Both of these can still cause local physiological changes, and are not a true placebo control.

AUTHOR'S CONCLUSIONS

Implication for practice
Overall, the research supports the use of wet and dry needling of trigger points to decrease pain and increase range of motion. The effect seems to be somewhat transient, with benefits lasting anywhere from two days to five weeks. However, these studies often did not address the structural or postural imbalances related to the MTrPs. The combination of dry needling, stretching and exercise therapy, hydrotherapy, and other non-invasive treatments would likely extend the documented benefits of dry needling. Dry needling has an added benefit over wet needling as it bypasses the extra stress processing pharmaceutical compounds to the already overworked athlete's body, and has less possible side effects. For athletes, this treatment has the ability to have a positive impact on pain, performance and quality of life.

Implication for research
Although there is extensive research on myofascial pain syndrome, dry and wet needling of trigger points, and chronic pain, there is clearly a lack of quality research on dry needling of trigger points and its effects on athletic performance. Empirically, acupuncture and dry needling is a safe procedure; however the studies included in this review did not assess safety and adverse effects. There is a need for well-designed studies in this area, as it is a practice used by a wide range of health care practitioners.

TABLES

Characteristics of included studies

Cummings & White (2001)[26]	
Methods	Systematic review
Studies	Twenty-three randomized controlled clinical trials
Interventions	Direct dry needling or wet needling of trigger points
Outcomes	Eight of 10 wet needling studies found the effect of needling to be independent of the substance injected In five studies comparing wet and dry needling, there was no difference found Two trials found the efficacy of dry needling to be no greater than placebo Three trials found dry needling of trigger points to have no effect beyond

	therapies of known efficacy such as physiotherapy or splints Three trials investigating indirect wet needling found the intervention ineffective
Notes/biases	Most of the studies summarized in the review were of poor quality, not properly blinded or had high dropout rates. Most studies showed a decrease in pain associated with either dry or wet needling of trigger points; however this effect was not statistically greater than placebo.

Tough et al. (2008)[22]	
Methods	Meta-analysis
Studies	Seven studies of direct needling of myofascial trigger points
Interventions	Direct needling of trigger points, usual care, or placebo
Outcomes	Two studies had conflicting results Four placebo-controlled studies found no statistically significant improvements, but had marked statistical heterogeneity One study found dry needling to be an effective treatment compared to standardized care
Notes/biases	Most studies had small sample sizes and did not show statistical significance, however the general direction of the meta-analysis points to a beneficial effect of dry needling trigger points on decreasing pain.

Ingber (2000)[17]	
Methods	Case summaries
Participants	Three racquet sport athletes previously referred for arthroscopic surgery
Interventions	Eleven myofascial treatment sessions in the form of dry needling once per week, along with muscle stretching
Outcomes	Follow-up 1-2 years post-treatment revealed no further pain or limitations in range of motion for all three patients
Notes/biases	Case studies have poor strength of evidence; small sample size; no control group; good length of follow-up.

Edwards & Knowles (2003)[19]	
Methods	Randomized controlled clinical trial
Participants	Forty patients with identified trigger points (a maximum of six points identified)
Interventions	Group 1: dry needling of trigger point and appropriate stretches recommended by Simons et al for three weeks, after which participants continued regimes at home Group 2: stretches recommended by Simons et al three times daily Group 3: no treatment
Outcomes	Pain thresholds at the start of treatment and following three weeks of treatment showed no significant differences between groups 1 and 2. At a six week follow up, group 1 fared significantly better than groups 2 or 3.
Notes/biases	Small sample size; would benefit from a longer-term follow up; does not isolate the effects of dry needling alone.