A Review of Research Evidence for Dry Needling and Ischemic Compression Interventions in the Reduction of Pain Associated with Myofascial Trigger Points

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Abstract

The purpose of this research study was to review the strength of existing research involving two types of physical therapy treatment interventions (noninvasive ischemic compression and invasive dry needling) used to alleviate musculoskeletal pain in patients attributed to MyoFascial Trigger Points (MTrPs). Review of the literature was based on specific inclusion criteria related to levels of evidence, quality, and methodology, which generated research articles related to strong and moderate Level II and Level III studies comparing these and other treatment approaches. The authors conclude that more Level I studies are needed in this area of research.
Keywords: *Physical therapy; MyoFascial Trigger Points (MTrPs); ischemic compression; dry needling*

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Introduction

Myofascial Trigger Points (MTrPs) are a common source of musculoskeletal pain affecting a large number of individuals (Tough et al., 2009). These are defined as hyperirritable points in taut bands of skeletal muscle which exhibit a local twitch response (LTR) and referred patterns of pain (Trampas et al, 2010; Tsai et al., 2010). MTrPs can develop anywhere in the body, but are seen most commonly in postural muscles such as the levator scapulae, sternocleidomastoid, upper trapezius, scalenes, and quadratus lumborum (Rickards, 2006).

MTrPs are thought to develop in response to sudden injury or muscle overload. Tough et al. (2009) state that "...the injured muscle fibres shorten (forming taut bands) either in response to excessive amounts of calcium ions being released from within the damaged fibres, or in response to the corresponding motor end plate releasing excessive amounts of acetylecholine. Local tenderness and referred pain ensues as muscle nociceptors are stimulated in response to reduced oxygen levels and increased inflammatory chemicals present at the site of injury."

MTrPs can cause reduced range of motion (ROM) and subjective reports of stiffness in nearby joints, musculoskeletal pain, tension headaches, dizziness, tinnitus, a local twitch response, and tenderness to palpation (Trampas et al., 2010; Tough et al., 2009; Venancio et al., 2009; Kostopolous et al., 2008; Shah et al., 2008). A wide variety of treatments have been used to resolve MTrPs (Trampas et al., 2010; Rickards, 2006). One of the most common treatments

is manual therapy, which includes manual stretching, skin rolling, cross-fiber massage, Swedish massage, Thai massage, myofascial release, strain-counterstrain, and ischemic compression (Trampas et al., 2010). Needling therapies are also very common, including acupuncture, dry-needling, and injection therapies using substances such as botulinum toxin, lidocaine, procaine, mepivacaine, saline solution, and corticosteroids in various concentrations and combinations (Venancio et al., 2009).

Ischemic compression (IC) is an intervention where a bearable amount of sustained pressure is applied with fingertips or thumb against the palpable resistance of an MTrP (Okhovatian et al., 2012). The term IC can be used interchangeably with ischemic compression blockage, manual pressure release, trigger point pressure release, and sustained manual pressure (Wang et al., 2010; Okhovatian et al., 2012). Pain reduction and MTrP resolution following IC results from local reactive hyperemia, due to either spinal reflex mechanisms or a counterirritant effect, bringing about a reflexive relaxation of the affected muscle (Okhovatian et al., 2012; Hou et al., 2002). Proponents point out that this therapy is inexpensive, needs no instrumentation, and is non-invasive (Okhovatian et al., 2012).

Dry needling (DN) is an intervention which involves inserting a small needle into an MTrP, causing it to mechanically rupture (Venancio et al., 2009). The exact mechanism by which this therapy works is unclear, but it is thought to mediate pain through hyperstimulation analgesia of spinal cord reflexes, and that mechanical damage to muscle fibers and nerve endings increases extracellular potassium, dilutes nerve-sensitizing substances, increases vasodilation, and causes necrosis in the area of the MTrP (Tsai et al., 2010; Ay et al., 2010).

Although the exact cause of MTrPs and the mechanism by which these treatments work are unclear, the two interventions described above have been proven effective. While dozens of treatments are available, few studies have compared the efficacy of older, noninvasive therapies such as ischemic compression with the efficacy of newer, more invasive treatments like dry needling. The purpose of this article is to review and compare the strength of existing research that has been performed on these two specific therapies.

Methodology

A search of online databases including Science Direct, EBSCO, PubMed, and CINAHL (2007-2012) was performed with the following inclusion criteria: 1) English only, peer-reviewed articles from 2007-2012; and 2) intervention studies which utilized the Visual Analog Scale (VAS) as an outcome measure. The strategy used involved a general search strategy including search terms "dry needling + physical therapy," "ischemic compression + physical therapy," "myofascial trigger points", and "trigger points."

The articles that met the search criteria were subjected to two reviews. The first review determined the *level of evidence* of the article according to Sackett's levels of evidence, as outlined in the Center for Evidence-Based Medicine (www.cebm.net). The second review assessed the *quality and methodology* of the articles based on seven review questions outlined by the American Academy for Cerebral Palsy and Developmental Medicine's (AACPDM) Treatment Outcomes Committee (AACPDM Treatment Outcomes Committee, 2004). A "strong" score for an article is judged as "yes" to 6 or 7 questions, "moderate" to 4 or 5, and "weak" to a score of 3 or less. All articles assessed were found to be "strong" or "moderate." Because the AACPDM deals with the type of study in descending order of methodological strength, case studies and lower levels of evidence were excluded due to their low methodological quality.

Table 1 outlines the classification system used in this study. The combination of these reviews subjects the literature to a more thorough evaluation than those which evaluate study design only.

This study reviewed the strength and quality of existing research relative to the

TABLE 1
AACPDM Review Criteria

AACPDM Review Criteria	Name of Article Reviewed
A. Level of Study Design	(I, II, III)
B. Quality of the Study	(Strong, Weak, or Moderate)
1. Were inclusion and exclusion criteria of the study population well described and followed? 2. Was the intervention well described and was there adherence to the intervention assignment? (for 2-group designs, was the control exposure also well described?) Both parts of the question need to be met to score 'yes'. 3. Were the measures used clearly described, valid and reliable for measuring the outcomes of interest? 4. Was the outcome assessor unaware of the intervention status of the participants (i.e., were the assessors masked)? 5. Did the authors conduct and report appropriate statistical evaluation including power calculations? Both parts of the question need to be met to score 'yes'. 6. Were dropout/loss to follow-up reported and less than 20%? For 2-group designs, was dropout balanced? 7. Considering the potential within the study design, were appropriate methods for controlling confounding variables and limiting potential biases used?	Yes or No

effectiveness of ischemic compression and dry needling in reducing pain. Several studies examined showed favorable results for each intervention regarding the treatment of MTrPs. These studies were first categorized according to Sackett's level of evidence, and only evidence levels I-III were included. The studies were then subjected to the grading criteria set forth by the AACPDM Treatment Outcomes Committee, which examined their quality and methodology. These seven questions are a quality assessment of level I-III studies. A "strong" score for an article is judged as "yes" to 6 or 7 questions, "moderate" to 4 or 5, and "weak" to a score of 3 or less. All articles assessed were found to be "strong" or "moderate."

Results

The search strategy yielded 12 articles that met the inclusion criteria. Seven represented dry needling while 5 represented ischemic compression. The former were comprised of randomized controlled trials, while the latter were comprised of randomized controlled trials and a cohort study.

Dry Needling

Huang et al. (2011) studied a group of 92 individuals with myofascial trigger points due to myofascial pain syndrome for duration of at least three months in a cohort study with a concurrent control group (Level III). This study aimed to apply a dry needling protocol and assess the intensity of pain and interference of the pain in daily life. Both were assessed on a self-reported inventory based on a 0-10 scale with the pain interference being broken up into categories such as during general activities, walking ability, relationships with others, etc. They were each assessed at baseline and then again 2, 4, and 8 weeks later. Results showed that after the intervention period there was a significant negative change in pain intensity ($p < 0.001$). Also in the 8th week, the reduction slopes for aggregated

pain interference significantly differed from those observed at the 2-week time point ($p < 0.001$).

A randomized control trial was performed by Hsieh et al. (2007) looked at a group of 14 participants with bilateral shoulder pain with active trigger points in the infraspinatus on each side (Level II). The purpose of this study was to use the homogeneity of the tissues on the same participant to determine the difference of range of motion, pain intensity, and pain pressure threshold on a dry needle treated side versus the other side that would serve as the control. Range of motion was assessed with internal rotation of the shoulder; pain was assessed by the visual analog scale; and pain pressure threshold by an algometer that was proven to be both valid and reliable. In each of the three categories there were significant improvements in the dry needled side compared to the non-needled side ($p < 0.01$). Weaknesses of this study include the small sample size and the lack of a "sham" procedure.

Venancio et al. (2009) conducted a randomized control trial with 45 patients (Level II), each having myofascial pain and headaches that could be reproduced by activating at least one trigger point. They were placed in three groups: dry needling, 0.25% lidocaine injections, and botulinum toxin injection. The outcome measures were levels of pain intensity, frequency and duration, local post-injection sensitivity, effect time and duration of relief, and the need to use analgesics to control headaches after a 12-week period. All groups showed significant improvement ($p < 0.05$) with the botulinum toxin having the best results. The authors were not blinded to the outcome and the study did not have a control group.

A randomized control trial was conducted by Tsai et al. (2010) (Level II) to examine the efficacy of dry needling on the irritability of a MTrP in the upper trapezius muscle. The participants were randomly divided into two groups. Eighteen patients were in the control group who received sham needling, and 17 patients were in the dry-needling group who received dry needling into a trigger point in the extensor carpi radialis longus muscle. Cervical range of motion, pressure pain threshold, and subjective pain intensity were assessed before and immediately after the treatment. The results showed that mean pain intensity was significantly reduced ($p < 0.05$) immediately after dry needling in the experimental group; the mean pressure threshold and mean range of motion of the cervical spine were also significantly increased in this group. The changes in pain intensity, pressure pain threshold, and range of motion of the neck were significantly larger in the dry needling group than in the control group. The authors acknowledged that a lack of long term follow-up with patients was a weakness of the study.

Ay et al. (2010) conducted a randomized controlled trial with 80 subjects (Level II) to compare the effects of local anesthetic injection to dry needling on pain, cervical range of motion, and depression in patients with myofascial pain syndrome (MPS). Subjects were divided into two groups of 40 people, with Group 1 receiving a local anesthetic injection (2ml of 1% lidocaine) and Group 2 receiving dry needling on trigger points. Both groups were also given stretching techniques for the trapezius muscle. The Visual Analog Scale (VAS) was used to assess pain, a goniometer measured active cervical range of motion, and the Beck Depression Inventory (BDI) assessed level of depression. There were no statistically significant differences in pre-treatment evaluation parameters of the patients. The results showed significant improvements ($p < 0.05$) in VAS, cervical ROM, and BDI scores after 4 and 12 weeks in both groups compared to pre-treatment results. There were no significant differences between the groups. A weakness in the study is the description of the intervention. It was unclear in the article how often they were receiving treatment, only discussing the results after 4 and 12 weeks; in addition, there was not a control group for this research.

A randomized control trial by Ga et al. (2007) (Level II) studied 40 subjects to observe the effectiveness of dry needling, with and without paraspinal needling on trigger points. Paraspinal needling was

defined as normal dry needling with the addition of dry needling to the multifidi at C3-C5. They measured the effects of both on pain (using the Visual Analog Scale, FACES, and Pressure Pain Threshold), depression, local twitch responses, passive cervical ROM, and post-treatment soreness. There were 4 treatments at days 0, 7, 14, and 28 on both groups. Results showed that both groups improved in all measurements at the end of four treatments in the pain category. Measures of depression, local twitch response, and post-treatment soreness showed no significance while all directions in passive ROM improved except extension in the dry needling only group ($p < 0.05$). The authors indicated that the lack of blinding and the measurement of pain threshold using thumb pressure were weaknesses of the study.

Fernandez-Carnero et al. (2010) conducted a randomized control trial (Level II) on 12 female patients to investigate the effectiveness of dry needling over active trigger points in the masseter muscle. The participants received a dry needling and a sham needling intervention on two different days (seven days apart) assigned randomly for each patient. Pain and pressure pain threshold were assessed, and both showed significant improvement in the dry needle intervention versus the sham intervention. This study only described the immediate effects of the treatment in a small sample, which is a considerable weakness to the results.

Table 2 provides a summary review of the seven articles representing dry needling. The table indicates that the articles were primarily Level II studies which had strong and moderate grades.

Ischemic Compression

In a random control, single blind, placebo-controlled trial by Gemmell et al. (2008) (Level II), authors studied the immediate effect of ischemic compression, trigger point pressure release, and sham ultrasound on pain, cervical lateral flexion, and pressure pain threshold of upper trapezius trigger points. Forty-five participants were assigned to one of the three blinded intervention groups and measures were taken by a pressure algometer, cervical range of motion goniometer, and the VAS for pain. Clinically significant differences were found between the ischemic compression and sham ultrasound interventions ($p < 0.05$) according to a one-way ANOVA. The study also recommended that additional research be undertaken in this area.

Okhovatian et al. (2012) (Level II) compared immediate effects of manual pressure release and strain/counterstrain techniques on latent trigger points of the upper trapezius muscle by randomly assigning participants to either manual pressure release therapy, strain counterstrain therapy, or sham ultrasound. They then used the pressure pain threshold and the visual analog scale to measure pain after the intervention was completed. Results showed significant differences ($p < 0.05$) between the manual pressure release and the strain counterstrain therapy versus the sham ultrasound. The authors concluded from this that the manual pressure therapy was the best at immediately reducing pain associated with trigger points in the trapezius muscle.

Kostopoulus et al. (2008) conducted a randomized control trial (Level II) that examined separate and combined effects of ischemic compression and passive stretching therapies on trapezius trigger points in terms of pain and spontaneous electrical activity. Ninety people with upper trapezius trigger points were placed in three groups: ischemic compression alone, passive stretching alone, and a group receiving both. Compression was applied for three 45-second periods, with a 30 second rest period in between each action. All patients received the same amount of therapy. Significant reductions were found in both pain perception and in spontaneous electrical activity, but the combination group had better gains than either of the other two. According to the authors, no control group was used for ethical reasons.

A study was done by Kannan (2012) (Level II) that compared laser, ultrasound, and ischemic compression therapies for the treatment of upper trapezius myofascial trigger points in terms of pain and cervical range of motion. Pain was measured with

TABLE 2
Summary Review for Dry Needling

Review Criteria	Articles Reviewed						
	Ay et al.	Fernandez - Carnero et al.	Ga et al.	Hsieh et al.	Huang et al.	Tsai et al.	Venancio et al.
Level of Evidence	II	II	II	II	III	II	II
Quality of the Study	Moderate	Strong	Strong	Strong	Strong	Strong	Moderate
1. Inclusion and exclusion criteria	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Intervention assignment	No	Yes	Yes	Yes	Yes	Yes	Yes
3. Measures and outcomes of interest	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Blind outcome assessors	No	Yes	Yes	No	No	Yes	No
5. Statistical and power calculation	Yes	No	Yes	Yes	Yes	Yes	No
6. Drop-out and loss follow up	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Control of variables and biases	Yes	Yes	No	Yes	Yes	Yes	No
Quality Score	5	6	6	6	6	7	4

a VAS and a provocative pain test using a "soft tissue tenderness grading scheme" (p. 48). Active range of motion was measured with a tape measure in inches. The results of the study found that laser therapy was the most effective at reducing pain, followed by ultrasound, with ischemic compression being the least effective with regards to perceived pain and range of motion. Weaknesses of this study include the fact that there was no control group, and that there was not a power calculation mentioned to determine what was considered significant data.

Aguilera et al. (2009) (Level II) compared the immediate effectiveness of ischemic compression, ultrasound, and a sham ultrasound therapy in the treatment of myofascial trigger points (MTrP) in the trapezius. Cervical active range of motion, basal electrical activity (BEA) of the trapezius, and trigger point pressure tolerance were assessed before and after each treatment. BEA was measured with surface electromyography and pressure tolerance was measured using a VAS with application of 2.5 kg/cm over the MTrP. The study found that there was a decrease in BEA and pain sensitivity with both the ultrasound and ischemic compression therapies as compared to the sham ultrasound. There was also an

increase in active range of motion with ischemic compression as compared to the other two. No power calculations were stated in the article.

Table 3 provides a summary review of the five articles representing ischemic compression. The table indicates that the articles were primarily Level II and III studies which had strong and moderate grades.

Discussion

The purpose of this study was to review the strength of existing research on ischemic compression and dry needling for MTrPs. Review of literature was conducted using a set of inclusion criteria and a specified search strategy. Articles which met the inclusion criteria were included in the study. They were reviewed based not only on their levels of evidence using Sackett's Level of Evidence, but also on their quality and methodology using the grading criteria set forth by the AACPDM Treatment Outcomes Committee. The search resulted in the inclusion of seven articles on dry needling and five articles on ischemic compression.

A review of research evidence suggested that dry needling consisted of Level II and III studies whose quality was also rated moderate to strong while ischemic compression consisted of Level II studies whose quality was rated moderate to strong. For both interventions, the most frequently referenced outcome of interest across all the research studies was pain relief. In this regard, research articles involving dry needling showed statistically significant results in decreasing pain. On the other hand, all but one research article involving ischemic compression showed statistically significant results in decreasing pain. This particular study compared the effectiveness of laser, ultrasound, and ischemic compression in improving pain and cervical range of motion. The results of the study found that laser therapy was the most effective at reducing pain, followed by ultrasound, with ischemic compression being the least effective. Weaknesses of this study included the absence of both a control group and a power calculation to determine what was considered significant data.

Conclusion

A review of research literature consisting of moderate to strong Level II and III studies suggests that both ischemic compression and dry needling are effective in reducing pain among patients with MTrPs. However, more Level I studies are needed to validate the results of this review and to add to the body of research on the effectiveness of ischemic compression and dry needling relative to this and other outcome measures.

TABLE 3
Summary Review for Ischemic Compression

Review Criteria	Articles Reviewed				
	Aguilera et al.	Gemmell et al.	Kannan	Kostopolous et al.	Okhovatian et al.
Level of Evidence	II	II	II	II	II
Quality of the Study	Moderate	Strong	Moderate	Strong	Strong
1. Inclusion and exclusion criteria	Yes	Yes	Yes	Yes	Yes
2. Intervention assignment	Yes	Yes	Yes	Yes	Yes
3. Measures and outcomes of interest	Yes	Yes	Yes	Yes	Yes
4. Blind outcome assessors	No	Yes	Yes	No	Yes
5. Statistical and power calculation	No	Yes	No	Yes	Yes
6. Drop-out and loss follow up	Yes	Yes	Yes	Yes	Yes
7. Control of variables and biases	Yes	Yes	No	Yes	Yes
Quality Score	5	7	5	6	7

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