Systematic Review

Effectiveness of acupuncture/dry needling for myofascial trigger point pain

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Background: Myofascial trigger points (MTrPs) are widely accepted by clinicians and researchers as a primary source of pain. Needling is one common treatment, with dry needling as effective as injection. What is not clear is whether or not needling of any kind is superior to placebo.
Objectives: To update a systematic literature review and meta-analysis (undertaken in 2007) investigating the effectiveness of direct MTrPs needling compared with placebo, and to discuss the variation in needling approaches adopted by randomized controlled trials (RCTs) investigating acupuncture/dry needling for MTrP pain.
Methods: An electronic database search of RCTs published since the original review and a critical review of the literature.
Results: Three RCTs of direct MTrP needling were identified as eligible for review. One concluded that needling was superior to standard care; two adopted a placebo control and were added to our original meta-analysis of four studies. Combining six studies (n=183), needling was found to be statistically superior to placebo [weighted mean difference=16.67 (95% CI: 3.23–30.11)]; however, marked statistical heterogeneity was observed (I^2=82.6%).
Conclusion: There is limited evidence that direct MTrP dry needling has an overall treatment effect when compared with standard care. While the results of the meta-analysis indicate that direct needling is superior to placebo, the results should be interpreted with caution due to the marked heterogeneity observed in this model. There remains a need for large-scale, adequately powered, high-quality placebo-controlled trials to provide a more trustworthy result.

Keywords: Acupuncture, Myofascial trigger points, Pain, RCTs, Systematic review

Introduction

Myofascial trigger points (MTrPs) are widely accepted by clinicians and researchers as a primary source of regional musculoskeletal pain.[1] MTrPs are defined as 'hyperirritable points located in taut bands of skeletal muscle which when compressed produce a referred pain characteristic of that muscle and a pain that the patient recognises'.[2] They are believed to develop in muscles in response to sudden injury, e.g. whiplash, or sustained postural overload, e.g. working at a computer. Although a number of novel laboratory and radiological techniques have been used to identify MTrPs, none has yet proved definitive as a diagnostic test.[3–7] Moreover, no longitudinal cohort study has been undertaken to determine whether or not MTrPs develop in response to the mechanisms proposed. This lack of evidence has led some to dismiss the construct of MTrP derived pain altogether,[8] while others suggest that MTrPs are simply a clinical manifestation of another condition, such as joint disease or neuropathic pain.[9,10]

Despite this ambiguity, MTrPs continue to form the basis for treatment, especially among manual and physical therapists, and MTrP-derived pain continues to be an active topic for clinical research. Numerous therapies have been investigated as potential beneficial treatments for this condition.[1] Of these, needling therapies are by far the most common. Although the mechanism of effect is not clear, inserting needles into points of soft tissue tenderness as a means of pain relief is long established, with clinicians commonly adopting either the Western orthodox approach of injection or the traditional Chinese approach of acupuncture dry needling.

Dr Janet Travell, the American physician who clarified the terminology and diagnosis of MTrPs, promoted the use of lidocaine injection administered directly into the site of the MTrPs to alleviate pain.[11,12] More recently, the results of a systematic review exploring the use of various needling therapies

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for MTrP-derived pain, suggested that simply inserting a needle into the site of a MTrP produced the same effect as injecting it with either a local anaesthetic, botulinum toxin, or corticosteroid.[13] These findings imply that it is the direct mechanical stimulus of the MTrP by the needle that causes a relief in symptoms, rather than the injected medication itself. However, what was not clear from this review is whether or not needling of any kind is superior to placebo.

In 2007, we undertook a systematic review to investigate whether or not direct 'dry' needling of MTrPs (e.g. acupuncture) was effective at reducing pain for patients with a diagnosis of MTrP derived pain, compared with a usual care or placebo control. This study has been published elsewhere.[14] Therefore, in this paper, we provide a summary of this review, and discuss in detail a key observation made when analysing all the studies identified by the literature search — that of the wide variation in needling approaches adopted. In addition for this paper, the literature search has been updated, with the aim of identifying whether or not the conclusions made from the original review have changed in light of more recent research.

Summary of the Original Review

The literature search

The aim of our original literature search (carried out in April 2007), was to identify whether or not needling directly into MTrPs achieved superior pain reduction in patients with a clinical diagnosis of MTrP-derived pain when compared with either: no additional intervention; indirect local needling either superficially over the MTrP or elsewhere in the muscle; or a placebo control such as a non-penetrating sham needle or sham laser.

We included studies where MTrPs were needled directly, based on Simons' commonly held belief that inserting a needle directly into the locus of a MTrP causes a mechanical disruption of the muscle fibre contraction of the taut band, resulting in an increase in blood flow to the area, bringing with it oxygen and nutrients, which in turn resolves the 'energy crisis' which maintains the pain.[7,15]

We excluded studies in which the control intervention was considered to be an active treatment, classified as: (1) oral medication; (2) an injected substance; or (3) traditional meridian acupuncture needling — in view of laboratory and radiological evidence which shows a direct association between acupuncture and the stimulation of pain inhibitory mechanisms.[16,17] We extracted data on pain outcomes which reported a visual analogue scale (VAS) or comparable pain score as a principle outcome measure.

The literature search involved sequentially searching electronic databases: PubMed; a combined search of EMBASE, AMED, and MEDLINE; Cochrane Central/Cochrane Reviews; PEDro, and SCI-EXPANDED, plus a hand search of relevant journals not indexed on the electronic databases. We used the search terms 'myofascial pain' OR 'myofascial pain syndrome' OR 'trigger point' OR 'trigger points' and then in turn acup* and needl*.

Results

The search identified 26 randomized controlled trials (RCTs) as potentially eligible for inclusion. Of these, seven studies met our criteria for inclusion.[14]

Variation in needling approaches

When considering all the RCTs, it became evident that there was a large variation in the treatment approaches adopted by clinicians using acupuncture/dry needling for MTrP derived pain.

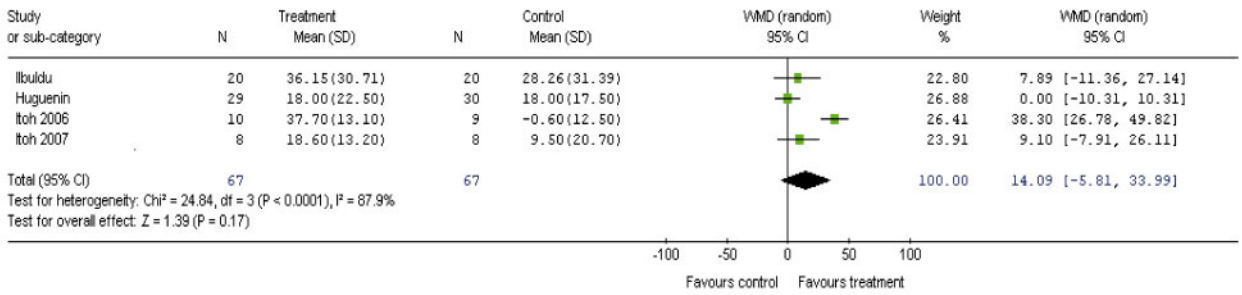
Indirect needling

A number of studies adopted an indirect needling approach whereby the MTrPs themselves were not needled. Five studies needled classic acupuncture points,[18–22] while two studies needled superficially (at a sub-cutaneous level), either at sites of classic acupuncture points[23] or over, but not into, clinically identified MTrPs.[24] Four studies combined an indirect needling approach of classical acupuncture point needling with direct MTrP needling, thus confounding the interpretation of the clinical effectiveness of either needling approach.[25–28]

Despite the diversity in needling approaches, the outcome of these studies was largely similar. All five studies which investigated a classical acupuncture needling approach also included an inactive control (e.g. sham needle or usual care), allowing between-study comparisons to be made.[18–22] While all the studies reported within-group improvements in pain for acupuncture (which could be considered as clinically beneficial), only one study found acupuncture superior to the control.[22]

In the two studies where a superficial needling approach was adopted, contradictory results were found. In the first study, in which needles were inserted superficially over classical acupuncture points, significantly greater pain relief was experienced by patients in the acupuncture group compared with patients in the control group (superficial needling over non-acupuncture points).[23] While in the second study, where needles were inserted superficially over the sites of clinically identified MTrPs, the pain relief experienced by patients in the acupuncture group was no greater than that experienced by those in the control group (stretching exercises).[24]

Finally, in the four studies where direct MTrP needling was carried out in combination with



Key: WMD = weighted mean difference; SD = standard deviation; CI = confidence intervals

Figure 1 Original meta-analysis of MTrP acupuncture needling versus sham.

needling elsewhere, only one reported a statistically significant between-group difference in favour of acupuncture.[26]

Overall, the results from these studies suggest that indirect needling is as effective at reducing MTrP derived pain as usual care, but is likely to be no more effective than placebo.

Direct MTrP needling

Even among the seven studies eligible for review where MTrPs were needled directly, there were variations in the needling technique adopted. Three of the studies inserted the needles and then left them *in situ* for different periods of time,[29–31] while four studies adopted a 'sparrow pecking' technique whereby needles were manipulated in and out of each MTrP, one at a time, to elicit a local twitch response (LTR) — defined as a transient muscle contraction.[32–35] Treatment regimes were largely similar in so far as five RCTs offered a course of three or more treatments given once a week.[30,31,33–35]

Of the seven studies, one compared direct MTrP acupuncture needling with usual care.[31] This study reported a significant short-term reduction in post-stroke shoulder pain in patients who received MTrP needling plus standard rehabilitation compared with those who received standardized rehabilitation alone. Two RCTs compared MTrP needling with 'local needling'. The first, investigating patients with neck and shoulder pain, was poorly designed and employed inadequate statistical analysis, thereby undermining the reliability of the study findings which were in favour of a beneficial effect of direct MTrP needling.[29] The second, investigating elderly patients with chronic low back pain, and which compared direct MTrP needling with superficial needling over the site of the MTrP, reported no statistically significant between-group difference.[35]

Four RCTs compared MTrP needling with a 'placebo' intervention. These studies were considered sufficiently homogeneous (in so far as the interventions and measured outcome were concerned) to undertake a meta-analysis. The population groups under investigation varied from patients with upper trapezius pain ($n=40$)[30] and young athletes with gluteal MTrPs causing hamstring pain ($n=59$),[32] to elderly patients with chronic neck pain ($n=35$)[33] and chronic low back pain ($n=27$).[34] For the meta-analysis, we used Review Manager (Rev Man) 4.2.10 software, adopting a random-effects model to take into account expected clinical heterogeneity.[36] We used I^2 statistic to evaluate statistical heterogeneity.

Figure 1 shows that the short-term effectiveness of direct MTrP needling on pain was not statistically significantly superior to placebo [weighted mean difference=14.09 (95% CI: −5.81–33.99)] and marked statistical heterogeneity was observed in this model ($I^2=88\%$).[14]

Conclusion from the original review

We concluded that there was limited evidence, derived from one study that needling directly into MTrPs has an overall treatment effect when compared with standardized care. While the result of the meta-analysis of needling compared with placebo did not attain statistical significance, the overall direction could be compatible with a treatment effect of dry needling on MTrP derived pain. However, the limited sample size and poor quality of these studies highlighted and supported a need for large-scale, good-quality placebo-controlled trials in the area.[14]

Updated Systematic Review and Meta-analysis

In March 2010, the literature search was repeated — using identical search terms, database resources (limited to 2007 onwards), and inclusion criteria as the first review. For this update, we only included studies that involved an inactive control of either sham acupuncture or usual care, a direct MTrP needling approach, and a primary outcome measure for pain. An updated meta-analysis of direct MTrP needling versus sham 'placebo' control was planned if there was sufficient clinical homogeneity between studies and if outcomes were adequately reported (e.g. mean and SD available for a VAS of pain intensity or data that allowed conversion).

Results

The search identified 10 potentially eligible RCTs, with two meeting the criteria for inclusion.[37,38] Table 1 lists the excluded studies and provides the reasons for exclusion. Five studies were excluded on the grounds of employing an active control, i.e. an alternative needling intervention,[39–43] and three for adopting an indirect needling approach.[44–46]

At the time of the literature search, the author had a pilot RCT — investigating the use of direct MTrP needling for whiplash associated pain — under submission, which is now published.[47] As this study fulfilled the review's inclusion criteria, and in light of the paucity of eligible RCTs identified by the literature search, it was decided to add this study into the review.

Description of eligible RCTs

Table 2 shows the key characteristics of the three RCTs included for review, and Table 3 their results. All three studies adopted a 'sparrow pecking' needling technique, to elicit either an LTR[37,38] or to reproduce the patient's pain.[47] Two RCTs used a co-intervention in both groups: a standardized physiotherapy programme of self-care advice and exercise;[47] and a home exercise programme of upper trapezius stretching.[37] Two of the RCTs offered a course of treatment delivered once a week,[38,47] while one involved a single intervention.[37] All three RCTs adopted a VAS as a measure of pain.

Data synthesis

One RCT compared the effect of direct MTrP needling with a standard therapy.[37] The study, carried out on patients with neck pain, reported a significant short and long-term reduction in pain in patients who received a single treatment of MTrP needling plus upper trapezius self-stretching exercises, compared with those who undertook upper trapezius stretching alone ($P=0.016$).

Two RCTs (described as preliminary or feasibility studies) compared MTrP needling with a sham needle control. Both offered a course of treatment delivered once a week, and both were considered sufficiently homogeneous to be added to our original 2007 meta-analysis, comparing direct MTrP needling with placebo. Figure 2 shows the forest plot of the meta-analysis which indicates that direct MTrP needling is statistically significantly superior to placebo in reducing pain [weighted mean difference=16.67 (95% CI: 3.23–30.11)]; however, marked statistical heterogeneity was observed in this model ($I^2=82.6\%$).

Discussion

Updating the literature search has produced similar conclusions to the original review, in so far as there is limited evidence from one study that direct MTrP needling has an overall treatment effect when compared with standard care.[37] While the result from the revised meta-analysis of direct MTrP needling compared with placebo indicates a treatment effect that is statistically superior to sham, these result should be interpreted with caution. According to the Cochrane Handbook, an I^2 value over 75% represents considerable heterogeneity, which means that there is considerable variability in the intervention effects being evaluated, and some reviewers do not report such results to avoid misleading the reader.[48] Therefore, the reliability of this meta-analysis ($I^2=82.6\%$) is strongly compromised.

Statistical heterogeneity is a consequence of clinical or methodological diversity. Although the studies included in the meta-analysis were considered similar in so far as interventions and measured outcomes were concerned, there were variations in the population groups included and the number of treatments administered, both of which could have influenced the effectiveness of the intervention. The marked statistical heterogeneity could also reflect the variability of the results when study size is inadequate. Indeed, small studies are commonplace in MTrP acupuncture/dry needling research with most studies involving less than 50 participants. From our own feasibility study ($n=41$), we calculated that 125 participants would be required for a definitive trial in whiplash-associated pain.[47]

Therefore, although the results of the meta-analysis suggest an overall treatment effect in favour of direct MTrP needling compared with placebo, this result is far from conclusive and there is still a need for large-scale, adequately powered, high-quality placebo-controlled trials to provide a more conclusive result.

Recommendations for Future Research

With respect to study design, consideration needs first to be given to the intervention selected as a control. From an earlier systematic review of dry needling and injection therapy, it seems that inserting a needle into the site of a MTrP is likely to be as effective at alleviating pain as injecting a medicinal substance.[13] Three of the studies identified in the latest literature search compared direct MTrPs acupuncture needling with an injection therapy.[40,42,43] All three failed to identify a difference between the effectiveness of dry needling and injection, supporting that review's suggestion. Furthermore, of the two RCTs (identified by the latest literature search) which adopted an alternative dry needling intervention as a control, similar results were found.[39,41] Therefore, two recommendations are proposed for future research.

First, that investigation of the effectiveness of an injection therapy for MTrP-derived pain is not a research priority as there is evidence that dry needling is as effective in reducing pain as injecting a medicinal substance, and is arguably safer. Second, that all future RCTs should include a control intervention which is

Table 1 Description of ineligible studies and reasons for exclusion (*n*=8)

First author (year)	Total *n* allocated	Population	Acupuncture/dry needling interventions	Control/comparator	Reported outcome* (*I*=intervention; *C*=control)
Exclusion criteria					
Active control					
Ga (2007)[39]	40	Elderly patients. Myofascial pain upper trapezius	Direct acupuncture needling of clinically identified MTrPs in upper trapezius	Direct acupuncture needling of clinically identified MTrPs in upper trapezius plus needling paraspinal muscle points	*I* 'resulted in more continuous subjective pain reduction than' *C*
Ga (2007)[40]	39	Elderly patients. Regional myofascial pain with active MTrPs in upper trapezius	Direct acupuncture needling of clinically identified MTrPs in upper trapezius	0.5% lidocaine injection directly into MTrP	No significant between-group difference (*P*=NS). Both groups reported significant reduction in pain at end of treatment ($P<0.001$)
Perez-Palomares (2009)[41]	122	None specific chronic LBP	Direct acupuncture needling of clinically identified lumbar and gluteal MTrPs	Percutaneous electrical nerve stimulation	No between-group mean difference (*P*=NS). Both groups reported comparable reduction in pain
Venancio (2008)[42]	45	Headaches triggered by palpation of MTrPs located in head and neck muscles	Direct MTrP needling with a syringe	Direct MTrP injection with 0.25% lidocaine Direct MTrP injection with 0.25% lidocaine associated with corticoid	Significant reduction in pain in all three groups at 12 weeks ($P<0.05$) No between-group mean difference
Venancio (2009)[43]	45	Headaches triggered by palpation of MTrPs located in head and neck muscles	Direct MTrP needling with a syringe	Direct MTrP injection with 0.25% lidocaine Direct MTrP injection with botulinum toxin	*I*: significant reduction in pain at 12 weeks ($P<0.05$) *C*: significant reduction in pain in both groups at 12 weeks ($P<0.05$) No between-group mean difference
Indirect needling					
Chou (2009)[46]	20	Patients with chronic pain in shoulder region with clinically identified MTrPs in upper trapezius	Acupuncture needle inserted sequentially into classic acupuncture points Wai-guan (TE5) and Qu-chi (LI11) but using a 'sparrow pecking' technique to elicit de qi and a LTR at the site of the acupoint	Blunt-ended needle held in place using an adherent rubber connector and left *in situ*	*I* superior to *C* ($P<0.5$)
Shen (2007)[44]	15	Chronic myofascial jaw pain	Acupuncture needling of LI4 (Hegu) classic acupuncture point	Sham non-penetrating acupuncture at the site of LI4 (Hegu)	*I* superior to *C* ($P=0.027$)
Tsai (2010)[45]	35	Patients with pain and clinically identified MTrPs in upper trapezius	Acupuncture needling of clinically identified MTrPs in extensor carpi radialis longus muscle NOT in upper trapezius	Sham non-penetrating acupuncture at the site of clinically identified MTrPs in extensor carpi radialis longus muscle	*I* 'mean pain intensity significantly reduced immediately following treatment' compared with *C*

Note: *Visual analogue scale for pain intensity.

either 'inactive', such as a sham intervention (testing efficacy) or usual care (testing clinical effectiveness), to allow a clearer evaluation of the effectiveness of acupuncture/dry needling on MTrP-derived pain.

Admittedly, testing the efficacy of any acupuncture intervention is problematic. Any intervention that appears similar to genuine acupuncture (e.g. a blunt needle) probably has some biological effect

Table 2 Description of studies eligible for review

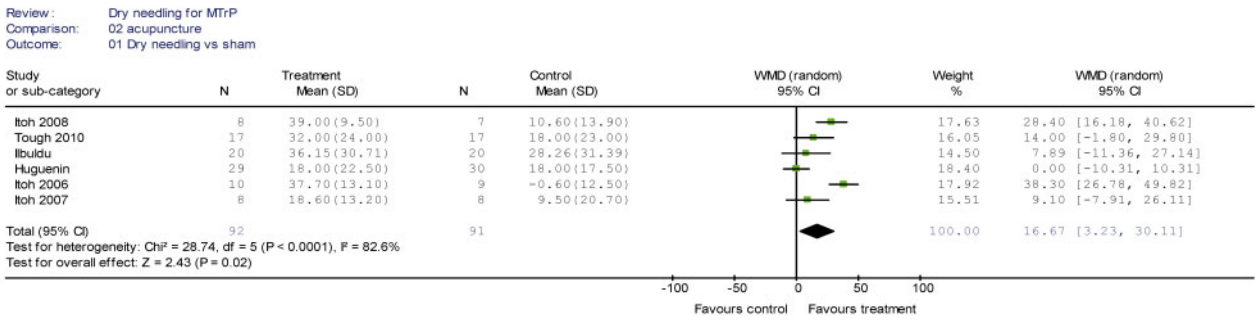
First author (year)	Total *n* allocated	Population	Intervention (*n* of sessions; times/week) Acupuncture/dry needling interventions	Control/comparator
Usual care control				
Ma (2010)[37]	43	Patients with myofascial neck pain and clinically identified MTrPs in upper trapezius muscle	(a) Miniscalpal needle inserted directly into clinically identified MTrPs, manipulated up and down 2–3 times and left in situ for 1 minute (1) (b) Acupuncture needle (diameter 0.30 mm) inserted rapidly into clinically identified MTrPs and manipulated forwards and backwards in a 'sparrow pecking' motion to elicit an LTR and continued until LTR no longer observed. Self-stretching exercises for upper trapezius muscle* (1)	Self-stretching exercises for upper trapezius muscle (repeat three times/day for 3-month follow-up period)
Sham needle control				
Itoh (2008)[38] Pilot study	30	Patients with pain associated with osteoarthritis of the knee >6-month duration	(a) Acupuncture needle (diameter 0.20 mm) inserted directly into clinically identified MTrPs 'sparrow pecking' technique until LTR elicited and left *in situ* for a further 10 minutes* (5/1) (b) Acupuncture needle (diameter 0.20 mm) inserted into classic acupuncture points located around the knee joint, manipulated to produce de qi and left in situ for 10 minutes (5/1)	Blunt-ended needle (diameter 0.20 mm) applied over site of MTrPs; needle manipulated to mimic sparrow pecking; mimic removal after 10 minutes (5/1)
Tough (2010)[47] Pilot study	41	Patients with a recent whiplash injury (2–16 week duration) and clinically identified MTrPs in and around the neck	Acupuncture needles (diameter 0.25 mm) inserted into clinically identified MTrPs, one at a time, using a 'sparrow pecking' technique to elicit the patient's pain. Plus standardized physiotherapy self-care advice and exercise (up to 6/1)	Blunt-ended needle (diameter 0.30 mm) manipulated over the sites of clinically identified MTrPs, one at a time, mimicking the 'sparrow pecking' technique. Plus standardized physiotherapy self-care advice and exercise (up to 6/1)

Note: *Group of interest. Results=short-term outcome for pain (unless otherwise stated), measured using a visual analogue scale (VAS) and defined as taken 24 hours to 30 days after the final reported treatment.

Table 3 Results from studies eligible for review

First author (year)	*n* allocated *I*, *C* (*n* analysed)	Results* [short-term outcome for pain (unless otherwise stated), measured using a visual analogue scale (VAS)]		
		I=intervention MTrP needling versus *C*=control		
		Between-group mean difference	Within-group mean difference	
Itoh (2008)[38] Pilot study	10,10 (8,7)	*I* superior to *C* ($P<0.001$)		
Ma (2010)[37]	15,13 (15,13)	*I* superior to *C* ($P=0.016$)	*I*: significant short-term reduction in pain ($P<0.01$) and long-term ($P<0.05$) at 3 months *I*: mean short-term change (2 weeks) 31.0; and 3 months 30.0	*C*: no significant short-term reduction in pain; significant reduction ($P<0.05$) at 3 months *C*: mean short-term change (2 weeks) 8.0; and 3 months 12.0
Tough (2010)[47] Pilot study	20,21 (17,17) Intention to treat analysis	No between-group mean difference (P=NS) At end of treatment (7 weeks)	No statistical comparison *I* mean change 32.0	*C*: mean change 18.0

Note: *Outcome measure for pain classified as short term when taken 24 hours to 30 days after the final reported treatment.



Key: WMD = weighted mean difference; SD = standard deviation; CI = confidence intervals

Figure 2 Updated meta-analysis of direct MTrP acupuncture needling versus sham.

necessitating large sample sizes to show small differences. However, if Simons' integrated hypothesis is to be believed, then the mechanism underlying the analgesic effect associated with MTrP needling is different from that proposed for classical acupuncture (nerve stimulation). Simons hypothesises that it is the mechanical disruption of the muscle fibre contraction of the taut band by the needle that results in symptom relief. Therefore, for studies in which MTrPs are needled directly, a sham non-penetrating needle could be judged an adequate control.

It is more difficult to interpret the studies in which MTrPs were not needled directly but where treatment effects were reported in favour of the acupuncture intervention. All three of the studies identified by the latest literature search, reported a statistically significant improvement in pain in patients who received genuine acupuncture compared with a sham control. It could be argued that these results support the notion that in certain cases, clinically identified MTrPs are not the primary source of pain, but are instead a clinical manifestation of another pain condition. An alternative argument is that classical acupuncture involving nerve stimulation can produce effects on the MTrP, presumably at the spinal cord level (i.e. a segmental pain inhibitory effect) which makes the MTrP less sensitive.

In a recent RCT of 89 patients who presented with upper trapezius MTrPs, C4/5 facet joints were injected rather than the MTrPs themselves. This resulted in a significantly greater reduction in pain intensity scores and pain sensitivity over the site of the MTrPs, compared with a control in which the corresponding unilateral mutifidi muscles were injected.[49] Assuming that the mechanism of effect in this case is via segmental pain inhibition rather than via a local effect within the muscle, needling MTrPs or muscle tender points identified in and around painful joints (e.g. osteoarthritis knee, cervical, or lumbar spondylosis) could be equally as effective as needling directly into a joint (via injection), with the potential added benefit of being safer.

Implications for Clinical Practice

Although there is a lack of a consensus approach to acupuncture/dry needling for MTrP derived pain, current evidence suggests that direct acupuncture needling is likely to be the most effective approach.

There is limited evidence from two studies that direct MTrP needling combined with standard exercise therapy is more effective in reducing MTrP derived pain than exercise alone.[31,37] Therefore, combining acupuncture/dry needling with usual care appears to be a valid way of treating patients who present with regional musculoskeletal pain and who have clinically identifiable MTrPs. With respect to the treatment schedule, the most common approach in these studies is to treat once a week for at least 3 weeks.

None of the RCTs reported a worsening of a patient's condition as a result of receiving a dry needling intervention, and there were no indications that serious adverse events occurred as a result of any of the interventions being tested. The practice of acupuncture/dry needling for MTrP-derived pain appears safe in the locations treated in these studies and not harmful to a patient's recovery. Therefore, there is no indication at this stage that the practice of acupuncture/dry needling for MTrP-derived pain should cease provided that it is conducted by adequately trained clinicians.

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