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ORIGINAL ARTICLE

# Effects of Spray and Stretch on Postneedling Soreness and Sensitivity After Dry Needling of a Latent Myofascial Trigger Point

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**Abstract**

**Objectives:** To investigate (1) the effect of spray and stretch versus control on reducing postneedling soreness of 1 latent myofascial trigger point (MTrP) and (2) whether higher levels of psychological distress are associated with increased postneedling pain intensity.

**Design:** A 72-hour follow-up, single-blind randomized controlled trial.

**Setting:** University community.

**Participants:** Healthy volunteers (N=70; 40 men, 30 women) aged 18 to 36 years (mean age, 21±4y) with latent MTrP in 1 upper trapezius muscle.

**Intervention:** All subjects received a dry needling application over the upper trapezius muscle. Then, participants were randomly divided into 2 groups: an intervention group, which received spray and stretch over the needled trapezius muscle, and a control group, which did not receive any intervention.

**Main Outcome Measures:** Visual analog scale (at postneedling, posttreatment, and 6, 12, 24, 48, and 72h after needling), pressure pain threshold (at preneedling, postneedling, and 24 and 48h after needling). Psychological distress was evaluated by using the Symptom Checklist-90-Revised.

**Results:** Repeated-measures analysis of variance demonstrated a significant interaction between group and time ($F_{3,204.8}=3.19$; $P<.05$; $\eta_p^2=.04$) for changes in postneedling soreness. Between-group differences were significant only immediately after intervention ($P=.002$), and there were no differences found between groups after 6 hours of the intervention ($P>.05$). Repeated measures of covariance showed that none of the psychological covariates affected these results. Somatization, anxiety, interpersonal sensitivity, and hostility were significantly correlated ($P<.05$) with postneedling pain intensity. Repeated-measures analysis of variance did not show a significant effect of spray and stretch on mechanical hyperalgesia ($F_{2.6,175}=1.9$; $P=.131$; $\eta_p^2=.02$).

**Conclusions:** The spray and stretch had a short-term (<6h) effect in reducing postneedling soreness of a latent MTrP. Pressure pain threshold did not significantly change after spray and stretch. Psychological factors are related to postneedling pain.

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Myofascial trigger points (MTrPs) are hyperirritable spots in skeletal muscles that are associated with hypersensitive palpable nodules in taut bands. MTrPs are classified as active MTrPs, which are symptom-producing by triggering local or referred spontaneous pain, and as latent MTrPs, which do not trigger pain without being stimulated. The pain reproduced by stimulation is not recognized by the patient in latent MTrPs, whereas in active MTrPs the stimulation replicates patient's pain symptoms.[1] Active MTrPs are associated with many pain conditions such as shoulder pain,[2] mechanical neck pain,[3] tension-type headache,[4] pelvic pain,[5] migraine,[6] or lateral epicondylalgia.[7] Other characteristic effects different from those of spontaneous pain are present in both MTrPs, for example, altered muscle activation,[8,9] increased muscle tension, muscle shortening, restricted range of motion,[1] muscle weakness,[10] or accelerated muscle fatigability.[11]

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Regarding the treatment of MTrPs, needling therapies are invasive techniques frequently used by different health care providers.[12,13] Dry needling has been recommended (grade A) compared with sham or placebo for immediate reduction of pain, and cautiously recommended at 4 weeks, in patients with upper quarter myofascial pain syndrome.[14] Some deep dry needling methods have been described by different authors on the basis of various conceptual models.[15] A dry needling technique commonly used in the treatment of MTrPs is Hong's fast-in, fast-out technique.[16] This technique involves rapidly inserting and withdrawing a needle in and out of the MTrP to obtain local twitch responses, which are associated with a higher effectiveness of the treatment in reducing myofascial pain.[16,17] These needling procedures provoke many perforations in the tissue, which produce muscle and nerve damage. A study[18] in mice has found that muscle fibers presented some signs of an inflammatory reaction after dry needling, triggering a regeneration process that was almost completed in 1 week. Intramuscular nerves, including the neuromuscular synaptic contact, were also fragmented, becoming reinnervated 3 days after intervention.[18] This damage associated with local hemorrhage is thought to be responsible for the onset of pain after needling application, which is known as postneedling soreness.[1,16]

In a study by Hong,[16] 100% of the patients with neck pain treated with dry needling presented soreness after the intervention. In healthy subjects, Hong's fast-in-fast-out technique with an acupuncture needle in latent MTrPs provoked postneedling spontaneous soreness in almost all patients at 24 hours, which was never present at 72 hours.[19]

Postneedling soreness is one of the main adverse effects associated with needling procedures[15,20] and is frequently generated after deep dry needling therapies.[1,16,19-22] Patient dissatisfaction and reduced treatment adherence seem to be associated with postneedling soreness. In cases of strong postneedling soreness, which represented 51% of total treated patients in the study by Lai and Hong,[23] subjects would not accept further needling therapies.

Regarding possible methods capable of relieving postneedling soreness, one study published in 1998[23] evaluated the effectiveness of ultrasound therapy. The authors suggested that ultrasound reduced hematoma and inflammatory reaction after the injection and also improved the range of motion and reduced tenderness. As far as the authors know, there are no published studies that evaluate other therapies such as spray and stretch, which is frequently used as a conservative method of reducing myofascial pain,[1,24,25] for reducing postneedling soreness.

Furthermore, to our knowledge, no previous studies have investigated how psychosocial factors are related to pain perception associated with MTrP dry needling procedures. Other needle-related procedures such as immunization are thought to produce pain, which is associated with psychological factors in children and adolescents.[26]

The purposes of the current study were (1) to investigate spray and stretch as a method for decreasing postneedling soreness and mechanical hyperalgesia produced by deep dry needling of latent MTrPs in the upper trapezius muscle and (2) to determine whether higher levels of psychological factors such as anxiety or somatization are associated with increased postneedling pain intensity.

***List of abbreviations:***

| | |
|---|---|
| **ANCOVA** | **analysis of covariance** |
| **ANOVA** | **analysis of variance** |
| **MTrP** | **myofascial trigger point** |
| **PPT** | **pressure pain threshold** |
| **SCL-90-R** | **Symptom Checklist-90-Revised** |
| **VAS** | **visual analog scale** |

# Methods

## Participants

Seventy healthy volunteers (40 men, 30 women) aged 18 to 36 years (mean age, 21±4y) were recruited from undergraduate courses at the Centro de Estudios Universitarios-San Pablo University. Subjects were included if they presented at least 1 latent MTrP in the upper trapezius muscle. The latent MTrP diagnosis was based on the fulfillment of all the following criteria[1]: (1) presence of a palpable taut band in the muscle; (2) presence of a hypersensitive tender spot in the taut band; (3) palpable or visible local twitch response with snapping palpation of the taut band; and (4) referred pain elicitation in response to compression. These criteria had good interexaminer reliability ($\kappa$) ranging from .84 to .88.[27]

Participants were excluded if they presented any of the following criteria: an insurmountable fear of needles as a reason for refusing the treatment, coagulation disorders, or head or neck pain.

## Ethical aspects

This study was approved by the ethical committee of the Centro de Estudios Universitarios-San Pablo University. All subjects signed an informed consent before their inclusion.

## Procedure of dry needling

The dry needling procedure for this study was based on the needling method described by Hong.[16] MTrP dry needling was performed with a solid filament needle (0.26×40mm).[a] The MTrP was held firmly in a pincer grasp between the thumb and the index finger.[1] Then, the muscle fibers were repeatedly perforated by rapidly inserting and partially withdrawing the needle from the MTrP, eliciting local twitch responses in some insertions. This procedure continued until no more local twitch responses were elicited. On removal of the needle, the area was compressed firmly with a cotton swab for 1 minute.

## Procedure of spray and stretch

The upper trapezius muscle was stretched on the basis of the technique originally described by Simons et al.[1] The subjects were seated in a relaxed position on their homolateral hand for anchoring the distal end of the studied muscle. Initially, 3 to 5 parallel sweeps of ethyl chloride spray[b] were applied covering the upper trapezius muscle. Then, the muscle was positioned in a maximal but tolerable stretch and lengthened until the physical therapist felt the muscle tension barrier. This procedure was repeated 2 or 3 times.[1]

## Outcome measures

Pain intensity was quantified using a 100-mm visual analog scale (VAS), ranging from 0mm (no pain) to 100mm (worst imaginable pain). VAS has shown high reliability for acute pain (intraclass correlation coefficient = .97; 95% confidence interval, .96−.98).[28]

Pressure pain threshold (PPT) was assessed with a mechanical pressure algometer[c] by a physical therapist with 3 years of experience in algometry. PPT is defined as the minimal amount of pressure

at which the sense of pressure first changes to pain. The pressure was applied at a rate of 1kg/s. Three consecutive trials of PPT on the latent MTrP at intervals of 30 seconds were conducted. The intraexaminer reliability has been found to be high in the upper trapezius muscle (intraclass correlation coefficient = .94–.97).[29]

### The Symptom Checklist-90-Revised

Symptom Checklist-90-Revised (SCL-90-R) is a 90-item questionnaire that measures symptoms of somatization, obsessive-compulsive disorder, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. The average of the scores over the total number of answered items allows calculating the "global severity index," which measures the degree of general distress. It has shown good internal consistency, as well as good interrater and test-retest reliability.[30] The Spanish version of the SCL-90-R was used in this study.[31] It has shown excellent internal consistency.[32]

### Study protocol

Before and immediately after the needling intervention, PPT was assessed in the latent MTrP. After the needling intervention, 2 VASs were assessed, one referring to the pain that subjects experienced during the needling procedure and the other to the pain that they presented after needling. Then, subjects were randomly divided into 2 groups by a computerized randomization program[d]: a control group that did not receive any intervention and an intervention group that received spray and stretch. All outcomes in both groups were assessed by an assessor blinded to the subject's allocation. Then, VAS scores were recorded immediately after the intervention or control and at 6, 12, 24, 48, and 72 hours after the intervention. PPT was assessed at 24 and 48 hours after the intervention. All subjects completed the SCL-90-R questionnaire referring to the week before the measures.

### Sample size

The sample size calculations were performed using the G*Power software (version 3.1.7).[33,e] Considering an effect size of .25, a minimum power of .95, and an $\alpha$ value of .05 resulted in 26 subjects. Allowing for a conservative dropout rate of 20%, we finally planned to recruit at least 32 subjects per group.

### Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences software (version 20.0).[f] Mean, SD, and 95% confidence interval for each variable were calculated. A normal distribution of quantitative data was assessed by using the Kolmogorov-Smirnov test ($P>.05$). Baseline data between groups were compared using chi-square tests of independence for categorical data and independent Student $t$ tests for continuous data. The data relating to the ages of both groups were not normally distributed ($P<.05$), and nonparametric analysis was undertaken (Mann-Whitney $U$ test). The VAS scores and PPT scores were submitted to a 2-way repeated-measures analysis of variance (ANOVA) with time (VAS scores, before intervention, after intervention, and 6, 12, 24, 48, and 72 hours after needling; PPT scores, before needling, before intervention, and 24 and 48 hours after needling) as within-subject factor and group (spray and stretch or control) as between-subject factor. Bonferroni correction was applied to within-group comparisons of treatment efficacy. To test the relation between psychological symptoms and the VAS scores, Pearson correlations were calculated separately for the control group and the experimental group. Variables that showed significant correlations with the VAS, and global severity index value, were submitted to a 2-way repeated-measures analysis of covariance (ANCOVA). The reported $P$ values associated with the F statistics for ANOVA and ANCOVA analysis were adjusted via Greenhouse-Geiser correction. For all analyses, statistical significance was set at $P<.05$.

## Results

One hundred four healthy subjects were screened for possible eligibility criteria, and 70 subjects successfully completed the study protocol, of which 37 were randomly assigned to the treatment group and completed the study protocol (19 men, 18 women; median age [interquartile range], 20y [19-21y]) and 33 were assigned to the control group (21 men, 12 women; median age [interquartile range], 20y [19.5-22.5y]). Figure 1 shows the process of recruitment and dropouts.

There were no significant differences between the 2 groups in terms of demographic, clinical, and psychological characteristics at baseline (table 1).

### VAS score for postneedling soreness

Repeated-measures ANOVA demonstrated a significant interaction between group and time ($F_{3,204.8}=3.19$; $P<.05$; $\eta_p^2=.04$) for changes in postneedling soreness. Repeated-measures ANCOVAs demonstrated that none of the covariables affected the interaction: somatization ($F_{3.1,209.6}=3.56$; $P<.05$; $\eta_p^2=.05$), anxiety ($F_{3,201.4}=3.2$; $P<.05$; $\eta_p^2=.05$), interpersonal sensitivity ($F_{3,202.2}=3.2$; $P<.05$; $\eta_p^2=.003$), hostility ($F_{3,202.3}=3.2$; $P<.05$; $\eta_p^2=.05$), or global severity index ($F_{3,202.2}=3.2$; $P<.05$; $\eta_p^2=.05$). Post hoc analysis showed that the spray and stretch group exhibited a greater decrement in postneedling pain than did the control group, but only immediately after intervention ($P=.002$) and it was not significant at 6 hours ($P=.200$), 12 hours ($P=.227$), 24 hours ($P=.889$), or 48 hours ($P=.332$) (fig 2). The ANOVA showed a significant effect for time ($F_{3,204.8}=77.96$; $P<.001$; $\eta_p^2=.53$): postneedling soreness disappeared within the first 72 hours in all subjects.

### Pressure pain threshold

Repeated-measures ANOVA did not show a significant interaction between group and time ($F_{2.6,175}=1.9$; $P=.131$; $\eta_p^2=.02$) for changes in PPT. The ANOVA showed a significant effect for time ($F_{2.6,175}=32.63$; $P<.001$; $\eta_p^2=.32$): PPT decreased immediately and at 24 hours after needling and returned near to baseline values at 48 hours, suggesting a quadratic effect (supplemental fig S1, available online only at http://www.archives-pmr.org/).

### Postneedling soreness and psychological distress

Correlational analysis revealed significant correlations for somatization and anxiety with postneedling soreness in both groups and hostility and interpersonal sensitivity were correlated with postneedling soreness only in the intervention group (table 2).

Repeated-measures ANCOVA demonstrated a significant interaction only between covariable and time for somatization ($F_{3.1,209.6}=4.5$; $P<.005$; $\eta_p^2=.06$). Anxiety ($F_{3,201.4}=.37$; $P=.78$; $\eta_p^2=.005$), interpersonal sensitivity ($F_{3,203.2}=0.2$; $P=.88$; $\eta_p^2=.003$), hostility ($F_{3,202.3}=0.7$; $P=.55$; $\eta_p^2=.01$), and global severity index ($F_{3,202.2}=.33$; $P=.81$; $\eta_p^2=.005$) did not show a significant interaction.

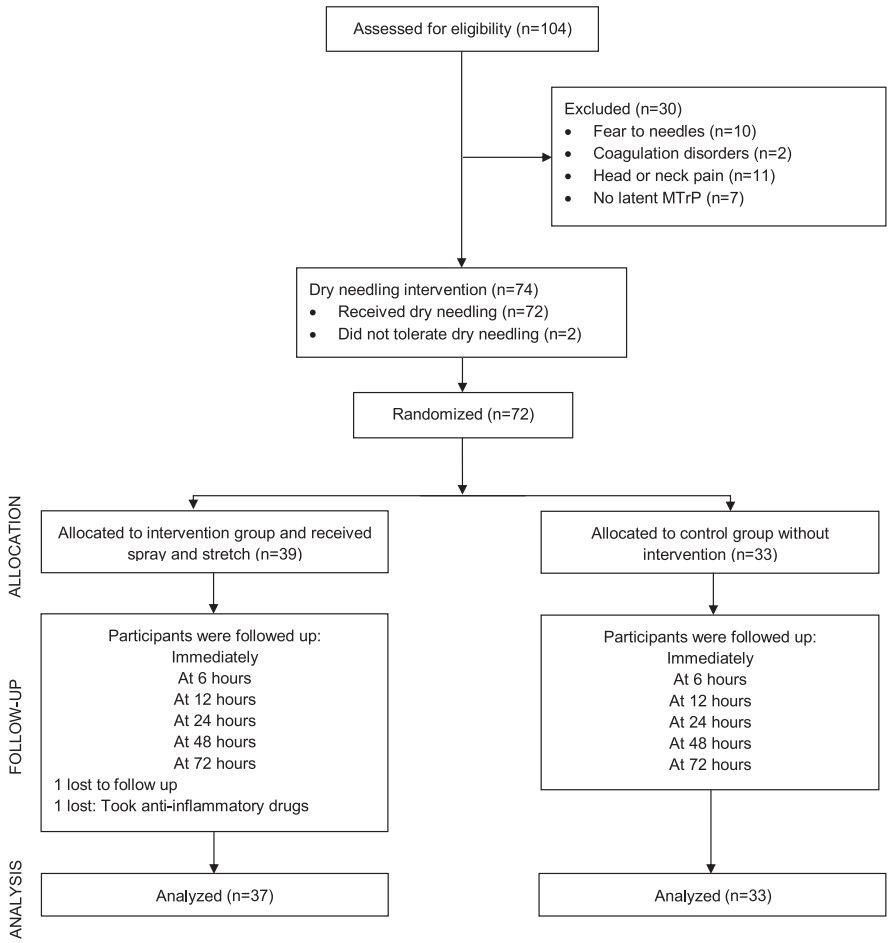


**Fig 1** Consolidated standards of reporting trials flow chart of the study.

## Discussion

The present study has shown that a single application of spray and stretch has an immediate effect in reducing postneedling soreness produced by deep dry needling techniques in a latent MTrP in the upper trapezius muscle. However, this effect is not maintained over time, with a similar level of pain persisting in both groups between 6 hours after dry needling and the end of pain 72 hours later. The immediate postneedling pain reduction produced by spray and stretch occurs when the highest postneedling pain is felt (mean ± SD, 37.9±25.7) and observed changes are shown to be clinically relevant (11.68mm; 95% confidence interval, 3.43−19.92) because a minimal difference of 9 to 13mm on the VAS is considered as a clinically significant change in acute pain conditions.[34-36] This pain reduction represents a change of 35% from baseline. Changes of approximately 30% are considered as clinically meaningful improvements in other pain conditions such as chronic pain.[37,38]

These results could be considered limited in clinical relevance because healthy subjects were selected for the study; however, the postneedling pain reduction by spray and stretch found in our study may be relevant to diminish patient dissatisfaction and reduced treatment adherence associated with postneedling soreness produced by needling therapies.[23] In addition, immediate clinically meaningful reduction in postneedling soreness by spray and stretch may be relevant for professionals who treat latent MTrPs in patients as a source of other clinical conditions, such as altered muscle activation. In this situation, dry needling in latent MTrPs has been shown to normalize altered muscle pattern activation.[39]

To our knowledge, there is only 1 previous study, by Lai and Hong,[23] that investigated a method for relieving postinjection soreness. In this study, some patients who received a procaine injection in an active MTrP presented with strong postinjection soreness. These patients were given continuous mode ultrasound treatment and showed a significantly greater index of pressure threshold pain and range of motion change than did patients who received only MTrP injections. In contrast to our results, spray and stretch did not show significant increases in PPT after treatment.

### Postneedling soreness

Postneedling soreness was present in 100% of the subjects who received dry needling with a solid filament needle in this study, disappearing before 72 hours in all cases. These results are consistent with previous studies that used acupuncture needles in healthy subjects.[19] The mean duration of postneedling soreness in our study was also similar to that in previous studies with patients with myofascial pain (24−48h),[20,22] but the percentage of subjects with soreness in these studies represented only 54.6%[22] and 52.5%, respectively.[20]

Dry needling is considered to be as effective as an injection of local anesthetics in the treatment of myofascial pain syndrome,[12,16,40] but dry needling is thought to produce a higher

**Table 1** Descriptive statistics and *t*-test results comparing groups in baseline scores

| Characteristic | Intervention Group (n=37) | Control Group (n=33) | *P* |
|---|---|---|---|
| Sex (male/female) | 19/18 | 21/12 | .300 |
| Age (y)* | 20 (19–21) | 20 (19.5–22.5) | .126 |
| VAS score during dry needling (mm) | 51±20 (44–58) | 56±21 (48–63) | .348 |
| VAS score after dry needling (mm)† | 33±20 (26–40) | 37±23 (29–44) | .506 |
| PPT before needling (kg/cm$^2$) | 3.5±0.8 (3.3–3.8) | 3.6±1.2 (3.1–4) | .998 |
| PPT after needling (kg/cm$^2$) | 3±1.1 (2.6–3.4) | 3±1.2 (2.7–3.5) | .734 |
| Somatization | 0.4±0.3 (0.3–0.5) | 0.4±0.4 (0.2–0.5) | .365 |
| Obsessive-compulsive | 0.6±0.6 (0.4–0.8) | 0.5±0.5 (0.3–0.7) | .991 |
| Interpersonal sensitivity | 0.3±0.4 (0.2–0.5) | 0.3±0.4 (0.2–0.5) | .946 |
| Depression | 0.4±0.4 (0.3–0.5) | 0.3±0.4 (0.2–0.5) | .816 |
| Anxiety | 0.4±0.4 (0.2–0.5) | 0.3±0.4 (0.1–0.4) | .456 |
| Hostility | 0.4±0.4 (0.2–0.5) | 0.4±0.5 (0.2–0.6) | .674 |
| Phobic anxiety | 0±0.1 (0–0.1) | 0.1±0.1 (0–0.1) | .153 |
| Paranoid ideation | 0.4±0.6 (0.2–0.6) | 0.4±0.6 (0.2–0.6) | .898 |
| Psychoticism | 0.2±0.3 (0.1–0.2) | 0.1±0.3 (0–0.2) | .408 |
| Global severity index | 0.4±0.3 (0.3–0.5) | 0.3±0.3 (0.2–0.4) | .903 |

NOTE. Values are mean ± SD (95% confidence interval) or n. None of the differences were significant ($P>.05$).
* The data of both groups were not normally distributed: Mann-Whitney *U* test was undertaken. Values are median (interquartile range).
† Postneedling soreness perceived immediately after needling and before treatment.

intensity and longer duration of postneedling soreness.[1-16] Nevertheless, there is little support for this assumption because dry needling procedures were performed by these authors with empty syringes with beveled needles of 0.4mm in diameter, in contrast to the diameter of 0.25mm or 0.3mm commonly used in solid filament needles.[15] When dry needling performed with solid filament needles and lidocaine injection with syringe needles are compared, no differences are observed in terms of the number of cases with pain and the duration of soreness.[21,22]

## Postneedling soreness and psychological distress

Based on the ANCOVA and the correlation analysis, the psychological factor that seems to play a more relevant role is somatization, which may be defined as a tendency to experience and communicate psychological distress in the form of physical symptoms. People with more somatization tend to exhibit more pain immediately after needling and in the long term (24–48h), but this psychological feature seems to be less relevant in the medium term (6–12h). These results are consistent with previous studies in which somatization was related to more pain intensity in patients with chronic[41,42] and acute[43] pain and in experimental conditions.[44,45] Although, to our knowledge, no data exist about the role of somatization in postneedling pain, some works have shown its influence in postsurgery pain[46,47] and after minor surgery or invasive techniques.[48] Moreover, previous investigations have shown that somatization is related to more pain awareness and hypervigilance,[47,49] and it could be hypothesized that

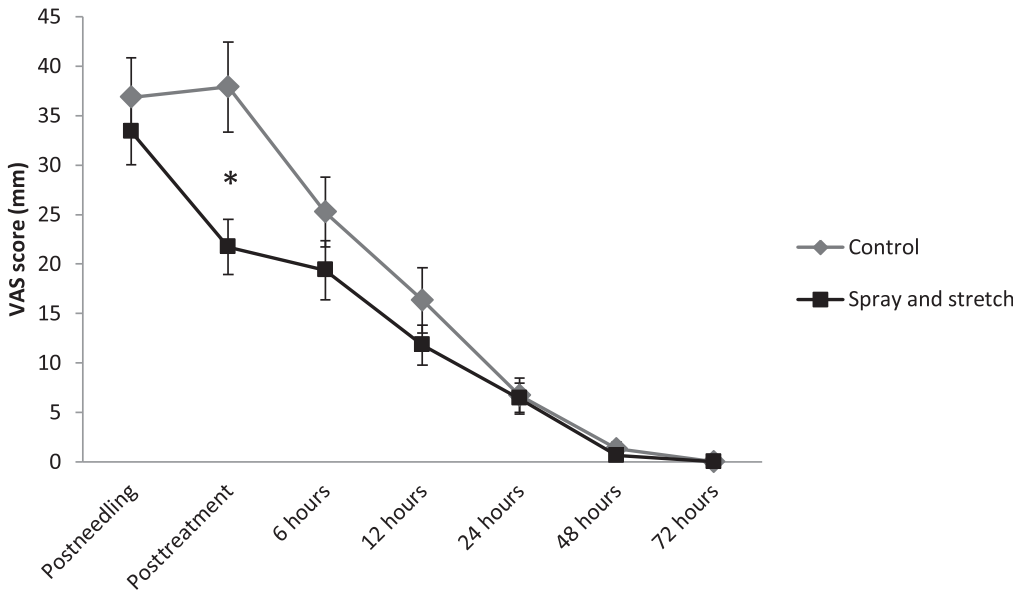


**Fig 2** Mean changes in the VAS score during the follow-up period. Mean values and SE are shown. *Statistically significant differences between groups ($P=.002$).

**Table 2** Correlational analysis between relevant psychological variables and postneedling soreness (VAS)

| Psychological Variable | After Needling | After Intervention | 6 h | 12 h | 24 h | 48 h |
|---|---|---|---|---|---|---|
| Intervention group | | | | | | |
| Somatization* | $r=.322$ $P=.052$ | $r=.350$ $P=.056$ | $r=.306$ $P=.065$ | $r=.061$ $P=.721$ | $r=.094$ $P=.579$ | $r=.537$ $P=.001$† |
| Anxiety | $r=.083$ $P=.624$ | $r=.101$ $P=.552$ | $r=.022$ $P=.899$ | $r=.076$ $P=.655$ | $r=.140$ $P=.409$ | $r=.354$ $P=.032$† |
| Hostility | $r=.363$ $P=.027$† | $r=.245$ $P=.144$ | $r=.052$ $P=.759$ | $r=.024$ $P=.890$ | $r=.010$ $P=.955$ | $r=.134$ $P=.428$ |
| Interpersonal sensitivity | $r=.370$ $P=.024$† | $r=.370$ $P=.024$† | $r=.019$ $P=.912$ | $r=.081$ $P=.636$ | $r=.079$ $P=.643$ | $r=.143$ $P=.400$ |
| Control group | | | | | | |
| Somatization* | $r=.464$ $P=.006$† | $r=.350$ $P=.046$† | $r=.126$ $P=.484$ | $r=.010$ $P=.949$ | $r=.411$ $P=.018$† | $r=.556$ $P=.001$† |
| Anxiety | $r=.105$ $P=.560$ | $r=.113$ $P=.533$ | $r=.042$ $P=.816$ | $r=.072$ $P=.691$ | $r=.334$ $P=.057$ | $r=.394$ $P=.023$† |

* Significant interaction between covariable and time obtained from ANCOVA analysis.
† Statistically significant correlations between VAS values and scores from dimensions of the SCL-90-R: Pearson correlation coefficients are low or moderate.

hypervigilance is a moderator between high levels of somatization and higher levels of pain intensity after needling. More studies measuring pain awareness are needed to test this hypothesis. Another possible mediator could be a minor recovery expectation in people with high levels of somatization,[50] which in turn would be associated with more pain intensity after the procedure.[51] In addition, our results show that the higher the level of anxiety the patient exhibits, the higher the pain intensity is in the long term (48h). These results obtained from correlational analysis may be limited in relevance and need further research because Pearson correlation coefficients are low.

Previous research has shown that anxiety levels are related to postoperative pain,[52] procedural pain, including needling,[53] and pain related to treatment techniques.[54] A link between elevated levels of anxiety and somatization could be established because the previous research has shown that individual differences in hippocampal amplification of pain related with anxiety are associated with somatizations levels.[55]

Based on these data, it might be hypothesized that increased pain levels after needling are related to changes in pain modulation due to factors related to attentional mechanisms (such as hypervigilance or pain awareness), and anxiety, that possibly underlie the manifestation of somatization.

Interpersonal sensitivity and hostility were related to pain intensity only for immediate postintervention pain, and the relevance of these psychological factors seems to emerge when people are treated with spray, possibly because this prolongs the intervention situation. Nevertheless, Pearson correlation coefficients were low and results are limited in relevance. High SCL-90-R scores in interpersonal sensitivity reflect feelings of personal inadequacy, and people with high hostility tend to experience anger and a state of negative affect. These characteristics have been related to fear of pain and anxiety,[56] which in turn may yield more pain intensity in response to stimulus.[57] Fear may also be related to these psychological characteristics, and so we might wonder whether fear of pain or of needling would be associated as well. Previous investigations have shown that the fear of needling is not related to pain thresholds after needling,[58] but additional research is needed.

These results have shown, for the first time, how postneedling soreness is associated to psychological conditions and may help physiotherapists to design actions oriented to diminishing the risk of experiencing high levels of postneedling pain by diminishing somatization or anxiety by mindfulness or relaxation techniques.[59] Breathing exercises or distraction is effective in reducing the pain associated with childhood immunization[60] and acute pain in medical procedures.[26] Other interventions, such as sensory or procedural information, may be useful in reducing anxiety, fear, and pain.[61]

## Study limitations

The current study has several limitations. First, we assessed the postneedling pain and spray and stretch effect only in healthy subjects with latent MTrPs, and although postneedling soreness was generated, it might not be similar to that generated in a population presenting with myofascial pain from active MTrPs. It would be interesting to investigate these issues in active MTrPs present in pain population. Second, because there was no placebo group, we cannot exclude the placebo effect of spray and stretch. Third, postneedling soreness was produced by dry needling techniques applied with specific characteristics of duration, number of needle insertions, or needle diameter. In addition, geographical or cultural differences might be related to different needling tolerance. Finally, results are limited to the use of ethyl chloride, which is banned in some countries because of potential safety issues.

# Conclusions

Spray and stretch has an immediate effect in reducing postneedling soreness produced by deep dry needling of a latent MTrP in the upper trapezius muscle. The effect was not maintained over time (<6h), and soreness disappeared at 72 hours in all cases. In addition, spray and stretch did not show an improvement in mechanical hyperalgesia over the needled site of the latent MTrP.

Somatization is associated with higher levels of postneedling pain intensity. Anxiety also seems to affect postneedling soreness in the long term, but further research is needed.

# Suppliers

a. Suzhou Huanqiu Acupuncture Medical Appliance Co, Ltd, No. 8 Xin Yan Da Dao Weitang Town, Xiangcheng District, Suzhou, China.
b. Laboratorios ERN S.A., Pedro IV 499, 08020, Barcelona, Spain.
c. Pain Diagnostic and Treatment, Inc, 233 E Shore Rd, Ste 108, Great Neck, NY 11023.
d. G*Power; Franz Faul, Department of Psychology, Olshausenstr 62, D-24098 Kiel, Germany. Available at: http://www.psycho.uni-duesseldorf.de/aap/projects/gpower/.

e. Research Randomizer (Version 4.0); S. Plous, Social Psychology Network, Department of Psychology, Wesleyan University, 207 High St, Middletown, CT 06459-0408. Available at: http://www.randomizer.org/.
f. SPSS, Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606.

## Keywords

Needles; Pain; Pain threshold; Psychology; Rehabilitation; Trigger points

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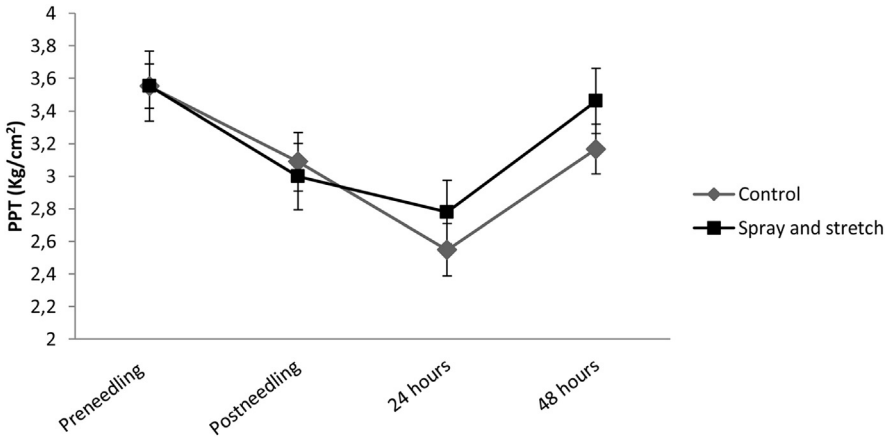
## References

1. Simons DG, Travell JG, Simons LS. Myofascial pain and dysfunction: The trigger point manual. 2nd ed, Vol 1. Baltimore: Williams & Wilkins; 1999.
2. Bron C, Dommerholt J, Stegenga B, Wensing M, Oostendorp RA. High prevalence of shoulder girdle muscles with myofascial trigger points in patients with shoulder pain. BMC Musculoskelet Disord 2011;12:139.
3. Fernandez-de-las-Penas C, Alonso-Blanco C, Miangolarra JC. Myofascial trigger points in subjects presenting with mechanical neck pain: a blinded, controlled study. Man Ther 2007;12:29-33.
4. Fernandez-de-Las-Penas C, Alonso-Blanco C, Cuadrado ML, Gerwin RD, Pareja JA. Myofascial trigger points and their relationship to headache clinical parameters in chronic tension-type headache. Headache 2006;46:1264-72.
5. Jarrell J. Myofascial dysfunction in the pelvis. Curr Pain Headache Rep 2004;8:452-6.
6. Calandre EP, Hidalgo J, Garcia-Leiva JM, Rico-Villademoros F. Trigger point evaluation in migraine patients: an indication of peripheral sensitization linked to migraine predisposition? Eur J Neurol 2006;13:244-9.
7. Fernandez-Carnero J, Fernandez-de-Las-Penas C, de la Llave-Rincon AI, Ge HY, Arendt-Nielsen L. Prevalence of and referred pain from myofascial trigger points in the forearm muscles in patients with lateral epicondylalgia. Clin J Pain 2007;23:353-60.
8. Ibarra JM, Ge HY, Wang C, Martinez Vizcaino V, Graven-Nielsen T, Arendt-Nielsen L. Latent myofascial trigger points are associated with an increased antagonistic muscle activity during agonist muscle contraction. J Pain 2011;12:1282-8.
9. Lucas KR, Rich PA, Polus BI. Muscle activation patterns in the scapular positioning muscles during loaded scapular plane elevation: the effects of latent myofascial trigger points. Clin Biomech (Bristol, Avon) 2010;25:765-70.
10. Celik D, Yeldan I. The relationship between latent trigger point and muscle strength in healthy subjects: a double-blind study. J Back Musculoskelet Rehabil 2011;24:251-6.
11. Ge HY, Arendt-Nielsen L, Madeleine P. Accelerated muscle fatigability of latent myofascial trigger points in humans. Pain Med 2012;13:957-64.
12. Cummings TM, White AR. Needling therapies in the management of myofascial trigger point pain: a systematic review. Arch Phys Med Rehabil 2001;82:986-92.
13. Tough EA, White AR, Cummings TM, Richards SH, Campbell JL. Acupuncture and dry needling in the management of myofascial trigger point pain: a systematic review and meta-analysis of randomised controlled trials. Eur J Pain 2009;13:3-10.
14. Kietrys DM, Palombaro KM, Azzaretto E, et al. Effectiveness of dry needling for upper-quarter myofascial pain: a systematic review and meta-analysis. J Orthop Sports Phys Ther 2013;43:620-34.
15. Dommerholt J, Mayoral del Moral O, Gröbli C. Trigger point dry needling. J Man Manip Ther 2006;14:E70-87.
16. Hong CZ. Lidocaine injection versus dry needling to myofascial trigger point: the importance of the local twitch response. Am J Phys Med Rehabil 1994;73:256-63.
17. Hong CZ. Considerations and recommendations of myofascial trigger points injection. J Musculoskelet Pain 1994;2:29-59.
18. Domingo A, Mayoral O, Monterde S, Santafe MM. Neuromuscular damage and repair after dry needling in mice. Evid Based Complement Alternat Med 2013;2013:260806.
19. Torres R, Mayoral O, Díez E. Pain and tenderness after deep dry needling. J Musculoskelet Pain 2004;12:40.
20. Ga H, Choi JH, Park CH, Yoon HJ. Dry needling of trigger points with and without paraspinal needling in myofascial pain syndromes in elderly patients. J Altern Complement Med 2007;13:617-23.
21. Ga H, Choi JH, Park CH, Yoon HJ. Acupuncture needling versus lidocaine injection of trigger points in myofascial pain syndrome in elderly patients—a randomised trial. Acupunct Med 2007;25:130-6.
22. Ga H, Koh HJ, Choi JH, Kim CH. Intramuscular and nerve root stimulation vs lidocaine injection of trigger points in myofascial pain syndrome. J Rehabil Med 2007;39:374-8.
23. Lai MW, Hong CZ. Additional ultrasound therapy after myofascial trigger point injection for the management of post-injection soreness. J Rehab Med Assoc ROC 1998;26:111-8.
24. Nielsen AJ. Case study: myofascial pain of the posterior shoulder relieved by spray and stretch. J Orthop Sports Phys Ther 1981;3:21-6.
25. Travell J. Ethyl chloride spray for painful muscle spasm. Arch Phys Med Rehabil 1952;33:291-8.
26. Uman LS, Chambers CT, McGrath PJ, Kisely S. A systematic review of randomized controlled trials examining psychological interventions for needle-related procedural pain and distress in children and adolescents: an abbreviated cochrane review. J Pediatr Psychol 2008;33:842-54.
27. Gerwin RD, Shannon S, Hong CZ, Hubbard D, Gevirtz R. Interrater reliability in myofascial trigger point examination. Pain 1997;69:65-73.
28. Bijur PE, Silver W, Gallagher EJ. Reliability of the visual analog scale for measurement of acute pain. Acad Emerg Med 2001;8:1153-7.
29. Walton DM, Macdermid JC, Nielson W, Teasell RW, Chiasson M, Brown L. Reliability, standard error, and minimum detectable change of clinical pressure pain threshold testing in people with and without acute neck pain. J Orthop Sports Phys Ther 2011;41:644-50.
30. Derogatis LR. The SCL-90-R: administration, scoring, and procedures manual II for the revised version and other instruments of the Psychopathology Rating Scale. Towson: Clinical Psychometric Research 1983.
31. Gonzalez de Rivera JL, Derogatis LR, De Las Cuevas C, et al. The Spanish version of the SCL-90-R: normative data in the general population. Towson: Clinical Psychometric Research; 1989.
32. Caparros-Caparros B, Villar-Hoz E, Juan-Ferrer J, Viñas-Poch F. Symptom Check-List-90-R: reliability, normative data, and factor structure in university students [Spanish]. Int J Clin Health Psychol 2007;7:781-94.
33. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods 2007;39:175-91.
34. Gallagher EJ, Liebman M, Bijur PE. Prospective validation of clinically important changes in pain severity measured on a Visual Analog Scale. Ann Emerg Med 2001;38:633-8.
35. Kelly A. Does the clinically significant difference in visual analog scale pain scores vary with gender, age, or cause of pain? Acad Emerg Med 1998;5:1086-90.

36. Todd KH, Funk KG, Funk JP, Bonacci R. Clinical significance of reported changes in pain severity. Ann Emerg Med 1996;27:485-9.
37. Ostelo RW, Deyo RA, Stratford P, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. Spine 2008;33:90-4.
38. Farrar JT, Young JP Jr, LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. Pain 2001;94:149-58.
39. Lucas KR, Polus BI, Rich PA. Latent myofascial trigger points: their effects on muscle activation and movement efficiency. J Bodyw Mov Ther 2001;8:160-6.
40. Ay S, Evcik D, Tur BS. Comparison of injection methods in myofascial pain syndrome: a randomized controlled trial. Clin Rheumatol 2010;29:19-23.
41. Fishbain DA, Lewis JE, Gao J, Cole B, Steele Rosomoff R. Is chronic pain associated with somatization/hypochondriasis? An evidence-based structured review. Pain Pract 2009;9:449-67.
42. Mahrer NE, Montaño Z, Gold JI. Relations between anxiety sensitivity, somatization, and health-related quality of life in children with chronic pain. J Pediatr Psychol 2012;37:808-16.
43. Dougall AL, Jimenez CA, Haggard RA, Stowell AW, Riggs RR, Gatchel RJ. Biopsychosocial factors associated with the subcategories of acute temporomandibular joint disorders. J Orofac Pain 2012;26:7-16.
44. Sherman JJ, LeResche L, Huggins KH, Mancl LA, Sage JC, Dworkin SF. The relationship of somatization and depression to experimental pain response in women with temporomandibular disorders. Psychosom Med 2004;66:852-60.
45. Castrillon EE, Cairns BE, Ernberg M, et al. Glutamate-evoked jaw muscle pain as a model of persistent myofascial TMD pain? Arch Oral Biol 2008;53:666-76.
46. Lautenbacher S, Huber C, Baum C, Rossaint R, Hochrein S, Heesen M. Attentional avoidance of negative experiences as predictor of postoperative pain ratings and consumption of analgesics: comparison with other psychological predictors. Pain Med 2011;12:645-53.
47. Lautenbacher S, Huber C, Schöfer D, et al. Attentional and emotional mechanisms related to pain as predictors of chronic postoperative pain: a comparison with other psychological and physiological predictors. Pain 2010;151:722-31.
48. Young KD. Pediatric procedural pain. Ann Emerg Med 2005;45:160-71.
49. Huber C, Kunz M, Artelt C, Lautenbacher S. Attentional and emotional mechanisms of pain processing and their related factors: a structural equations approach. Pain Res Manag 2010;15:229-37.
50. Laisné F, Lecomte C, Corbière M. Biopsychosocial predictors of prognosis in musculoskeletal disorders: a systematic review of the literature (corrected and republished)*. Disabil Rehabil 2012;34:1912-41.
51. Bialosky JE, Bishop MD, Cleland JA. Individual expectation: an overlooked, but pertinent, factor in the treatment of individuals experiencing musculoskeletal pain. Phys Ther 2010;90:1345-55.
52. Pan PH, Coghill R, Houle TT, et al. Multifactorial preoperative predictors for postcesarean section pain and analgesic requirement. Anesthesiology 2006;104:417-25.
53. Uman LS, Chambers CT, McGrath PJ, Kisely S. Psychological interventions for needle-related procedural pain and distress in children and adolescents. Cochrane Database Syst Rev 2006;18:CD005179.
54. Karadottir H, Lenoir L, Barbierato B, et al. Pain experienced by patients during periodontal maintenance treatment. J Periodontol 2002;73:536-42.
55. Gondo M, Moriquchi Y, Kodama N, et al. Daily physical complaints and hippocampal function: an fMRI study of pain modulation by anxiety. Neuroimage 2012;63:1011-9.
56. Dragkioti E, Kotrotsiu E, Damigos D, Mavreas V, Gouva M. Fear of pain and hostility. Eur Psychiatry 2011;26:1206.
57. Leeuw M, Goossens ME, Linton SJ, Crombez G, Boersma K, Vlaeyen JW. The fear-avoidance model of musculoskeletal pain: current state of scientific evidence. J Behav Med 2007;30:77-94.
58. Joseph L, Mohd Ali K, Ramli A, et al. Fear of needles does not influence pain tolerance and sympathetic responses among patients during a therapeutic needling. Polish Ann Med 2013;20:1-7.
59. Rosenzweig S, Greeson JM, Reibel DK, Green JS, Jasser SA, Beasley D. Mindfulness-based stress reduction for chronic pain conditions: variation in treatment outcomes and role of home meditation practice. J Psychosom Res 2010;68:29-36.
60. Chambers CT, Taddio A, Uman LS, McMurtry CM. Psychological interventions for reducing pain and distress during routine childhood immunizations: a systematic review. Clin Ther 2009;31:S77-103.
61. Suls J, Wan CK. Effects of sensory and procedural information on coping with stressful medical procedures and pain: a meta-analysis. J Consult Clin Psychol 1989;57:372-9.




**Supplemental Fig S1** Mean changes in the PPT score at preneedling, postneedling (before spray and stretch or control), and 24 and 48 hours after needling. There were no significant differences between spray and stretch and the control group. Mean values and SE are shown.