Comparing Trigger Point Dry Needling and Manual Pressure Technique for the Management of Myofascial Neck/Shoulder Pain: A Randomized Clinical Trial

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Abstract

Objective: The aim of this study was to investigate short-term and long-term treatment effects of dry needling (DN) and manual pressure (MP) technique with the primary goal of determining if DN has better effects on disability, pain, and muscle characteristics in treating myofascial neck/shoulder pain in women.

Methods: In this randomized clinical trial, 42 female office workers with myofascial neck/shoulder pain were randomly allocated to either a DN or MP group and received 4 treatments. They were evaluated with the Neck Disability Index, general numeric rating scale, pressure pain threshold, and muscle characteristics before and after treatment. For each outcome parameter, a linear mixed-model analysis was applied to reveal group-by-time interaction effects or main effects for the factor "time."

Results: No significant differences were found between DN and MP. In both groups, significant improvement in the Neck Disability Index was observed after 4 treatments and 3 months ($P < .001$); the general numerical rating scale also significantly decreased after 3 months. After the 4-week treatment program, there was a significant improvement in pain pressure threshold, muscle elasticity, and stiffness.

Conclusion: Both treatment techniques lead to short-term and long-term treatment effects. Dry needling was found to be no more effective than MP in the treatment of myofascial neck/shoulder pain. (J Manipulative Physiol Ther 2017;40:11-20)

Key Indexing Terms: *Neck Pain; Trigger Points; Myofascial Pain Syndromes*

Introduction

Neck/shoulder pain is a common musculoskeletal complaint that is more frequent in women[1-5] and affects 45% to 54% of the general population.[1] Jobs involving prolonged static postures and/or repetitive upper limb movements, such as office work, may lead to the development of myofascial neck pain.[6-9]

Myofascial pain can be diagnosed by the presence of one or more myofascial trigger points (MTrPs), defined as a hyperirritable spot in a palpable taut band of skeletal muscle fibers.[10-12] Myofascial trigger points can be clinically classified as active or latent. An active MTrP causes spontaneous pain or pain during movement, stretch, or compression, whereas latent MTrPs are usually asymptomatic, with pain or discomfort provoked by compression only.[10-12] The pathophysiology of MTrPs is poorly understood, but it is hypothesized that sustained postures and/or repetitive low-level tasks lead to the development of MTrPs.[8,13,14] Typical symptoms associated with MTrPs are local and referred pain, muscle weakness, and restricted range of motion.[10] A combination of these symptoms could have a large impact on the quality of life, mood, and health status.[15]

Treatment of myofascial pain is based on inactivating the MTrPs, mostly by a manual pressure (MP) technique or dry needling (DN).[16-18] In the MP technique, the physiotherapist applies increasing pressure directly on the MTrP.[19] There are two types of DN: superficial DN, which penetrates only the skin and superficial muscle, and deep DN, which involves the insertion of a solid filiform needle directly into the MTrP.[20-23] Precise needling of the MTrP provokes a local twitch response (LTR), a brief muscle contraction, which should be elicited for successful therapy.[24] The needle is moved up and down with or without withdrawal from the muscle tissue to elicit LTRs.[25]

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Several recent studies[19,22,26-39] and a systematic review[40] reported evidence for the use of MP and DN in the treatment of patients with neck and shoulder pain. They reported a decrease in pain intensity,[26-33,40] a higher pressure pain threshold (PPT),[19,22,31-34,40,41] improvement in functionality,[30,32,35,36,40] increase in range of motion,[27,28,31,33,37,40] reduction of stiffness,[38] and improvement of muscle strength[19,28,39] after DN and/or MP. These studies often compared DN or MP with a placebo or other treatment techniques, but studies comparing treatment effects between DN and MP and evaluating effects in the long term for both treatment techniques are lacking.[40]

Therefore, the aim of this study was to investigate whether both treatment techniques lead to short-term and/or long-term treatment effects, with our primary goal to determine if DN has a better effect than MP on disability, pain intensity (primary outcome measures), PPT, and muscle characteristics which involve muscle tone, elasticity, and stiffness (secondary outcome measures) in female office workers with neck/shoulder pain of myofascial origin. We hypothesized that both treatment techniques will lead to short-term and long-term treatment effects, but with significantly larger effects in the DN group than in the MP group.

Methods

Study Population

Female office workers with neck and/or shoulder pain related to MTrPs in neck and shoulder muscles were recruited from several workplaces with predominantly computer-based tasks from September to November 2014. It was opted to include only women, as myofascial neck/shoulder pain is typically more prevalent among women and to avoid the influence of sex differences on outcome. They had to be performing at least 20 hours of computer work a week and had to have neck/shoulder complaints for at least 3 months and a Neck Disability Index (NDI) score ≥10/50 to be included. Subjects were excluded for the following reasons[1]: if they were diagnosed with neurologic problems, a systemic disease, or an injury caused by trauma[2]; if they were in therapy for their actual complaints at the time of the study; and[3] if they were pregnant. All subjects signed an informed consent, and the study was approved by the local ethics committee of Ghent University Hospital. This study was registered at ClinicalTrials.org PRS under Registration No. 2013/ 903 NCT02301468.

General Study Design

The general study design is illustrated in a flowchart (Fig 1). Before testing, participants had to complete an online questionnaire on demographic features, work, and current complaints together with the NDI. During the first meeting, subjects were asked to rate their general pain intensity on a numeric rating sale (NRS). In addition, a clinical examination of the neck and shoulder region was performed by an experienced physiotherapist to identify the 4 most painful MTrPs. Subjects were then evaluated for PPT and muscle characteristics at these MTrPs (see below). These measurements were repeated after the first treatment (post 1) and together with the NDI after 4 treatments (post 2). The NDI and general pain score were repeated again after 3 months (post 3). Subjects underwent 4 treatment sessions (once a week), consisting of MP or DN to the 4 MTrPs identified as most painful. During the 4-week treatment period, participants were not allowed to have any other treatment for their neck/shoulder complaints. Treatments were performed at the clinical practice of 1 of 2 experienced physiotherapists participating in this study. Outcome measures were evaluated before and after treatment by the same assessors, who were blinded to the treatment allocation. Statistical analysis was performed by an independent researcher.

Testing Protocol

Primary Outcome Measures

Disability. Disability was evaluated using the NDI. The NDI (Dutch-language version) is a valid questionnaire to measure self-reported neck pain-related disability.[42] A score between 5 and 14 represents a mild disability, whereas a score between 15 and 24 is interpreted as a moderate disability. Neck Disability Index scores >25 reflect a severe disability.[43]

General NRS. The NRS was used to measure general pain experience (neck/shoulder pain during the past week). Subjects had to score their pain on a scale from 0 (no pain) to 10 (worst pain).[44]

Secondary Outcome Measures

Pressure Pain Threshold. First, pressure pain sensitivity was determined by deep palpation of 6 anatomical MTrP locations on the left and right sides: upper and middle trapezius, levator scapulae, infraspinatus, and supraspinatus (medial and lateral MTrPs). After identification of a taut band, a pressure of 50 N was applied with the thumb to the most sensitive tender spot/nodule. Subjects were asked to rate their pain on an NRS from 0 to 10, for each MTrP location.

On the basis of this rating, the 4 most painful points were selected for evaluation of PPT using a Wagner FPX Digital Algometer. The examiner applied an increasing pressure of 1 N/s on the MTrPs until the patient indicated that the feeling of pressure changed into a feeling of pain. The pressure at that moment was determined as the PPT (expressed in N). Each of the selected MTrPs was evaluated consecutively, and this procedure was repeated 3 times with a 30-second break in between. The use of pressure algometry has been found to be a reliable technique for determining PPT.[45]

Muscle Characteristics. The MyotonPRO was used to measure muscular mechanical properties (tone, elasticity,

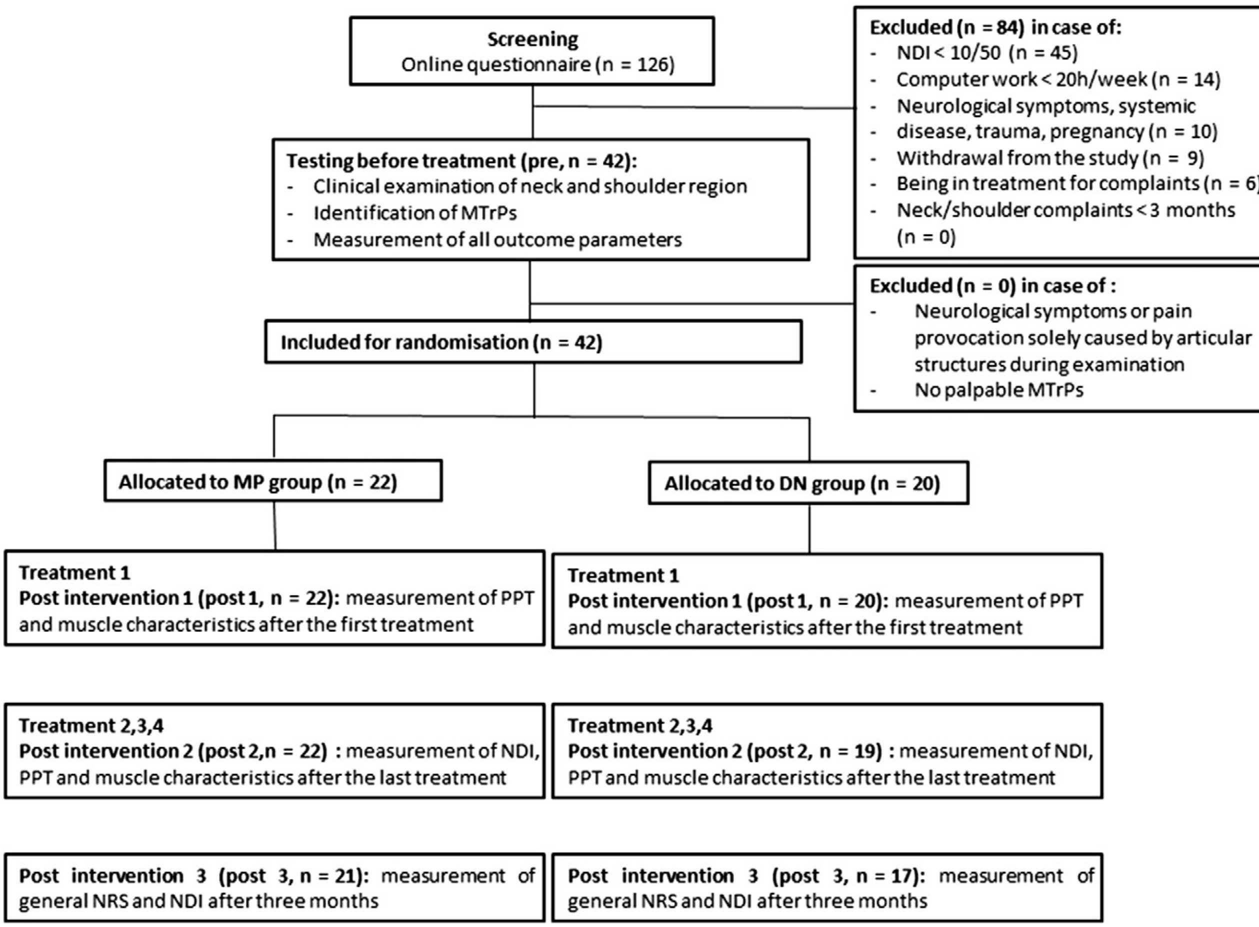

Fig 1. *Flowchart of general study design and number of participants during each phase of the study. DN, dry needling; MP, manual pressure technique; MTrPs, myofascial trigger points; n, number of participants; NDI, neck disability index; NRS, numeric rating scale; PPT, pressure pain threshold.*

and stiffness) of the upper trapezius. Both sides were measured 2 consecutive times at the midpoint between the spinous process of C-7 and the acromion. Oscillation frequency, expressed in Hertz (Hz), characterizes muscle tone in the resting state. Logarithmic decrease in the natural oscillation of a muscle indicates the elasticity, which represents the ability of a muscle to recover its shape after contraction. Elasticity is inversely proportional to the decrement. Dynamic stiffness, expressed in newtons per meter, represents the resistance of the muscle to contraction.[46] The intrarater reliability of the MyotonPRO has been reported to be high in measuring mechanical properties of the quadriceps muscle, but psychometric properties on the upper trapezius are currently lacking.[46]

Intervention

Participants were randomly allocated to either the MP or DN group using block randomization. They were asked to choose a card from an envelope (group A: MP, group B: DN). A block size of 10 was consecutively used with the allocation of 5 subjects to each group. This was performed by an independent researcher. Manual pressure and DN were both applied to the 4 most painful MTrPs, which were determined as mentioned before. The therapist localized the MTrP within a taut band of the muscle and performed the treatment precisely on the MTrP. This procedure was repeated consecutively for each MTrP, and each patient was treated once a week for 4 weeks.

MP Technique. Patients were asked to sit on a chair with their hands resting on the thighs to relax the neck/shoulder muscles. Manual pressure was performed with a wooden cone; the apex of the cone was placed on the MTrP. The therapist slowly increased the pressure at 10 N/s until the subjects reported their highest tolerable level. This pressure was maintained for 60 seconds.

Dry Needling. Patients were asked to lie in a prone position with the arms next to the body. Dry needling was performed with a 0.30 × 30-mm J-type acupuncture needle with a guiding tube. The therapist palpated the MTrPs and then inserted the needle through the skin. Consecutively, the taut band was needled forward and backward until the exact position of the MTrP was reached. Precise needling of the MTrP elicited a brief contraction followed by relaxation of the muscle fibers; this is known as an LTR. Needling of the MTrP was repeated until LTRs were extinct.

Statistical Analysis

Data were analyzed using SPSS Statistics for Windows, Version 22.0 (IBM, Armonk, NY, USA). Descriptive statistics (means ± standard deviation) were calculated for all parameters. For each outcome parameter, a linear mixed-model analysis was applied with the factors "time" (pre, post 1, post 2, and post 3) and "treatment" (MP and DN) to determine if there were significant differences between different time points and treatment modalities. The residuals of the linear mixed models were checked for normal distribution. Post hoc pairwise comparisons were performed when required using a Bonferroni correction. Only group-by-time interaction effects or a main effect for the factor "time" was further interpreted. Because we were interested only in differences between different time points, the main effect for the factor "treatment" was not further interpreted. Statistical significance was accepted at an α level of .05.

A total sample size of at least 36 subjects had to be recruited based on an a priori power analysis (G*Power 3.1.5). This power analysis was performed for the within-between interaction in a repeated-measures analysis of variance with 2 groups, 3 measurements (baseline, measurements after 4 interventions, and measurements after 3 months), a minimum power of 0.90, an effect size of 0.25, and an α level of .05.

Results

Subjects

Forty-two female office workers (age range, 24-54 years) participated in this study. Twenty-two subjects were allocated to the MP group, whereas 20 subjects were included in the DN group. Demographic features of both treatment groups are summarized in Table 1. As there was no imbalance in demographic data, no covariates were included for data analysis. One patient in the MP group and 3 patients in the DN group dropped out during the course of the study (Fig 1). The majority of MTrPs were found in the left (14%) and right (16%) upper trapezius, right levator scapulae (11%), and right middle trapezius (11%). Of all participants, 71.4% had had complaints for more than 12 months. Apart from some minor side effects reported after treatment, such as postneedling soreness in the DN group, no adverse events were reported.

Table 1. *Demographics of the MP and DN Group*

Demographics	MP	DN
Age, y	40.5 ± 8.3	36.1 ± 10.7
Length, cm	167.7 ± 5.1	165.0 ± 4.7
Weight, kg	75.1 ± 16.5	72.0 ± 13.1
Duration of employment, y	12.3 ± 9.0	8.3 ± 8.8
NDI baseline, range 0-50	13.1 ± 4.6	11.0 ± 5.1
Hours of computer work/wk (21-30 h/31-40 h/>40 h)	7/11/4	11/7/2
Duration of current complaints (<3 mo/3-12 mo/>12 mo)	3/4/15	4/1/15
Lateralization (right/left/bilateral)	20/1/1	15/4/1

Values are expressed as the mean ± standard deviation or number of participants. DN, dry needling; MP, manual pressure; NDI, neck disability index.

Primary Outcome Measures

Descriptive statistics of primary outcome measures are shown in Table 2. The linear mixed-model analysis revealed no significant group-by-time interaction effects for NDI and general NRS ($P > .05$).

Neck Disability Index. The linear mixed-model analysis revealed a significant main effect for time in the NDI ($P < .001$) (Table 3). Post hoc tests revealed significantly decreased NDI scores after 4 weeks of treatment ($P = .001$) and after 3 months ($P < .001$) compared with baseline.

General NRS. A significant main effect for time was observed for the general NRS ($P = .001$) (Table 3). Post hoc tests revealed a significant decrease in general pain scores after 3 months ($P = .001$).

Secondary Outcome Measures

Descriptive statistics of secondary outcome measures are shown in Table 2. No significant group-by-time interaction effects were observed for PPT and muscle characteristics ($P > .05$).

Pressure Pain Threshold. Significant main effects for time were observed for all MTrPs (MTrPs 1, 3, 4: $P < .001$; MTrP 2: $P = .004$; Table 3). Post hoc tests revealed a significant increase in PPT after 4 weeks of treatment compared with baseline for all MTrPs (MTrPs 1, 3: $P < .001$; MTrP 2: $P = 0.022$; MTrP 4: $P = .001$).

Muscle Characteristics. No main effects were observed for muscle tone (Table 3).

Significant main effects for time were observed for left ($P = .003$) and right ($P = .006$) elasticity (Table 3). Post hoc tests revealed a significant decrease in decrement after 4 treatments in comparison with baseline measurements (left: $P = .017$; right: $P = .030$).

A significant main effect for time was observed for right stiffness ($P = .009$; Table 3). After the 4-week treatment program, post hoc tests revealed a significant decrease in muscle stiffness on the right side compared with baseline measurements ($P = .012$).

Discussion

The primary aim of this study was to determine whether DN is better than MP in treating myofascial neck/shoulder pain with respect to effects on disability, pain, and muscle characteristics. The secondary aim of this study was to

Table 2. *Descriptive Statistics of NDI, General NRS, PPT, and Muscle Characteristics of Each Group at Different Time Points*

Primary Outcome Measures Outcome Measure	Group	Baseline	After 4 Treatments	After 3 Months
NDI	MP	13.14 ± 4.60	10.95 ± 4.63	9.09 ± 4.35
	DN	11.00 ± 5.12	7.71 ± 4.66	8.06 ± 5.08
General NRS	MP	5.86 ± 1.36		4.19 ± 1.97
	DN	4.70 ± 1.81		3.59 ± 2.06
Secondary Outcome Measures Outcome Measure	Group	Baseline	After 1 Treatment	After 4 Treatments
PPT MTrP 1	MP	16.20 ± 5.96	16.59 ± 6.87	21.47 ± 8.18
	DN	19.62 ± 7.26	16.46 ± 6.97	24.01 ± 8.45
PPT MTrP 2	MP	16.69 ± 7.25	18.04 ± 7.93	23.50 ± 9.35
	DN	20.01 ± 9.14	16.68 ± 7.15	23.71 ± 12.14
PPT MTrP 3	MP	19.50 ± 8.59	18.87 ± 8.13	25.54 ± 7.89
	DN	20.63 ± 8.48	17.70 ± 6.91	25.68 ± 10.68
PPT MTrP 4	MP	18.07 ± 7.64	18.78 ± 7.46	26.20 ± 10.73
	DN	21.34 ± 8.38	18.06 ± 7.35	28.07 ± 11.31
Tone left	MP	19.29 ± 2.12	19.69 ± 2.10	19.18 ± 2.00
	DN	18.61 ± 2.83	18.80 ± 2.57	18.44 ± 3.11
Tone right	MP	19.33 ± 1.79	19.04 ± 1.74	18.79 ± 1.47
	DN	19.21 ± 2.81	19.28 ± 2.97	18.86 ± 3.55
Elasticity left	MP	1.28 ± 0.19	1.29 ± 0.17	1.23 ± 0.14
	DN	1.24 ± 0.22	1.24 ± 0.19	1.17 ± 0.15
Elasticity right	MP	1.26 ± 0.18	1.29 ± 0.19	1.22 ± 0.15
	DN	1.21 ± 0.16	1.21 ± 0.16	1.14 ± 0.14
Stiffness left	MP	398.32 ± 61.69	410.30 ± 60.58	390.02 ± 65.81
	DN	382.30 ± 81.82	386.55 ± 71.07	365.66 ± 90.61
Stiffness right	MP	401.86 ± 56.07	394.55 ± 52.42	380.11 ± 49.47
	DN	402.28 ± 83.82	403.68 ± 84.18	385.24 ± 102.80

Values are expressed as the mean ± standard deviation. Descriptive statistics calculated prior to the linear mixed-model analysis.
DN, dry needling; *MP,* manual pressure; *MTrP,* myofascial trigger point; *NDI*, neck disability index; *NRS*, numeric rating scale; *PPT*, pressure pain threshold.

investigate whether both techniques lead to short-term and/or long-term treatment effects.

It was hypothesized that both techniques would lead to short-term and long-term treatment effects, but with larger effects in the DN group than in the MP group. This because we hypothesized, based on clinical experience, that treatment with DN is more local and specific because of the smaller contact point and the possibility of accessing deeper muscles and provoking LTRs more easily, compared with MP. On the basis of the results, DN seems to be no more effective than MP.

Improvements after treatment with MP or DN were found in the short term for NDI, PPT, muscle elasticity, and stiffness and in the long term for both NDI and general NRS.

Both interventions resulted in a significant decrease in NDI scores in the short and long terms. The improved functionality may be a consequence of the decrease in pain and improvement in muscle tone and elasticity after treatment. Despite these statistically significant results, the observed changes are lower than the minimal clinical important difference for the NDI, which requires a decrease of 14 points to obtain a patient--perceived change (Table 3).[47] Previous studies also indicated a decrease in NDI scores after DN[48] and MP.[49] However, the latter study investigated this only after 2 and 4 weeks so no long-term follow-up was done. In addition, only the upper trapezius was treated and evaluated. In contrast, Cagnie et al did not observe significant changes in NDI scores, probably because of a low mean baseline score (8.63/50).[19] In this study, the mean baseline score was higher (12.1/50) so there was more potential for improvement.

A significant decrease in general NRS after treatment with MP or DN was observed in the long term. Despite this significant difference, the decrease in NRS was lower than the minimal clinical important difference of 1.5 points, which is required to obtain a small detectable patient-perceived change (Table 3).[47] Llamas-Ramos et al also investigated the effect on pain of DN, compared to MP.[33] In line with our findings, they also observed a similar decrease in pain intensity after both interventions. In contrast, Ziaeifar et al compared DN with MP and observed a significantly larger decrease in pain scores after DN.[50] Several other studies also observed an improvement in pain intensity after treatment with either DN[31,32] or MP,[19,49] compared with other control interventions.

Cagnie et al[19] and Mejuto-Vazquez et al[31] observed a significantly higher decrease in pain scores after MP and DN, respectively, compared with a control group without intervention. Rayegani et al investigated the effect of DN on pain intensity and PPT in patients with myofascial pain in the upper trapezius muscle.[32] They observed similar improvements in pain intensity and PPT after 1 session of DN compared with 10 physiotherapy sessions. Nagrale et al found a greater improvement in pain

Table 3. *Within-Group Differences for Primary and Secondary Outcome Measures: Main Effects for Time*

Outcome Measure	Time Point	Mean ± Standard Deviation	Within-Group Differences Compared With Baseline	*P* Value
Primary outcome measures				
NDI (0-50) [a]	Baseline	12.07 ± 0.73		**<.001**
	After 4 treatments	9.37 ± 0.74	−2.70 ± 0.74 (−4.51, −0.88)	**.001**
	After 3 months	8.64 ± 0.76	−3.43 ± 0.76 (−5.29, −1.57)	**<.001**
General NRS (0-10) [b]	Baseline	5.29 ± 0.28		**.001**
	After 3 months	3.88 ± 0.29	−1.40 ± 0.37 (−2.16, −0.65)	**.001**
Secondary outcome measures				
PPT 1	Baseline	17.87 ± 1.13		**<.001**
	After 1 treatment	16.58 ± 1.13	−1.29 ± 1.13 (−4.07, 1.48)	.772
	After 4 treatments	22.79 ± 1.14	4.92 ± 1.14 (2.12, 4.71)	**<.001**
PPT 2	Baseline	18.29 ± 1.38		**.004**
	After 1 treatment	17.41 ± 1.38	−0.88 ± 1.28 (−4.00, 2.25)	.999
	After 4 treatments	23.70 ± 1.39	5.42 ± 1.29 (2.27, 8.57)	**.022**
PPT 3	Baseline	20.04 ± 1.31		**<.001**
	After 1 treatment	18.31 ± 1.31	−1.73 ± 0.99 (−4.15, 0.70)	.257
	After 4 treatments	25.72 ± 1.32	5.68 ± 1.00 (3.24, 8.13)	**<.001**
PPT 4	Baseline	19.66 ± 1.37		**<.001**
	After 1 treatment	18.47 ± 1.37	−1.19 ± 1.94 (−5.90, 3.52)	.999
	After 4 treatments	27.12 ± 1.39	7.46 ± 1.95 (2.72, 12.20)	**.001**
Frequency (tone)				
Left	Baseline	18.95 ± 0.38		.330
	After 1 treatment	19.25 ± 0.38	0.31 ± 0.26 (−0.33, 0.94)	.739
	After 4 treatments	18.88 ± 0.38	−0.06 ± 0.26 (−0.71, 0.58)	.999
Right	Baseline	19.27 ± 0.38		.127
	After 1 treatment	19.16 ± 0.38	−0.11 ± 0.20 (−0.61, 0.39)	.999
	After 4 treatments	18.86 ± 0.38	−0.41 ± 0.21 (−0.91, 0.09)	.148
Decrement (elasticity)				
Left	Baseline	1.26 ± 0.03		**.003**
	After 1 treatment	1.27 ± 0.03	0.01 ± 0.02 (−0.04, 0.05)	.999
	After 4 treatments	1.21 ± 0.03	−0.05 ± 0.02 (−0.10, −0.01)	**.017**
Right	Baseline	1.24 ± 0.03		**.006**
	After 1 treatment	1.25 ± 0.03	0.01 ± 0.02 (−0.04, 0.06)	.999
	After 4 treatments	1.19 ± 0.03	−0.05 ± 0.02 (−0.10, −0.004)	**.030**
Stiffness				
Left	Baseline	390.23 ± 11.19		.081
	After 1 treatment	398.52 ± 11.19	8.30 ± 7.82 (−10.83, 27.42)	.876
	After 4 treatments	380.54 ± 11.24	−9.68 ± 7.90 (−28.97, 9.61)	.670
Right	Baseline	402.20 ± 11.25		**.009**
	After 1 treatment	399.03 ± 11.25	−3.17 ± 6.14 (−18.17, 11.84)	.999
	After 4 treatments	383.93 ± 11.28	−18.27 ± 6.19 (−33.40, −3.13)	**.012**

Values are expressed as the mean ± standard deviation (95% confidence interval). Significant differences are presented in boldface. Main effects for time for each outcome parameter are underlined. Statistical analyses were performed using linear mixed-model analyses. Post-hoc pairwise comparisons for the different time points were performed using Bonferroni correction.
NDI, neck disability index; *NRS*, numeric rating scale; *PPT*, pressure pain threshold.
[a] Score from 0 (no disability) to 50 (complete disability).
[b] Score from 0 (no pain) to 10 (worst pain).

intensity after a combination of MP techniques, compared with muscle energy techniques.[49] It should be noted that only 1 study also evaluated treatment outcome in the long term.[19]

Pressure pain threshold was measured at the most painful trigger points, which were present mainly in the upper trapezius, middle trapezius, and levator scapulae muscles. Pressure pain threshold increased significantly for all 4 most painful MTrPs, after 4 weeks of treatment with MP or DN. This is in line with the findings of Ziaeifar et al, who observed a similar increase in PPT after treatment with DN and MP.[50] On the contrary, Llamas-Ramos et al observed a higher increase in PPT after DN, compared with MP, in patients with chronic neck pain.[33] Other studies have also reported an increase in PPT after either MP[19,51] or DN,[31,52] compared with other control interventions. Cagnie et al[19] and Mejuto-Vazquez et al[31] observed higher PPTs after treatment with MP and DN respectively, compared with no intervention. In the latter study, they found higher PPTs at distant locations from the MTrP, which may represent reduced widespread pain sensitivity.[31] Oliveira-Campelo et al reported better effects on PPT 24 hours and 1 week after MP, compared with other interventions.[51] Pecos-Martin et al investigated the effect of DN on an MTrP of the lower trapezius and observed a higher increase in PPT, compared with a control intervention.[52]

Little is known of the working mechanisms underlying the effects of DN and MP on pain, but several hypotheses exist.

Needle stimulation of the MTrP may lead to increased blood flow and a reduction in nociceptive substances.[21,53-55] Dry needling may also stimulate Aδ fibers and activate inhibitory pain systems.[56] Additionally, pain relief from MP may result from reactive hyperemia and a spinal reflex mechanism resulting in a release of muscle spasm.[57]

A significant improvement in bilateral elasticity and stiffness on the right side was observed. To our best knowledge, this is one of the first studies investigating changes in muscle characteristics after DN or MP. In a preliminary study, Maher et al investigated changes in shear modulus by means of ultrasound shear wave elastography.[38] They observed a significant reduction in shear modulus, which may indicate a reduction in muscle stiffness. Although the exact underlying mechanisms are unclear, several hypotheses may explain the improvement in muscle characteristics observed in the present study. A release of muscle spasm by MP[57] may explain improvements in muscle elasticity and stiffness. Furthermore, eliciting LTRs by DN may interrupt motor endplate noise[58] and relax actin-myosin filaments in tight muscle fibers.[59]

The present study has several strengths. A novelty of this study was the use of the MyotonPro device, which is an easily applicable and noninvasive tool used to obtain information on muscle tone, stiffness, and elasticity. These muscle characteristics are rarely investigated in the field of myofascial pain and may be of added value in evaluating treatment effects of DN and MP.

This study also aimed at evaluating pain intensity and disability in the long term, because most studies on DN or MP limited the follow-up period to maximally 4 weeks, and no long-term treatment effects could be evaluated.[24,31-33,39,49,50-52,60,61] In contrast to our study, in which several neck/shoulder muscles were treated during multiple treatment sessions, the majority of previous research involved treatment of only 1 muscle, mostly the upper trapezius.[24,31-33,39,50,60,62] Treatment was also often limited to 1 session.[24,31,32,39,51,62] The present study emphasizes the need for the investigation of other neck and shoulder muscles during multiple treatment sessions and with long-term follow-up evaluation. To our best knowledge, this is also one of the first studies comparing DN and MP, two myofascial release techniques frequently used in clinical practice.

The lack of differences between the DN and MP groups may be explained by the fact that all treated muscles are superficial muscles so they are all easily accessible for both techniques. This could be interesting for clinical practice, as MP could serve as an effective alternative for the treatment of myofascial pain, in case of needle phobia of the patient or limited DN skills of the physiotherapist.

Study Limitations

When interpreting the results of this study, some limitations have to be taken into account. First, patients and therapists could not be blinded for intervention, inherent to the techniques that were used. However, the assessors of the outcome measures were blinded to the treatment allocation, and the statistical analysis was performed by an independent researcher. Second, treatments were performed by 2 different therapists. To minimize differences in outcome, both therapists practiced the treatment protocol together to optimize uniformity. Third, additional treatments were not allowed in the study protocol to evaluate the specific treatment effects of MP and DN. This is, however, not a reflection of the actual clinical practice, which may also explain the rather low treatment effect in both groups. In addition, treated MTrPs were individually determined and were consequently not equal in all participants, which made interpretation more difficult. On the other hand, this way of handling patients in a more individualized manner is more equal to clinical practice. Fourth, because of the absence of a control group, improvements could be attributed to nonspecific intervention effects or the passage of time. Finally, these results may not be generalizable to all neck pain patients because only women in a specific age category (working population) and culture were included in the present study. On the other hand, variability in outcome with respect to sex, cultural, or age differences could be ruled out.

Future studies should include multiple treatment sessions of multiple muscles and evaluate treatment effects in the long term. In addition, a control group should be included to evaluate treatment effects of DN and MP.

Conclusion

Dry needling was found to be no more effective than MP in the treatment of neck/shoulder pain of myofascial origin in female office workers. After both treatments, reduced disability was observed in the short and long terms, and general NRS improved in the long term. After the 4-week treatment program, there was improvement in PPT, muscle elasticity, and stiffness.

Practical Applications

- Dry needling and MP technique both have positive short-term and long-term effects on disability, pain, and muscle characteristics in people with myofascial neck/shoulder pain.
- Dry needling was no more effective in the treatment of myofascial pain than MP technique.

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References

1. Fejer R, Kyvik KO, Hartvigsen J. The prevalence of neck pain in the world population: a systematic critical review of the literature. *Eur Spine J.* 2006;15(6):834-848.
2. Hoy D, March L, Woolf A, et al. The global burden of neck pain: estimates from the global burden of disease 2010 study. *Ann Rheum Dis.* 2014;73(7):1309-1315.
3. Cote P, van der Velde G, Cassidy JD, et al. The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *J Manip Physiol Ther.* 2009;32(2 Suppl):S70-S86.
4. Fernandez-de-Las-Penas C, Alonso-Blanco C, Hernandez-Barrera V, Palacios-Cena D, Jimenez-Garcia R, Carrasco-Garrido P. Has the prevalence of neck pain and low back pain changed over the last 5 years? A population-based national study in Spain. *Spine J.* 2013;13(9):1069-1076.
5. Korhonen T, Ketola R, Toivonen R, Luukkonen R, Hakkanen M, Viikari-Juntura E. Work related and individual predictors for incident neck pain among office employees working with video display units. *Occup Environ Med.* 2003;60(7):475-482.
6. Gerr F, Marcus M, Ensor C, et al. A prospective study of computer users: I. Study design and incidence of musculoskeletal symptoms and disorders. *Am J Ind Med.* 2002;41(4):221-235.
7. Brandt LP, Andersen JH, Lassen CF, et al. Neck and shoulder symptoms and disorders among Danish computer workers. *Scand J Work Environ Health.* 2004;30(5):399-409.
8. Treaster D, Marras WS, Burr D, Sheedy JE, Hart D. Myofascial trigger point development from visual and postural stressors during computer work. *J Electromyogr Kinesiol.* 2006;16(2):115-124.
9. Fernandez-de-las-Penas C, Grobli C, Ortega-Santiago R, et al. Referred pain from myofascial trigger points in head, neck, shoulder, and arm muscles reproduces pain symptoms in blue-collar (manual) and white-collar (office) workers. *Clin J Pain.* 2012;28(6):511-518.
10. Simons DGTJ, Simons LS, editors. *Travell and Simons' Myofascial Pain and Dysfunction: The Trigger Point Manual: Vol. 1. Upper Half of the Body*. 2nd edition. Lippincott, Williams & Wilkins: Baltimore; 1999.
11. Hong CZ. Treatment of myofascial pain syndrome. *Curr Pain Headache Rep.* 2006;10(5):345-349.
12. Kuan TS. Current studies on myofascial pain syndrome. *Curr Pain Headache Rep.* 2009;13(5):365-369.
13. Hoyle JA, Marras WS, Sheedy JE, Hart DE. Effects of postural and visual stressors on myofascial trigger point development and motor unit rotation during computer work. *J Electromyogr Kinesiol.* 2011;21(1):41-48.
14. Kaergaard A, Andersen JH. Musculoskeletal disorders of the neck and shoulders in female sewing machine operators: prevalence, incidence, and prognosis. *Occup Environ Med.* 2000;57(8):528-534.
15. Gerber LH, Sikdar S, Armstrong K, et al. A systematic comparison between subjects with no pain and pain associated with active myofascial trigger points. *PM R.* 2013;5(11):931-938.
16. 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(1):3-10.
17. Fogelman Y, Kent J. Efficacy of dry needling for treatment of myofascial pain syndrome. *J Back Musculoskelet Rehabil.* 2015;28(1):173-179.
18. Cummings M, Baldry P. Regional myofascial pain: diagnosis and management. *Best Pract Res Clin Rheumatol.* 2007;21(2):367-387.
19. Cagnie B, Dewitte V, Coppieters I, Van Oosterwijck J, Cools A, Danneels L. Effect of ischemic compression on trigger points in the neck and shoulder muscles in office workers: a cohort study. *J Manip Physiol Ther.* 2013;36(8):482-489.
20. Kalichman L, Vulfsons S. Dry needling in the management of musculoskeletal pain. *J Am Board Fam Med.* 2010;23(5):640-646.
21. Cagnie B, Dewitte V, Barbe T, Timmermans F, Delrue N, Meeus M. Physiologic effects of dry needling. *Curr Pain Headache Rep.* 2013;17(8):348.
22. Kietrys DM, Palombaro KM, Mannheimer JS. Dry needling for management of pain in the upper quarter and craniofacial region. *Curr Pain Headache Rep.* 2014;18(8):437.
23. Baldry P. Superficial versus deep dry needling. *Acupunct Med.* 2002;20(2-3):78-81.
24. 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(4):256-263.
25. Dunning J, Butts R, Mourad F, Young I, Flannagan S, Perreault T. Dry needling: a literature review with implications for clinical practice guidelines. *Phys Ther Rev.* 2014;19(4):252-265.

26. DiLorenzo L, Traballesi M, Morelli D, et al. Hemiparetic shoulder pain syndrome treated with deep dry needling during early rehabilitation: a prospeticve, open-label, randomized investigation. *J Musculoskeletal Pain.* 2004;12(2):25-34.
27. Lee SH, Chen CC, Lee CS, Lin TC, Chan RC. Effects of needle electrical intramuscular stimulation on shoulder and cervical myofascial pain syndrome and microcirculation. *J Chin Med Assoc.* 2008;71(4):200-206.
28. Osborne NJ, Gatt IT. Management of shoulder injuries using dry needling in elite volleyball players. *Acupunct Med.* 2010;28(1): 42-45.
29. Settergren R. Treatment of supraspinatus tendinopathy with ultrasound guided dry needling. *J Chiropr Med.* 2013;12(1): 26-29.
30. Tekin L, Akarsu S, Durmus O, Cakar E, Dincer U, Kiralp MZ. The effect of dry needling in the treatment of myofascial pain syndrome: a randomized double-blinded placebo-controlled trial. *Clin Rheumatol.* 2013;32(3):309-315.
31. Mejuto-Vazquez MJ, Salom-Moreno J, Ortega-Santiago R, Truyols-Dominguez S, Fernandez-de-Las-Penas C. Short-term changes in neck pain, widespread pressure pain sensitivity, and cervical range of motion after the application of trigger point dry needling in patients with acute mechanical neck pain: a randomized clinical trial. *J Orthop Sports Phys Ther.* 2014; 44(4):252-260.
32. Rayegani SM, Bayat M, Bahrami MH, Raeissadat SA, Kargozar E. Comparison of dry needling and physiotherapy in treatment of myofascial pain syndrome. *Clin Rheumatol.* 2014;33(6): 859-864.
33. Llamas-Ramos R, Pecos-Martin D, Gallego-Izquierdo T, et al. Comparison of the short-term outcomes between trigger point dry needling and trigger point manual therapy for the management of chronic mechanical neck pain: a randomized clinical trial. *J Orthop Sports Phys Ther.* 2014;44(11):852-861.
34. Tsai CT, Hsieh LF, Kuan TS, Kao MJ, Hong CZ. Injection in the cervical facet joint for shoulder pain with myofascial trigger points in the upper trapezius muscle. *Orthopedics.* 2009;32(8).
35. Hains G, Descarreaux M, Hains F. Chronic shoulder pain of myofascial origin: a randomized clinical trial using ischemic compression therapy. *J Manipulative Physiol Therapy.* 2010; 33(5):362-369.
36. He D, Hostmark AT, Veiersted KB, Medbo JI. Effect of intensive acupuncture on pain-related social and psychological variables for women with chronic neck and shoulder pain: an RCT with six month and three year follow up. *Acupunct Med.* 2005;23(2):52-61.
37. Martin-Pintado-Zugasti A, Pecos-Martin D, Rodriguez-Fernandez AL, et al. Ischemic compression after dry needling of a latent myofascial trigger point reduces postneedling soreness intensity and duration. *PM R.* 2015;7(10):1026-1034.
38. Maher RM, Hayes DM, Shinohara M. Quantification of dry needling and posture effects on myofascial trigger points using ultrasound shear-wave elastography. *Arch Phys Med Rehabil.* 2013;94(11):2146-2150.
39. Myburgh C, Hartvigsen J, Aagaard P, Holsgaard-Larsen A. Skeletal muscle contractility, self-reported pain and tissue sensitivity in females with neck/shoulder pain and upper Trapezius myofascial trigger points: a randomized intervention study. *Chiropr Man Therap.* 2012;20(1):36.
40. Cagnie B, Castelein B, Pollie F, Steelant L, Verhoeyen H, Cools A. Evidence for the use of ischemic compression and dry needling in the management of trigger points of the upper trapezius in patients with neck pain: a systematic review. *Am J Phys Med Rehabil.* 2015;94(7):573-583.
41. Kamanli A, Kaya A, Ardicoglu O, Ozgocmen S, Zengin FO, Bayik Y. Comparison of lidocaine injection, botulinum toxin injection, and dry needling to trigger points in myofascial pain syndrome. *Rheumatol Int.* 2005;25(8):604-611.
42. Jorritsma W, de Vries GE, Dijkstra PU, Geertzen JH, Reneman MF. Neck pain and Disability Scale and Neck Disability Index: validity of Dutch language versions. *Eur Spine J.* 2012;21(1): 93-100.
43. Vernon H. The Neck Disability Index: state-of-the-art, 1991-2008. *J Manip Physiol Ther.* 2008;31(7):491-502.
44. Jensen MP, Turner JA, Romano JM, Fisher LD. Comparative reliability and validity of chronic pain intensity measures. *Pain.* 1999;83(2):157-162.
45. Antonaci F, Sand T, Lucas GA. Pressure algometry in healthy subjects: inter-examiner variability. *Scand J Rehabil Med.* 1998; 30(1):3-8.
46. Aird L, Samuel D, Stokes M. Quadriceps muscle tone, elasticity and stiffness in older males: reliability and symmetry using the MyotonPRO. *Arch Gerontol Geriatr.* 2012;55(2):e31-e39.
47. Abbott JH, Schmitt J. Minimum important differences for the patient-specific functional scale, 4 region-specific outcome measures, and the numeric pain rating scale. *J Orthop Sports Phys Ther.* 2014;44(8):560-564.
48. Itoh K, Katsumi Y, Hirota S, Kitakoji H. Randomised trial of trigger point acupuncture compared with other acupuncture for treatment of chronic neck pain. *Complement Ther Med.* 2007; 15(3):172-179.
49. Nagrale AV, Glynn P, Joshi A, Ramteke G. The efficacy of an integrated neuromuscular inhibition technique on upper trapezius trigger points in subjects with non-specific neck pain: a randomized controlled trial. *J Man Manipulative Ther.* 2010; 18(1):37-43.
50. Ziaeifar M, Arab AM, Karimi N, Nourbakhsh MR. The effect of dry needling on pain, pressure pain threshold and disability in patients with a myofascial trigger point in the upper trapezius muscle. *J Bodyw Mov Ther.* 2014;18(2):298-305.
51. Oliveira-Campelo NM, de Melo CA, Alburquerque-Sendin F, Machado JP. Short- and medium-term effects of manual therapy on cervical active range of motion and pressure pain sensitivity in latent myofascial pain of the upper trapezius muscle: a randomized controlled trial. *J Manip Physiol Ther.* 2013;36(5): 300-309.
52. Pecos-Martin D, Montanez-Aguilera FJ, Gallego-Izquierdo T, et al. Effectiveness of dry needling on the lower trapezius in patients with mechanical neck pain: a randomized controlled trial. *Arch Phys Med Rehabil.* 2015;96(5):775-781.
53. Cagnie B, Barbe T, De Ridder E, Van Oosterwijck J, Cools A, Danneels L. The influence of dry needling of the trapezius muscle on muscle blood flow and oxygenation. *J Manip Physiol Ther.* 2012;35(9):685-691.
54. Shah JP, Phillips TM, Danoff JV, Gerber LH. An in vivo microanalytical technique for measuring the local biochemical milieu of human skeletal muscle. *J Appl Physiol (1985).* 2005; 99(5):1977-1984.
55. Shah JP, Gilliams EA. Uncovering the biochemical milieu of myofascial trigger points using in vivo microdialysis: an application of muscle pain concepts to myofascial pain syndrome. *J Bodyw Mov Ther.* 2008;12(4):371-384.
56. Baldry PE. *Acupuncture, Trigger Points and Musculoskeletal Pain*. Edinburgh: Elsevier/Churchill Livingstone; 2005.
57. Hou CR, Tsai LC, Cheng KF, Chung KC, Hong CZ. Immediate effects of various physical therapeutic modalities on cervical myofascial pain and trigger-point sensitivity. *Arch Phys Med Rehabil.* 2002;83(10):1406-1414.
58. Chen JT, Chung KC, Hou CR, Kuan TS, Chen SM, Hong CZ. Inhibitory effect of dry needling on the spontaneous electrical activity recorded from myofascial trigger spots of rabbit skeletal muscle. *Am J Phys Med Rehabil.* 2001;80(10):729-735.

59. Chu J. Does EMG (dry needling) reduce myofascial pain symptoms due to cervical nerve root irritation? *Electromyogr Clin Neurophysiol.* 1997;37(5):259-272.
60. Ga H, Koh HJ, Choi JH, Kim CH. Intramuscular and nerve root stimulation vs lidocaine injection to trigger points in myofascial pain syndrome. *J Rehabil Med.* 2007;39(5):374-378.
61. Kannan P. Management of myofascial pain of upper trapezius: a three group comparison study. *Glob J Health Sci.* 2012;4(5):46-52.
62. Ay S, Evcik D, Tur BS. Comparison of injection methods in myofascial pain syndrome: a randomized controlled trial. *Clin Rheumatol.* 2010;29(1):19-23.