



Deep dry needling versus muscle energy technique on pain and functional disability in chronic nonspecific neck pain.

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ABSTRACT

Background: Chronic non-specific neck pain (CNSNP) is linked to limitations in everyday activities, decreased productivity at work, and a decline in quality of life. **Objectives:** This study aimed to investigate and compare the effect of deep dry needling (DDN) and muscle energy technique (MET) on pain and function in chronic nonspecific neck pain. **Methodology:** This randomized control trial randomly assigned 66 patients of both genders with CNSNP aged from 18-40 years to either Group (A) received deep dry needling plus Conventional therapy, Group (B): received MET plus Conventional therapy, and Group (C): received conventional therapy only in a form of Transcutaneous Electrical Nerve Stimulation (TENS), Infrared, and Cervical core stability exercises. This trial evaluated pain intensity using Visual analogue scale (VAS) and functional disability using the Arabic version of neck disability index (ANDI) pretreatment and four weeks after the intervention.

Results: Within-group analysis revealed a significant decline in VAS and ANDI post-intervention ($p < 0.001$). Multiple comparison analysis revealed a significant differences between groups, with the major differences favoring group A ($p < 0.05$). **Conclusion:** In CNSNP patients, DDN and MET are both effective in reducing neck pain and enhancing neck function; however, DDN is more effective, making it preferable treatment.

Keywords: Chronic nonspecific neck pain, Deep dry needling, Muscle energy technique, post-isometric relaxation.

1. Introduction

Diffuse, non-specific pain, especially while moving the neck, is how mechanical neck pain is often described (Daniels et al., 2011). When neck movements or prolonged neck postures caused or made the pain worse and no specific underlying pathology could be found, the pain is classified as "non-specific" or mechanical (Ferrari and Russell.,2003). Most mechanical neck diseases, such as whiplash-associated illnesses, torticollis, and myofascial neck pain, have activity-related neck discomfort as a major symptom (Bello et al., 2015).

Individuals who have chronic non-specific neck pain (CNSNP) have less quality of life. (Binder, 2008). More over studies showed that patients with CNSNP have poorer postural control than healthy subjects (Ravi et al.,2016).

The average prevalence of neck pain in the general population is about 23%, making it a prevalent, costly, and disabling musculoskeletal disorder (Hoy et al.,2010). It usually happens in middle age, and females are more likely than males to experience it (Groeneweg et al.,2010). According to Saavedra-Hernández et al. (2012), symptoms of mechanical neck discomfort can manifest in both the neck and upper extremities. It is characterized by an insidious onset that may result from a variety of causes, including depression, anxiety, bad posture, muscle strain from participating in sports, and occupational antecedents (Bello et al., 2015).

In addition to neck pain, patients with CNSNP also have other motor dysfunctions, including increased forward head posture, decreased proprioception as a sensorimotor and neuromuscular disturbances, in addition to psychosocial dysfunction. Deep cervical flexor muscle activation is usually inhibited, and this is

accompanied by hyperactivity and increased fatigability of the superficial neck flexors (Kapreli et al., 2008). The upper trapezius, levator scapulae, Sternocleidomastoid, multifidi, and splenius cervicis muscles are the most often involved muscles, since these are demonstrated to have the most prevalent myofascial trigger points (MTrPs) among patients with CNSNP. (Cerezo-Téllez et al., 2015).

A non-manual method, called deep dry needling (DDN) is used to treat MTrPs. Acupuncture needles are placed directly into MTrPs during this minimally invasive treatment. (Basak et al., 2018) The benefits of DDN are becoming better documented and include immediate relief in local, referred, and widespread pain as well as a restoration of range of motion and muscle activation patterns (Lari et al., 2016). The central biasing mechanism may get more input from specific nerves or tissues after being stimulated by needles, which would close the pain gates to inputs from those parts of the body. (Sedighi et al., 2017).

DDN has been reported as a technique with rapid and beneficial effects on MTrPs treatment compared to other physiotherapy modalities. However, it is suggested that the definition of DDN be expanded to include stimulation of connective, muscular, and neural tissues as well as MTrPs (Fernández-de-Las-Peas and Nijs 2019). By releasing the tight muscle bands linked to trigger points, DDN may ease pain and enhance function (Dommerholt et al., 2019).

Muscle energy technique (MET), a direct, noninvasive manual therapy, is also used to restore muscle length and promote range of motion, and its primary goal is to relax hypertonic muscles. When appropriate, further stretching of the muscles can be performed by applying the post-isometric stretching technique to elongate the sarcomeres of the contraction knot that is present in the problematic muscles. This tends to reduce the tension in the muscle fibers and relieves pain in MTrPs patients. (Kashyap et al., 2018)

It is a frequent technique for tonus releasing in a muscle before stretching. The strategy involves applying an isometric contraction to the affected muscle, which results in post-isometric relaxation due to the action of the Golgi tendon organs (autogenic inhibition). It can also be used to treat the antagonistic muscle group that is responsible for the offending agonistic muscle (reciprocal inhibition). (Jamil et al., 2022)

However, no studies have conducted to compare the therapeutic potentials of DDN and MET in order to determine the most appropriate intervention for CNSNP; thus, the purpose of this study was to investigate and compare the effects of DDN and MET on pain and function in CNSNP patients. It was hypothesized that both interventions would be equally effective in reducing neck pain and improving neck function.

2. Materials and methods

2.1. Design and setting

A Single -blinded, randomized, controlled trial was carried out at the outpatient clinic of physical therapy at Delta University for science and technology.

2.2. Procedures:

Ethical considerations

The study protocol was approved by the Research Ethical Committee of the Faculty of physical therapy, Cairo University, Giza, Egypt (No.P.T.REC/012/003913) and registered at Clinicaltrials.gov (Registry ID NCT05730426). This study was conducted between August 2022 and February 2023. All participants were thoroughly explained the study's methods and objectives, and they were asked to provide informed legal consent to participate in the study and generalize the findings.

Sample size calculation

The sample size for this study was calculated using the G*power program 3.1.9 (G power program version 3.1, Heinrich-Heine-University, Düsseldorf, Germany). Sample size calculation based on F-tests (MANOVA: Special effects and interactions), Type I error (α) = 0.05, power (1- β error probability) = 0.90, effect size f^2 (V) = 0.393. The appropriate sample size for this study was 66 patients as a minimum (22 individuals per group, 1:1:1 ratio).

Subjects

Sixty-six patients of both genders have been referred from the outpatient clinic of the Faculty of Physical Therapy, Delta University for science and technology with CNSNP. Their age ranged from 18-40 years and were diagnosed and referred from an orthopedist complaining of CNSNP. Subjects were chosen for the study after meeting certain inclusion criteria. They had CNSNP for at least 12 weeks, with one or two MTrPs in the upper trapezius, levator scapulae, or sternocleidomastoid muscles, based on the diagnostic criteria of a tight band with palpable nodule and distant pain when pressure was applied (Ball et al., 2022). Subjects with a history of neck or shoulder pathology (e.g. fracture, surgery, inflammatory and infectious diseases), cervical disc pathology, systematic disorder, fibromyalgia and contraindications for DDN such as anticoagulants,

infections, or bleeding, Or those who had received physical therapy in the previous 3 months were excluded. (Bernal-Utrera et al., 2020)

Randomization and allocation

Sixty-six chronic nonspecific neck pain patients were evaluated for eligibility; participants were randomized in a 1:1:1 ratio using computer-generated block randomization, followed by a concealed allocation by opening sequentially numbered and sealed envelopes; a card inside revealed the group assignment as either A, B or, C.; group A (DDN), received DDN plus conventional therapy, group B (MET), received the MET to the same muscles in group A in addition to conventional therapy, and group C (control group) received the conventional therapy only in the form of Transcutaneous Electrical Nerve Stimulation (TENS), Infrared, and Cervical core stability exercises. Figure (1) shows a flow diagram of the study.

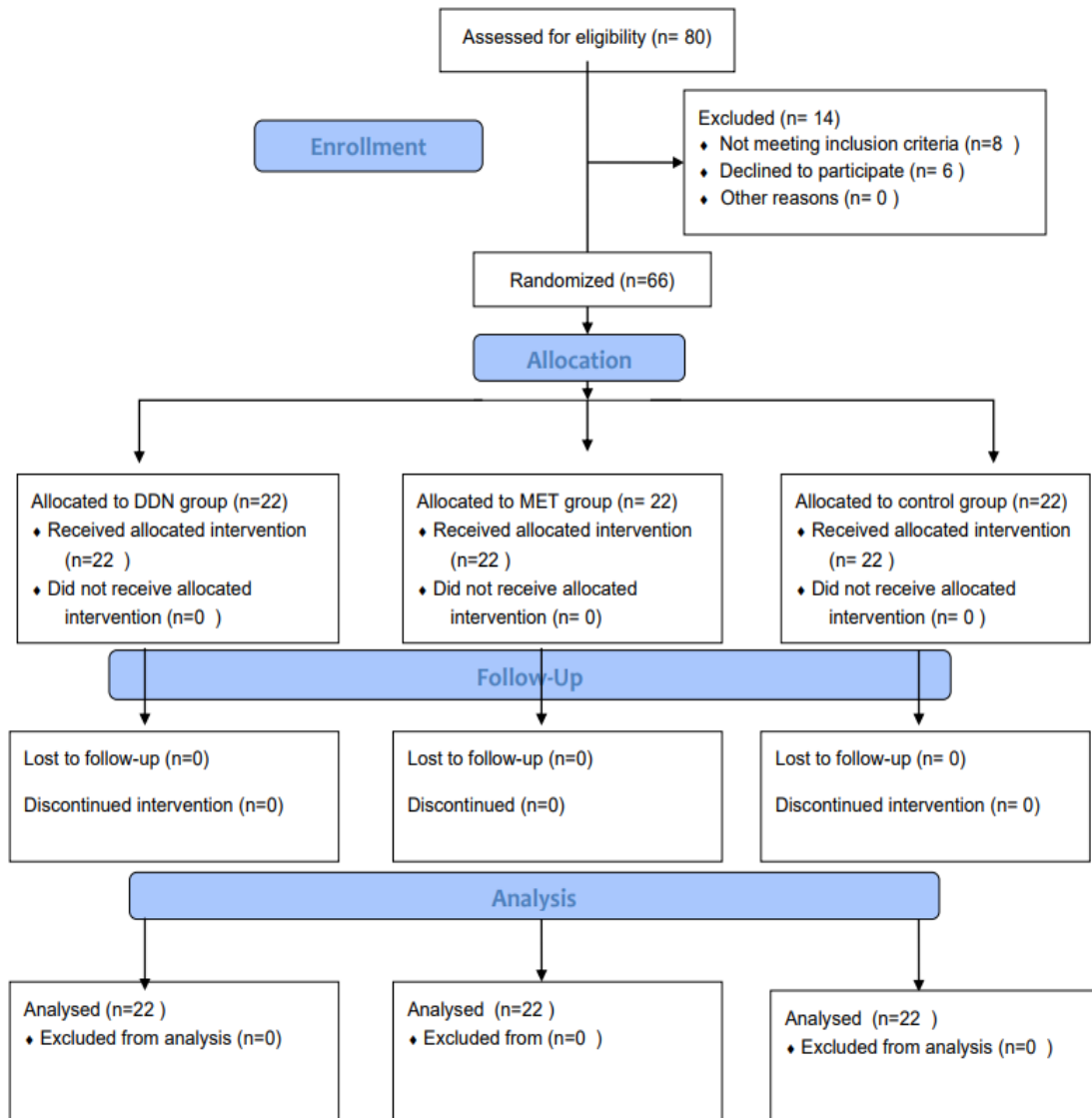


Figure (1): Flow chart

2.3. Clinical Assessment

- Pain Intensity.

The Visual analogue scale (VAS) was used to assess pain intensity. It is a 10 cm or 100 mm psychometric response scale that measures pain severity based on numerical values with a 0 for no pain and a 10 for the greatest imaginable pain. Subjects were instructed to make a vertical mark on the line to indicate their level of pain. The interclass correlation ranges for the VAS, a reliable and validated instrument for measuring pain intensity, are 0.95-0.98. Those who scored between 3.4 and 7.4 were considered to be in mild pain, 3.5 to 7.4 to be in moderate pain, and 7.5 to be in severe pain (Khan et al.,2022).

-Functional disability.

Neck function assessment was performed using Arabic Version of Neck Disability Index (ANDI). It is a condition-specific, or patient-filled questionnaire composed of 10 items to measure pain, and functional status. Each item on the scale is graded from 0 to 5, and the sum of all the scores is turned into percentages. The patient chose the one that best describes his or her condition, with higher scores indicating greater disability. Patients who scored 0 to 4 points (0 to 8%) were deemed to have no disability, 5 to 14 points (10 to 28%) were deemed to have a mild disability, 15 to 24 points (30 to 48%) were presumed to have a moderate disability, 25 to 34 points (50 to 64%) were considered to have a severe disability, and 35 to 50 points (70 to 100%) were regarded to have a total disability. With interclass co-relation values between 0.50-0.98, the Neck Disability Index (NDI) is a reliable and valid questionnaire. (Jacob et al., 2022).

2.4. Intervention:

The DDN:

The patients in this group completed a DDN in the upper trapezius, levator scapulae, and sternocleidomastoid muscle. In order to elicit any local twitch responses, the needle was then manipulated upwards and downwards at ~1 Hz (2-3 mm vertical motions, without rotations) for 25–30 s while penetrating a new region of the MTrP. The needle was then left still for a short period of time so that it could work its analgesic effect. A 25 mm, 0.25G acupuncture needle was used for all of the participants' treatments. Each acupuncture needle was only used once. The physiotherapist used surgical gloves throughout the therapy and used an alcohol swab to sanitize the needled area. This was 3 sessions per week for four weeks in a row. Needling application follows the research of (Gyer et al.,2016)

Upper trapezius muscle:

From a prone lying position, the MTrP was identified by using pincer palpation. The needle was then inserted between the fingers that had located the MTrP, and the needle penetrated the MTrP at an angle of about 30° to the skin. (Gyer et al.,2016)

Levator scapulae muscle:

From the sidelying position with the affected side is the uppermost, MTrP was identified by flat or deep palpation. The needle was inserted with a perpendicular angle into the muscle belly toward the superior medial border scapulae. (Gyer et al.,2016)

Sternocleidomastoid muscle:

From the supine lying position with head in a neutral position, the sternocleidomastoid was gently moved away from the midline of the throat using a pincer grip with the non-needling hand. The needle was inserted perpendicularly to the table. Needling was according to MTrP location through the muscle mid-belly, at the sternal and clavicular attachment sites. (Gyer et al.,2016)

The MET:

MET (post isometric relaxation technique) for the upper trapezius, levator scapulae, and sternocleidomastoid was applied according to the work of (Shady et al.,2021), the patient's limb is positioned at the point at which resistance was first felt, and then instructed to isometrically contract the agonist muscles, which necessitates using no more than 20% of the available strength determined by portable dynamometry against hard, unyielding resistance provided by the therapist. The contraction was maintained for 7 seconds, followed by 7 seconds of relaxation, then the passive stretch was maintained and held beyond the barrier for 30 seconds. This was done three times, for each side.

The Conventional therapy:

Over 4 weeks, all patients received conventional therapy three times a week, consisting of TENS (typical, 100 Hz, 20 mins on the cervical region with two silicon-carbon), Infrared on the same region while the patient in prone lying position (7 mins) (Vahedi et al., 2021) and Exercises (Cervical Stability Exercises in supine – prone - quadruped and standing positions) as the patient was instructed to slowly nod the head in an action indicating “yes,”. Participants held the contraction for 10 seconds at each position, with 8-12 repetitions (Çelenay et al.,2016).

2.5. Outcomes:

VAS and ANDI were evaluated both at baseline and after 4 weeks of interventions.

2.6. Data collection

Data were screened, for normality assumption and homogeneity of variance. Normality test of data using Shapiro-Wilk that revealed the data was normally distributed ($P>0.05$) after removal outliers that were detected by box and whiskers plots. Additionally, Levene's test for testing the homogeneity of variance revealed that there was no significant difference ($P>0.05$).

2.7. Statistical analysis:

The statistical analysis was conducted by using statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). Quantitative data are expressed as the mean and standard deviation for age, BMI, VAS, and ANDI variables. Qualitative data are expressed as mean and standard deviation for gender variable and compared among 3 groups by Chi-square test. Analysis of variance (ANOVA-test) was used to compare among group A, group B, and group C for age and BMI variables. Mixed design 3 x 2 MANOVA-test was used, the first independent variable (between subject factors) was the tested group with 3 levels (group A, group

B, and group C). The second independent variable (within subject factor) was measuring periods with 2 levels (before- and after-treatment). The dependent variables were VAS and ANDI. Bonferroni correction test was used to compare between pairwise within and between groups of the tested variables which P-value was significant from MANOVA test. All statistical analyses were significant at probability ($P \leq 0.05$).

3. Results

The findings revealed no significant differences ($P > 0.05$) in age ($P = 0.813$), BMI ($P = 0.879$), and gender ($P = 0.941$) among groups A, B, and C (Table 1).

Table 1: Clinical general characteristics

Items	Groups			P-value
	Group A (n=22)	Group B (n=22)	Group C (n=22)	
Age (year)	26.90 \pm 5.11	26.75 \pm 5.70	25.90 \pm 5.01	0.813
BMI (Kg/m ²)	25.86 \pm 2.30	25.41 \pm 3.24	25.73 \pm 3.05	0.879
Gender (males: females)	10 (45.50%): 12 (54.50%)	10 (45.50%): 12 (54.50%)	11 (50.00%): 11 (50.00%)	0.941

Group A: DDN group; Group B: MET group; Group C: control group

Quantitative data (age and BMI) are expressed as mean \pm standard deviation (SD) and compared statistically by ANOVA test.

Qualitative data (gender) are expressed as number (percentage) and compared statistically by Chi-square test.

P-value: probability value

P-value > 0.05: non-significant

Multiple pairwise comparison tests (time effect) for VAS and ANDI variables within each group revealed a significant decreased in VAS (Table 2 and Figure 1) after treatment compared to before-treatment within group A ($P = 0.0001$), group B ($P = 0.0001$), and group C ($P = 0.0001$). The ANDI (Table 2 and Figure 2) significantly decreased after-treatment within group A ($P = 0.0001$) and group B ($P = 0.0001$) compared to before-treatment. But, no significant difference ($P > 0.05$) was noted in ANDI after-treatment within group C ($P = 0.790$) compared to before-treatment. This significant decrease in VAS and ANDI after-treatment is in a favor of DDN group with a % of change (70.44 and 59.69%, respectively) for (Group A), (53.75 and 32.97%, respectively) for Group B, and (26.09 and 1.42%, respectively) for Group C.

Multiple pairwise comparison tests (group effect) for VAS and ANDI variables among groups A, B, and C (Table 2) showed no significant differences ($P > 0.05$) at before-treatment for VAS ($P = 0.967$) and ANDI ($P = 0.053$). In contrast, there were significant differences ($P < 0.05$) among group A, group B, and group C after treatment in VAS ($P = 0.0001$) and ANDI ($P = 0.0001$). These significant decreases in VAS and ANDI after-treatment are in a favor of DDN group (group A) than Group B and Group C.

The Bonferroni post-hoc test and mean differences for VAS and ANDI after-treatment (Table 2) revealed that there were significant differences ($P < 0.05$) in VAS and ANDI after-treatment between pairwise of group A versus group B ($P = 0.002$ and $P = 0.0001$, respectively), group A versus group C ($P = 0.0001$ and $P = 0.0001$, respectively), and group B versus group C ($P = 0.0001$ and $P = 0.0001$, respectively).

Table 2: Within and between group comparison for VAS and ANDI variables

Variables	Items	Groups (Mean \pm SD)			P-value	Post-hoc (P-value)		
		Group A (n=22)	Group B (n=22)	Group C (n=22)		Group A vs. Group B	Group A vs. Group C	Group B vs. Group C
VAS	Before-treatment	7.95 \pm 1.53	8.00 \pm 1.21	8.05 \pm 1.19	0.967	1.000	1.000	1.000
	After-treatment	2.35 \pm 0.87	3.70 \pm 1.22	5.95 \pm 1.15	0.0001*	0.002*	0.0001*	0.0001*
	Change (MD)	5.60	4.30	2.10				
	Improvement %	70.44%	53.75%	26.09%				
	P-value	0.0001*	0.0001*	0.0001*				

ANDI	Before-treatment	19.35 ±4.15	18.50 ±3.69	21.20 ±3.38	0.053	1.000	0.307	0.054
	After-treatment	7.80 ±3.86	12.40 ±3.06	20.90 ±3.00	0.0001*	0.0001*	0.0001*	0.0001*
	Change (MD)	11.55	6.10	0.30				
	Improvement %	59.69%	32.97%	1.42%				
	P-value	0.0001*	0.0001*	0.790				

Group A: DDN group; Group B: MET group; Group C: control group

VAS: visual analogue scale; ANDI: Arabic version of neck disability index

Data are expressed as mean ± standard deviation (SD)

MD: Mean difference

P-value: probability

value * Significant (P<0.05)

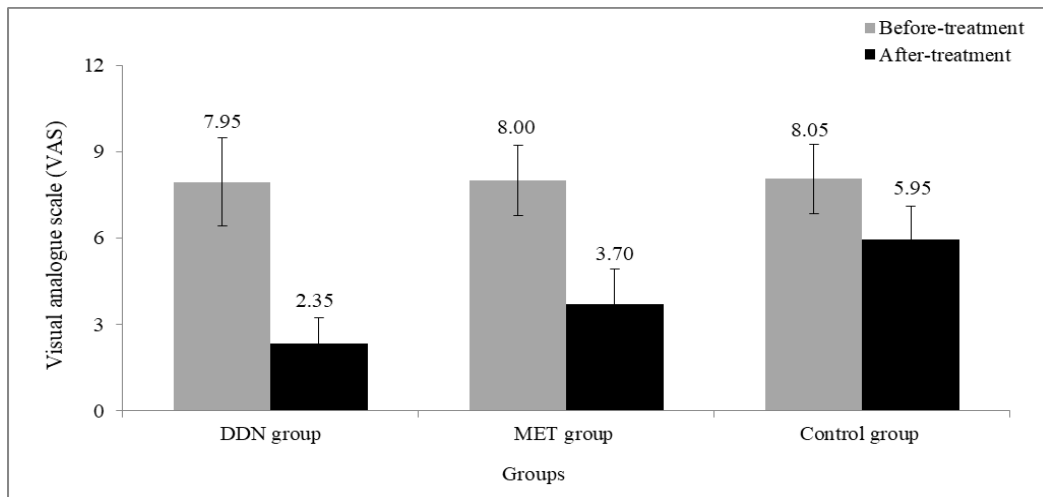


Figure (1): Mean values of VAS at pre- and post-treatment among groups.

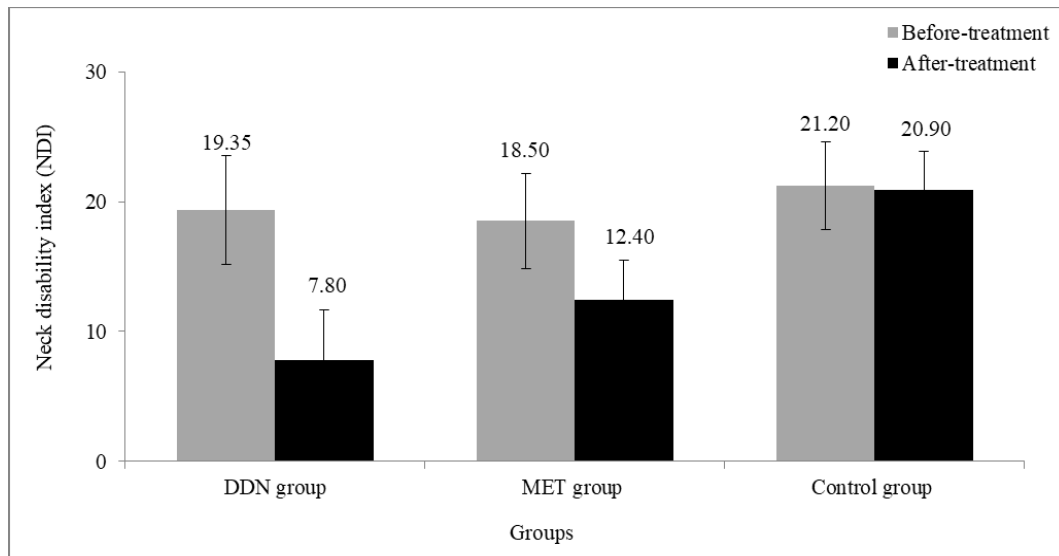


Figure (2): Mean values of ANDI at pre- and post-treatment among groups.

Discussion

This randomized controlled trial investigated and compared the effects of DDN and MET on pain intensity and functional disability in subjects with CNSNP. The findings showed that the DDN offered more significant improvements in pain intensity and functional disability.

For DDN, these improvements may be because of the activation of the central nervous system: complex endogenous pain-modulating mechanisms and the activation of the autonomic nervous system to produce electromyographic changes in the MTrPs. (Martín-Sacristán et al., 2022) such as deactivation of MTrPs, normalizing the MTrPs chemical environment which causes a release of muscle shortness, eliminate the stimulation source of muscle, reducing peripheral and central sensitization by removing the source of peripheral nociception (trigger point) which would normalize the sensitivity of peripheral nerves and reduce spontaneous muscle activity (Ziaefar et al., 2014).

On the other, the improvements induced by MET may be due to the isometric contraction of the muscles which stimulates the muscle and joint mechanoreceptors and proprioceptors causing release of beta endorphins from the pituitary gland, which, in turn, reduces the sensation of pain, making the consecutive stretch easier and more tolerable. It helps to decrease hyperactivation and tightness of the shortened muscles via the neurophysiological mechanism activated by the Golgi tendon reflex which inhibits the alpha motor neuron and results in reflex relaxation of muscles and decreases pain which, in turn, affects functional status. (Joshi & Poojary, 2022)

These results are consistent with Cerezo-Téllez et al., 2016, who evaluated the effectiveness of deep dry needling (DDN) of active MTrPs in the upper, middle, and lower trapezius muscles after 5 sessions over 3 weeks. They provided evidence to support the claim that deep dry needling combined with passive stretching appears to be more effective at reducing pain (VAS) in office workers with neck pain than passive stretching alone.

Martín-Sacristán et al., 2022 assessed the effectiveness of deep dry needling (DDN) applied on an active myofascial trigger point (MTrP) in comparison to a latent-MTrP and even though to a non-MTrP site on pain reduction and cervical functional limitations in patients with chronic neck pain. Their investigation found that regardless of whether deep dry needling was used to treat trigger points, latent trigger points, or areas without trigger points, both mechanical hyperalgesia measured by pressure pain algometer (PPT) and pain intensity (VAS) were improved equally in all points that were treated.

Naghikhani et al.2020 assessed the effects of DN on patients with musculoskeletal complaints brought on by active MTrPs in shoulder girdle muscles over the period of two weeks including five sessions, one session every other day. They showed that when compared to the values obtained prior to the intervention, a significant difference was seen in the VAS and PPT outcomes. Considering the DN can be an effective treatment option for MTrPs in the muscles of the shoulder girdle.

Additionally, this outcome was consistent with a study by Jalilipanah et al., 2021 that looked at the effects of a combination of dry needling (DN) and muscle energy technique (MET) on pain intensity (VAS), pressure pain threshold (PPT), and shoulder active range of motion (ROM) in patients with shoulder impingement syndrome and active trigger points in the infraspinatus muscle. They concluded that both methods work well for treating MTrPs when using DN, MET, and their combination can lessen pain and improve PPT.

On the other hand, Charles et al., 2019 carried out a systematic review to evaluate the effectiveness of manual therapy, dry needling, and dry cupping in treating myofascial trigger points and discomfort in the short term. And their findings demonstrated that there is no stronger support for dry needling and cupping than the placebo effect. This discrepancy might be due to small sample sizes, unclear randomization and concealment procedures, inappropriate blinding, lack of standardized guidelines in the location of trigger points, and paucity of data on the use of dry cupping.

A possible drawback of the current study is assessing the short-term effects without reevaluating the long-term effects. So, it will be beneficial to be addressed to future studies.

Conclusion

DDN and MET are both effective in reducing neck pain and improving neck function in CNSNP patients, however, DDN is more effective, making it the better option.

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Disclosure

The authors declare that there is no financial conflict of interest with regard to the content addressed.

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