

Effects of Joint Mobilization Versus Acupuncture on Pain and Functional Ability in People with Chronic Neck Pain: A Randomized Controlled Trial of Comparative Effectiveness

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Background: Chronic Neck Pain (CNP) is one of the main contributing factors to disability in people of working age.

Objectives: The aim of this randomized clinical trial was to compare the efficacy between acupuncture and joint mobilization on pain and disability in patients with CNP.

Methods: The study involved 45 men and women with CNP, divided into three groups of 15 each. The first group followed a manual therapy protocol with joint mobilization for eight weeks three times per week. The second group followed an acupuncture protocol of equal duration and frequency, while the third group did not follow any treatment. Pain with the Visual Analog Scale (VAS) for pain and functional limitations with the Neck Disability Index (NDI) questionnaire were assessed before and after an 8-week intervention. Analysis of variance was applied while post-hoc comparisons were made to determine the differences among the groups at each time of measurement.

Results: Both intervention groups showed statistically significant differences compared to the control group after the end of the intervention in both the VAS and the NDI scores ($p < .001$). Furthermore, the acupuncture group showed a statistically significant improvement compared to the joint mobilization team after the end of the intervention in the VAS score ($p < .001$) and the NDI score ($p < .05$).

Conclusion: Both joint mobilization and acupuncture appear to be effective interventions in reducing pain and improving functional ability in people with CNP. However, acupuncture appears to have a greater analgesic effect than joint mobilization.

Keywords: Chronic neck pain, Acupuncture, Joint mobilization, Rehabilitation

INTRODUCTION

Chronic neck pain is defined as neck pain with symptoms that manifest for more than three months [1,2]. Millions of people worldwide are directly affected by chronic neck pain both personally and socially [3-6]. According to epidemiological data in the USA alone, the costs associated with treating patients with chronic neck pain increased by 65% between 1997 and 2005. 50% of episodes of acute neck pain will continue to show symptoms for a long time [7,8]. Nonspecific neck pain is defined as neck pain whose presence is not associated with any serious pathology and can be managed through various therapeutic regimens such as pharmacotherapy, acupuncture, physiotherapy and exercise

[2,3,5,9-13].

Manual techniques as well as complementary therapies have been shown to help treat chronic neck pain effectively [10,14-18]. Two of the methods that have been widely used in clinical practice in recent decades are joint mobilization and acupuncture [2,10,19].

Joint mobilization is a manual technique that is comprised from specialized continuous passive movements on the joints. These movements, according to the International Federation of Orthopedic Manipulative Physical Therapists (IFOMPT) [20] are varied in speed and range. Possibly they may be short-range and high-speed manipulations with the aim to restore optimal movement, functioning and reduce pain.

Joint mobilization is part of manual therapy, which is

defined as the set of dexterous movements applied with the hands, with the aim of direct or indirect relief of the patient from pain by the World Confederation for Physical Therapy [21].

Research data from recent decades have shown that the application of joint mobilization significantly reduces pain and improves the functioning of patients with chronic neck pain [22-24]. However, the findings of the studies show great heterogeneity in terms of their results [2,22,25]. This may be due to the heterogeneity observed between the different protocols in terms of time, duration, dosage and the appropriate combination of techniques used [9,22]. Tsakitzidis et al. [2] report that more research is needed to determine which interventions provide the best results in the treatment of chronic neck pain.

A second method for treating chronic neck pain with very good results is acupuncture [10,16,19]. Research has shown that acupuncture effectively reduces pain and improves the functional ability of people with chronic neck pain [10,16,26]. However, although recent research data suggests acupuncture as an appropriate and effective treatment for chronic pain [27,28], the efficacy of the technique is disputed by various researchers [26,29]. The aim of this study is to compare the efficacy of these two techniques through the application of two different protocols that were applied to patients with chronic neck pain.

MATERIALS AND METHODS

1. Design

This was an assessor-blind randomized clinical trial conducted under the supervision of the Department of Physiotherapy of the International Hellenic University during the period November 2020-April 2021. Study was conducted following the Consolidated Standards of Reporting Trials (CONSORT) extension for pragmatic clinical trials. The 45 participants with chronic neck pain were randomly divided into three groups (two intervention and one control) of 15 people each. The distribution of participants was done through the Research Randomizer Computer software (version 4) [30] by an independent researcher. The randomization process was conducted in small groups and thus allocation concealment was achieved. The first intervention group followed a treatment protocol based on the application of joint mobilization (Manual Therapy Group); the second intervention group followed an acupuncture protocol (Acupuncture Group) while the third group (Control) did not follow any treatment. The intervention had a total duration of eight weeks while the frequency of each program was three times a week. This study was performed in compliance with the ethical standards outlined in the Declaration of Helsinki.

Ethical approval was granted by the Ethics Committee of the Department of Physiotherapy of the International Hellenic University University (No. EC-02/2021). Written informed consent was obtained from all subjects in our institution.

2. Participants

The inclusion criteria of the participants were: Medical report with a diagnosis of neck pain, referral to a physician for physiotherapy, duration of symptoms longer than three months, and written consent to participate in the research. The exclusion criteria of the participants were: History of acute neck injury and conditions that refer to red flags in neck pain (severe pathology due to vertebral artery syndrome, intramedullary tumor, cervical fractures, cervical vertebral osteomyelitis). The demographic characteristics of the participants in each group are presented in Table 1.

All participants were informed of the purpose of the research and received printed information material for the purposes of the research before signing their participation consent form. To avoid any distortion in the clinical picture of the results, participants were recommended to refrain from the use of painkillers or anti-inflammatory medication for the eight weeks of the program. However, when this was necessary in some cases, we asked the participants to report it to the members of the research team.

3. Measurements

The following measurements were performed at the beginning (baseline) and end of the study (eighth week) by the same outcome assessor. All measurements took place in a different room and the assessor was unaware about which group each participant belonged to.

4. Subjective perception of pain with the visual analog scale (VAS) for pain

The intensity of the present pain was assessed with the visual analog scale for pain (pain VAS). It is a tool for measuring pain that is essentially based on the subjective self-assessment of the patient. It is a straight 100mm horizontal line with the phrase “No Pain” on one side and “Unbearable

Table 1. Demographic characteristics of the participants

Demographic characteristics	Manual therapy group	Acupuncture group	Control group
Number of participants	15	15	15
Age (years)	41 ± 7.69	40 ± 3.93	44 ± 4.3
Gender (%) (Women)	75% (n = 10)	75% (n = 10)	75% (n = 10)

Pain” on the other. The patient is asked to indicate or mark the point of this line that they consider representative of their pain levels. The examiner then measures the distance with a ruler in mm. This scale is widely used in research as a tool for measuring pain and shows satisfactory indices of reliability and validity in people with neck pain [31,32].

5. Functional ability with the Neck Disability Index (NDI) questionnaire

The Neck Disability Index (NDI) is a self-report questionnaire for inability to perform daily activities due to neck pain [33,34]. It is a widely used tool with a high reliability index ($r = 0.89$), used in clinical practice and research to assess the degree of disability of the examinee (Vernon and Mior, 1991 [35]). The questionnaire includes 10 questions related to activities regarding personal care, weightlifting, driving, work, sleep, entertainment, and other everyday life skills. Each question can have 6 possible answers, which are scored on a scale of 0-5. The total score resulting from the sum of all the answers ranges from zero (no disability) to 50 (complete disability) [33].

6. Experimental protocols

Each of the two intervention protocols had a session duration of 30 minutes. Both intervention groups completed a total of 24 sessions over eight weeks. An Orthopedic Manual Therapy (OMT) physiotherapist specializing in manual mobilization with eight years of clinical experience applied the protocol to the manual therapy team, while a second physiotherapist with two years of training in acupuncture and seven years of relevant clinical experience applied the treatment protocol to the second intervention group (acupuncture group).

7. Manual therapy protocol

Prior to the application of the joint mobilization manipulations, the physiotherapist examined the mobility of the cervical and thoracic vertebrae to locate the areas with impaired movement. This assessment was performed through the Posterior-Anterior Segmental Mobility test [36,37]. The aim of this test is to detect pain and impairments in the cervical and thoracic joints by assessing their mobility [36]. The procedure is as follows: (1) The patient is placed in a prone position, (2) The examiner stands directly behind their head, (3) The examiner places their hands (specifically only their thumbs) on the spinous processes of the cervical vertebrae with their elbows extended so as to utilize the motion of their entire upper torso, and finally, (4) The examiner exercises on each vertebra separately a posterior to anterior force in a progressive oscillatory fashion controlling the mobility of each vertebra. The procedure for assessing

the thoracic vertebrae is similar; the examiner also exerts a posterior to anterior force in a progressive oscillatory fashion controlling the mobility of each thoracic vertebra. The difference is that the pressure originates from the back of their hands (opisthenar) and not the thumbs. The test is deemed successful when the pressure reproduces the symptoms of the patient. The assessor uses their experience and sensation to categorize each vertebral segment as “normal”, “hyperactive” or “hypoactive”. Furthermore, the underlying and overlying vertebral sections are used to compare and evaluate the mobility of each examined section [36].

Joint mobilization was then performed to the cervical and thoracic vertebrae with emphasis on the points where the limitation had been identified during the evaluation. Joint mobilization involved pulling and sliding with the patient in supine position and sitting. The protocol we implemented was based on the protocol of Lopez-Lopez et al. [24]. Cervical pulling was applied with the patient lying down and the hands of the physiotherapist were placed on their occipital bone. The physiotherapist was pulling from the occipital bone of the patient using both hand manipulations as well as a stabilization belt, which was passing around the pelvis of the physiotherapist and ending at the dorsal surface of both their hands. The patient was then placed in a sitting position and sliding was performed on the respective vertebral sections. The patient should not feel pain during the manipulations. The procedure to perform joint mobilization on the cervical vertebrae is the following: (1) The patient is in a prone position on the stretcher with both their hands under their forehead, (2) The therapist places both their thumbs on the spinous processes of the C2 vertebra of the patient and (3) The therapist performs grade III posteroanterior impulses with a duration of two minutes and a speed of 2 Hz (120 movements per minute). This procedure is repeated threefold with one-minute rest periods between each application.

8. Acupuncture protocol

Before inserting the special needles, the physiotherapist disinfected the skin with a cotton swab with pure alcohol. 25 × 30 mm needles were used for acupuncture (Dongbang DB105 spring handle needle). Two types of acupuncture disposable needles were used in terms of length: 1.0 and 1.5 cun. The 1st ones were inserted into the Houxi (SI3) acupoints and the latter into the Fenhchi (GB20) and Jianliao (TE14) acupoints. Traditional Chinese Medicine (more specifically its meridian theory) states that the central neckline is part of the governor vessel, to which the Houxi acupoints connect. This reason led to the selection of these acupoints. Additionally, needles were inserted into the suboccipital area (BL10, GV16, GB20), and locally into the neck and shoulder area (Jianjing GB21, Jianwaishu SI14, Jianzhongshu (SI15). Moreover, a

“Qi” sensation was achieved by twisting the needles after their insertion. Lastly, after twisting the needles, they were left undisturbed for 25 minutes. This protocol was based on that of Sun et al. [29]. The duration of the application was 30 minutes.

9. Sample size calculation

A total sample size of at least 51 subjects was calculated based on an a priori power analysis (G*Power 3.0.10). As a basic prerequisite for this calculation, the power ($1-\beta$) was set at 95%, and the detection of a difference in the order $f = .5$ (Cohen's f) [38]. The alpha was set at .05 for all tests. Despite strong efforts, the targeted sample size of $n = 51$ was not reached. Due to the difficulties caused by the pandemic, it was not possible to include more than 45 patients in the study.

10. Statistical analysis

Data were analyzed using SPSS Statistics for Windows, Version 25.0 (SPSS Inc., Chicago, IL, USA). The Shapiro-Wilk test and Q-Q and P-P plots were used to check normal distribution. A two-way analysis of variance (ANOVA) with repeated measures was applied. The ANOVA was applied to examine the interaction effect of “Group” and “Time of measurement”. The “Group” factor was tested at three levels (Manual therapy group [MT], Acupuncture group [AG] and Control group [CG]), while the factor “Time of measurement” was tested at two levels (before and after the intervention). If the “Group” \times “Time” interaction effects were statistically significant, the simple main effects were reported using Tukey's post-hoc test (HSD). The significance level was set at

$p < .05$.

RESULTS

Between November 2020-December 2020, a total of 63 persons were screened for eligibility. Only 45 of them (71.4%) were included in the study and randomly allocated into one of the three groups (interventions or control) (Fig. 1). None of the participants quit the research prematurely. All 45 participants completed the eight weeks of intervention. There were no missed sessions or missed measurement appointments during the conduction of research. Also, none of the participants experienced any unwanted side effects during the implementation of the treatment protocols.

1. Pain VAS score

The analysis of variance revealed an interaction between the “Group” factor and the “Time of measurement” factor ($p < .001$), a major effect on the “Time of measurement” factor ($p < .001$) and a major effect on the “Group” factor ($p < .001$). The post-hoc test showed that the acupuncture group had a statistically significantly lower value on the pain scale compared to the other two groups ($p < .001$) after the intervention, while there was a statistically significant improvement between the manual therapy and control groups ($p < .05$) (Table 2). The results of our study revealed that both intervention groups exhibited reduced levels of pain after the end of the intervention compared to the control group. However, in the acupuncture group the reduction in pain was greater than in the manual therapy group with a

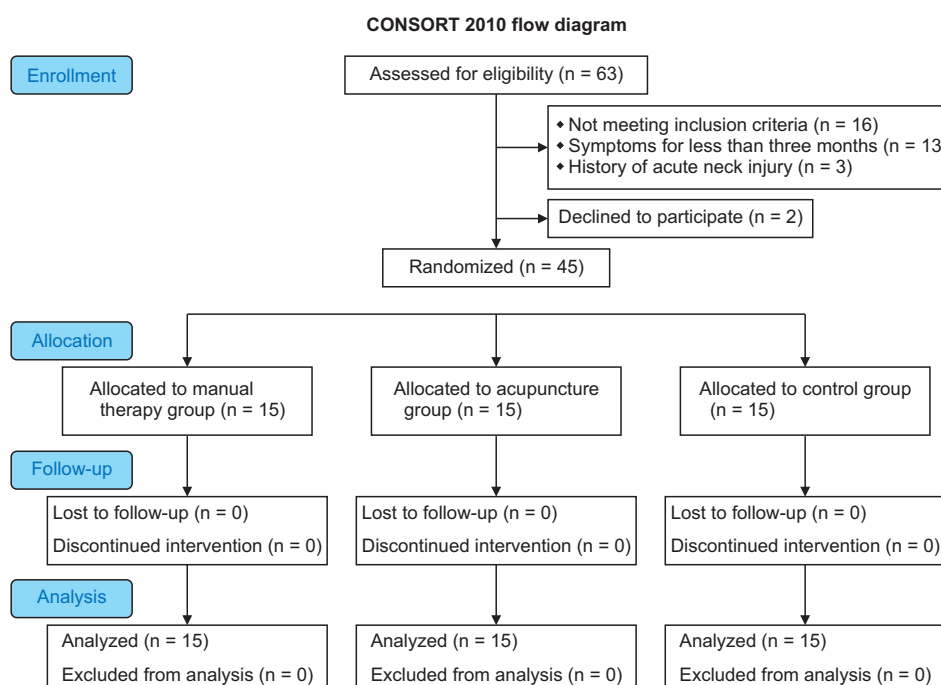


Fig. 1. CONSORT flow diagram of the study. CONSORT = Consolidated Standards of Reporting Trial.

Table 2. Outcome measures mean scores (SD) and *p*-values of the three groups after intervention

Outcome measures	Baseline	8 weeks	<i>p</i> -value (between group)	Post hoc Tukey's test (<i>p</i> -value)
	Mean (SD)	Mean (SD)		
VAS pain score				
Acupuncture group (n = 15)	60.21 (9.28)	22.25 (9.35)	< 0.001*	Acupuncture vs control (<0.001*)
Manual Therapy group (n = 15)	59.22 (8.64)	31.34 (8.78)		Acupuncture vs manual (<0.001*)
Control group (n = 15)	58.72 (10.21)	57.92 (10.21)		Manual vs control (0.004*)
NDI				
Acupuncture group (n = 15)	26.90 (4.25)	12.11 (6.34)	0.002*	Acupuncture vs control (0.002*)
Manual Therapy group (n = 15)	27.11 (5.23)	15.65 (5.61)		Acupuncture vs manual (0.007*)
Control group (n = 15)	27.01 (4.21)	27.00 (6.37)		Manual vs control (0.01*)

VAS = visual analog scale, NDI = neck disability index. *Statistically significant *p*-value.

statistically significant difference ($p < .05$).

2. NDI score

From the analysis of variance, an interaction was found between the “Group” factor and the “Time of measurement” ($p < .05$), a major effect on the “Time of measurement” factor ($p < .05$) and a major effect on the “Group” factor ($p < .001$). The post-hoc test showed that the acupuncture group had a statistically significantly lower value in the NDI score compared to the other two groups ($p < .05$) after the intervention, while there was a statistically significant improvement between the manual therapy and control groups ($p < .05$) (Table 2). The results of our study showed that both intervention groups showed reduced levels of disability after the completion of the intervention compared to the control group. However, in the acupuncture group this reduction was greater than in the manual therapy group with a statistically significant difference ($p < .05$).

DISCUSSION

The aim of this randomized clinical trial was to compare the efficacy of two different therapeutic approaches, that of joint mobilization and that of acupuncture in pain and disability of patients with chronic neck pain. Although there is evidence that both techniques are effective in improving symptoms in people with chronic neck pain, there is limited evidence as to which of the two methods is more effective. The results of this randomized clinical trial showed that both interventions significantly improved levels of pain and disability compared to control group participants. The findings of our study are in line with those of other studies regarding the efficacy of both joint mobilization [39,40] and acupuncture [26,41] in individuals with chronic neck pain. However, the improvement in pain and disability was greater in the participants of the acupuncture group than in the

participants of the manual therapy group, which means that the acupuncture protocol proved more effective than the manual therapy protocol.

This greater reduction in the VAS pain score presented in the acupuncture group compared to the manual therapy group may be due to the mechanism through which acupuncture induces analgesia. Previous research has shown that the analgesic effect of acupuncture may be related to the activation of centrifugal nerve fibers A δ and C in muscles when the needle is inserted at acupuncture points, as the signals are transmitted directly to the spinal cord and through the centrifugal pathways to midbrain [42,43]. This analgesic mechanism in the participants of the acupuncture group may have been the reason why the participants in this group experienced lower levels of pain compared to the participants in the manual therapy group. The findings of our study are consistent with those of previous studies that also found the analgesic effect of acupuncture in patients with neck pain [19,41]. However, they contrast those of Sun et al. [29], who did not find a significant effect on pain after applying a corresponding acupuncture protocol for three weeks in 34 patients with chronic neck pain. One explanation for this may be the time factor; the possibility that the three-week period was too short for significant differences to occur. In contrast, in other studies in which longer-term acupuncture protocols were applied, a strong analgesic effect with the application of acupuncture to chronic pain was identified [19].

A similar improvement in the participants of the acupuncture group was also found in the NDI score, meaning that the patients of the acupuncture group experienced fewer functional limitations than those of the manual therapy group. This is a logical consequence, since the participants of the acupuncture group experienced lower levels of pain and were therefore expected to show fewer functional limitations compared to the participants of the manual therapy group.

The main limitation of the research was the small number

of samples, which was caused by the fact that this research was conducted during the COVID-19 pandemic period, when in Greece strict restrictions on the movement of citizens were imposed.

CONCLUSIONS

Applying an eight-week acupuncture protocol three times a week seemed more effective than applying an equal frequency and duration joint mobilization protocol to patients with chronic neck pain to reduce pain and disability. Both joint mobilization and acupuncture appear to be effective interventions in the treatment of chronic neck pain. However, it seems that the analgesic effect of acupuncture is greater. The further reduction of pain and disability experienced by acupuncture is significant as it is associated with fewer functional limitations, reduced drug administration, and reduced medical care costs for people with chronic neck pain; thus, economically unburdening the health system.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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