

Effect of McKenzie Technique Combined with Ultrasound Therapy in Mechanical Neck Pain

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Abstract

Background: McKenzie protocol has been widely advocated for management of patients with different spinal conditions; although that, its combined effect with ultrasound therapy (US) in patient with Mechanical Neck Pain (MNP) are not fully investigated.

Aim of Study: To investigate the effect of McKenzie technique combined with US In patient with MNP.

Subjects and Methods: Sixty six patients with MNP aged from 18-40 years were randomly assigned into three groups: Group A (study): 22 patients received McKenzie technique, US and traditional physical therapy, Group B (study): 22 patients received US and traditional physical therapy, Group C (control): 22 patients received the traditional physical therapy only (hot packs and isometric strengthen exercises). Interventions were conducted three times a week for six weeks. Pain intensity was measured by Numeric Rating Scale (NRPS), Cervical ROM was measured by Smartphone Clinometer application and neck functional ability was measured by Neck Disability Index (NDI). All outcome measures were assessed for all participants before and after the treatment program.

Result: There was no significant difference between groups pre treatment ($p>0.05$). Within-group comparison revealed a significant improvement in all measured variables in all groups post treatment compared with that pre treatment ($p<0.001$). Comparison between groups post treatment revealed a significant improvement in all measured variables in group A compared with that of group B and group C ($p<0.01$), and a significant decrease in NRPS and NDI of group B compared with that of group C ($p<0.01$). While there was no significant difference in ROM of group B compared with that of group C post treatment ($p>0.05$).

Conclusion: Adding McKenzie technique to US for patients with MNP could provide an additional improvement in neck pain, ROM and functional ability.

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Key Words: Mechanical Neck pain – McKenzie technique – Ultrasound Therapy – Isometric exercise.

Introduction

NECK pain is one of the most common musculoskeletal disorders, with an annual prevalence among the general and workforce populations of 30% to 50%. In particular, chronic Mechanical Neck Pain (MNP) represents the vast majority of cases, contributing to substantial health care costs, work absenteeism, and loss of productivity at all levels [1]. Patients with MNP usually complain of intermittent pain, restriction of end range of movement and muscle dysfunction [2]. The goals of physiotherapy in patients with MNP include elimination of pain, restoration of the lost extent of movements, functional improvement. These objectives are achieved by various protocols of exercise, manipulation, massage, and different electrotherapy modalities [3]. McKenzie method is one of many treatment modalities of MNP [4]. It is a system of mechanical diagnosis and management of spinal pain syndromes, based on comprehensive and reproducible evaluation, knowledge of symptoms patterns, directional preference, and centralization phenomenon [5]. McKenzie method is based on the phenomenon of movement of the nucleus pulposus inside the intervertebral disc, depending on the adopted position and the direction of the movements of the spine [6].

On the other hand, therapeutic Ultrasound (US) is another treatment modality which frequently used in treatment of neck pain and is often combined with other physiotherapeutic modalities, as there is no recommendation for using mono therapeutic ultrasound for neck pain [7].

To the best of our knowledge, up till now none of the previous studies verified whether adding McKenzie to US improve the treatment of MNP patients. So, this study was conducted to investigate the effect of adding McKenzie to US in reducing pain and improving the neck functional ability in patients with MNP.

Material and Methods

Study design: This study was A Pretest posttest randomized control trial.

Subjects:

This study was conducted between October 2020 and December 2021. A total of 66 patients with MNP were recruited from Outpatient Clinic at Kafr El Sheikh Hospital. The study protocol was explained in details for each patient before the initial assessment and enrollment in the study and all patients signed an institutionally approved informed consent form which was approved by the Ethics Committee of the Faculty of Physical Therapy, Cairo University (P.T.REC/012/003036). No patient from any group dropped out during treatment, as shown in Fig. (1). The inclusion criteria were as follows: Patients with MNP for at least 3 months duration without arm pain” [8], Age ranged

from 18-40 years [9], Only patients score 4-8 (moderate cases) on numeric rating scale (NRPS), only patients that score (30%-48%) moderate disability on the Neck Disability Index (NDI). Patients were excluded from the study if they have (a) Tumor, infection, or other non-mechanical cause of neck pain, (b) Spinal fractures and recent cervical surgery, (c) shoulder diseases (tendonitis, bursitis, capsulitis), (d) inflammatory rheumatic diseases, (e) severe psychiatric illness, and patients any who take medication that can affect or reduce the pain.

Randomization:

Randomization took place as follows; sixty six folded papers marked (A), (B) or (C) were put in a box; then each subject was asked to pick a paper out of that box. The subjects were then assigned to their group according to the letters chosen. Group (A) (study group) twenty two patients received McKenzie technique in addition to US and traditional physical therapy treatment. Group (B) (study group) twenty two subjects received ultrasound in addition to traditional physical therapy treatment, and Group (C) (control group) twenty two subjects received traditional physical therapy treatment (hot packs and isometric strengthen exercises) [10].

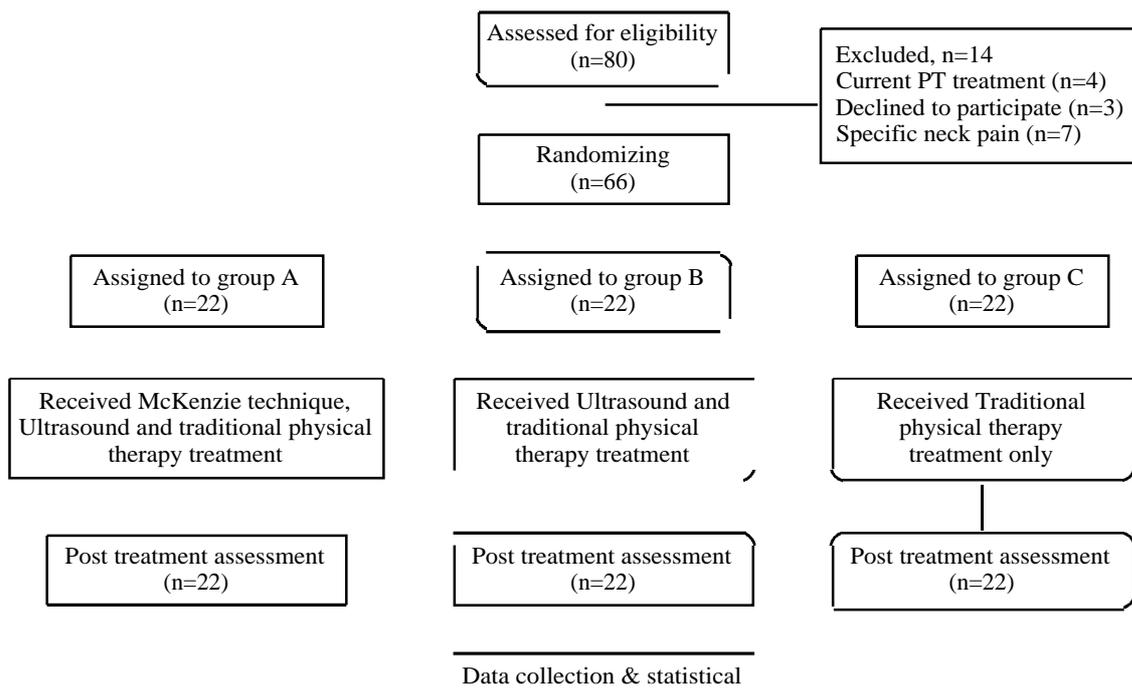


Fig. (1): Flowchart of patients randomization.

Procedures:

Numeric pain Rating Scale: Pain intensity was measured by Numeric pain Rating Scale (NPRS). NPRS exhibits fair to moderate test-retest reliability in patients with MNP [11]. The patient was asked to mark the number that that represent his intensity of pain, in which 0 represents (no pain) and 10 represents (the worst pain imaginable).

Neck Disability Index: Neck Disability Index (NDI) is a self-assessment application form of the specific functional status of subjects with neck pain with 10 elements, including pain, personal care, weight gain, reading, headache, concentration, work, driving, sleeping, and leisure. Each section is rated on a scale of 0 to 5, where 0 means “painless” and 5 means “the worst pain imaginable”. The index was calculated by dividing the summed score by the total possible score, which was then multiplied by 100 and expressed as a percentage. It is a valid and reliable measure for neck pain [12].

Smartphone Clinometer application (clin-app) to measure Cervical ROM. This application, named Smart Compass-Clinometer, consists of a digital compass-clinometer module, a data visualization module, a data analysis module, and a data management module. The compass-clinometer module measures the orientation of geological structures using data collected from built-in sensors. Previous findings have indicated the Clin-app is a reliable and valid device for assessing cervicle flexion, extension, lateral flexion and rotation [13].

Cervical flexion and extension: From sitting position with securing the smartphone on the lateral (right) side of head, and head and neck in the anatomically neutral position was first performed, instructions given to the subject for performance of flexion were, tuck your chin first, then move your head forward and down as far as possible; while the instructions for extension were, raise your chin first, then move your head backward, looking up as far as possible. To avoid thoracic movement, the subject was also instructed, do not move your shoulders or change the amount of pressure being applied to the backrest of your chair.

Cervical right and left lateral bending: From sitting position and head and neck in the anatomically neutral position, with securing the smartphone on the anterior surface of head over the forehead; specific instructions for performance of side bending in each direction were given to the patient straight ahead and side-bend your neck by moving your ear toward your shoulder as far as possible.

To avoid thoracic and shoulder girdle movement, the subject was also instructed, do not move your shoulders, and the therapist stabilized the contralateral shoulder.

Cervical right and left rotation: The subject was lying in a supine position on a plinth securing the smartphone over the top of the head, and head and neck in the anatomically neutral position was first performed. The tester was sitting in front of the head of the plinth directly behind subject, such that the top of the subject’s head and the tip of the subject’s nose were visible to the tester. Specific instructions for performance of rotation in each direction were, turn your head, as far as possible. To avoid thoracic and shoulder girdle movement, the subject was also instructed, do not move your shoulders or change the amount of pressure being applied to the plinth, and the therapist stabilized the contralateral shoulder.

Intervention:

Traditional physical therapy program: Patients in all groups received the same traditional physical therapy program. This includes hot packs followed by isometric strengthening exercises. The patient was asked to lie prone with exposed cervical and upper trapezius region, then hot packs was applied on the cervical spine for 20 minutes [14]. Then, Isometric strengthening exercises for neck flexion, extension, lateral flexion and rotation from sitting position. Contraction was held for 5 seconds/ repetitions and was be repeated 10 times, with 3 seconds rest in between them. These exercises were done for 2 sets with 1 to 2 minutes rest in between each set.

Group B: A total of 22 patients underwent the same conventional physical therapy program plus US only. Continuous ultrasound was used with 1.5 W/cm² intensity and at a frequency of 1 MHz. Ultrasound was applied perpendicular from sitting position on the upper fibers of trapezius for 1.5 minutes, using Metron Accusonic Plus (Metron Medical, Australia Pty Ltd. Carrum Downs Victoria Australia 3201).

Group A: A total of 22 patients underwent the same conventional physical therapy program and US in addition to McKenzie technique.

McKenzie protocol: McKenzie protocol was applied according to the protocol of Rathore, [4], included head retraction and neck extension from both sitting and supine positions, neck flexion from sitting position, lateral bending to the right and left, and head rotation. Each participant maintained the maximal muscle contraction in each exercise

for 7 seconds. Each movement was done for four sets of 10-15 repetitions with 1-2 minutes rest between each set. The patient was taught to remain in their therapeutic posture and was instructed to avoid any stressful postures or movements.

Sample size determination:

Sample size was determined a priori using G*Power (version 3.1.9.2). Calculations were made using $\alpha=0.05$, $\beta=0.2$ and effect size=0.4, the appropriate minimum sample size for this study was 66 patients.

Statistical analysis:

Descriptive statistics and unpaired *t*-tests were used to compare ages between groups. Chi-squared test was used to compare the sex distribution between groups. Shapiro Wilk test was used to verify the normal distribution of the data. Levene's test for homogeneity of variances was performed to ensure homogeneity between groups. Mixed MANOVA was conducted to compare the effect of time (pre versus post) and the effect of treatment (between groups), as well as the interaction between time and treatment on mean values of NRPS, NDI and ROM. The level of significance for all statistical tests was set at $p<0.05$. Statistical analysis was performed through the statistical package for social studies (SPSS) version 25 for windows.

Results

Subject characteristics:

Table (1) showed the subject characteristics of all groups. There was no significant difference between groups in age, weight, height, BMI and sex distribution ($p>0.05$).

Effect of treatment on NRPS, NDI and ROM:

Mixed MANOVA revealed that there was a significant interaction of treatment and time ($F=14.73$, $p=0.001$). There was a significant main effect of time ($F=432.23$, $p=0.001$). There was a significant main effect of treatment ($F=3.96$, $p=0.001$). Tables (2,3) showed descriptive statistics of NRPS, NDI and ROM and the significant level of comparison between groups as well as significant level of comparison between pre and post treatment in each group.

Within group comparison:

Within-group comparison revealed a significant decrease in NRPS and NDI in the three groups post treatment compared with that pre treatment ($p<0.001$) as shown in (Table 2). There was a significant increase in ROM in the three groups post treatment compared with that pre treatment ($p<0.001$) as shown in (Table 3).

Between group comparison:

There was no significant difference between groups pre treatment ($p>0.05$). Comparison between groups post treatment revealed a significant decrease in NRPS and NDI of group A compared with that of group B ($p<0.01$) and group C ($p<0.01$), and a significant decrease in group B compared with that of group C ($p<0.01$) as shown in (Table 2). There was a significant increase in ROM of group A compared with that of group B ($p<0.05$) and that of group C ($p<0.001$) and a non-significant difference in ROM of group B compared with that of group C post treatment ($p>0.05$) as shown in (Table 3).

Table (1): Basic characteristics of participants.

	Group A	Group B	Group C	<i>p</i> -value
Age, Mean \pm (SD), years	27.63 \pm 5.7	28.36 \pm 5.68	29.95 \pm 3.73	0.31
Weight, Mean \pm (SD), kg	73.77 \pm 8.73	75.36 \pm 11.37	74.41 \pm 10.92	0.87
Height, Mean \pm (SD), cm	164.27 \pm 6.54	166.45 \pm 5.41	165 \pm 5.66	0.46
BMI, Mean \pm (SD), kg/m ²	27.32 \pm 2.57	27.12 \pm 3.28	27.26 \pm 3.18	0.97
<i>Sex, n (%)</i> :				
Females	14 (64%)	16 (73%)	14 (64%)	0.76
Males	8 (36%)	6 (27%)	8 (36%)	

SD: Standard deviation. *p*-value: Level of significance.

Table (2): Mean NRPS and NDI pre and post treatment of group A, B and C.

	Group A	Group B	Group C	<i>p</i> -value		
	Mean ± SD	Mean ± SD	Mean ± SD	A vs B	A vs C	B vs C
NRPS:						
Pre treatment	6.59±0.85	7.09±0.75	6.95±0.89	0.15	0.46	1
Post treatment	2.31±1.08	4.13±0.71	4.95±0.84	0.001	0.001	0.01
% of change	64.95	41.75	28.78			
	<i>p</i> =0.001	<i>p</i> =0.001	<i>p</i> =0.001			
NDI (%):						
Pre treatment	12.81±1.53	12.09±2.18	11.86±2.12	0.67	0.33	1
Post treatment	6.31±1.21	7.81±1.84	9.41±1.96	0.01	0.001	0.009
% of change	50.74	35.40	20.66			
	<i>p</i> =0.001	<i>p</i> =0.001	<i>p</i> =0.001			

SD: Standard deviation. *p*-value: Level of significance.

Table (3): Mean ROM pre and post treatment of group A, B and C.

ROM (degrees)	Group A	Group B	Group C	<i>p</i> -value		
	Mean ± SD	Mean ± SD	Mean ± SD	A vs B	A vs C	B vs C
Flexion:						
Pre treatment	46.68±3.68	45.91±4.43	44.7±4.43	1	0.37	1
Post treatment	58.72±3.89	53.13±5.63	52.43±4.64	0.001	0.001	1
% of change	25.79	15.73	17.29			
	<i>p</i> =0.001	<i>p</i> =0.001	<i>p</i> =0.001			
Extension:						
Pre treatment	55.5±4.37	57.17±5.78	57±4.88	0.82	0.98	1
Post treatment	69.5±3.08	65.57±4.39	64.09±4.65	0.007	0.001	0.7
% of change	25.23	14.69	12.44			
	<i>p</i> =0.001	<i>p</i> =0.001	<i>p</i> =0.001			
Right bending:						
Pre treatment	22.55±4.69	23.68±3.63	24.09±4.66	1	0.74	1
Post treatment	35.18±3.42	32±4.11	30.13±3.79	0.02	0.001	0.32
% of change	56.01	35.14	25.07			
	<i>p</i> =0.001	<i>p</i> =0.001	<i>p</i> =0.001			
Left bending:						
Pre treatment	21.04±4.8	22.91±4.1	23.18±5.02	0.56	0.4	1
Post treatment	35.55±3.29	31.5±4.21	29.45±4.33	0.004	0.001	0.27
% of change	68.96	37.49	27.05			
	<i>p</i> =0.001	<i>p</i> =0.001	<i>p</i> =0.001			
Right rotation:						
Pre treatment	66.33±5.49	68.04±2.83	67±4.35	0.59	1	1
Post treatment	77.48±3.27	73.31±3.13	71.59±4.13	0.001	0.001	0.33
% of change	16.81	7.75	6.85			
	<i>p</i> =0.001	<i>p</i> =0.001	<i>p</i> =0.001			
Left rotation:						
Pre treatment	65.42±5.98	67.22±2.67	65.54±4.35	0.57	1	0.67
Post treatment	76.89±3.48	72.81±3.31	70.86±3.97	0.001	0.001	0.23
% of change	17.53	8.32	8.12			
	<i>p</i> =0.001	<i>p</i> =0.001	<i>p</i> =0.001			

SD: Standard deviation. *p*-value: Level of significance.

Discussion

This study was conducted to investigate the effect of adding McKenzie to US in reducing pain and improving the neck functional ability in patients with MNP. This study demonstrates that, the group received McKenzie technique combined with US (group A) showed more improvement in all measured variables than that of group B and group C, and a significant decrease in NRPS and NDI of group B compared with that of group C. While there was no significant difference in ROM of group B compared with that of group C post treatment.

The percent of change of NPRS and NDI in group A was 64.95 and 50.74% respectively, in group B was 41.75 and 35.4% respectively and in group C was 28.78 and 20.66% respectively. The findings of the current study was supported by Abd Elmeged et al. [15] who found that, there was a significant effect for Mckenzie exercises on functional neck disability and pain intensity at post treatment compared to pre-treatment at study group in females with dowager's hump.

The result of the current study agree with Kjellman et al. [16] who found that, there was a significantly greater improvement in neck pain in the McKenzie group than in the control group in terms of VAS and NDI at 3-week and 6-month follow-ups, and concluded that McKenzie treatment was superior to general exercise and ultrasound with a quicker improvement in neck pain intensity during the first 3 weeks. Also, the results come in agreement with Kumar et al. [17] who reported that, McKenzie therapy is successful in reducing neck pain in chronic neck pain patients following a rehabilitation plan of four sets of 10-15 repetitions per day for four weeks.

The finding of the current study regarding cervical ROM are supported by Moustafa et al. [18] whom conducted a study to investigate the effect of adding a sagittal cervical posture corrective orthotic device to a multimodal rehabilitation program in patients with discogenic cervical radiculopathy, and they found that adding the postural correction improves short-and long-term outcomes concerning cervical ROM, pain intensity, and neck functional activity. In a similar Abdulwahab and Sabbahi [19] agree with the current study as it discovered that neck retraction, which McKenzie has recommended as a treatment for patients with cervical issues, promotes extension of the lower cervical segments, improve neck posture and may

lessen stress on the posterior annulus. In a similar Ebadi et al. [20] agree with the current study whom found that, the amount of improvement in ROM was significantly greater in the continuous US group on chronic non-specific low back pain. The study demonstrated a significant improvement in function, ROM and endurance time when continuous US was added to a semi-supervised workout regimen.

The results of the current study agree with the work of Kim et al. [21], who investigated the effects of McKenzie exercise on functional recovery and forward head position in patients with chronic neck pain and they reported that, McKenzie exercise resulted in significant changes of craniovertebral angle and NDI. In contrast, the study done by Lytras et al. [22] found that the NPRS, NDI and ROM scores improved equally in both groups, (therapeutic ex and McKenzie ex) suggests that the McKenzie method is equally effective in improving the clinical presentation of chronic neck pain patients. Abdel-Aziem et al. [23] agree with the current study as they found that, McKenzie exercises were better than DNF combined with scapulothoracic exercises to treat neck pain, functional disability, and mobility. In addition, the result of the current study come in accordance with Amjad et al. [24] who found that the McKenzie group's mean flexion was noticeably higher following treatment compared to the general exercise group, with a *p*-value of 0.05. Furthermore, the result of the current study supported by Busanich et al. [25] who provided evidence that McKenzie therapy results in a decrease in pain and disability for back pain patients compared with other standard treatments, such as nonsteroidal anti-inflammatory drugs, educational booklet, back massage with back care advice, strength training with therapist supervision, and spinal mobilization.

Although the current study reveals objective data with statistically significant differences, there are some limitations. The main one is the short study duration. Therefore, longitudinal studies are needed to evaluate long-term effects of multimodal approach of McKenzie or therapeutic Ultrasound on pain, CROM, and functional restriction in treatment of chronic MNP.

Conclusion:

Adding McKenzie exercises to therapeutic US provides an additional effect and great improvements in pain intensity, functional neck ability and CROM in patients.

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تأثير تقنية ماكنزى المدمجة مع الموجات فوق الصوتية على علاج آلام الرقبة الميكانيكية

شارك فى هذه الدراسة ٦٦ مريضاً يعانون من آلام الرقبة الميكانيكية أعمارهم بين ١٨-٤٠ تم تقسيمهم عشوائياً إلى ٣ مجموعات: المجموعة أ (مجموعة الدراسة): تلقى ٢٢ مريضاً تقنية ماكنزى بالإضافة إلى الموجات فوق الصوتية العلاجية والعلاج الطبيعى التقليدى، المجموعة ب (مجموعة الدراسة): تلقى ٢٢ مريضاً الموجات فوق الصوتية العلاجية والعلاج الطبيعى التقليدى، المجموعة ج (مجموعة التحكم): ٢٢ مريضاً تلقى العلاج الطبيعى التقليدى فقط (الكمامات الساخنة وتمارين تقوية متساوية القياس). تم إجراء البرنامج ثلاث مرات فى الأسبوع لمدة ستة أسابيع. تم قياس شدة الألم من خلال مقياس التناظر الرقى وتم قياس نطاق الحركة بواسطة برنامج (كلينو ميتر) وتم قياس الإعاقة الوظيفية بواسطة مؤشر العجز العنقى. تم تقييم جميع مقاييس النتائج لجميع المشاركين قبل وبعد برنامج العلاج.