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The effectiveness of modified postural correction exercise using combined kendall and mckenzie exercises in chronic nonspecific neck pain

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ABSTRACT

Background: Chronic non-specific neck pain (CNSNP) is associated with daily activity limitations, reduction of work productivity and decrease in quality of life. **Objectives**: This study aimed to examine the combinated effect of McKenzie and Kendell posture correction exercises on pain intensity and cervical range of motion (ROM) in patients with CNSNP. **Methodology:** Sixty patients with CNSNP their ages ranges from 25 to 50 were randomly assigned to two equal groups. Study group (GA) received combined McKenzie and Kendell exercise plus Conventional therapy. Control group (GB) received the Conventional therapy in a form of hot packs, ultrasound and cervical stretching and strengthening exercises. For a month, both groups got three sessions per week. Pain intensity and cervical range of motion were measured by visual analogue scale (VAS) and cervical range of motion device (CROM), respectively pretreatment and four weeks after the intervention. **Results:** Within-group analysis showed a significant change in pain intensity and cervical ROM after treatment (P<0.001). Between-group analysis revealed a significant difference between groups post-intervention favoring the intervention group (P<0.04), however, there was no significant difference between the two groups regarding their impact on cervical extension (P=0.086). **Conclusion**: The combined Kendell and Mackenzie exercises is more effective as a therapeutic approach than conventional therapy in lowering neck pain and improving cervical ROM in patients with CNSNP.

Keywords*: Chronic non-specific neck pain, Kendell and Mackenzie exercise, pain intensity, cervical range of motion.*

1. Introduction

Chronic nonspecific neck pain (CNSNP) is a widespread public health problem in the modern world **(Vassilaki and Hurwitz 2014),** with a reported prevalence of 50% lifetime prevalence **(Fejer et al., 2006).** CNSNP is considered as persistent neck pain or severe discomfort in the neck for over 3 months **(Monticone et al., 2013),** which is caused by poor posture and mechanical and degenerative changes, excluding pain from neck cancer, infections, fasciitis, or other areas of the body **(Binder., 2007).** The 2018 Burden of Disease Report reported that CNSNP was the sixth leading cause of disability in the United States of America in 2016 **(Mokdad et al., 2018)**, and contributes to higher costs due to loss of productivity, disability, and increased absenteeism from work, resulting in $77.2 billion in annual medical expenses **(Dieleman et al., 2016).**

Treatment of CNSNP includes several treatment modalities such as therapeutic ultrasound, hot packs, transcutaneous electric nerve stimulation and infrared, but we should necessarily consider correction of posture, work environment, and exercise therapy as well. Correction of postural deviation have been attempted using different modalities, such as heat, traction, and exercise including cervical manipulation, mobilization, stretching, isometric strengthening exercises, endurance exercises, and proprioceptive exercises **(Sarig-Bahat, 2003).**

Several studies reported the effect of cervical postural correction exercises on pain pressure threshold and cranio-cervical angle in patients with chronic non-specific neck pain **(Jaroenrungsup et al., 2021)**. Few studies have been concerned with measuring pain intensity and cervical range of motion as an indicator technique for the effect of different modalities on chronic non-specific neck pain.

McKenzie's exercise is one of the numerous techniques used by physical therapists to assess and treat patients. McKenzie exercise used in the form of neck retraction (extension) exercise. The patient is instructed to move the head backwards as far as possible but at the same time maintain forward facing position. It is important that the movement is made to the maximum. On completion the patient returns to the neutral rest position **(Kong et al.,2017).** It helps patients moving their spine in the least detrimental direction for their problem, minimizing movement restrictions caused by pain, the mechanical improvement may be attributed to treating the adaptive muscle shortening of the neck region, resulting in limited uncomfortable movement and reduced spinal mobility necessitating activities that promote the rebuilding process. Normal tissue function was only reestablished with the use of loading tactics like the McKenzie method **(Horton & Franz, 2007).**

On the other hand, kendall exercise is generally used as physical therapy exercise technique for forward head posture, induces proper neck alignment and range of motion using strengthening methods for two muscles (deep cervical flexors and retractors of the scapula) **(Kong et al.,2017).** Chung et al. mentioned that retraining of deep neck flexors and scapular retractors can lead to stabilize the neutral posture of cervical vertebrae, enhance balance and function of cervical vertebrae, which improved the quality of cervical range of motion and decrease cervical pain (**Chung et al., 2012).**

However, their combined effect has not been studied yet, so the objective of this study was to investigate the combined effect of McKenzie and Kendall exercises on pain and cervical range of motion in subjects with chronic nonspecific neck pain.

2. Material and methods

2.1. Design and setting

Pre-test and post-test randomized controlled trial design.

2.2. Procedures:

Ethical considerations

The study protocol was approved by the Research Ethics Committee of the Faculty of physical therapy, Cairo university, Giza, Egypt (approval number: P.T.REC/012/003920), and registered in clinical trials with ID (NCT05578547). This research was carried out between April 2022 to September 2022. All participants were fully informed about the study's methodology and objectives before providing informed legal consent to participate in the investigation and generalize the findings.

Sample size calculation

Based on a previous study of Metawee et al. (2021), the sample size was calculated according to the significant difference in the mean value of difference (post-treatment – pre-treatment values) in ROM between control (2.8 ± 0.6) and study (10.9 ± 1.1) groups in chronic non-specific neck pain patients. Using two tailed unpaired t test, with α=0.05, power of 80%, and an effect size of 0.52. A sample size of 30 patients/per group would be required (G.Power 301 http:www.psycho.uni-duesseldorf.de)

Subjects

In this study, sixty patients of both genders with CNSNP were included from the outpatient clinic of the faculty of physical therapy Delta University for science and technology and Alsafa hospital in Damietta. The participant's age ranged from 25 to 50 years and were diagnosed and referred from an orthopedist complaining of CNSNP. Subjects were chosen for the study after meeting certain inclusion criteria. i)Having neck discomfort symptoms that were triggered by certain neck positions and by palpating the cervical musculature for at least three months, ii) Subjects with a BMI between 25-30, iii) All subjects were office workers. Subjects were excluded, if they experienced i) A history of neck injuries, neck surgery or facet joint inflammation, ii) Neurological disorders such as cervical spondylosis, spondylolisthesis, disc prolapse and rheumatic disease. iii) Patients who received pain medication or physical therapy for their neck pain during the last 3 months **(Beltran et al., 2015).**

Randomization and allocation

All subjects were evaluated for eligibility and were randomized into two equal groups using computer permuted randomization method, followed by a concealed allocation by opening sequentially numbered and sealed envelopes; a card inside revealed the group assignment as either A or B.; group A (study group) received combined Kendell and McKenzie exercise plus conventional therapy, and group B (control group) received the conventional therapy only in the form of hot packs, ultrasound and cervical stretching and strengthening exercises **(kisner et al., 2017; Starkey, 2013)**. Figure (1) shows a flow diagram of the study.

2.3. Outcomes:

Pain intensity and cervical range of motion were evaluated both at baseline and after 4 weeks of interventions.

2.4. Pain intensity.

The visual analogue scale (VAS) was used to evaluate pain intensity pre- and post-treatment. The VAS is well known as valid measurement tool for recording pain intensity. The participant's pain intensity was recorded by using a self- reported score with single handwritten mark placed at one point along the length of a ten cm line ranged from the left side zero score (no pain) to the right side ten score (maximum pain), Those who scored between 3.4 and 7.4 were considered to be mild pain, 3.5 to 7.4 to be in moderate pain, and 7.4 to be in severe pain **(Shin et al., 2017).**

2.5. Cervical range of motion.

Cervical range of motion was measured by using CROM device as an objective tool according to the work of **(Nordin et al., 2009)**. This device consists of a plastic frame placed on the head over the nose and the ears, secured by a Velcro strap. Two independent inclinometers, 1 in the sagittal plane and 1 in the frontal plane, are attached to the frame and indicate the position of the head with respect to the line of gravity. A third inclinometer is positioned in the horizontal plane and indicates the position of the head in rotation, with respect to a reference position**.** Patient were seated in a chair with back to 90 degrees, with feet flat on the floor, arms along the body, and head in neutral position. Verbal commands were given to the subjects to perform the neck movements until the pain or maximal ROM, without moving the shoulders or trunk. First, assess mobility in the sagittal plane, followed by the frontal plane, and finally the transverse plane. The mean of 3 trials (intraexaminer reliability) was calculated and used for the analysis **(Audette et al., 2010).**

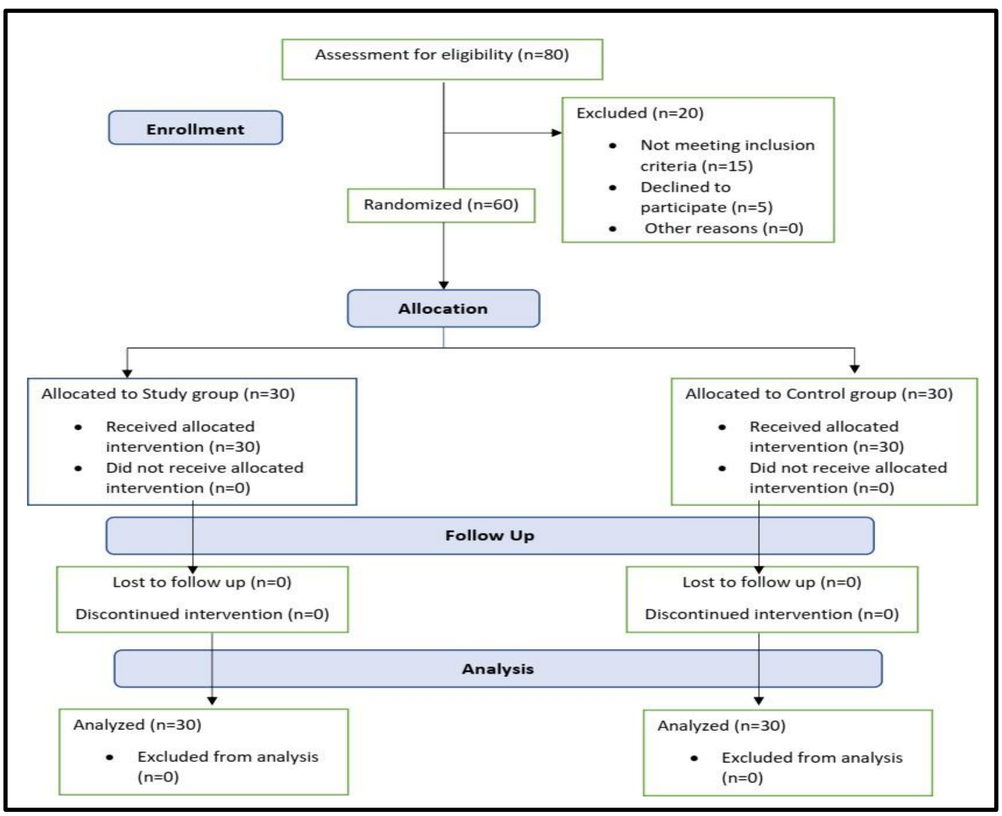

Figure (1): Flow chart

2.6. Intervention:

The combined Kendell and Mckenzie exercise:

All patients in the study group received the combined cervical exercises performed in the following manner: (1) slowly pull the subject's neck to the head, thereby attaching the chin to the neck; (2) the subject's eyes should be looking directly forward; (3) hold both hands on the back of the subject's head; (4) ask the subject to push his/her head backwards against the hands, then ask for the hands to be spread as wide as possible in order to stretch the pectoralis major. Each patient performed three sets of exercises, each with five circuits, that is, performing 7 sec of exercises followed by 10 sec of rest. **Figure (2, 3, 4) (Kong et al., 2017).**

Figure (2): The physiotherapist attached the chin of the patient to the neck (chin tuck)

Figure (3): patient hold his hands behind his head keeping his eyes looking forward

Figure (4): finally, the patient maintains the arm spread as much as possible while maintaining chin tuck

The conventional therapy:

Over the course of 4 weeks, all patients undergo conventional therapy three times a week, which included i) moist heat packs applied to the cervical region in prone lying and covered with two layers of towels for 20 minutes **(Starkey., 2013).** In addition**,** all patients received ii) ultrasound therapy to cover the trapezius muscle bilaterally for eight minutes **(**continuous US waves with a frequency of 1 MHz and a power density of 1.5 W/cm2. Three sessions each week for four weeks was administered **(Noori et al., 2020). iii)** Exercise for stretching**:** To stretch stiff muscles such as:

1) Sternocleidomastoid: the patient sits comfortably on chair keeping the spine straightened. The physiotherapist was in stride standing behind the patient with one hand at occiput at one side and fingers resting on the head behind the ear, while the hand on ipsilateral shoulder. The stretch was done by moving the patient's head in extension, side bending to contralateral side and rotation to ipsilateral side **(Mcatee, 2013).**

2) Upper trapezius muscle: the patient sits comfortably on chair with their hands on their lab. Physiotherapist was in stride standing at the head of the patient with one hand at occiput at one side and fingers resting on the head behind the ear while, the other hand on ipsilateral shoulder. The stretch was moving the patient's head in flexion, side bending to contralateral side and rotation to ipsilateral side. Each stretch was sustained for 15-30 sec, repeated 3 times for right and left sides were applied for both groups **(Mcatee, 2013). iv)** exercise for strengthening:

1) Neck isometrics through sitting on chair. The physiotherapist was in stride standing behind the patient with one hand at the lateral aspect of the occiput give resistance to lateral flexion for isometric contraction on each side. The physiotherapist put his hand anteriorly to give resistance to neck flexion for isometric contraction of neck flexors. Then the physiotherapist put his hand at the posterior aspect of the occiput to give resistance to neck extension for isometric contraction of neck extension. **(Shete and Shah., 2019).**

2) Chin tucks from supine lying position, the physiotherapist asked the patient to retract his chin, then relax. Each exercise was done for 3 sets of 10 repetitions with 1 to 3 minutes’ rest between each set **(Shete and Shah., 2019).**

2.7. 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).

2.8. Statistical analysis

For each patient in the two groups, the data were gathered both before and after the treatment program. SPSS for Windows, version 18, was used to conduct the statistical analysis (SPSS, Inc., Chicago, IL). For subject characteristics, descriptive statistics in the form of mean and standard deviation were utilized. The tested variables of interest were compared for each patient before and after therapy using the T-test both within and between groups. P<0.05 was chosen as the threshold for statistical significance.

3. Results

As shown in table (1) there were no significant differences between both groups in the demographic characteristics, including age as (P value=0.145), height (P value=0.503), weight (P value=0.602), BMI (P value=0.832) and gender (P value=0.392), (p > 0.05).

Table 1. Demographic characteristics of subjects

	Group A $\bar{x}$±SD	Group B $\bar{x}$±SD	MD	t-value	p-value	x^2	Sig.
Age (years)	34.70±7.31	32.03±6.67	2.67	1.47	0.145		NS
Height (cm)	167.90±10.13	169.57±8.97	-1.67	-0.67	0.503		NS
Weight (kg)	76.80±9.68	78.13±9.99	-1.33	-0.52	0.602		NS
BMI kg/m^2	27.16±1.48	27.08±1.58	0.08	0.213	0.832		NS
Gender (no.)	11 (37%) Men 19 (63%) women	9 (30%) Men 21 (70%) Women			0.392	0.785	NS

$\bar{x}$: Mean **MD: Mean Difference** **P-Value: Probability value**
SD: Standard Deviation **t-value: Unpaired t-test** **NS: Non-significant**
x2 = Chi-squared test

As represented in table (2): in terms of pain intensity and cervical ROM, both groups exhibited significant change post intervention relative to baseline with more enhancement in the combined kendall and mckenzie exercise group by a change of (↓ 57.74% vs 46.67%), (↑ 27.39% vs 9.96%), (↑ 28.06% vs 11.02%), (↑ 23.10% vs 10.43%), (↑ 19.70% vs 8.23%), (↑ 18.76% vs 11.14%), (↑ 16.70% vs 14.36%) for pain intensity, cervical flexion, cervical right-side bending, cervical extension, cervical left side bending, cervical right rotation and cervical left rotation, respectively. Between group analysis were noteworthy (P value=0.000), (P value=0.041), (P value=0.016), (P value=0.040), (P value= 0.045), (P value=0.019) for pain intensity, cervical flexion, cervical right-side bending, cervical left side bending, cervical right rotation and cervical left rotation, respectively. However, there was no significant difference between the two interventions regarding their impact on cervical extension (P value=0.086).

Table 2. Within and between subject analysis

Variables		Groups ($\bar{x}$±SD)		T-value	P-value
		Gr A (n=30)	Gr B (n=30)		
VAS	Pre-treatment	7.17 ±1.39	7.07 ±0.94	-0.326	0.746
	Post-treatment	3.03 ±0.67	3.77 ±0.77	3.927	0.000*
	Improvement %	57.74%	46.67%		
	Mean Difference	4.13	3.30		
	T-Value	22.46	30.329		
	P-Value	0.000*	0.000*		
CROM(Flexion)	Pre-treatment	48.82 ±10.44	51.40 ±10.71	0.943	0.350
	Post-treatment	62.19 ±10.74	56.52 ±10.24	-2.092	0.041*
	Improvement %	27.39%	9.96%		
	Mean Difference	-13.36	-5.12		
	T-Value	-9.79	-7.610		
	P-Value	0.000*	0.000*		
CROM(Rt. Side bending)	Pre-treatment	33.61 ±8.08	34.27 ±7.85	0.321	0.750
	Post-treatment	43.04 ±8.76	38.07 ±6.62	-2.478	0.016*
	Improvement %	28.06%	11.02%		
	Mean Difference	-9.43	-3.80		
	T-Value	-6.31	-5.658		
	P-Value	0.000*	0.000*		
CROM(extension)	Pre-treatment	44.23 ± 9.14	45.80 ± 9.42	0.654	0.516
	Post-treatment	54.45± 8.49	50.58 ± 8.68	-1.747	0.086
	Improvement %	23.10%	10.43%		
	Mean Difference	-10.22	-4.78		
	T-Value	-7.78	-3.507		
	P-Value	0.000*	0.001*		
CROM (Lt. side bending)	Pre-treatment	38.32 ± 9.01	38.27 ± 8.05	-0.022	0.982
	Post-treatment	45.87± 9.57	41.42 ± 6.55	-2.103	0.040*
	Improvement %	19.70%	8.23%		
	Mean Difference	-7.56	-3.16		
	T-Value	-4.11	-5.658		
	P-Value	0.000*	0.000*		
CROM (Rt. Rotation)	Pre-treatment	51.69± 13.40	50.33 ± 12.67	-0.402	0.689
	Post-treatment	61.39± 10.13	55.94 ± 10.51	-2.044	0.045*
	Improvement %	18.76%	11.14%		
	Mean Difference	-9.71	-5.61		
	T-Value	-6.82	-7.145		
	P-Value	0.000*	0.000*		
CROM (Lt. Rotation)	Pre-treatment	54.23 ± 10.81	50.00 ± 14.42	-1.286	0.204
	Post-treatment	63.29± 7.65	57.18 ± 11.49	-2.423	0.019*
	Improvement %	16.70%	14.36%		
	Mean Difference	-9.06	-7.18		
	T-Value	-7.20	-5.887		
	P-Value	0.000*	0.000*		

CROM: cervical range of motion MD: Mean Difference P-Value: Probability value
SD: Standard Deviation $\bar{x}$: Mean t-value: Unpaired t-test *: significant

Discussion

This randomized control trial investigated and compared the effect of combined Kendell and McKenzie cervical postural correction exercises and the conventional physical therapy program on pain intensity and cervical range of motion in chronic non-specific neck pain patients. The results showed that the combined Kendell and McKenzie cervical postural correction exercises offered more significant improvements in pain intensity and cervical range of motion.

These findings are in line with the results from previous studies that showed reduced neck pain after deep cervical flexor training **(Kong et al., 2017; Kage et al., 2016; Iqbal et al., 2013)**.
According to a study conducted by Edmondston et al., 2011, patients suffering from neck pain have poor activation of the deep cervical flexors. The authors stated that a low-load program concentrating on motor control of the deep neck flexors alleviated neck pain and headache. Furthermore, activating the deep cervical flexors with a biofeedback unit has been demonstrated to be useful in strengthening weaker muscles and thus boosting muscle function. **(Kang., 2015).**
In the current study, decreased neck discomfort and disability were linked to increased strength and activation of deep cervical flexor muscles and scapular retractors, which improved muscular performance **(Kong et al., 2017; Kang et al., 2015; Falla et al., 2004)**. Furthermore, deep cervical flexor exercise may have helped to rectify the cervical angle **(Lee et al., 2013).** The reduction in cervical spine stresses as a result of the combined Kendell and McKenzie correction exercise could explain the improvement seen in the study group **(Martinez et al., 2020).**

Furthermore, an increase in endorphin release during exercise and an improvement in neuromuscular control may be responsible for the pain reduction produced by the combined Kendell and Mackenzie exercises. Muscle contractions trigger stretch receptors, and afferents from stretch receptors activate the pituitary gland, causing it to release endogenous opioids and beta-endorphins. **(O'Leary et al., 2007).**

According **to Chung et al. (2012),** retraining the deep neck flexor can help to stabilize the neutral posture of the cervical vertebrae, improve balance and function of the cervical vertebrae, improve quality of life, and reduce cervical pain. The findings were further supported by the work of **Moustafa et al., (2016),** who discovered that the McKenzie protocol of treatment resulted in significant improvements in cervical range of motion, pain intensity level, and neck functional activity.
Rathore (2003) revealed that neck retraction, which McKenzie advocated for in the treatment of patients with cervical problems, promotes extension of the lower cervical segments and may ease stress on the posterior annulus, so relieving discomfort. Repeated neck retraction was proven to result in a significant decrease in peripheral pain and nerve root compression in patients with neck and radicular pain. A good response to spinal loading might result in decreased pain intensity, symptom centralization, or enhanced range of motion.

Dusunceli et al. (2009) additionally conducted neck extension and deep neck flexor exercises on participants with neck pain. They reported that patients who performed 12-months of deep neck flexor exercises had less pain and a higher functional level, which was consistent with the current findings.

However, the drawback of this study is worth mentioning. one potential limitation of the current study is that it only evaluates the short-term impacts without considering the long-term effect of this technique.
Therefore, it would be beneficial to address it in future studies.

Conclusion

In CNSNP patients, both combined Kendell and Mckenzie cervical posture correction exercise and conventional therapy are effective at decreasing neck pain and enhancing cervical range of motion; however, the combined kendell and mckenzie exercise is superior and is therefore preferred method of treatment.

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Disclosure

No financial interest or benefit has been gained from this research.

Conflict of interest

No conflict of interest has been declared by the authors of the current research.

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