

## Cervical Stabilization Exercises Versus Scapular Stabilization Exercises in Treatment of Chronic Mechanical Neck Pain

HANAN S.S. EL-SAYED, M.Sc.; IBRAHIM M. ELNAGGAR, Ph.D. and  
MOHAMMED Sh. ABDELSALAM, Ph.D.

*The Department of Orthopedic Physical Therapy, Faculty of Physical Therapy, Cairo University*

### Abstract

**Background:** Mechanical neck pain is pain in the cervical region accompanied by restriction of range of motion and functional limitation which results in significant use of medication, work related absenteeism, impaired performance and poor quality of life. Spinal stabilization exercises are popular for treating and preventing musculoskeletal spinal disorders by the activation of deep muscles and controlling the over activity of surface muscles.

**Aim of Study:** The aim of this study was to compare between the efficacy of cervical stabilization exercises and scapular stabilization exercises on neck pain severity, neck functional disability and neck mobility in treatment of patients with chronic mechanical neck pain.

**Material and Methods:** Forty male and female patients diagnosed as chronic mechanical neck pain whose age ranged between 30 to 50 years with duration of illness between 3 and 12 months participated in this study. They were randomly distributed into two equal experimental groups.

The first group received cervical stabilization exercises which consisted of strengthening exercises for deep neck flexors and extensors muscles added to stretching exercises for pectoralis minor, upper trapezius and sternocleidomastoid muscles. The second group received scapular stabilization exercises which consisted of strengthening exercises for serratus anterior, middle trapezius and lower trapezius muscles added to stretching exercises similar to the first group. All patients were treated for 12 sessions (3 sessions/week) every other day for four weeks.

**Results:** Both groups had significant improvement in all the measured variables. Scapular stabilization exercises was significantly more effective than cervical stabilization exercises in increasing neck transverse mobility. However, there was no significant difference between groups in neck pain severity, functional disability, neck sagittal and coronal mobility.

**Key Words:** Mechanical neck pain – Cervical stabilization exercises – Scapular stabilization exercises – Functional disability – Neck mobility.

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**Correspondence to:** Dr. Hanan S.S. El-Sayed,  
The Department of Orthopedic Physical Therapy,  
Faculty of Physical Therapy, Cairo University

### Introduction

**NECK** pain is one of the most common musculoskeletal disorders in modern societies, it was estimated that about 67% of people had experienced neck pain at least once in their life [1,2]. Neck pain is more prevalent in middle and old age and can lead to severe disability in 5% of patients [3,4].

Chronic mechanical neck pain is defined as pain in the posterior and lateral aspect of the neck with no signs or symptoms of major structural pathology with the absence of neurological signs. Symptoms appear to be worsened during prolonged static muscle activity and repetitive job tasks with duration of symptoms longer than three months [5,6].

Several physical therapy interventions have been recommended for patients with neck pain. These interventions include range of motion exercises, stretching, strengthening and endurance exercises, aerobic training, dry needling, laser therapy, intermittent mechanical/manual traction, patient education and reassurance and manual therapy [7]. Exercise approaches especially spinal stabilization exercises have been popular for treating and preventing musculoskeletal spinal disorders by the activation of deep muscles and arranging the over-activity of surface muscles [8].

Cervical stabilization exercises aiming to train deep stabilizer muscles of the cervical spine and improve coordination between superficial and deep cervical muscles have been increasingly used in recent years [9]. Cervical stabilization exercises have been shown to reduce pain and disability by increasing the activation of deep neck flexor muscles [10].

Scapular muscles impairment has been associated with neck pain as the scapula is linked to the

neck anatomically and functionally [11,12]. It was found that using scapular stabilization exercises in treatment of patients with chronic mechanical neck pain had significant effect on neck pain, functional disability, neck posture, quality of life and cervical range of motion [13,14].

To our knowledge there are no previous studies that compared between the pure effect of cervical stabilization exercises versus scapular stabilization exercises in treatment of patients with chronic mechanical neck pain. Therefore the purpose of this current study was to compare between the effect of these two types of exercises in treatment of chronic mechanical neck pain.

### **Subjects and Methods**

This study was conducted in the outpatient clinic of the Faculty of Physical Therapy, Cairo University, Egypt From Dec. 2020 – April 2021. Forty male and female patients diagnosed as chronic mechanical neck pain participated in this study, their age ranged between 30 to 50 years with duration of illness ranged between 3 and 12 months. All patients were referred by orthopedic surgeons who diagnosed the cases based on the clinical and radiological examinations. Patients were randomly distributed into two equal treatment groups. All patients were treated for 12 sessions (3 sessions/week) every other day for four weeks.

The first group consisted of 20 patients, their mean age was 43.95 ( $\pm 6.51$ ) years, mean weight was 76.70 ( $\pm 17.83$ ) kg and mean height was 161 ( $\pm 7.65$ ) cm. The second group consisted of 20 patients, their mean age was 43.90 ( $\pm 5.57$ ) years, their mean weight was 82.88 ( $\pm 10.90$ ) kg and mean height was 161.70 ( $\pm 5.13$ ) cm.

Each patient was assessed pretreatment within 2-3 days before the first session and post treatment within 2-3 days after the last session by measuring neck pain severity, functional disability and neck mobility in the sagittal, coronal and transverse planes.

Neck pain severity was assessed using an 11-point numerical pain rating scale based on the work of Farrar et al. [15]. The patient was asked to choose only one number on this scale which consists of a 10cm line divided from 0 to 10 with 1cm interval. It was explained to patient that 0 means no pain at all and 10 means the worst imaginable pain. In this study the Arabic version of the numerical pain rating scale was used [16].

Neck functional disability was assessed by the neck disability index based on the work of Vernon

and Mior [17]. It consists of 10 sections, each section consists of 6 possible statements and each statement is scored from 0 (no disability) to 5 (total disability). The maximum possible score is 50. The patient was asked to answer each section by marking one choice that most applies to him. The Arabic version of the neck disability index was used in this study [18].

Neck mobility in the sagittal, coronal and transverse planes was measured by the Myrin (OB) goniometer (the version used was OB goniometer Myrin, Lic-Rehab, 17183 Solna, Sweden) based on the work of Mohamed and Shendy [19]. It consists of a fluid filled rotatable component container mounted on a plate. The container has a compass needle, an inclination needle and a scale on the container floor giving range of motion on tenth of degree. It is fixed to the appropriate part of the head with the compass needle measures motion in the transverse plane and the inclination needle measures motion in the coronal and sagittal planes [20].

Patients in the first group received cervical stabilization exercises which consisted of strengthening exercises for deep neck flexors and deep neck extensors based on the work of Petersen [21] and Durall [22]. Each strengthening exercise was held for 10 seconds and was repeated 10 times for 3 sets of repetitions. In addition to that they received stretching exercises for pectoralis minor, sternocleidomastoid and upper trapezius muscles based on the work of Borstad and Ludewig [23], Bodes-Pardo et al. [24] and Kisner et al. [25]. Stretching was held for 30 seconds followed by 30 seconds of relaxation. Each stretching exercise was given for 3 repetitions on each side for each muscle.

Patients in the second group received scapular stabilization exercises which consisted of strengthening exercises for serratus anterior, middle trapezius and lower trapezius muscles according to the work of Flynn et al. [26]. Each strengthening exercise was held for 10 seconds and was repeated for 10 times with 3 sets of repetitions on each side for each muscle. In addition to strengthening exercises they also received stretching exercises similar to the first group.

### **Results**

Pretreatment comparison between groups of the demographic data (age, weight and height) was done using the unpaired *t*-test showed that there was no significant difference between groups ( $p > 0.05$ ). Pretreatment comparison between groups of neck pain severity, functional disability and

neck sagittal, coronal, transverse mobility was done by using the unpaired *t*-test also showed no significant difference between groups ( $p>0.05$ ).

Post treatment within groups difference using the paired *t*-test showed that there was significant difference between the pretreatment means and the post treatment means of neck pain severity, functional disability and neck sagittal, coronal and transverse mobility within groups as shown in Tables (1,2).

Table (1): Within the first group (cervical stabilization exercises) difference.

Variables	Pretreatment Mean (±SD)	Post treatment Mean (±SD)	<i>t</i> -value	<i>p</i> -value
Pain severity	6.75 (±2.20)	3.05 (±1.67)	8.73	0.001*
Functional disability	0.38 (±0.16)	0.15 (±0.13)	6.08	0.001*
Sagittal mobility	53.42° (±5.24)°	57.48° (±6.77)°	3.38	0.003*
Coronal mobility	43.05° (±7.19)°	49.58° (±6.44)°	6.18	0.001*
Transverse mobility	66.12° (±7.25)°	72.33° (±8.14)°	5.39	0.001*

\*Significant difference.

Table (2): Within the second group (scapular stabilization exercises) difference.

Variables	Pretreatment Mean (±SD)	Post treatment Mean (±SD)	<i>t</i> -value	<i>p</i> -value
Pain severity	6.80 (±1.93)	3.70 (±1.65)	8.56	0.001*
Functional disability	0.37 (±0.15)	0.15 (±0.11)	9.01	0.001*
Sagittal mobility	56.42° (±4.70)°	61.26° (±5.60)°	5.51	0.001*
Coronal mobility	46.42° (±4.79)°	50.92° (±4.77)°	5.16	0.001*
Transverse mobility	71.33° (±9.68)°	79.73° (±10.59)°	5.29	0.001*

\*Significant difference.

Post treatment between groups difference using the unpaired *t*-test showed that there was no significant difference between the post treatment means of neck pain severity, functional disability and neck sagittal and coronal mobility. However, there was significant difference between the post treatment means of neck transverse mobility in favor of scapular stabilization exercises group as shown in Table (3).

Table (3): Post treatment between groups difference.

Variables	Cervical stabilization exercises group Mean (±SD)	Scapular stabilization exercises group Mean (±SD)	<i>t</i> -value	<i>p</i> -value
Pain severity	3.05 (±1.67)	3.70 (±1.65)	1.23	0.22
Functional disability	0.15 (±0.13)	0.15 (±0.11)	0.07	0.94
Sagittal mobility	57.48° (±6.77)°	61.26° (±5.60)°	1.92	0.06
Coronal mobility	49.58° (±6.44)°	50.92° (±4.77)°	0.74	0.46
Transverse mobility	72.33° (±8.14)°	79.73° (±10.59)°	2.47	0.02*

\*Significant difference.

## Discussion

Our results showed that scapular stabilization exercises was more effective than cervical stabilization exercises in increasing neck transverse mobility. However, both treatments are equally effective in reducing neck pain severity, functional disability and increasing neck sagittal and coronal mobility.

In our current study, there was a significant reduction in neck pain severity in patients treated with cervical stabilization exercises. This result is in agreement with Rajalaxmi et al. [27], Akodu et al. [28] and Ashfaq & Riaz [29].

There was also a significant reduction of neck pain severity in patients treated with scapular stabilization exercises. This findings is in agreement with Park & Lee [30], Chuachan et al. [31] and Ganu & Gor [32].

Reduction of neck pain through spinal stabilization exercises according to Kaka & Ogwumike [33] is due to increasing activity in the motor pathways which leads to inhibitory effect on pain centers in the brain. Stimulation of mechanoreceptors including muscle spindle, Golgi tendon organ and proprioceptors of the joints which cause release of endogenous opioids and endorphins from the pituitary gland may also cause both peripheral and central pain to be blocked [34-36].

According to Falla et al. [37] and Falla et al. [38] reduction of pain with cervical stabilization exercises is due to activation of deep cervical flexors which have more type II fibers than type I and have a high density of muscle spindles which affects posture and stability [39]. Scapular correction and decreasing compressive forces on the cervical facets after scapular stabilization exercises are believed to be the causes for reduction of pain in the scapular stabilization exercises group [40,41].

In our current study, there was a significant reduction of neck functional disability in patients treated with cervical stabilization exercises. This result is in agreement with the findings of Rajalaxmi et al. [27], Akodu et al. [28] and Suvarnnato et al. [42].

There was also a significant decrease in neck functional disability in patients treated with scapular stabilization exercises. This result coincides with the findings of Park & Lee [30], Chuachan et al. [31] and Ganu & Gor [32].

Iqbal et al. [43] reported that reduction of neck functional disability after cervical stabilization

exercises was due to reduction of neck pain intensity. The relationship between neck pain and neck disability is quite strong as pain intensity is one of the ten areas addressed in the neck disability index [44]. According to Suvarnnato et al. [42] improvement of strength of deep cervical flexors and deep cervical extensors resulted in reduction of neck pain and associated disability.

Park & Lee [30] and Chuachan et al. [31] reported that improvement of neck functional disability with scapular stabilization exercises is attributed to the increase of the strength of upper trapezius, serratus anterior and lower trapezius muscles which decreases the imbalance between the scapular muscles and improves these muscles length-tension. This helps to regain proper posture of neck and scapula and reduction of functional disability.

In our current study, there was a significant increase of sagittal, coronal and transverse neck mobility in patients treated with cervical stabilization exercises. This result is in agreement with the findings of Ammar [45], Yesil et al. [46] and Bhatikar et al. [47].

Inhibition of pain through increased muscle strength by cervical stabilization exercises targeting weakened deep neck muscles and the concomitant decrease in spasm of superficial muscles may have contributed to the achievement of these results. At the same time, a reduction in neck pain severity may have increased soft tissue flexibility, thereby increasing neck range of motion. The improvement in motor control through exercise may have also led to a reduction in over-straining and an improvement in the mobility of the neck [46].

There was also a significant increase in sagittal, coronal and transverse neck mobility in patients treated with scapular stabilization exercises. This result is similar to the findings of Ashwini et al. [14], Ganu & Gor [32] and Lee et al. [48].

According to Javdaneh et al. [49], scapular exercises focused on increasing activation of the upward rotation muscles of the scapula (serratus anterior, upper trapezius and lower trapezius muscles). Improving the function and strength of the weak muscles and the balance between the scapular upward and downward rotator muscles can improve scapular alignment. This leads to a reduction of pain and it is likely that this reduction in pain will release the muscles from tension and allow the cervical spine to move more.

We attribute our findings as scapular stabilization exercises were more effective than cervical

stabilization exercises in improving neck transverse mobility due to combination of upper trapezius stretching and strengthening of middle trapezius, lower trapezius and serratus anterior muscles. The upper trapezius and levator scapula muscles act together to elevate the scapula and levator scapula acts on cervical spine to induce rotation. Improvement of upper trapezius muscle tension and scapular muscles strength may lead to reduction of levator scapulae muscle spasm and increase its flexibility which consequently leads to increase in neck transverse mobility due to its anatomical link between the cervical spine and the scapula.

According to Helgadottir et al. [50], the mechanism of increase in the rotation range of motion induced by scapular stabilization exercises could be attributed to the effect of these exercises which normalize the activity of the levator scapulae and trapezius muscles, thereby reducing the abnormal load on the posterior neck structures. Any alteration in the scapular position causes increased tension on the cervicoscapular muscles i.e. upper trapezius and the levator scapulae muscles which can limit the cervical rotation range of motion [51].

#### *Conclusion:*

The use of cervical stabilization exercises or scapular stabilization exercises is effective method for treatment of chronic mechanical neck pain patients between 30-50 years. Any of these two exercise programs can be used to reduce neck pain severity and functional disability as well as increase neck sagittal, coronal and transverse mobility. However, scapular stabilization exercises is more effective in increasing neck transverse mobility.

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## تمارين التثبيت العنقى مقابل تمارين تثبيت لوح الكتف فى علاج ألم الرقبة الميكانيكى المزمن

الخلفية: ألم الرقبة الميكانيكى هو ألم فى الجانب الخلفى والجانبى للرقبة بين الخط الخلفى العلوى وشوكة الفقرة الصدرية الأولى مع عدم وجود علامات أو أعراض لأمراض بنيوية رئيسية، وقد ثبت أن تمارين التثبيت العنقى تقلل الألم والعجز مع مرضى ألم الرقبة الميكانيكية المزمنة عن طريق زيادة تنشيط عضلات الرقبة العميقة، كما توفر تمارين تثبيت لوح الكتف القدرة على الحركة ومكاسب وظيفية للمرضى الذين يعانون من ألم الرقبة الميكانيكية المزمنة.

الهدف من البحث: الهدف من هذه الدراسة هو مقارنة تأثير تمارين التثبيت العنقى مقابل تأثير تمارين تثبيت لوح الكتف على شدة ألم الرقبة والإعاقة الوظيفية والمدى الحركى للرقبة لمرضى ألم الرقبة الميكانيكى المزمن.

الطرق المستخدمة: شارك فى الدراسة أربعون مريضاً من الذكور والإناث تتراوح أعمارهم من ٣٠ إلى ٥٠ عاماً، تم تقسيم المرضى إلى مجموعتين علاجيتين. المجموعة الأولى تم علاجهم بتمارين تقوية عضلات الرقبة الأمامية العميقة وعضلات الرقبة الخلفية العميقة. المجموعة الثانية تم علاجهم بتمارين تقوية العضلة المنشارية الأمامية والعضلة شبه المنحرفة الوسطى والسفلى.

بالإضافة إلى أن كلا المجموعتين تلقت تمارين الإستطالة للعضلة الصدرية الصغرى، العضلة القصية الترقوية الخشائية والعضلة شبه المنحرفة العلوية. تم علاج جميع المرضى فى المجموعتين لمدة ١٢ جلسة بواقع ٣ جلسات أسبوعياً على مدار ٤ أسابيع.

النتائج: أظهرت النتائج الإحصائية الخاصة بكل مجموعة إنخفاضاً ملحوظاً فى شدة ألم الرقبة، الإعاقة الوظيفية وزيادة ملحوظة فى المرونة السهمية والتاجية والعرضية للرقبة. بينما أظهر التحليل الإحصائى بين المجموعتين أن تمارين تثبيت لوح الكتف كانت أفضل من تمارين التثبيت العنقى فى زيادة المرونة العرضية للرقبة. ومع ذلك، لم يكن هناك فرقاً ملحوظاً بين كلا المجموعتين فيما يتعلق بشدة ألم الرقبة والإعاقة الوظيفية ومرونة الرقبة السهمية والتاجية.