

## EFFECT OF SUSTAINED NATURAL APOPHYSEAL GLIDES VERSUS KINESIOTAPE ON NON SPECIFIC NECK PAIN

ALSHAFEI, M.E, KAMEL, R.M. and AHMED, S.B.

Faculty of Physical Therapy, Cairo University, Egypt.

*Key words: Infrared Radiation, Sustained Natural Apophyseal Glides, Kinesiotape, Non Specific Neck Pain, Active Range of Motion, Visual Analogue Scale, Isometric Exercises.*

تأثير التحريك الطبيعي المستمر للمفاصل المسطحة مقابل الشريط الكينيسيو  
اللاصق على ألم الرقبة غير محدد السبب

محمد عيسى الشافعي وراجية محمد كامل وصلاح الدين باسط أحمد

### خلاصة

**الخلفية:** يعتبر ألم الرقبة غير محدد السبب هو ألم الرقبة مع عدم وجود مرض دقيق معين يجري تحديدها. وتتميز بأنها الألم الميكانيكي الذي يقع بين مؤخر الرأس والفقرة الصدرية الثالثة وتضم العضلات مع عدم وجود مسببات معينة. يعتبر التحريك الطبيعي المستمر للمفاصل المسطحة بأنه ينطوي على الانزلاق السلبي التبعي للقرات العنقية بينما في نفس الوقت يتحرك المريض حركة نشطة. شريط الكينيسيو هو شريط لاصق يتكون من ١٠٠٪ ألياف قطن التي توفر الدعم والحماية للانسجة الرخوة والمفاصل لتقليل التورم والألم بعد الإصابة ، مما يؤدي إلى تحسين الدورة الدموية والسوائل للمفاوية في منطقة الشريط. كلاهما يعمل على تقليل الألم وزيادة مدى الحركة وتحسين الأنشطة اليومية. **الغرض من الدراسة:** مقارنة تأثير التحريك الطبيعي المستمر للمفاصل المسطحة مقابل الشريط الكينيسيو اللاصق على ألم الرقبة غير محدد السبب. **الدراسة:** تم اختيار ٣٠ مريض يعانون من ألم الرقبة غير محدد السبب تتراوح أعمارهم ما بين ١٩ - ٣٢ عام. تم تقسيمهم عشوائيا الي مجموعتين المجموعة الأولى التحريك الطبيعي المستمر للمفاصل المسطحة والأشعة تحت الحمراء والتمارين الساكنة لعضلات الرقبة، والمتوسط  $\pm$  الانحراف المعياري للعمر (٢٦.٩٣  $\pm$  ٣) سنوات و للوزن (٧٠.٨  $\pm$  ٣.٢) كجم وللطول (١٦٩.٨٧  $\pm$  ٣.٢) سم

ولمؤشر كتلة الجسم ( $24.46 \pm 0.45$ ) كجم/م<sup>2</sup> والمجموعة الثانية شريط الكينيسيو اللاصق والأشعة تحت الحمراء والتمارين الساكنة لعضلات الرقبة والمتوسط  $\pm$  الانحراف المعياري للعمر ( $27.4 \pm 2.72$ ) سنوات وللوزن ( $72.33 \pm 2$ ) كجم وللطول ( $170.6 \pm 2.5$ ) سم ولمؤشر الكتلة بالجسم ( $25 \pm 0.52$ ) كجم/م<sup>2</sup> وكانت مدة العلاج مرتين أسبوعياً لمدة 6 أسابيع. الوسائل والأدوات: تم استخدام المقياس الوصفي البصري للألم لقياس مستوى الألم واستخدام جهاز قياس المدى الحركي لقياس المدى الحركي قبل وبعد العلاج. النتائج: تغير ذو دلالة إحصائية علي زياده المدى الحركي ونقص مستوى الألم. الخلاصة: ليس هناك اختلاف بين التحريك الطبيعي المستمر للمفاصل المسطحة و الشريط الكينيسيو اللاصق في التغير في المدى الحركي ونقص مستوى الألم ولكن نسبة التحسن للتحريك الطبيعي المستمر للمفاصل المسطحة أفضل من الشريط الكينيسيو اللاصق عند علاج ألم الرقبة غير محدد السبب.

**الكلمات الدالة:** الأشعة تحت الحمراء- التحريك الطبيعي المستمر للمفاصل المسطحة - الشريط الكينيسيو اللاصق - ألم الرقبة غير محدد السبب - المدى الحركي - المقياس الوصفي البصري للألم - التمارين الساكنة.

### ABSTRACT

*Background: nonspecific neck pain is neck pain with no particular precise illness being identified. It is characterized as mechanical pain that located between the occiput and the 3rd thoracic vertebra and encompassing muscles with no particular etiology. Sustained natural apophyseal glides described as involving the application of an accessory passive glide to the cervical vertebrae while the patient simultaneously performs an active movement. Kinesiotape is an adhesive tape (100%) cotton fibers which provide support and protection to soft tissues and joints, to decrease swelling and pain after injury, prompting improvement of blood circulation and lymphatic fluids drainage in the taped area. Both decrease pain, increase active range of motion and improve activities of daily living. Purpose of the study: This study was conducted to compare effect of sustained natural apophyseal glides and kinesiotape in patients with nonspecific neck pain. Design of the Study: Thirty patients with nonspecific neck pain ages between 19-32 years old. They were divided randomly into two equal groups. Group A received sustained natural apophyseal glides, infrared radiation and isometric exercises for neck muscles and their mean  $\pm$  SD; age was ( $26.93 \pm 3$ ) years, weight was ( $70.8 \pm 3.2$ ) kg, height was ( $169.87 \pm 3.2$ ) cm, and body mass index was ( $24.46 \pm 0.45$ ) kg/m<sup>2</sup>. Group B received kinesiotape infrared radiation and isometric exercises for neck muscles and their mean  $\pm$  sd; age was ( $27.4 \pm 2.72$ ) years, weight was ( $72.33 \pm 2$ ) kg, height was ( $170.6 \pm 2.5$ ) cm, and body mass index was*

*(25 ± 0.52) kg/m<sup>2</sup> and the period of the treatment was twice per week for 6 weeks. Method: Visual analogue scale was used to measure the pain intensity level and the inclinometer was used to measure active range of motion the cervical spine. Results: There was a high significant decrease in pain level in Group A and Group B (p<0.0001). There was a high significant improvement in cervical active range of motion in both groups A and B. In Group A and Group B; flexion, extension, lateral flexion and rotation probabilities' values were p<0.0001. Conclusion: There was no significant difference between the sustained natural apophyseal glides and kinesiotape for the patients with nonspecific neck pain in increasing cervical active range of motion and pain relief after treatment, but the sustained natural apophyseal glides has more percent of improvement than the kinesiotape in nonspecific neck pain.*

## **INTRODUCTION**

Neck pain is the fourth leading cause of disability, limits and restricts the person to take part actively in Activities of Daily Living (ADL), with an annual prevalence rate exceeding 30 % (Cohen, 2015). Non Specific Neck Pain (NSNP) is neck pain with no particular precise illness being identified as the hidden reason for the objections and without any specific systematic disease being detected. It is characterized as mechanical pain that located between the occiput and the 3rd thoracic vertebra and encompassing muscles with no particular etiology (Diab et al., 2016).

The Mulligan concept is now an integral component of many manual physiotherapists' clinical practice. It encompasses a number of mobilizing treatment techniques that can be applied to the spine; these include Natural Apophyseal Glides (NAGs), Sustained Natural Apophyseal Glides (SNAGs), and Mobilization with Movement (MWM) for the extremities (Exelby, 2002). Sustained natural apophyseal glides described as involving the application of an accessory passive glide to the cervical vertebrae while the patient simultaneously performs an active movement. The direction of the glide is argued to be along the plane of the facet joints and the technique is performed in a weight-bearing position (i.e. sitting, standing). Among the SNAGs basic principles of clinical management is an immediate reduction or cessation of pain and an increase in Active Range of Motion (AROM) (Kazmi et al., 2012).

Kinesiotape (KT) is a therapeutic modality that corrects and treats many musculoskeletal disorders which is based on natural healing process. Kenzo Kase, the creator of KT, proposed the following mechanisms for the effects of KT: Altered muscle function by the tapes effects on weakened muscles, improved circulation of blood and lymph by eliminating tissue fluid or bleeding beneath the skin, decreased pain through neurological suppression, repositioning of subluxed joints by relieving abnormal muscle tension, and helping to affect the function of

fascia and muscle. Kinesiotape can restore muscle function and assist the postural alignment (Ali et al., 2015).

**Aim of the work:**

**Purpose of the study:**

This study was conducted to compare effect of sustained natural apophyseal glides and kinesiotape in patients with nonspecific neck pain.

**MATERIALS AND METHODS**

The study was conducted on 30 patients with nonspecific neck pain in belgas central hospital from April 2017 to June 2017; their age ranged from (19-32) years old, their height ranged from (154-198) cm, their weight ranged from (53-95) kg and their BMI ranged from (20.95-27.89) kg/m<sup>2</sup>. They were divided randomly into two equal groups (A & B). In this study; the independent variables were sustained natural apophyseal glides and kinesiotape. The dependent variables were pain and AROM of cervical spine.

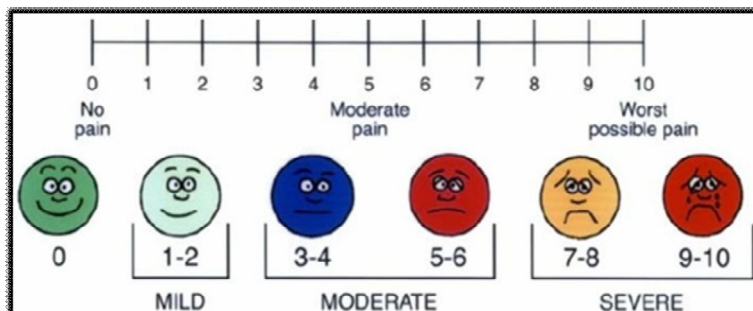
**Group A:** included fifteen patients (8 females, 7 males) had received infrared radiation and isometric exercises for neck flexors, extensors and lateral flexors in addition to sustained natural apophyseal glides for (2 times/week) for 6 weeks.

**Group B:** included fifteen patients (7 females, 8 males) had received infrared radiation isometric exercises for neck flexors, extensors and lateral flexors in addition to kinesiotape for (2 times/week) for 6 weeks.

**Procedures for assessment and treatment:**

**A. Visual Analogue Scale for pain (VAS):**

A Visual Analogue Scale is a measurement instrument that measures a characteristic that is believed to range across a continuum of values and cannot easily be directly measured. Operationally a VAS is usually a horizontal line, 100 mm in length, anchored by word descriptors at each end. The patient marks on the line the point that they feel represents their perception of their current state (Gould et al., 2001).

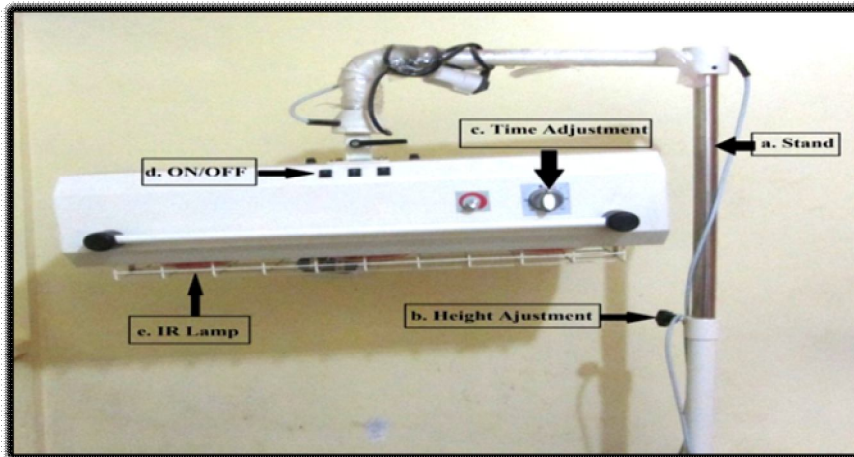


**B. The Inclinometer:**

An inclinometer, instrument that is used to measure spinal motion, is a hand-held, circular, with a weighted gravity pendulum indicator that remains oriented in the vertical direction. Cervical spine mobility is measured with the inclinometer device. The inclinometer is an instrument that assesses the active range of motion of the cervical segment. It is reliable method of measuring. The therapist measured while the patient was sitting with their back against a chair. The inclinometer was placed over his head. The therapist instructed the patient to stop at the point where pain symptoms began, or, otherwise, to continue to the fullest extent of their mobility. Each movement was recorded three times and the average was taken. The inclinometer has a good validity and reliability for all cervical spine movements (ICCs =0.91-0.93) (De Koning et al., 2008).

**c. INFRA-RED RADIATOR (IRR):**

IRR device used in the study was 1979902 IRR 3 INFRA-RED RADIATOR, from ENRAF-NONIUS, the Netherlands. Effective wavelengths of this therapy include 700 nm to 1400 nm. The whole range of wavelengths has the same healing and therapeutic effect, the big difference is the longer the wavelength, the deeper it penetrates into the body, the longer wavelengths of near infrared are more beneficial. 850 nm and 980 nm are common.



### **Treatment procedures:**

#### **For group (A&B):**

- 1- The Patient received Infrared Radiation (IRR) and each session for 15 min, for 2 days per week for 6 weeks.
- 2- Isometric Exercises for neck flexors, extensors and lateral flexors. For neck flexion; patient was sitting in a relaxed position with good back support. The therapist was standing behind the patient with one hand stabilizing the patient's shoulder and the other hand on the forehead of the patient to apply maximum resistance. The therapist instructed the patient to try to flex his head against the resistance applied by the hand. The same steps for extension; the hand on the back of the head and the patient extended his neck against maximum resistance from the hand. The same steps for lateral flexion; one hand was stabilizing the patient's one shoulder and the other hand placed on the other side of the patient's head to apply maximum resistance against maximum lateral flexion. Hold for 6 seconds, and then relax for 6 seconds. These procedures were repeated five times.

#### **Group A: Sustained Natural Apophyseal Glides:**

A manual force according to the therapist's clinical judgment was applied and sustained during AROM in a direction argued to be parallel to the cervical facet joints. This was applied by direct palpation via the ulnar border of the hand on the relevant spinous process in the manner described by Mulligan. Each SNAG was sustained for a few seconds at the end of ROM. Application of SNAGs was for (6-10) repetitions for 3 sets that lasted up to (10 to 15) minutes. Treatment was given 2 times a week for total of 6 weeks (El-Sodany et al., 2014). As follow:

**1- Cervical SNAGs Flexion:** The therapist was standing behind the patient while the patient was seated in a supportive low back chair, thus the cervical was

in a vertical position. The therapist used the medial border of one thumb's distal phalanx reinforced by the pad of the other thumb to apply an antero-superior accessory glide through the superior spinous process or articular pillar of the involved motion segment (i.e. the vertebra above the suspected site of the problem). The thumb nail would slope at approximately 45 degrees. The other fingers are comfortably placed laterally on each side of the neck to give some lift and prevent the neck from flexing. Then The therapist moved the spinous process up in the direction that must follow the plane described by the surfaces of the apophyseal joints under treatment. As the patient flexes his neck you push up along the treatment plane. In full flexion the treatment plane was nearly horizontal and this directional change must be remembered or the mobilization was ineffective and probably painful. Several repetitions should bring results (Mulligan, 2010).

**2- Cervical SNAGs Extension:** the same position of the patient and the same grasp of the therapist. The therapist maintained this glide until the neck returned to the neutral position. When the neck moved into extension the facet joints now lied vertically. Allowances for this facet directional change must be made to ensure that the therapist still glided up in the direction of the treatment plane (Mulligan, 2010).

**3- Cervical SNAGs side bending;** the same position of the patient and the same grasp of the therapist. The therapist tilted the hands with it to ensure that as the therapist pushed up, the upper facets moved correctly. The patient applied side flexion overpressure with a hand pushing the head over and sustained this end range position for 2 seconds (Mulligan, 2010).

**4- Cervical SNAGs Rotation;** The therapist was standing behind the patient. The medial border of one thumb's distal phalanx was placed on the end of the spinous process of the vertebra above the suspected site of the lesion. The thumb nail would be slope at approximately 45, in the direction of the eyeball. The other thumb reinforced this. The other fingers are comfortably placed laterally on the mandible or just below. The therapist moved the spinous process up the direction of the treatment plane towards the eyeball. The patient applied overpressure by using one of his hands to push the head further round and sustain this position for 2 seconds (Mulligan, 2010).

**Group B: Kinesiotape:**

The tape was worn on the skin 2 times per week for 6 weeks. Two strips (I and Y) of the tape were used; "Y" strip started from thoracic vertebrae (3-5) to occiput of the skull (hair line), and "I" strip was put at middle of the neck horizontally. The therapist asked the patient to put his head in neutral position then the base of "Y" strip was applied over the spinous process of T3-5 then patient was asked to flex his head then the remaining of "Y" strip were applied para-spinal up to the hair line with no tension on the ends of the tape. Patient was asked to return his head to neutral position then the middle paper packing of "I" strip was torn and

tension was applied on the middle, adhesive of the tape at middle of the neck horizontally then the tension was released at the ends (Ali et al., 2015).

## RESULTS

The mean age of group A was matching the group B without statistically significant difference ( $26.93 \pm 3$  years and  $27.4 \pm 2.72$  years, respectively) ( $p > 0.05$ ). The mean BMI was  $24.46 \pm 0.45$  and  $25 \pm 0.52$  kg/m<sup>2</sup> in the group A and the B, respectively. There were statistically no significant differences between both groups regarding all anthropometric measures ( $p > 0.05$ ).

### 1-Visual analogue scale (VAS) for pain in both groups:

A table (1) shows the pre and post treatment visual analogue scale (VAS) for pain in both groups. There were statistically significant lower mean values of VAS for pain in post-test in comparison to pre-test in both groups ( $p < 0.0001$ ), however, the mean decrease in post-test VAS for pain was higher in group A than in group B. Also, the decrease percent was higher in group A compared to group B (-63.92% versus -51.9% respectively). There was non significant difference between the sustained natural apophyseal glides and kinesiotape for the patients with nonspecific neck pain in pain relief.

*Table (1): Comparison between mean values of VAS of group A and B:*

Variables	Pre treatment	Post treatment
<b>Group A (n=15)</b>		
Mean $\pm$ SD	7.4 $\pm$ 1	2.67 $\pm$ 0.98
Range	6-9	0-4
t test		17.75
P Value		0.0001
Change %		-63.92%
<b>Group B (n=15)</b>		
Mean $\pm$ SD	6.8 $\pm$ 1.26	3.27 $\pm$ 1.58
Range	5-9	1-6
t test		12.2
P Value		0.0001
Change %		- 51.9%



## 2- The Inclinator (Cervical AROM)

### Flexion and Extension:

A table (2) shows the pre and post treatment inclinometer for flexion and extension cervical AROM in both groups. There were statistically significant higher mean values of cervical Flexion and extension AROM in post-test in comparison to pre-test in both groups ( $p < 0.0001$ ), however, the mean improvement in post-test flexion and extension cervical AROM was higher in group A than in group B. Also, the improvement rate was higher in group A compared to group B Flexion (38.36% versus 24.27%, respectively) and extension (93% versus 57.1%, respectively). There was no significant difference between the sustained natural apophyseal glides and kinesiotope for the patients with nonspecific neck pain in increasing flexion and extension AROM.

*Table (2): Comparison between mean values of Flexion and Extension AROM of Both Groups A and B.*

Variables	Flexion		Extension	
	Pre treatment	Post treatment	Pre treatment	Post treatment
<b>Group A (n=15)</b>				
Mean $\pm$ SD	52.27 $\pm$ 7.88	72.32 $\pm$ 6.37	53.67 $\pm$ 9.64	67.6 $\pm$ 2.82
Range	40-70	60-80	30-65	60-70
t test		-17.54		-6.19
P Value		0.0001		0.0001
Improvement %		38.36%		25.95%
<b>Group B (n=15)</b>				
Mean $\pm$ SD	55.47 $\pm$ 6.98	68.93 $\pm$ 4.57	47.93 $\pm$ 10.18	59.93 $\pm$ 7.37
Range	45-70	63-78	20-60	42-70
t test		-13.34		-11.32
P Value		0.0001		0.0001
Improvement %		24.27%		25%

### Right and Left lateral flexion AROM:

Table (3) shows the pre and post treatment inclinometer for cervical Right and Left lateral flexion AROM in both groups. There were statistically significant higher mean values of cervical Right and Left lateral flexion AROM in post-test in comparison to pre-test in both groups ( $p < 0.0001$ ), however, the mean

improvement in post-test cervical Right and Left lateral flexion AROM was higher in group A than in group B. Also, the improvement rate was higher in group A compared to group B Right (31.36% versus 22.86%, respectively) and Left (23.88% versus 21.47%, respectively). There was non-significant difference between the sustained natural apophyseal glides and kinesiotape for the patients with nonspecific neck pain in increasing right and left lateral flexion AROM.

**Table (3): Comparison between mean values of Right and Left Lateral Flexion AROM of Both Groups A and B.**

Variables	Right lateral flexion		Left lateral flexion	
	Pre treatment	Post treatment	Pre treatment	Post treatment
<b>Group A (n=15)</b>				
Mean $\pm$ SD	32.33 $\pm$ 3.96	42.47 $\pm$ 2.47	34.93 $\pm$ 3.73	43.27 $\pm$ 1.83
Range	28-40	38-45	30-40	40-45
t test		-12.6		-10.7
P Value		0.0001		0.0001
Improvement %		31.36%		23.88%
<b>Group B (n=15)</b>				
Mean $\pm$ SD	30.93 $\pm$ 5	38 $\pm$ 2.99	34.47 $\pm$ 3.44	41.87 $\pm$ 2.2
Range	20-40	34-43	30-40	38-45
t test		-6		-9.1
P Value		0.0001		0.0001
Improvement %		22.86%		21.47%

#### **Right and Left Rotation AROM:**

Table (4) shows the pre and post treatment inclinometer for cervical Right and Left Rotation AROM in both groups. There were statistically significant higher mean values of cervical Right and Left Rotation AROM in post-test in comparison to pre-test in both groups ( $p < 0.0001$ ), however, the mean improvement in post-test cervical Right and Left Rotation AROM was higher in group A than in group B. Also, the improvement rate was higher in group A compared to group B Right (27% versus 23%, respectively) and Left (29.27% versus 26.34%, respectively). There was non significant difference between the sustained natural apophyseal glides and kinesiotape for the patients with nonspecific neck pain in increasing right and left rotation AROM.

**Table (4): Comparison between mean values of Right and Left Rotation AROM of Both Groups A and B.**

Variables	Right Rotation		Left Rotation	
	Pre treatment	Post treatment	Pre treatment	Post treatment
<b>Group A (n=15)</b>				
Mean $\pm$ SD	63.67 $\pm$ 7.83	80.87 $\pm$ 7.46	62.87 $\pm$ 6.85	81.27 $\pm$ 4.89
Range	40-70	67-90	50-72	72-90
t test		-9.6		-9.56
P Value		0.0001		0.0001
Improvement %		27%		29.27%
<b>Group B (n=15)</b>				
Mean $\pm$ SD	62.13 $\pm$ 4.84	76.47 $\pm$ 4.6	62 $\pm$ 5.98	78.33 $\pm$ 3.15
Range	55-70	70-84	54-75	74-85
t test		-19.34		-14.87
P Value		0.0001		0.0001
Improvement %		23%		26.34%

## DISCUSSION

The results of this study suggested that there was a highly significant difference of Visual analogue scale and the inclinometer for cervical AROM assessment after applying the sustained natural apophyseal glides and kinesiotape on nonspecific neck pain patients.

This supported with Gautam et al. (2014) who compared the effect of Maitland and mulligan mobilization in improving neck pain for the treatment of NSNP on 30 patients (Group A was the control group and received conventional physiotherapy, Group B received conventional therapy plus Maitland grade 2 oscillatory movements and Group C received conventional therapy plus mulligan mobilization). It is showed that Mulligan mobilization is more effective than Maitland mobilization in improving pain.

This agrees with the results of El-Sodany et al. (2014) who compared the effects between SNAGs mobilization and manipulation in the treatment of patients with cervical spine disorders on 49 patients (SNAGs group, manipulation group, and exercise group) to improve AROM. It is showed that Both SNAGs mobilization and manipulation were effective in the treatment of cervical spine

disorders, where no one was superior to the other as they yielded approximately the same results. In addition, the combination of mobilization or manipulation with exercise therapy produced greater increase in cervical AROM, which in turn caused an improvement of function in patients with chronic cervical disorders both after treatment and at short-term follow up.

Our results agreed with Ali et al. (2015) who investigated the effect of combined kinesiotape with therapeutic exercises on 45 mechanical neck dysfunction patients. It is approved that combined kinesiotape with therapeutic exercises proved to be beneficial and had a superior effect in improving neck pain, head posture and decreasing the limitation of function more than therapeutic exercises only in patients with mechanical neck dysfunction.

In agreement with the concept of this study Saavedra-Hernandez et al. (2012) compared the effectiveness of cervical spine thrust manipulation to that of kinesiotape applied on 80 mechanical neck pain patients (manipulation group and kinesiotape group). It is suggested that Patients with mechanical neck pain who received cervical thrust manipulation or kinesiotape exhibited similar changes in cervical active range of motion, except for rotation. Additionally, patients in both groups experienced similar improvements in cervical flexion, extension, and lateral flexion in both directions. However, individuals who received the cervical thrust manipulation exhibited a greater increase in cervical rotation range of motion than those treated with kinesiotape.

## CONCLUSION

There is no significant difference between the sustained natural apophyseal glides and kinesiotape for the patients with nonspecific neck pain in increasing cervical AROM and pain relief after treatment, but the sustained natural apophyseal glides has more percent of improvement than the kinesiotape in nonspecific neck pain.

## REFERENCES

- Ali, M., El-Wardany, S. and Alduraibi, S. (2015): Effect of Kinesio Taping in Patients with Mechanical Neck Dysfunction. *Med. J. Cairo Univ*; 83(1): 867-873 (2015).
- Cohen, S. Epidemiology, diagnosis, and treatment of neck pain. *Mayo Clin Proc*; 90(2): 284-299 (2015).
- De Koning, C., Van den Heuvel, S., Staal, J., Smits-Engelsman, B. and Hendriks, E., Clinimetric evaluation of active range of motion measures in patients with non-specific neck pain: a systematic review. *Eur Spine J*; 17(7): 905-921 (2008).
- Diab, R., Hamed, R. and Mustafa, I., Efficacy of Mckenzie Protocol on Non-Specific Neck Pain. *Int J Physiother Res*; 4(5): 1631-1638 (2016).
- El-Sodany, A., Alayat, M. and Zafer, A., Sustained natural apophyseal glides

- mobilization versus manipulation in the treatment of cervical spine disorders: a randomized controlled trial. *Int. J. Adv. Res.*; 2(6): 274-280 (2014).
- Exelby, L., The Mulligan concept: Its application in the management of spinal conditions. *Man Ther*; 7(2): 64-70 (2002).
- Gautam, R., Dhamija, J., Puri, A., Trivedi, P., Sathiyavani, D., Nambi, G. and Elshafey, M., Comparison of Maitland And Mulligan Mobilization In Improving Neck Pain, ROM and Disability. *Int J Physiother Res*; 2(3):561-566 (2014).
- Gould, D., Kelly, D., Goldstone, L. and Gammon, J., Examining the validity of pressure ulcer risk assessment scales: developing and using illustrated patient simulations to collect the data information point: Visual Analogue Scale. *J Clin Nurs*; 10(5): 697-706 (2001).
- Kazmi, S., Iqbal, S., Rafi, M. and Hamidi, K., Immediate Effects of Spinal Manipulation Compared to Mulligan Sustained Natural Apophyseal Glide Mobilization Technique in Cervical Pain. *Pak J Rehabil*; 1(2): 1-8 (2012).
- Mulligan, B., *Mulligan Concept: Manual Therapy NAGS, SNAGS, MWMS etc.* (6<sup>th</sup> ed). Plane View Services Ltd, distributed by OTP. New Zealand. (pp. 10-13) (2010).
- Saavedra-Hernandez, M., Castro-Sanchez, A., Arroyo-Morales, M., Cleland, J., Lara-Palomo, I. and Fernandez-De-Las-Penas, C., Short-term effects of kinesio taping versus cervical thrust manipulation in patients with mechanical neck pain: a randomized clinical trial. *J. Orthop. Sports Phys Ther*; 42(8): 724-730 (2012).