Effect of Neurodynamic Mobilization on Chronic Discogenic Sciatica

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ABSTRACT

Sciatica is a term refers to a burning, tingling, and/or numbing pain that is felt in the buttock, thigh, leg, and/or foot. It may or may not be associated with low back pain. This study was designed to determine the influence of neurodynamic mobilization of sciatic nerve on chronic discogenic sciatica. Ten patients diagnosed as unilateral sciatica results from lumbar (L5-Sl) disc prolapsed (bulge or protrusion) were recruited for the study. Each patient was subject to complete physical and clinical examination. The patients received traditional physical therapy program which consists of electrotherapy and exercises and neurodynamic techniques session per week for one month. Three dependant variables (pain, straight leg raising and H-reflex) were conducted before, immediately after and after one month from the beginning of the study. The results of this study showed that there was a highly statistically significant difference in the mean values of Soleus H- Reflex between sound (mean ± sd) (6.12 ± 1.41), affected pre (3.06 ± 0.93) and affected post (4.84 ± 1.33). Also in the mean values of straight leg raising between affected pre (23 ± 5.37) and affected post (47.5 ± 8.89) and in the mean values of the visual analogue scale (at the level of P = 0.0001), between affected pre (7 ± 1.05) and affected post (4.6 ± 1.17). It can be concluded that neurodynamic mobilization has the effect of improving patient's symptoms.

INTRODUTION

Sciatica is a term refers to a burning, tingling, and/or numbing pain that is felt in the buttock, thigh, leg, and/or foot. It may or may not be associated with low back pain. It has been known for years and is generally accepted that a compressive lumbar disc hemiation is a common cause of sciatica, and the patient's symptoms usually depend upon which spinal nerve root is involved[11].

In primary disc-related problems, radicular pain can come from different sources when a slump test or SLR test is performed. Compression of an inflamed root will cause radicular pain[1,21]. In patients, with lumbar disc protrusion, not only is the nerve root compressed by the disc, but this compression will also cause a simultaneous increase in tension within the root. This increased tension occurs because the nerve root is fixed both at its exit from the cal sac as well as at its exit through the intervertebral foramen[4,9].

One of the few studies documenting the pain-provoking effect of tension was performed by Smyth and Wright[23]. In this study symptoms of root pain were provoked after nylon threads were looped around the affected roots during disc surgery and a slight pull was exerted. Tension causes a decrease in blood flow, both arterial and venous, as well as a decrease in the nutritional transport of cerebrospinal fluid. This local ischemia causes a local chemical reaction at the nerve root, leading to inflammation[8].

Clinical investigations determined that abnormal H-reflex complex present in patients with S1 nerve root compression H-reflex responses were recorded bilaterally from the gastrosoleous muscle following stimulation of tibial sensory fibers in the popliteal fossa. H-

reflex amplitude in mill volts (HRA) and H-reflex latency in milliseconds (HR-L) were measured from the spinal reflex response. Pre- and post-manipulation measurements were compared between the affected side and the healthy side[5,7].

Clinical Neurodynamics is an extension of two manual therapy approaches (adverse neural tension and neural mobilization). Neural tension was derived from the notion that patients who demonstrated positive neural tension tests were treated on the basis that their nervous system was tight and needed stretching[2]. Neural mobilization relied on mobilizing neural structures when they were at fault. Clinically, nerves are still being mobilized in isolation when no attention is paid to how the body really moves, by integrating both the musculoskeletal and nervous systems harmoniously. The clinical neurodynamic approach takes the subject of integrated function of both these systems[3].

Neural mobilization can be used as another form of manual therapy similar to joint mobilization. The treatment of signs and symptoms based on the severity, irritability, and nature of the impairment must be kept in mind at all times. The danger in presenting this material outside the context of the entire art and science of neural mobilization is that it be seen as a technique rather than a comprehensive system involving clinical reasoning, problem solving, and a thorough understanding of the anatomy, physiology, and pathophysiology of neurobiological structures. Contraindications include irritable conditions, inflammation, spinal cord signs, malignancy, nerve root compression and peripheral neuropathy[2].

Sciatica cause significant disability. The annual costs are estimated to be as high as € 1, 18 billion. Direct medical expenses account for a relatively small part of the total costs of sciatica. The indirect expenses caused by long periods of disability and loss of productivity account for the larger part of the annual costs. Conservative therapy has not demonstrated unequivocal effectiveness for managing this disabling condition[25]. It is hoped that this study will improve the conservative treatment for sciatica and will decrease the cost of treatment and disability of the patient.

The nervous system as a whole is a mechanically and physiologically continuous structure from the brain to the distal ends of the peripheral nerves. This means that mechanical or physiological changes anywhere in the CNS can have an impact on the entire nervous system. This concept of mechanical and physiological continuity is applicable between the CNS and Peripheral Nervous System (PNS), and must be taken into account when assessing patients with pain[19].

Neural Tissue Provocation Test (NTPT) is used to evaluate the mobility and sensitivity of the nervous system. The NTPT are: Straight Leg Raise (SLR), Passive Knee Bend (PKB), Slump Test, and Upper Limb Tension Test (ULTT). These tests offer the clinician a means of detecting and determining the nature and extent of neural pathomechanics. The aim of using NTPT in assessment is to change the length of the neural tracts using body segments as levers. By applying tension on the neural structures, an impression of their mobility and sensitivity to mechanical stresses is gained. Nevertheless, there is little objective evidence of the mechanism involved[18].

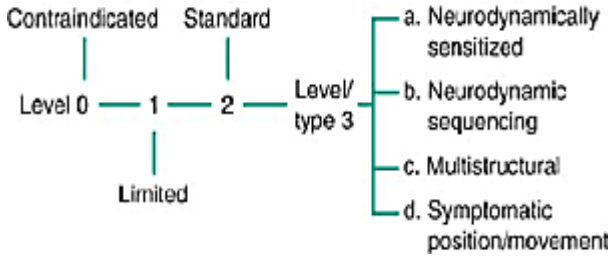
The Straight Leg Raise (SLR) originated as the Lasegue test in 1864, using knee movements while passively holding the hip in 90 degrees of flexion. The effects of these sensitizing maneuvers on the patient's pain were then considered to confirm the diagnosis of Sciatica. The test has since been modified but the basis remains the same: While

performing the SLR the clinician elevates the straight leg in the sagittal plane noting the tissue texture through the available range, comparing the findings to the other leg and the expectation for that patient[22].

Elvey[6] reported that increased muscle tone in related areas will protect the inflamed neural tissues after the discharge of the neural tissue nociceptors. He is supported by Hall[10] who demonstrated that in the case of radiculopathy, medial hamstring muscle is provoked with greater ease and there is an accompanying increase in resistance. Other research has suggested that muscle plays a less significant role. Magnusson and Simonsen[15] demonstrated that electromyography (EMG) activity did not significantly contribute to resistance to stretch during passive knee extension. SLR creates tension and movement to the neural tissue by increasing the distance between the extremities of the neural tissue tract, causing caudal movements of the lumbosacral roots in relation to the intervertebral foramen.

Passive neck flexion is often used in conjunction with other neural tissue provocation test to ascertain the involvement of neural tissues. Movement can be applied to the upper or lower cervical spine, with relatively more movement occurring during upper cervical movements due to the fulcrum effect of the upper cervical vertebrae[10]. The effect of passive neck flexion is not limited to cervical and upper thoracic spine but also to lumbar symptoms[24]. PNF is often used in combination with the Slump test and a recent study by Lew[14]. Demonstrated that an increase in pain during cervical flexion did not correlate with either the tension difference or the EMG activity of the biceps femoris muscle during the slump test. This suggests that the pain intensity may not be due to the change of tension of the biceps femoris muscle but from increased resistance or sensitization of the neural tissue.

Movement sequencing is now an important variable in neurodynamic testing. This is called "neurodynamic sequencing" and relies on the principle that the nervous system does not behave uniformly and instead responds to movement in a variable way, depending on the local anatomy, biomechanics and applied movements[17].



From Shacklock (2005) Elsevier, Oxford[21]

Hypothesis

The neurodynamic mobilization has no significant effect on patient's symptoms, including the degree of straight leg raising and H-reflex recovery in chronic discogenic sciatica.

MATERIAL AND METHODS

Subject Selection

Ten patients diagnosed as unilateral sciatica results from lumbar (L5-Sl) disc prolapsed (bulge or protrusion) were recruited from outpatient clinic in the Faculty of Physical Therapy, Cairo University.

Inclusion criteria

1- All patients with radicular pain for at least six weeks up to one year.
2- All patients with unilateral lumbosacral radiculopathy.
3- Diagnosis was confirmed by clinical and radiological assessment (CT or MRI).

4- The age of patient ranged from 25 to 40 years. Body weight ranged from 70 to 90 kg. Height ranged from 170 to 185Cm.

Instrumentation

Assessment equipment:

- Electromyography (EMG) (TOENNES Neuro Screen plus 1.70C) for recording of H-reflex. Consists of an amplifier; an oscilloscope display, gain and filter controls. A stimulator electrode was plugged into a box that transmits signals to a preamplifier that in turn transmits signals to the main unit by a shielded cable. Bar electrodes with 2 surface electrodes.
- Inclinometer (ISOMED) unilevel inclinometer a fluid type used for measuring straight leg raising.
- Visual Analog Scale.

Pre-experimental evaluation:

Each patient was subject to complete physical and clinical examination. The neurological examination including, History, Personal data, medical history, present history and intensity of pain by Visual Analogue Scale. Also Sensory assessments, motor assessment, Special tests for sciatica were done to each patient (straight leg raising test, slump test).

Procedure

Ten patients received traditional physical therapy program which consists of electrotherapy and exercises and neurodynamic techniques session per week for one month.

The pre and post assessment of three dependant variables (pain, straight leg raising and H-reflex) were conducted before, immediately after and after one month from the beginning of the study (the end of treatment).

Measurement

A. Soleus H-reflex:

H-reflex was recorded from so1eus, via stimulation of the posterior tibial nerve using 1 ms pulse at 0.2 pps of H-max. For each subject, the peak -to-peak amplitude of the maximum obtained H-reflex and the onset latencies of 8 separated traces was averaged for both lower extremities. Sensitivity/pain: 1-5 mV/div., Filter sitting: 10 Hz-10 kHz, Sweep speed: 5-10 ms/div[13,16].

B. Straight Leg Raising:

Passive straight leg raising (SLR) test was done using uni-level inclinometer center on the lower third of tibia. The inclinometer was held in a vertical position during the SLR test by the examiner's hand between the index and the middle fingers. The examiner performed the SLR with the patient lies supine on a flat plinth towards the side of the examiner, with the neck slightly extended. The examiner placed one hand under the Achilles tendon which held the inclinometer and the other hand above the knee to prevent any knee flexion. The leg was lifted perpendicular to the point at which the patient expressed the perception of pain. Then the degree of SLR measured before 1st session, after 1st session, and after 4 weeks (12 sessions).

C. Visual analog scale

Pain perception was measured using a graphic rating scale. The examiner illustrated to the participant the meaning of the visual analog scale (VAS). The subject was asked to place a "x" at that point he felt his pain.

Treatment

Neurodynamic technique:

Straight leg raising

The patient lies supine, relaxed and comfortable on examination bed, toward the side of the examiner. The trunk and hips in a neutral position the examiner placed one hand

under the Achilles tendon and other hand above the knee. The leg was lifted perpendicular to the bed, with the hand above the knee preventing any knee flexion. The leg was then taken to a predetermined symptom response or range of movement.

The most commonly used and useful sensitizing additions to straight leg raising were:

- Ankle dorsiflexion
- Ankle planter flexion \inversion
- Hip adduction
- Hip medial rotation
- Passive neck flexion

The number of repetitions and the amplitude of the maneuver were gradually increased. In irritable disorder, sequence of gentle oscillations was performed, for 20 seconds and then reassessed.

Statistical Analysis

The results were statistically analyzed to compare the difference between the sound leg and pre and post treatment of the affected leg.

- Repeated measure ANOVA was performed to determine the significance between the Soleus H- Reflex between sound, affected pre and affected post.
- Paired T- test to compare the difference between the mean values of straight leg raising between affected pre and affected post. Also with the mean values of the visual analogue scale between affected pre and affected post.

RESULTS

The results of this study showed that there was a highly statistically significant difference in the mean values of Soleus H-Reflex between sound (mean ± SD) (6.12 ± 1.41), affected pre (mean ± SD) (3.06 ± 0.93) and affected post (mean ± SD) (4.84 ± 1.33). Table (1) shows changes in the mean and standard deviation, there was highly significant difference with (P = 0.0001).

Table (1): Changes in the mean values of Soleus H- Reflex, between sound, affected pre and affected post.

Variable	Sound	Pre-affected	Post-affected
Mean	6.12	3.06	4.84
SD	1.41	0.93	1.33
F	15.42		
P	0.0001		

While Post Hoc LSD test revealed that:

There was a highly statistically significant difference in Soleus H- Reflex between sound & affected pre with significant difference between affected pre & affected post and between sound & affected post (Tab. 2).

Table (2): Comparison between sound & affected pre, sound & affected post and affected pre & affected post mean values of Soleus H- Reflex, straight leg raising and visual analogue scale.

Variable	Sound & Affected pre Comparison	Sound & Affected post Comparison	Affected pre & Affected post Comparison
	P- value	P- value	P- value
Soleus H- Reflex	0.0001	0.028	0.003

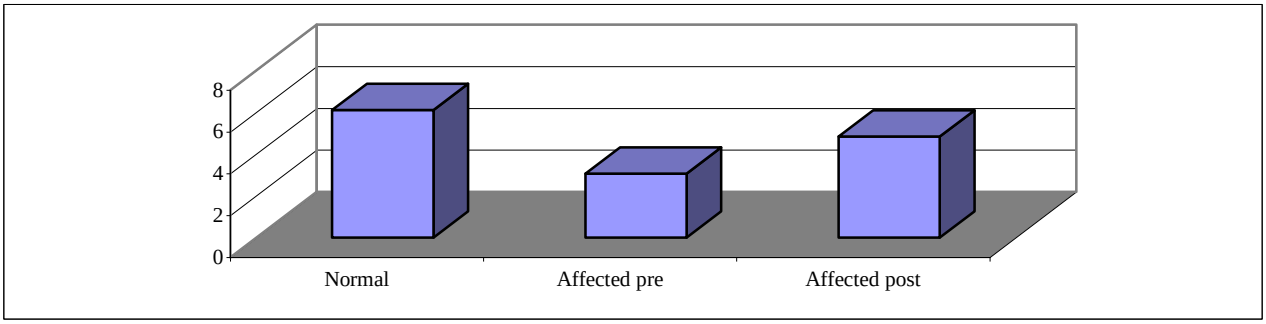


Fig. (1): Changes in the mean values of Changes in the mean values of Soleus H- Reflex, between sound, affected pre and affected post.

The results by using paired T test showed that there was a highly statistically significant difference in the mean values of straight leg raising between affected pre (mean ± SD) (23 ± 5.37) and affected post(mean ± SD) (47.5 ± 8.89). Table (3) shows changes in the mean and standard deviation (at P level of 0.0001).

Table (3): Changes in the mean values of straight leg raising between affected pre and affected post.

Variable	Pre-affected	Post-affected
Mean	23	47.5
SD	5.37	8.89
t	- 10.16	
P	0.0001	

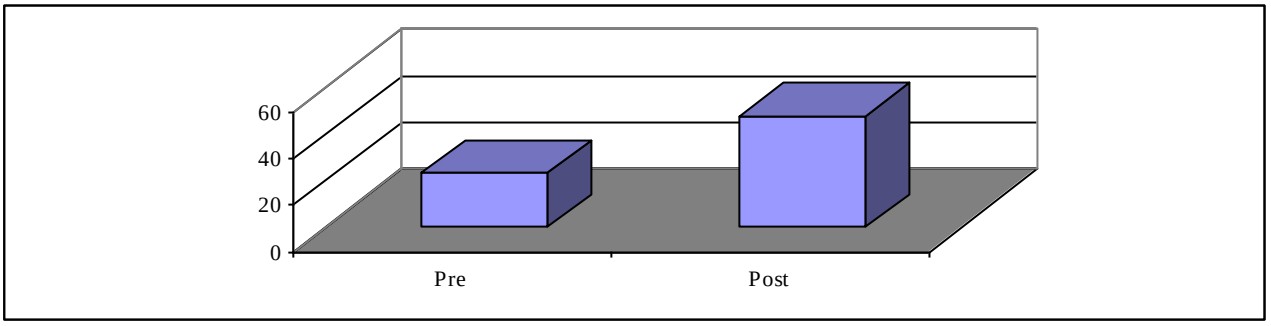


Fig. (2): Changes in the mean values of straight leg raising between affected pre and affected post.

The results by using paired T test showed that there is a highly statistically significant difference in the mean values of the visual analogue scale (at the level of P = 0.0001), between affected pre (mean ± SD) (7 ± 1.05) and affected post (mean ± SD) (4.6 ± 1.17). Table (4) shows changes in the mean and standard deviation.

Table (4): Changes in the mean values of the visual analogue scale between affected pre and affected post.

Variable	Pre-affected	Post-affected
Mean	7	4.6
SD	1.05	1.17
t	10.85	
P	0.0001	

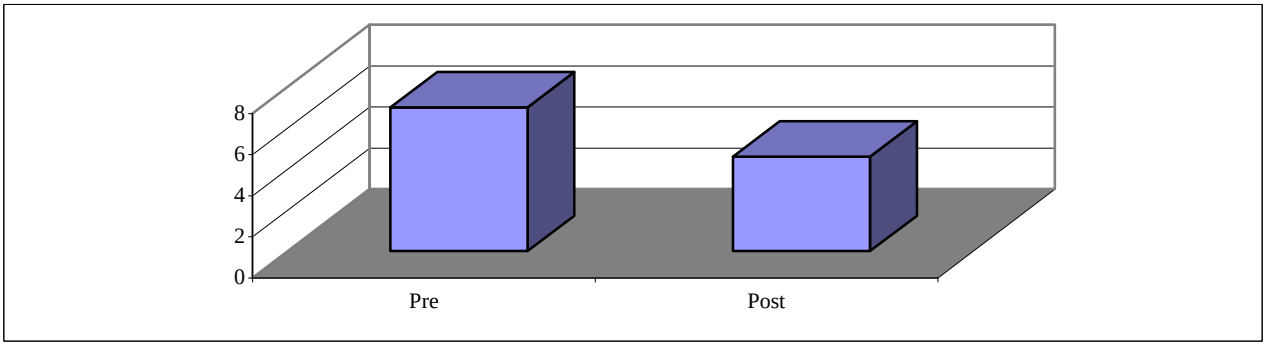


Fig. (3): Changes in the mean values of the visual analogue scale between affected pre and affected post.

DISCUSSION

Results of the present study showed changes in the mean values of Soleus H-Reflex between sound, affected pre and affected post which can be explained by changes in the alpha motor neuron excitability as was supported by the of Kerr et al.,[12] studied the changes in alpha motor neuron excitability with positions that tension neural tissue. The purpose of this study was to establish whether the slump test was associated with an increase or decrease in excitability of alpha motor neuron and, an alteration in muscle activity at the end of the range of movement of the test. Forty-three normal subjects and eight subjects with abnormal neural tension participated in this study.

Changes in alpha motor neuron excitability in the neck flexion moderate slump and maximum slump positions were assessed by observing.

They measured the changes in H-reflex recruitment curves on normal subjects. in moderate and maximum slump position demonstrated a significant decrease ($P<0.05$) in slope of H-reflex recruitment curve. Subjects with abnormal neural tension showed non significant increase in slope when in these position. These finding of these study have important implication for the rationale for treatment selection and success of treatment outcomes in the clinical setting.

Shaker H.A.A.[20] studied the involvement of neural tissue as well as the local soft tissue in case of lateral epicondylities, he reported significant improvement in elbow extension after using neural mobilization, this findings in agreement with the present study findings that the neural mobilization can improve radicular manifestation.

Conclusion

It can be concluded that neurodynamic mobilization has the effect of improving patient's symptoms, including the degree of straight leg raising and H-reflex recovery in chronic discogenic sciatica. This study showed that adding neurodynamic mobilization to the conservative treatment might improve the treatment for sciatica and might decrease the cost of treatment and disability of the patient.

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الملخص العربي

تأثير التحريك العصبي الديناميكي في حالات التهاب عرق النسا الغضروفي المزمن

عرق النسا هو اسم يطلق على التنميل والحرقان والشكشكة التي تحس في الأرداف والفخذ والساق والقدم مع ألام في الظهر .
صممت هذه الدراسة لتحدد مدى تأثير التحريك العصبي الديناميكي في التهاب عرق النسا الغضروفي المزمن، عشره مرضى يعانون من التهاب عرق النسا الغضروفي المزمن في إحدى القدمين، كل المرضى بعد الفحص الجسماني والإكلينيكي . اعتمد علاج المريض على أساليب العلاج المعتادة وتتمثل في علاج كهربائي وتمرينات علاجية وعلاج باستخدام التحريك العصبي الديناميكي لثلاث جلسات أسبوعية لمدة شهر. اعتمدت نتائج البحث على دراسة ثلاث عوامل مختلفة وهى الألم و رفع القدم على استقامتها إلى أعلي و توصيل العصب الحسي الحركي، نتائج هذه الدراسة أوضحت أن هناك دلالة إحصائية عالية على وجود اختلاف إحصائي واضح في متوسط التوصيل العصبي الجسمي الحركي لعضلة السمانة بين القدم السليمة (متوسط ± معدل التغير) (6.12 ± 1.41) والمصابة قبليه (3.06 ± 0.93) والمصابة بعديه (4.84 ± 1.33) وأيضا في متوسط رفع القدم بين المصابة قبلية (23.00 ± 5.37) والمصابة بعدية (47.5 ± 8.89) وأيضاً في متوسط الشعور بالألم (7± 1.05) للمصابة قبلية و (4.6 ± 1.17) للمصابة بعدية . ومن هنا يمكن القول أن التحريك العصبي الديناميكي يمكن أن يسهم في تقليل أعراض المرض بالتهاب عرق النسا الغضروفي المزمن .