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# Impact of Different Neurodynamic Tension Techniques on H Reflex of Sciatic Nerve

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Neurodynamic tension techniques are beneficial in reducing the intrinsic pressures on the neural tissue in symptomatic subjects. However, its effect on asymptomatic subjects are still uncertain, so the aim of this study was to investigate the effect of three neurodynamic tension techniques on H reflex and H/M ratio of sciatic nerve in normal asymptomatic subjects. Sixty subjects participated in this study, their age ranged between 20-30 years and BMI between 19-25 kg $m^{-2}$. They were assigned into three groups (A, B and C) divided equally, Group A received only slump technique (slider), group B received only piriformis technique (new innovation of neural mobilization technique that utilize a stretching exercise) and group C received only straight leg raising technique (proximal slider). Each participant was evaluated by measuring H reflex and H/M ratio using Schwarzer topas EMG machine before (pre-technique) and after neurodynamic tension techniques (post I) and after neurodynamic tension techniques with oscillation (post II). Mean, standard deviation and MANOVA-test were carried out for comparison and statistical method used was SPSS. In group A, B and C there was a significant decrease in the H reflex latency ($p = 0.0001$) at post I compared with pre-technique, at post II compared with pre-technique and at post II compared with post I. Moreover in group A, B and C there was a significant increase in the H/M ratio ($p = 0.0001$) at post II compared with pre-technique and at post II compared with post I, also at post I compared with pre-technique for group B and C, while there was a significant increase in the H/M ratio ($p = 0.001$) at post I compared with pre-technique in group A. The result of this study revealed that there was a significant difference in H reflex and H/M ratio of sciatic nerve after application of neurodynamic tension techniques. The study contributed to use the neurodynamic tension technique as a prophylactic treatment for subjects who are susceptible to have sciatica due to their life style.

**Key words:** Neurodynamic tension techniques, H reflex, H/M ratio, sciatic nerve, asymptomatic subjects

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## INTRODUCTION

The explanation of the theory of neurodynamics divides the body into three mechanical parts: Neural structures, innervated tissues and a mechanical interface. The mechanical interface is defined as the structure(s) that surround the nervous system. The different components of the nervous system are referred to as the neural structures and the innervated tissues (defined as tissues that have a nerve supply)[1].

The nervous system is a continuous system as it is a mechanically and physiologically continuous structure from the brain to the end terminals in the periphery[2]. As a result of being a continual system it is very important when considering the mechanical influences upon any region of the peripheral nervous system can have mechanical and/or physiological consequences elsewhere in the system[3,4]. The fact that the nervous system is a continual system has important implications during assessment and treatment. As the influence in the nervous system at one point can have a direct influence at more distant locations, with quite important ramifications[1].

There was a lack of research which has quantified the movement of lower limb nerve *in-vivo*. Femoral nerve excursion was examined in response to different ranges of hip lateral rotation *in vivo* analysis. A range of 0.99-2.63 mm ventral and 0.68-1.22 mm lateral excursion was seen with lateral hip rotation ranging from 0-45°[5]. However in cadaveric studies, sciatic nerve excursion has been reported to be a range from 3.47-46.8 mm whilst tibial nerve excursion has been reported to range from 3.1-49.2 mm[6]. While *in vivo* the available analyses for the lower limb's peripheral nerves, which is restricted to the femoral nerve only. The upper limit of *in vivo* femoral nerve excursion has been shown to be 2.63 mm[7].

The neurodynamic tension techniques consists of gliding or sliding techniques. These techniques are neurodynamic maneuvers that attempt to produce a sliding movement between neural structures and adjacent nonneural tissues. While tensile loading technique is used to restore the physical capabilities of neural tissues to be able to tolerate movements that lengthen the corresponding nerve bed. Neurodynamic maneuvers are performed in an oscillatory fashion to gently resist the movement that is usually associated with protective muscle activity, also it is important to emphasize that tensile loading techniques are not stretches[8].

The name H-wave was derived from Johann Hoffmann, who found the response of weak electrical stimulation that can excite group Ia fibers from muscle spindle for the first time in 1918[9]. The H reflex test was used to investigate the inhibitory or excitatory influences of specific pathways on the activation of α-motoneurons in conditioning reflex protocols[10]. Recently, the H reflex test has been utilized in studies on the role of Ia afferent spinal loop in various aspects of human movement, for example, in relation to performance of functional tasks, such as single and multiple joint movements, postural control and locomotion[11].

This study was going to investigate whether different types of neural mobilization techniques and different biomechanical oscillations of joint movements result in different effect on H reflex and H/M ratio of sciatic nerve and that will allow therapists to use this technique to enhance the rehabilitation period and decrease the duration of treatment, in addition this will influence the patients economically by decreasing the number of sessions required for treatment. And also used in prevention of peripheral nerve disorders in asymptomatic subjects.

## MATERIALS AND METHODS

**Subjects:** sixty male and female subjects from physical therapy students, workers and colleagues at Pharos University of age 20-30 years and BMI 19-25 kg $m^{-2}$ were selected by means of convenience sampling and assigned randomly in 3 equal groups using only one type of neurodynamic tension technique for each group and The study was carried out in the EMG lab at Faculty of Physical Therapy, Pharos University from July, 2016 till February, 2017.

Inclusive criteria were that body mass index (BMI) didn't exceed 25 kg $m^{-2}$, no complaint from back pain, no history of surgery in the back and no significance difference in demographical data.

Exclusion criteria were Pregnancy, Sciatica, total or partial hip replacement or any recent surgery of back and knee, subjects with neurological symptoms, musculoskeletal conditions, cognitive impairment that interfere with making the subjects active participants.

**Procedures:** H reflex and H/M ratio were evaluated before neurodynamic tension techniques (pre-technique), after neurodynamic tension techniques (post I technique) and after neurodynamic tension techniques with oscillation (post II technique) using Schwarzer topas EMG machine. Comfortable room temperature and light had been used throughout the procedure.

**H reflex testing:** Skin preparation: The skin overlying the sites of the electrodes were rubbed very well using skin prepping gel to decrease the skin impedance then were cleaned using alcohol to remove any debris or dirt.

Position of the subject: The subject was laid in prone lying position over a comfortable bed in a quiet room. The head of the subject maintained in mid position to avoid asymmetrical tonic reflex. The examined dominant leg was placed between hip abduction and adduction. The gastrocnemius was relaxed by putting small pillow under the knee joint and made it semi flexed (flexed 20°) so it would reduce any influence on the H reflex and ankle hanging outside the plinth in planter flexion.

Placement of electrodes: The reference electrode were placed over the Achilles tendon. While the recording electrode were placed over the soleus muscle, 2-3 finger breadth distal to where the soleus meets the

two heads of the gastrocnemius and that location is the optimal location to record.

H reflex. The recording and reference electrodes were fixed to the skin using adhesive plaster or tape to ensure their fixation during the procedure.

Ground electrode were placed at half distance between stimulating electrode and recording electrodes.

The stimulating electrode were placed in the popliteal fossa, with anode placed distal to the cathode to stimulate the tibial nerve then the stimulus was started at very low stimulus intensities.

**Neurodynamic tension techniques:** Three neurodynamic tension techniques were used in the current study, each one of the three groups used only one type of neurodynamic tension technique which were:

- Group A Slump technique (Slider mobilization): unloading of nervous system cranially by active cervical extension from full comfortable cervical flexion to full comfortable cervical extension at the same time the sciatic nerve was loaded caudally via the tibial nerve by passive knee extension (from 80-20° flexion-as measured by universal goniometer)[12]. This technique was repeated again and again for approximately 10 min[13], then the H reflex and H/M ratio was recorded, after that, the procedure was repeated but with oscillation in the movement of passive knee extension. Then H reflex and H/M ratio was recording again
- Group B (Piriformis technique): Neural mobilization technique, through increasing tension of piriformis and sciatic nerve " crook lying position, hip 45° external rotation, knee flexed 90°, heel is rested on the other knee (loading on piriformis) asking to increase flexion of hip (loading on sciatic nerve)". This technique was repeated again and again for approximately 10 min[13], then the H reflex and H/M ratio was recorded, after that, the procedure was repeated but with oscillation in the movement of hip flexion. Then H reflex and H/M ratio was recording again
- Group C Straight leg raising (Proximal slider): subject laid in supine lying position, the hip was supported in approximately 45° flexion and the leg horizontal. The foot was held to enable the therapist to control the ankle, forefoot and toes. The first movement was dorsiflexion and eversion of the ankle and forefoot then dorsiflexion of the toes as far as practicable into the range. Then the next movement was knee extension while stabilizing the ankle joint and the rest of the limb and the final movement was the release of dorsiflexion of the forefoot and toes to release distal tension from the digital nerves and allowed the tibial part to displace in a proximal direction[8]. This technique was repeated again and again for approximately 10 min[13], then the H reflex and H/M ratio was recorded, after that, the procedure was repeated but with oscillation in the movement of hip flexion. Then H reflex and H/M ratio was recording again

**Statistical analysis:** It was performed through the statistical package for social sciences (SPSS) version 19 for Windows[14]. Mean, standard deviation and MANOVA-test were carried out for comparison of the mean age, weight, height and BMI of the participants and used as descriptive statistics. The MANOVA with repeated measures-test was carried out for comparison between pre-technique, post I and post II mean values of H reflex latency and H/M ratio in each group. The significance level was set at $p<0.05$.

## RESULTS

**Demographic data**

**Group A:** Twenty healthy subjects (9 females and 11 males) included in this group. Their mean±SD age, weight, height and BMI were 26.2±2.94 years, 71.05±2.7 kg, 169.9±3.3 cm and 24.62±0.86 kg $m^{-2}$, respectively.

**Group B:** Twenty healthy subjects (10 females and 10 males) included in this group. Their mean±SD age, weight, height and BMI were 26.75±3.02 years, 70.45±3.21 kg, 170.15±3.77 cm and 24.33±0.69 kg $m^{-2}$, respectively.

**Group C:** Twenty healthy subjects (7 females and 13 males) included in this group. Their mean±SD age, weight, height and BMI were 26.6±2.85 years, 72.25±3.89 kg, 171.65±4.4 cm and 24.51±0.79 kg $m^{-2}$, respectively.

Comparing the general characteristics of the subjects of the three groups revealed that there was no significance difference between the three groups in the mean age, weight, height and BMI ($p>0.05$).

**Mean values of H reflex latency at pre-technique, post I and post II of group A:** Noticeable decrease in the H reflex latency was found when comparing pre-technique with both post I and post II and also when comparing post I with post II. At the same time there was a percent of change between the pre-technique, post I and post II but the highest one was between post II and pre-technique (Table 1).

**Mean values of H/M ratio at pre-technique, post I and post II of group A:** The H/M ratio was increased from pre-technique to post I and post II, also when comparing post II with post I. Meanwhile the percent of change that happened between the post II and pre-technique was the highest one and after that was the percent of change of the post I compared to pre-technique and the percent of change at the post I compared to post II was the lowest (Table 2).

**Mean values of H reflex latency at pre technique, post I and post II of group B:** H reflex latency was decreased at post I coupled with pre-technique, also found that it was decreased at post II when coupled it with post I, moreover found the same result after coupling post II with pre-technique. However, the percent of change of the post II coupled with

Table 1: Comparison between pre-technique, post I and post II mean values of H reflex latency of group A

| | Multiple comparison (Bonferroni test) | | |
|---|---|---|---|
| | MD | Change (%) | p-value* |
| Pre- post I | 0.64 | 2.25 | 0.0001 |
| Pre- post II | 1.68 | 5.93 | 0.0001 |
| Post I- post II | 1.04 | 3.75 | 0.0001 |

x̄: Mean SD: Standard deviation, p-value: Probability value, *Significant

Table 2: Comparison between pre-technique, post I and post II mean values of H/M ratio of group A

| | Multiple comparison (Bonferroni test) | | |
|---|---|---|---|
| | MD | Change (%) | p-value* |
| Pre- post I | -0.17 | 2.72 | 0.001 |
| Pre- post II | -0.46 | 7.37 | 0.0001 |
| Post I- post II | -0.29 | 4.52 | 0.0001 |

x̄: Mean SD: Standard deviation, p-value: Probability value, *Significant

Table 3: Comparison between pre-technique, post I and post II mean values of H reflex latency of group B

| | Multiple comparison (Bonferroni test) | | |
|---|---|---|---|
| | MD | Change (%) | p-value* |
| Pre- post I | 1.56 | 5.57 | 0.0001 |
| Pre- post II | 2.23 | 7.97 | 0.0001 |
| Post I- post II | 0.67 | 2.53 | 0.0001 |

x̄: Mean SD: Standard deviation, p-value: Probability value, *Significant

Table 4: Comparison between pre-technique, post I and post II mean values of H/M ratio of group B

| | Multiple comparison (Bonferroni test) | | |
|---|---|---|---|
| | MD | Change (%) | p-value* |
| Pre- post I | -0.9 | 14.65 | 0.0001 |
| Pre- post II | -1.17 | 19.05 | 0.0001 |
| Post I- post II | -0.27 | 3.83 | 0.0001 |

x̄: Mean SD: Standard deviation, p-value: Probability value, *Significant

pre-technique was the highest percent of change then the post I compared to pre-technique and then the post I compared to post II (Table 3).

**Mean values of H/M ratio at pre-technique, post I and post II of group B:** In group B there was increase in the H/M ratio at post I compared with pre-technique, at post II compared with post I and at post II compared with pre-technique. However, the highest percent of change was found in the pre-technique compared with post II (Table 4).

**Mean values of H reflex latency at pre-technique, post I and post II of group C:** Significant decrease in the H reflex latency was found at post I compared with pre-technique, at post II compared with pre-technique and at post II compared with post I. While the percent of change was the highest in the post II compared with pre-technique then at the post I compared to post II then at the post I compared to pre-technique (Table 5).

**Mean values of H/M ratio at pre-technique, post I and post II of group C:** Comparing between (pre-technique, post I, post II) revealed that there was a significant increase in the H/M ratio. In addition the percent of change that happened when comparing between (pre-technique, post I, post II) was the lowest at the post I compared to pre-technique and the highest in the post II compared with pre-technique (Table 6).

Table 5: Comparison between pre-technique, post I and post II mean values of H reflex latency of group C

| | Multiple comparison (Bonferroni test) | | |
|---|---|---|---|
| | MD | Change (%) | p-value* |
| Pre- post I | 0.23 | 0.81 | 0.0001 |
| Pre- post II | 0.62 | 2.2 | 0.0001 |
| Post I- post II | 0.39 | 1.39 | 0.0001 |

x̄: Mean SD: Standard deviation p-value: Probability value, *S: Significant

Table 6: Comparison between pre-technique, post I and post II mean values of H/M ratio of group C

| | Multiple comparison (Bonferroni test) | | |
|---|---|---|---|
| | MD | Change (%) | p-value* |
| Pre- post I | -0.16 | 2.56 | 0.0001 |
| Pre- post II | -0.36 | 5.76 | 0.0001 |
| Post I- post II | -0.2 | 3.12 | 0.0001 |

x̄: Mean SD: Standard deviation, p-value: Probability value, *S: Significant

## DISCUSSION

This study was conducted to investigate the effect of different NDT techniques (slider slump technique- straight leg raising (proximal glide)-piriformis technique) on motor neuron excitability that can be measured through H reflex and H/M ratio and also to determine the effect of these NDT techniques with oscillation on H reflex and H/M ratio.

The finding was that neurodynamic tension techniques had significant effect on H reflex and H/M ratio as measured by EMG apparatus. As the H reflex latency decreased in all of the three types of neurodynamic tension techniques and also there was a significant effect of the oscillation that was added to the neurodynamic tension techniques and made the H reflex latency decreased more in the three types. Also there was a significant increase in the H/M ratio for all of the three types of neurodynamic tension techniques and when oscillation added to the techniques it produced more increase in the H/M ratio in all of the types.

The findings of a recent study come in agreement with the findings of the current study as they indicated that neural mobilization techniques had significant effect on monosynaptic H reflex that measured by electrophysiological testing. In this study they found that there was a decrease in H reflex latency, increase in H reflex amplitude and increase in H/M ratio[8]. And that support the findings of the current study.

Burns and Hangee[15] supported the beneficial effect of neurodynamic tension technique and that come in agreement with the findings of the current study as it was proved that neurodynamic techniques and mobilization have a role in

treatment of chronic low back pain and radiculopathy in this study which investigated the effect using thrust, non-thrust mobilization/manipulation coupled with neurodynamic mobilization (neural mobilization) exercises for an individual with recurrent lower back pain. The findings of the study revealed that there was a rapid improvement in pain and functions in patients after non-thrust and thrust manipulation to the lumbar spine and supine lower extremity neurodynamic mobilization (neural mobilization) techniques, so it support the purpose of this study which was enhancement of the rehabilitation period and decrease the duration of treatment.

The effects of two techniques (tensioner, slider) on knee extension in the slump position in females aged 19-24 was studied by Herrington[16] and found average improvement in knee extension after the slump (tensioner technique) and the slump (slider technique). The slider technique in this study was similar to that of the current study, that was made for sciatic nerve and lumbosacral nerve roots by making simultaneous cervical extension and knee extension from sitting position. And the findings of this study support the beneficial effect of neurodynamic tension techniques and support the findings of the current study. However, according to the phenomenon of convergence and by depending on the usage of joint movements' combination, sliders can be used to encourage either peripheral nerve excursion either proximally or distally[16]. And that may be an explanation of the findings of the current study.

In the study of El Desoky and Abutaleb[17] the experimental group who received neural mobilization technique along with conventional rehabilitation program found to be more effective than the control group who received only conventional program that include therapeutic ultrasonic, infrared and general exercises program and that beneficial effect were enhancement of functional disability, pain level and amplitude, latency and H/M ratio of H reflex after 6 weeks of treatment and that support the results of the current study as the H reflex latency and H/m ratio were enhanced. In their explanation for the improvement that happened in the level of pain and functional disability they stated that neural mobilization affected the mechanical properties of peripheral nerves and that made alteration in nerve mechanics that was lead to direct effect on nerve physiology and that explanation comes in agreement with these studies[8-18] and also may be used to explain the results of the current study.

The results of this study was matched with the explanation of Shacklock[1], who reported that the improvement in latency, amplitude of H reflex and H/M ratio after neural mobilization could be due to the restoring of neurophysiological and mechanical functions of the nerve. Moreover previous studies agreed that sensory fibers within the dorsal root stimulated by stretching of the connective tissues surrounding the nerve roots so there is a summation of Ia afferent inputs at the spinal cord that will lead to increased response from alpha motoneuron consequently, therefore, the nerve conduction improved leading to decrease in latency and increase in amplitude of H reflex and increase in the amplitude of H/M ratio[8-19] and that may considered to be another explanation for these results. This was supported by the findings of Ha *et al*.[20], who found that neural mobilization increased median nerve conduction velocity and that consequently support the findings of the present study.

Study of Cleland *et al*.[21] supported the current study's findings, as they illustrated that nerve conduction increased in the compressed nerve root with neural mobilization technique, as the findings of the present study showed significant decrease in H reflex latency after neural mobilization.

According to many authors' studies[22-25], promotion of nerve excursion considered to be one of the primary benefits of neural mobilisation in order to restore optimal nerve mobility and breakdown neural fibrosis, which supported the results of the current study. Moreover, the prophylactic use of exercises to promote nerve excursion following surgery (i.e., carpal tunnel release surgery), to mitigate the potential for extraneural fibrosis, has been advocated by Coppieters and Alshami[26], who according to their study when applying slider technique nerve excursion is promoted without the increase in nerve tension, that is proportionally associated with elongation or tensioning manoeuvres. This comes in agreement with the findings of this study.

Moreover, the findings of McCracking[27] showed the beneficial effect of the neurodynamic treatment (neural mobilization) techniques like the findings of the present study. However, in this study they tested the longterm effects of a neurodynamic tension on low back pain (LBP) and lower extremity (LE) pain patients and the symptoms did not resolve completely until introduction of a neurodynamic treatment technique.

In contrast with the present study, the results of some researches indicated that there was no significant effect of neurodynamic tension techniques as the study of Scrimshaw and Maher[28] that disagreed with the current findings as they reported that neural mobilization technique did not show any positive effect over lumbosacral radiculiopathy patients who undergone spinal surgery, also the study of Adel[29] showed no significant difference between post test results of neurodynamic techniques and post test results of mobilization on H reflex (Latency), where neurodynamic techniques and mobilization had a same effect on H reflex (Latency).The contradiction between the results of the current study and the results of these studies may be due to the fact that the participant in this study were asymptomatic which differ from the participants of the other studies who were patients.

This study was conducted aiming to investigate the effect of neural mobilization techniques and different oscillatory movements on asymptomatic subjects to provide an effective intervention that can help in management and prevention of peripheral nerve disabilities and provide clear evidence that the neurodynamic tension techniques can promote nerve root

function. The possible limitation of the current study is that the beneficial effect of oscillatory movement with neurodynamic tension technique in this study cannot be attributed to the session of neurodynamic tension technique with oscillation alone because another session of neurodynamic tension technique without oscillation was made by the participant before it, then H reflex and H/M ratio were measured, after that participants made another session of neurodynamic tension technique with oscillation to measure its effect on H reflex and H/M ratio. So it was recommend that only one session of neurodynamic tension technique whether with or without oscillation should be made in the day, then measure its effect using any type of measurement in the further study. Further studies are required to investigate the effect of other neurodynamic tension techniques on H reflex and H/M ratio and compare between them to distinguish which is the best technique of them. Furthermore, Studies should be performed to investigate the long term effect of neurodynamic tension techniques on H reflex and H/M ratio in asymptomatic subjects.

## CONCLUSION

This study concluded that there was a significant effect of neurodynamic tension techniques (slider-straight leg raising (proximal glide)-piriformis technique) on H reflex and H/M ratio when its effect was investigated over asymptomatic subjects, so it can be used as a prophylactic treatment for subjects who are susceptible to have sciatica due to their life style. Furthermore, therapists can use this technique to enhance the rehabilitation period and decrease the duration of treatment.

## SIGNIFICANCE STATEMENTS

This study confirmed that neurodynamic tension techniques had a significant effect on H reflex and H/M ratio of sciatic nerve in asymptomatic subjects. And that can be beneficial for using them in prevention and management of peripheral nerve disorders also it can be used as a prophylactic treatment for asymptomatic subjects. This study will provide clinicians' greater knowledge of physiological effects associated with the movement of nerves in the lower limb.

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