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RESEARCH ARTICLE

EFFICACY OF CONTRA-LATERAL NEURODYNAMIC TECHNIQUE ON SCIATIC NERVE EXTENSIBILITY IN YOUNG ASYMPTOMATIC ADULTS

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ABSTRACT

This study was done to find the efficacy of the contra-lateral single joint tensioner technique to measure changes in P1 range of knee extension on the affected side in seated slump's test. Pre-test post-test group design was used. Sixty asymptomatic male and female subjects within age group of 20 to 30 years were involved in the study. Neurodynamic testing and sequence for seated slump's test was performed for structural differentiation. Intervention was given for six days on the uninvolved side to determine the effect contra-lateral single joint tensioner technique on the involved side. Pre and post readings of knee extension range of motion (P1) were noted on the involved extremity. One week after intervention, seated slump's test was performed again on the involved extremity of subject and P1 was noted to find the longevity of the treatment manoeuvre. The results of study revealed there was a significant difference in the range of knee extension (P1) in asymptomatic adults. Therefore, we can ascertain that contra-lateral neurodynamic (tensioner) technique resulted in significant, long lasting improvement in knee extension range (P1) in asymptomatic young adults and promoting extensibility of sciatic nerve.

INTRODUCTION

'NEURODYNAMICS' conceptualised by Michael Shacklock was published in 1995. It refers to the integrated biomechanical, physiological and mechanical functions of the nervous system (Michael Shacklock, 1995, 2005). The nervous system is able to adapt to different mechanical loads and thus has the capacity to undergo changes in mechanical and physical properties in relation to the change in dimension of the tissue in interface (M. Shacklock 1995, Richard Ellis 2011, Goddard *et al*. 1965, Mclellan, D.C. 1975, Breig A 1978). Movement of the body is an integral part of human life. To carry out our daily tasks the muscles, fascias, and nerves must be flexible (Toby Hall *et al*. 1998). As seen in figure1, in a three part conceptual model nerve bed, neural structures & the innervated tissues) the tissues of the body are categorized with respect to the nervous system which enables one to categorize its dynamics according to the relevant components so that diagnosis and treatment can be derived from the causal mechanisms (Michael Shacklock, 2005).

Shacklock continous to explain that the musculoskeletal system is the mechanical interface to the neural structures, i.e., it houses the neuraxis, cranial nerves and nerve roots. These are the bones, joints, muscles, fascia, fibro osseous tunnels which come in contact with the neural structures during daily movements and postures. Abnormal postures may cause increased tension on nerves or fascia thus decreasing the flexibility of the nerves, muscles and fascia (Michael Shacklock, 2005, Toby Hall *et al*. 1998, Kleinrensink G 1997).

The nervous system acts as bi-directional transport system carrying information to and from different body systems in order to perceive process and activate human movement. And so to operate effectively they have to cope up with the mechanical stresses superimposed upon them by the surrounding tissues (Richard Ellis, 2011). Excursion of the nerve refers to the movement of the nerve in respect to the surrounding mechanical interface (Boyd, B. S 2005, Byl, C *et al*. 2002). This sliding capacity of the nerve allows it to adapt to the changes in the position and the length of mechanical interface imposed by limb movements (Byl, C *et al*. 2002, Dilley, A *et al* 2007, McLellan, D 1976).

If the nerves are not able to slide or glide freely then the portion of nerves closest to the axis of joint movement has greater tensile forces imposed on it (Dilley, A *et al*. 2008, Hunter, J. M 1991). The nervous system undergoes mechanical events like sliding, elongation, cross-sectional changes, angulations and compression in response to change in the dimensions of the surrounding tissues (Goddard, MD 1965, Breig A 1978, McLellan, D. L 1976). Movement of the nervous system also aids nerve nutrition and removal of metabolic wastes. The physiological responses of neural tissues to mechanical stresses are intra-neural blood flow, mechano-sensitivity, sympathetic activation and vibration. Both the mechanical and physiological functions of nervous system need to be considered while assessing and treating an

individual via nervous system mobilization and manual therapy.

An important aspect of the neurodynamic approach is that the healthy mechanics of nervous system enable pain-free posture and movement to be achieved (Fahrni W.H. 1966 Elvey, R. L 2004, Maitland, G. D 1985, Butler, D. S 2005). Essentially, neural mobilization techniques have been developed from neurodynamic tests. A neurodynamic test is a series of body movements that produces mechanical and physiological events in the nervous system according to movements of the test. These tests are used to gain knowledge about mechanical performance and sensitivity of the neural structures. Through its continuous nature, the nervous system provides the capacity for manual differentiation of symptoms as important aspects of diagnosis and treatment. Structural differentiation is performed with all the neurodynamic tests to gain information whether the neurodynamic events participate in the mechanism of symptoms. In this study seated slump's test or modified slump's test was used to examine the sensitivity of the structure of sciatic nerve.

Sciatic nerve is the thickest nerve of the body. It begins in the pelvis and terminates at the superior angle of popliteal fossa by dividing into tibial and peroneal nerves. It is the largest part of the sacral plexus with the root value of L4, L5, S1, S2, and S3. The nerve lies in front of the piriformis, under the cover of its fascia. The nerve enters the gluteal region through greater sciatic foramen below piriformis. The nerve then enters the back of thigh at the lower border of gluteus maximus and runs vertically downwards up to the superior angle of popliteal fossa, where it terminates dividing into tibial and peroneal nerves. The nerve may divide into its terminal branches anywhere above the usual level when division occurs in pelvis, the tibial nerve passes through the greater sciatic foramen inferior to the piriformis, but the common peroneal nerve pierces piriformis to enter gluteal region. As per Michael Shaclklock this nerve can withstand 50 kg of tension.

The Seated Slump's Test is thought to examine the sensitivity of neural structures including meningeal tissues, nerve roots, and the sciatic and tibial nerves. The test involves the patient sitting on the edge of the examination plinth in a slumped or slouched position (flexion of the thoracic and lumbar spine and a posterior pelvic tilt), flexion of the cervical spine with gentle manual overpressure, and passive extension of the subject's knee, while the ankle is dorsiflexed (Daves *et al*, 2009). This sequence is referred to as Slump's Test1 by Butler. A positive test again requires structural differentiation by noting a change in symptoms, range of motion, or resistance.

Neural mobilization techniques have been developed from neurodynamic tests (M. Shacklock, 19956, Maitland, G. D 1985, Butler, D. S 1989b, Byl, C *et al* 2002). Neurodynamics encourage peripheral nerve mobility through elongation of nerve bed or interface (Byl, C *et al* 2002, Coppieters, M. W *et al*. 2006). Now that a growing body of evidence is emerging regarding the mechanical effects of neural mobilization techniques like the ipsi-lateral sliders, ipsi-lateral tensioner for different nerves in the body, it is important to find the benefits of newer techniques like the contra-lateral techniques, so that they can be used in specific conditions of low back with radiating symptoms.

'Tensioners' are the short or large amplitude oscillatory movements within mild to outer range to exploit the nerve elongation and tension. They exploit the visco-elastic properties of nerve via elongation through the length of nerve tract. They create relative excursion of the peripheral nerve. They may be used for enhancing the visco- elastic function of a nerve but there is no empirical evidence. An application of a contra-lateral neurodynamic therapy helps to reduce tension in the ipsilateral nerve root (Louis R, 1981). Also in a patient with symptoms mobilizing the affected extremity in acute phase is difficult. One cannot nudge deep inside the tissues of the affected side as it would be very painful. In the past many studies have been done to find the efficacy of the ipsi-lateral neurodynamic technique. This study was done to find the efficacy of the contra-lateral technique as in this technique the unaffected side is mobilized, so the therapist can nudge deeper into the tissues and treat the condition without any limitations.

According to the International Classification of Impairment and Activities, and Participation of WHO, impairments represent a deviation from some 'norm' in the biomedical status of the body and its functions (Richard P. *et al*. 2001). Therefore, before examining patients with minor peripheral nerve injuries, we found it important to know the responses in asymptomatic participants, in such a manner that the signs of an individual patient can be interpreted in regard to the normal findings. Further research is needed to prove the efficacy of the contra-lateral neurodynamic treatment in patient population.

METHODOLOGY

A cross-sectional longitudinal study was conducted in the School of Physiotherapy, D.Y.Patil University, Nerul, Navi Mumbai wherein 60 adult male and female asymptomatic subjects within the age group of 20 to 30 years were evaluated for seated Slump's test. Subjects with seated slump's test or modified slump's test positive on structural differentiation were included in the study. Subjects with any neurological deficits, musculoskeletal disorders, vascular disorder, cardio-pulmonary disorders and psychological issues were excluded from the study. P1 (initial point or range at which discomfort starts) is measured during knee extension (from 90 degrees of knee flexion) with a goniometer in slump's position. If the pain or discomfort (P1) changed on structural differentiation then the slump's neural test was considered positive for that particular extremity. If there was no change in pain or discomfort then the test was considered negative. Once it was confirmed that the test was positive for neural structure on one side, it was necessary to find out at what range (P1) of knee extension (from 90 degrees of knee flexion) the test was positive. Seated slump's test was again performed and the range at which pain or discomfort started was assessed by goniometer. Similar neurodynamic testing procedure along with goniometric assessment for carried out for the opposite extremity. The range at which the pain or discomfort started (P1) during knee extension for both the extremities were compared. The extremity in which P1 occurred early from 90 degrees of knee flexion to knee extension was taken as the involved side. Subjects, in whom seated slump's test was positive only in one extremity and negative in the other, the positive tested extremity was taken as the involved side. The intervention was given on the uninvolved side to determine

the effect on the involved side (contra-lateral tensioner technique). After the pre readings of knee extension range (P1) of involved extremity was noted on day one, treatment technique was given to the uninvolved side, by maintaining all components of neurodynamic sequencing in slump's position -lumbar flexion, thoracic flexion, neck flexion, ankle dorsiflexion; therapist passively moves the knee into extension from 90 degrees of knee flexion. This is performed for 3 sets of 2 minutes each interspersed with 1 minute rest period between each set, daily for six days. On the sixth day after intervention, post readings of knee extension range of motion (P1) noted on the involved extremity. The subject was asked not to perform any technique at home or take any kind of treatment for the lower limb for one week and was called after a week. After one week, seated slump's test was performed again on the involved extremity of subject and the range at which pain or discomfort started was noted to find the longetivity of the treatment manoeuvre.

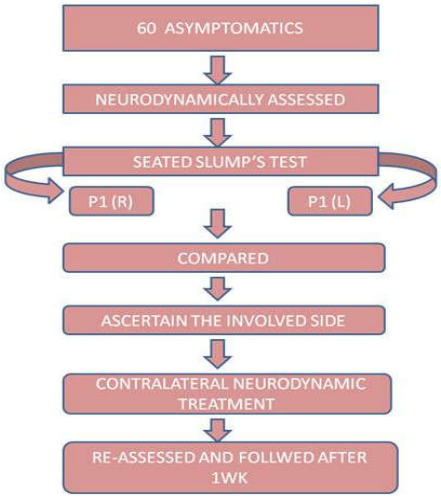

Figure 1 Flowchart of the methodology involved

Randomly selected3 sets of treatment for 6 days on the 6th Day

RESULTS

All analysis was conducted with SPSS for Windows, version 20.0. Normality of the data was found by using the Kolmogrov-Smirnov test. Comparison of pre and post values was done by paired T–Test. P was set at 0.05 and differences were considered significant if p value was less than 0.05.

Table 1 Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Knee Extension Pre Day-1	36.97	60	6.115	.789
	Knee Extension Post Day-6	53.80	60	6.383	.824
Pair 2	Knee Extension Post Day-6	53.80	60	6.383	.824
	Knee Extension 1Week Follow up	49.48	60	5.815	.751
Pair 3	Knee Extension Pre Day-1	36.97	60	6.115	.789
	Knee Extension 1Week Follow up	49.48	60	5.815	.751

Table 2

		t	df	Sig. (2-tailed)
Pair 1	Knee Extension Pre Day-1 - Knee Extension Post Day-6	-19.982	59	.000
Pair 2	Knee Extension Post Day-6 - Knee Extension 1Week Follow up	7.056	59	.000
Pair 3	Knee Extension Pre Day-1 - Knee Extension 1Week Follow up	-17.617	59	.000

Since all P-values are < 0.05 there is a significant change between each pair of readings. There is a statistically significant difference in the range of knee extension (P1) in asymptomatics. Therefore, we can ascertain that the contra-lateral neurodynamic (tensioner) technique results in significant improvement in the knee extension range (P1) in asymptomatics.

DISCUSSION

The percentage of samples included in the research was 100. There were 95% females and 5% males with the right extremity affection of about 73.3% and left extremity affection of about 26.7%. The average mean calculated in the study was 22.97. A Kolmogorov Smirnov test showed that the samples were distributed normally in the study. In all the samples included in the study were 60 participants. On the first day before the intervention was given, the mean value obtained was 36.97. On the sixth day after the intervention, the mean value obtained was 53.80. Thus the mean value significantly increased from day1 to day 6. After the neurodynamic assessment, subjects were treated with contra-lateral tensioner technique in slumps position and the P1 value during knee extension of the involved side was noted. Subjects when called for a follow up after one week, there was a slight decrease in the range of knee extension (P1) which was definitely more than the knee extension obtained on day 1 pre- intervention. The average mean obtained after a one week follow up was 49.48.

In symptomatic patients (e.g. sciatica), there is a distracting pain that starts in the lower back and extends down into one or both legs. The severity of the symptoms may vary. The symptomatic side may be too painful to be treated. At this point the contra-lateral neurodynamic treatment method is more beneficial, as in this, the technique is given on the unaffected side without mobilizing the affected side. Hence, there are no harmful effects on the affected extremity. Also according to Michael Shacklock patient would tolerate mobilisations. Tension in nerves produces some reduction in intra-neural blood flow. If given beyond an elastic limit, it will result in blockage of the vessels. Application of the tensioner technique on the contra-lateral or the unaffected side will not aggravate or worsen the symptoms on the affected side as it remains stationary. Hence, this study was done with the intention to find out the effects of the above technique in asymptomatics so that they can be used later in the patient's population.

The nerve roots interact across the spinal cord and produce movement in the cord during contra-lateral neurodynamic technique. The contralateral technique is based on the following principles:

- The nerve roots are in their neutral position.
- The ipsi-lateral nerve root is pulled and under tension.
- The ipsi-lateral nerve root has loosened because the spinal cord has moved downward by pulling of the contra-lateral nerve.

Lumbar nerve roots lie more parallel to each other compared to the cervical nerve roots. Cervical and lumbar nerve roots diverge from spinal cord at an angle. This contains two component vectors, horizontal and vertical. The vertical

vector is relevant as it is what produces the spinal cord movement necessary to reduce tension in the contra-lateral nerve root. As the contra-lateral technique is performed forces enter the spinal cord through contra-lateral nerve roots. The vertical component force passing along the contra-lateral nerve root causes the spinal cord to descend in the canal. This movement is most likely small but is sufficient enough to transmit a reduction of tension through the vertical component of ipsi-lateral nerve root (Louis R 1981, M. Shacklock 2005). During body movement, tension is applied to the nervous system at the site at which the force is initiated. As the force increases, the ensuing tension takes a short time to be transmitted further along the system. This slight delay is caused by the nervous system being visco-elastic and slightly wrinkled and loose whilst at rest. Forces pass along the system as slack is taken up. In the early part of joint motion, the primary event in the nervous system is taking up of slack. In the mid-range, slack is absorbed and neural sliding rate increases. In the later part slack and the capacity of the nerves to pass decreases causing tension in the nerves to rise. Thus, a tensioner is performed more towards the end-range of joint motion.

Effects of tensioner technique

It produces an increase in tension in the neural structures. It relies on the natural visco- elasticity of nervous system and does not pass the elastic limit (M. Shacklock 2005, Herrington, L. 2006). It does not produce any damage and when performed gently, may increase the viscoelastic and physiological functions (intra-neural blood flow, axoplasm functioning mechano-sensitivity, sympathetic activation, vibration) (Butler, D. S. 2000, Talebi, G. *et al* 2010). It is applied to the neural tissue by increasing the distance between each end of the nerve tract i.e. elongating the telescope or nerve bed in which the nerves are contained and attached at each end. A key feature of the tensioner is that, in addition to the joints being moved the innervated tissue is used to apply tension to the nerve. In lower limbs, dorsiflexion of the foot and toes can be used to apply tension to the sciatic nerve as this movement is combined with straight leg raise or slumps technique.

The slump's test is an example of using the points of nervous system fixation at each end of the nerve tract to apply elongational forces to nervous system. The nervous system is attached at its container at the top end by the dura inserting into the cranium and its bottom end by the digital nerves terminating in the toes. Hence movements that increases the distance between the two end points in the nervous system (at the head and feet) will increase tension in the nerves and evoke neural movement. Flexion of the spine opens up the inter-vertebral foramina and helps in better nerve mobility. Several authors have suggested that cervical flexion (Breig & Marions, 1963; Breig & Troup, 1979b; Lew *et al*. 1994; Shacklock, 2007; Troup, 1986) and general spinal flexion (Inman & Saunders, 1941; Penning & Wilmink, 1981; Shacklock, 2007) induces cephalic movement of the lumbar nerve roots. Neck movements, particularly flexion and extension produce changes in position and tension in the lumbar spinal cord and the nerve root. Performance of seated slumps test produces symptoms at the back of thigh or calf or both. When the limb is held stationary in the testing position and the same test is performed on contra-lateral side the symptoms in the held limb often subsides. This is normal and it occurs due to the relation between the angles of nerve roots and spinal cord movement. The spinal cord is an organ which extends from the cranium up to the lower border of L1 vertebrae. It works in unison. So any changes in the cervical spine will produce changes in the lumbar spine and vice-versa. Improving the physiological as well as the mechanical functions of the nervous system through the neurodynamic treatment is an integral part of the Shacklokck's concept of neurodynamics. Based on the findings of this study, there was a significant improvement seen in the range of knee extension (P1) in asymptomatic group. However further research is needed to find the efficacy of the contra-lateral neurodynamics in low back dysfunctions with radiating symptoms.

CONCLUSION

In this study, there is significant improvement in the range of knee extension (P1) assessed in the slump's position at the end of the treatment session on 6th day and the effect is maintained over a period of one week where no intervention is given. From the research it can therefore be concluded that the contra-lateral neurodynamic technique is effective in increasing the extensibility of sciatic nerve in asymptomatic subjects.

Clinical Implication

The contra-lateral neurodynamic tensioner technique helps the therapist to nudge into deeper tissues, which the patient will not allow if the affected extremity is to be mobilised. Therefore, it can be hypothesized that the above technique can be used in patients with severe low back pain presenting with radiating symptoms.

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