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Efficacy of contra-lateral neurodynamics on median nerve extensibility in cervical radiculopathy patients

Dr. Shivani Chowdhury Salian[1], Neha Vaidya Sachdeva[2]

[1] Ph. D (Electrotherapy), Professor and Head, Department of Electrotherapy and Electrodiagnosis, School of Physiotherapy, D.Y. Patil University, Nerul, Navi Mumbai, Maharashtra, India

[2] PG, Physiotherapist, Department of Electrotherapy and Electrodiagnosis, School of Physiotherapy, D.Y. Patil University, Nerul, Navi Mumbai, Maharashtra, India

Abstract

This study was done to find the efficacy of the contra-lateral sliders neurodynamics (NDS) in the treatment of patients presenting with cervical radiculopathy. Thirty asymptomatic male and female subjects between the ages 18 to 76 years were involved in the study. Neurodynamic testing and sequence for Median nerve test-1(MNT1) was performed for structural differentiation. Intervention was given for six days on the uninvolved side to determine the effect of MNT 1 contra-lateral sliders technique on the involved side. Pre and post readings of Visual analogue scale (VAS) pain measurement, cervical range of motion (ROM) and elbow ROM were noted on the involved extremity. One week after intervention, MNT1 test was performed again on the involved upper extremity of subject and the outcome measures were noted to find the efficacy of the contralateral slider NDS. The results of study revealed there was a significant improvement in the cervical ROM assessed in sitting and supine positions, significant improvement in elbow ROM assessed in MNT1 position post contra-lateral sliders NDS treatment in cervical radiculopathy. Therefore, we can ascertain that contra-lateral slider NDS technique is clinically efficacious in treatment of cervical radiculopathy in adult patients.

Keywords: neurodynamic solutions, median nerve test MNT1, cervical radiculopathy, adults, contralateral sliders technique, cervical ROM, elbow ROM, VAS

Introduction

Cervical radiculopathy is a disorder involving the dysfunction of cervical nerve roots that commonly manifests as pain radiating from the neck into the distribution of the affected nerve root [1]. Various conditions causing cervical radiculopathy comprise cervical disk herniation, bone spurs- in cervical spondylosis, cervical rib, spinal stenosis, Thoracic Outlet Syndrome, whiplash injuries [2, 3].

There are various therapeutic interventions to treat cervical radiculopathy like cervical collar, cervical traction, neck exercises, ice, rest, moist heat, ultrasound, TENS, cervical spine mobilization, neural mobilization [4, 5]. Mobilisation of the nervous system (MOTNS) has emerged successfully as an effective adjunct to assessment and treatment of pain syndromes [6-10]. A strong relation between the surrounding somatic tissue and the neural tissue has been established. Also, adaptations are made in the neural system based on fascicular structure, depth of the nerve and connection to the somatic tissue [9]. An important aspect of Shacklock's approach is that healthy mechanics of the nervous system enable pain-free posture and movement to be achieved. However, in the presence of patho-mechanics of neural tissues (e.g. nerve entrapment), symptoms may be provoked during daily activities [11].The nervous system possesses a natural ability to move and withstand mechanical forces that are generated by daily movements. This capacity is essential in the prevention of injury and malfunction. For the nervous system to move normally, it must successfully execute three primary mechanical functions; withstand tension, slide in its container, and be compressible. Neurogenic disorders are common and their incidence is probably underestimated [12]. With many recent developments in their management, it is merciful that they can now be treated with non-invasive physical methods.

Neural mobilizations have at times been the mainstay of treatment, rather than being applied in a way that addresses how the body really moves, that is, in an integrated fashion that includes the relational dynamics between both the neural and musculoskeletal systems. One of the key aspects in the treatment of neurodynamic problems is conjunction with the musculoskeletal system. After all, many neural problems have their causes in the musculoskeletal system and, unfortunately, the emphasis in the past has been on mobilizing the nervous system per se, at the expense of integrating treatment of the musculoskeletal system.

Ultimately, all mechanical events in the nervous system stem from these three functions, such that the more complex mechanical events that occur during human movement are merely combinations of tension, sliding and compression. These three primary events occur in both peripheral and central nervous systems. However, they are often achieved in different ways because of the existence of regional differences in anatomy and biomechanics. Always, each of the component mechanical events will interact with the others.

Neurodynamics (NDS) is a term referring to the integrated biomechanical, physiological and morphological functions of the nervous system. An application of a contra-lateral NDS therapy helps to reduce tension in ipsilateral nerve root [13].

Median nerve is formed by the C5-C8 and T1 nerve roots. In the axilla it courses on the lateral side of axillary artery and crosses it to join the lateral root of lateral cord. In the arm it runs on the lateral side of brachial artery, crosses it and passes anterior to the elbow joint into the forearm. In the forearm it passes between the two heads of pronator teres, then deep to flexor digitorum profundus, palmaris longus and enters the palm by passing under the flexor retinaculum. In the palm it lies medial to the muscles of thenar eminence [14].

Rubenach [15] found that 62% of subjects reported a reduction in the symptom response to MNT1 with performance of contra-lateral MNT1.

If we consider the tension to the nervous system as the key to mechanism of symptoms with MNT1, adding more tension to the nervous system with contra-lateral neurodynamic movement should theoretically increase the symptoms with contra-lateral test. But since the symptoms often reduce, a different mechanism related to contra-lateral effects must operate. Also, contra-lateral techniques of intervention make it achievable to reach deeper tissues and cross the barriers of pain and discomfort particularly in patients with acute symptoms on whom ipsilateral treatment may not be possible [16].

As very few studies have been done to study the efficacy of neural mobilization on the contra-lateral side in cervical radiculopathy, this study intends to do so, in order to alleviate the symptoms of the condition, the hypothesis being Contra-lateral Neurodynamics is effective in improving the median nerve extensibility in cervical radiculopathy patients.

Methodology: (Refer Figure 1)

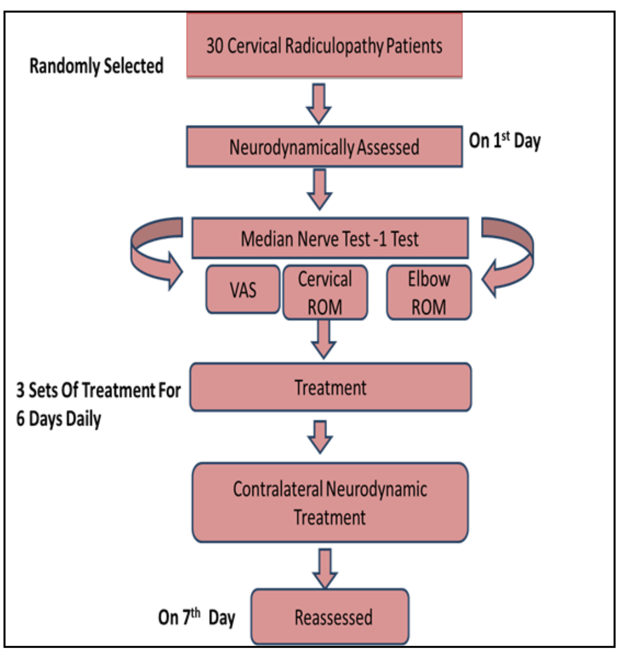

Fig 1: Flowchart of the methodology involved

A cross-sectional study was conducted in the School of Physiotherapy, D.Y.Patil University, Nerul, Navi Mumbai wherein 30 adult male and female patients with cervical radiculopathy of all age groups testing positive for MNT1 participated. The study protocol was sanctioned through the Institutional Ethics committee as per the ethical guideline for Biomedical Research on Human subjects, 2000 ICMR, New Delhi. The data sample comprised patients visiting the Musculoskeletal Physiotherapy OPD in D.Y.Patil Hospital and research centre, Nerul, Navi Mumbai. Prior to enrolling the patients for the study they were explained the purpose of the research study via an information sheet in the language best understood by them. The consenting patients were enrolled in the study. Patients with fractures in the upper extremity, any other orthopaedic condition in both upper extremity and any neurological condition were excluded from the data. The outcome measures comprised ROM at the elbow denoting P1 i.e. occurrence of symptoms, ROM of the cervical spine using an inclinometer and visual analogue scale (VAS) measuring subjective patient pain.

Methodology included the patients to undergo MNT1 test where they were made to lay supine-scapula stabilised, shoulder flush with the edge of the couch, as little abduction as possible, no pillow required. Elbow in 90 degrees of flexion. The procedure was explained to the patients. Testing position was maintained at arm down by side, elbow at 90 degrees, neutral wrist position followed by glenohumeral abduction and external rotation-upto 90 degrees (in frontal plane, stop shoulder elevation, without depressing the scapula, extend wrist and slowly extend elbow till the point where pain is produced. Differentiation was done with passive lateral flexion of the cervical spine to the contralateral side.

Table 1: Demographics of the patients in the involved study.

Age Groups	
18-25	1
24-30	2
30-36	6
36-42	6
42-48	2
48-54	2
54-60	5
60-66	3
66-72	2
72-78	1
Total	30
Gender	
Females	23
Males	7
Total	30
Affected extremity	
Lt	12
Rt	18
Total	30

Pain was assessed subjectively on VAS between 0 to 10 by asking the patient to mark between these two values, 0-being minimum and 10 being maximum. ROM of rotations at cervical spine was assessed in supine with an inclinometer. Cervical flexion, cervical extension and cervical lateral flexion (right and left) were assessed in seated position with an inclinometer. MNT1 procedure is performed with sliders on contra-lateral side in 3 sets of 20 each. The intervention was performed for six days. On the seventh day the outcome measures are re-assessed.

Results

Statistical analysis was conducted using SPSS version 20. Demographics of the data was as shown in Table 1.

30 patients both males and females between the age group 18-76 years presenting the cervical radiculopathy radiating to either of the upper limbs comprised the data sample.

After six days of treatment the outcome measures were assessed and noted in all the patients on the seventh day.

Table 2 shows the values of statistical analysis.

Table 2: Comparison between the outcome measures recorded pre and post contralateral slider technique to the upper limb.

		Mean		Std. dev		t value	Sig.
S. No		Pre	Post	Pre	Post		
1.	VAS	6.47	1.53	±2.21	±1.98	12.048	0.00
2.	Elbow ROM	39.3	79.33	±14.55	±9.14	-10.522	0.00
3.	Cervical Flexion	55.37	62.53	±13.11	±9.69	-4.3	0.00
4.	Cervical Extension	56.63	61.87	±15.64	±14.02	-3.201	0.003
5.	Cervical lateral flexion (Left)	45.9	51.53	±12.41	±12.76	-3.76	0.001
6.	Cervical lateral flexion (Right)	45.3	49.2	±14.32	±9.91	-2.279	0.03
7.	Left cervical rotation	64.73	70.07	±13.17	±12.79	-3.641	0.001
8.	Right cervical rotation	65.03	69.7	±15.22	±14.29	-3.553	0.001

Normality of the data was found by using the Kolmogrov-Smirnov test. Comparison of pre and post values was done by paired T-Test at 95% CI.

Statistical analysis showed a statistically significant difference in the pain levels denoted by VAS in cervical radiculopathy patients before and after the intervention. Therefore, we can ascertain that contra-lateral neurodynamics decreases pain levels denoted by VAS in cervical radiculopathy patients. There was a statistically significant difference in the elbow range of motion in cervical radiculopathy patients before and after the intervention. Therefore we can ascertain that contra-lateral neurodynamics causes improvement in the elbow range of motion in cervical radiculopathy patients. Also, there was a statistically significant difference in the cervical range of motion in cervical radiculopathy patients before and after the intervention. Therefore we can ascertain that contra-lateral neurodynamics causes improvement in the cervical range of motion in cervical radiculopathy patients.

Discussion

A total of 30 patients of cervical radiculopathy of all age groups and testing positive for Median Nerve Test-1 were selected for this study. There were 23% males and 77%females.The data was normally distributed as calculated by the Kolmogorov-Smirnov test. Therefore the parametric t-test was used to analyse the data. The outcome measures used to evaluate their complaints were Visual Analogue Scale (VAS), Elbow Range of Motion (ROM) and Cervical Ranges. Intervention was performed on the contra-lateral upper limb from day 1 to day 6 and reassessment was done on day 7 to check the effectiveness of the treatment.

Statistical Analysis of values of all the outcome measures i.e. VAS, Elbow Range, and Cervical Range showed significant improvement.

Many studies have been done to assess the efficacy of ipsilateral neurodynamics in symptomatic individuals. However, the efficacy of neurodynamics solution techniques on symptoms by using contra-lateral intervention was yet to be assessed. Also, when a patient presents with acute radicular symptoms, he/she may not allow intervention on the ipsilateral side. This is where the advantage of the contra-lateral intervention lies. Also, the contra-lateral method has no adverse effects. Studies in the past have aimed to measure longitudinal excursion and strain in the median and ulnar nerve at the wrist and proximal to the elbow during different types of nerve gliding exercises. The results confirmed the clinical assumption that sliding techniques results in a substantially larger excursion of the nerve than tensioning techniques [17]

According to Shacklock M., the most common cause of cervical radiculopathy is malfunction or pathology in the mechanical interface. The sequelae then consist of pressure on the nerve root, reduced venous return, further increases in tissue fluid pressure and hypoxia and mechano-sensitivity in the nerve root. This is compounded by the motion segment sometimes showing altered movement, which may then cause further neural irritation and inflammation. Consequently, a positive outcome it terms of range of motion, strength and function with neural mobilization for the left median nerve performing 3 sets 10 times each with 1Hz amplitude along with conventional treatment was demonstrated with studies. Additionally, it is possible for a sudden and short-lived injury to cause long term primary neural problems. Such triggers could consist of stretch to the brachial plexus or a short-lived compression of a nerve root with an unaccustomed or traumatic closing movement such as extension or ipsilateral rotation or lateral flexion [18].

In the patient with neck and arm pain, it is possible that two basic kinds of mechanical interface dysfunction exist. The first involves direct pressure on the nerve root and axons, such as that produced by a large disc bulge, and correlates with the tourniquet effect. The second is the mechanical dysfunction in which opening and closing dysfunctions such as instability, hypermobility and hypomobility may produce mechanical irritation. The end result involves several common mechanisms, namely altered intraneural pressure, inflammation and ischaemia and hypoxia. Consequently, the treatments for different nerve root problems often descend towards similar techniques that initially focus on the reduction of pressure on the root. Release of pressure in this situation may help venous return, improve resolution of the inflammatory process in the nerve root, reduce tissue fluid pressures and improve intraneural circulation. Therefore, from a clinical neurodynamics point of view, the most effective treatment of the problem with a preponderance of distal symptoms is usually to use opening techniques to start with. This is also because inflamed and exquisitely sensitive neural tissues generally do not respond well to changes in tension or pressure [18].

The nervous system is a continuum and a very long organ. As such, it provides unique features that explain many clinical problems that are not attributable to other systems and can be utilized by clinicians who treat neuro-musculoskeletal problems. The following illustrates the value in making clinical use of the length of the system [19].

Neck movements, particularly flexion and extension, produce changes in position and tension in the lumbar spinal cord and nerve roots. During body movement, tension is applied to the nervous system at the site at which the force is first initiated. As the force increases, the resultant tension takes a short time to be transmitted further along the system [20]. This slight delay is caused by the nervous system being viscoelastic and slightly wrinkled and loose whilst at rest [21-23]. Forces pass along the system as the slack in the system is taken up.

For a movement of one motion segment, gentle forces are transmitted only a short distance along the nervous system and will be dissipated easily. As the applied force increases in magnitude, its effects spread further along the nervous system from the site of force application [20]. This has important implications for the clinician because force and range of joint movement are significant variables in neurodynamic testing. When the nervous system is in a relaxed state, gentle forces produce local effects. However, in the tensioned state, even small forces can be used to move neural tissue that is located far remote from the site of force application.

Contra-lateral-Neurodynamics work on principle (Fig 22) which assumes that when the ipsilateral nerve root is trapped or tensed the technique firstly, concentrates on placing the nerve roots in neutral position which when followed by contra-lateral nerve root mobilisation technique loosens the ipsilateral nerve root by pulling down the entire spinal cord. As proposed, it appears that it is this downward movement of the spinal cord that produces reduction in tension in nerve roots [24].

Performance of the median neurodynamic test 1 normally produces symptoms in the ventral elbow and forearm regions [25]. When the test is held stationary and the same test is performed on the contra-lateral upper limb, the symptoms in the held limb often subside [6, 15]. Contra-lateral neurodynamics test reduces the response in the held side. It resides in the relationships between the angles of the nerve roots and spinal cord movement.

The cervical and lumbar nerve roots diverge from the spinal cord at an angle. This angle contains two component vectors, horizontal and vertical. The vertical vector is particularly relevant because it is what produces the spinal cord movements necessary to reduce tension in the contra-lateral nerve root. As the contra-lateral neurodynamic test is performed, forces enter the spinal cord through the contra-lateral nerve roots. The vertical component force passing along the contra-lateral nerve root causes the spinal cord to descend in the canal. Cadaveric observations similar to those of Michael Shacklock were made by Louis to ascertain the downward movement of the cord which is most likely small but is sufficient to transmit a reduction of tension through the vertical component of the ipsilateral held nerve root [26].

The event of a contra-lateral technique producing a change in symptoms in a limb that is held in a neurodynamic position will, at times, constitute evidence of a neurodynamic mechanism to the symptoms. Treatment with contra-lateral techniques can be justified in some circumstances, especially if the technique produces an improvement and can be integrated into the rest of patient management [27].

The present study chose to use slider contralateral neurodynamics treatment for patients presenting with cervical radiculopathy based on the physiological effects of the slider technique. Slider techniques can be excellent for neural problems in which pain is the key symptom. This is because they may milk the nerves of inflammatory exudates and produce increased venous blood flow thereby increasing oxygenation of the neural tissues. The result is thought to be improvement of the inflammation hypoxia cycle that develops in the nerves. It could also be because movement may help control pain at a central nervous system level. Slider techniques are also applied to conditions that involve specific neural sliding dysfunctions at low levels and serve as a primary mobilization aimed at treating the dysfunction. For this, they can be applied to the sliding dysfunctions at any level. Slider techniques are used as a secondary mobilization for tension dysfunctions and high level combinations so as to reduce the after-effect of mobilizations [28].

Slider techniques cause movement without tension. The value of neural sliders is that they produce significant movement in nerves without generating much tension or compression. Consequently, sliders are generally more useful in the reduction of pain and improving excursion of the nerves. To perform a slider, longitudinal force is applied at one end of the nerve tract whilst tension is released at the other. In an attempt to reduce tension, the nerves slide toward the point where tension is applied, or 'down the tension gradient [28].

Spinal movements bring about changes in the cervical spine causing a mechanical interface thereby altering spinal canal length. Flexion of the whole spine causes elongation of the spinal neural structures because they, and their canal, are located behind the axis of rotation of the spinal motion segments. This places them on the side that elongates and shortens with flexion and extension respectively [26]. Since the neural structures are attached at their caudal end to the coccyx by the highly elastic filum terminale and the cephalic end by the dura to the skull, with flexion, the neural structures are pulled from both ends.

Mechanical diagnosis leads the therapist toward a specific mechanical treatment. If a tension problem exists, a focus can be on improving the ability of the neural structures to respond to tension. Alternatively, the emphasis may be on preventing tension in the nerves so that they have a chance to settle. If a problem is predominantly a closing interface problem, then a treatment technique to improve this mechanism could be performed. Conversely, another choice of treatment for this problem might be to open the interface so that provocation of the neural structures is reduced. These points highlight the need for the clinician to link mechanical diagnosis to the causal mechanisms that produce specific clinical patterns

The key event with lateral flexion in relation to the mechanical interface is that the intervertebral foraminae close down around the nerve roots on the ipsilateral side and open up on the contra-lateral [29]. Increased pressure on the nerve roots will therefore occur on the ipsilateral side and decreased pressure on the contra-lateral side will result.

Lateral flexion produces increased tension in the neural structures on the convex side of the spine and reduces tension in those on the concave side [26, 30, 31]. In this situation, increased tension in the nervous system occurs through two mechanisms. The first is that lateral flexion itself produces elongation of the interface and neural tissues on the convex side. The second mechanism is by causing an increase in the distance between the spine and periphery by the sideways translation of the vertebrae (lateral glide). This produces mechanical stresses that pass along the peripheral nervous system

The primary event in the interface with spinal rotation is that the intervertebral foraminae on the ipsilateral side close down whereas, on the contra-lateral side, they open up[29]. Hence, in assessing closing mechanisms, a small degree of ipsilateral rotation can be combined with flexion or extension movements to ascertain whether a rotational element exists in an interface component of nerve root problems

The circumference of the spinal cord in the neck reduces with rotation [32], as if it were being rung out like a wet towel. It is not clear whether this has any significance for neurodynamic testing but it is possible that, in some patients, rotation can be applied to neurodynamic testing if it meets the patient's needs. An example of this would be the patient in whom a neurogenic symptom is provoked with neck rotation and arm movements. The appropriate upper limb neurodynamic test can be performed with neck rotation as a component of thetest. In the lumbar spine, it is common for rotation in combination with the SLR to be an effective treatment technique for low back and posterior thigh pain, given the correct choice of patient [33].

Although we had observed improvement in cervical range of motion, no pinpoint precise explanation can be commented upon at this stage regarding the increase in range of motion as no evaluation was done at the skeletal level of the cervical spine.

However it can be that the mere comfort level of the patient after NDS may have lead to the significant increment in the range of motion.

Therefore, studies need to be done to ascertain the exact reason of increase in the range of motion that occurs at the bony level post soft tissue mobilization.

Conclusion.

Post contra-lateral neurodynamic treatment there was significant reduction in pain levels evaluated by Visual Analogue Scale. There was also significant improvement in the cervical ranges of motion assessed in sitting and supine positions post contra-lateral NDS treatment in cervical radiculopathy. Also, there was significant improvement in elbow range of motion assessed in MNT1 position post contra-lateral NDS treatment in cervical radiculopathy.

In conclusion we can ascertain that contra-lateral neurodynamic intervention is effective in improving median nerve extensibility in cervical radiculopathy patients.

Clinical Implications

Based on the findings of the present research study there was significant improvement in the pain levels, elbow range of motion and cervical ranges on the symptomatic upper limb. This technique can therefore be used in patients with acute radicular symptoms where the affected upper limb cannot be mobilised due to pain. The advantage of this technique is that if the patient presents with acute symptoms, the therapist can nudge into deeper tissues on the contra-lateral side and is able to successfully treat the affected tissues on the ipsilateral side.

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