International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Effect of Tibial Nerve Mobilization on Nerve Conduction Velocity in Diabetic Neuropathy Patient

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ABSTRACT

Background: Diabetic neuropathy is a noteworthy reason for neuropathy worldwide and may prompt removal and inadequacy. Distal symmetrical polyneuropathy presents sensory and autonomic symptoms with predominant involvement of small fibers, evolving with the involvement of sensory large fibers and finally motor fibers in its more severe stages. Sensory disturbance is normally observed, and mostly recognized is the loss of vibration sense at the toes, checked by pinprick, temperature, and light touch sensations. Nerve mobilization is a technique to reduce injuries or to assist in upgrading performance in activities included in the management. It helps in improving the strength.
Objective: The aim of the current study was to find out the effect of tibial nerve mobilization on nerve conduction velocity in diabetic neuropathy patients. This was an experimental study using NCV test and nerve mobilization technique.
Method: Twenty participants were included between the age group of 50-60 years diagnosed with diabetic neuropathy. Tibial nerve mobilization technique was performed in the participant's lower limbs, pre and post sensory nerve conduction velocity was assessed. Outcome measure used in this study will be nerve conduction velocity test.
Result: The study showed that there was statistically significant difference in the nerve conduction velocity after giving the intervention for three weeks. ('p'= <0.05,'t'= 2.22)
Conclusion: The study showed that the SNCV of the dominant limb improved as compared to the pre-intervention SNCV. Thus, this study concluded that tibial nerve mobilization technique canimprove the nerve conduction velocity and helps subside the burning sensation in individuals.

Keywords: Diabetic Neuropathy, Tibial NM, NCV

INTRODUCTION

Diabetes mellitus is portrayed by chronic hyperglycemia with disruption of starches, fat and protein digestion coming about because of deformities in insulin emission, insulin activity or both. As indicated by diabetes atlas 2006 distributed by the worldwide diabetes league people with diabetes in India are around 40.9 million and are relied upon to ascend to 69.9 million by 2025 except if critical preventive advances are taken.[1] Diabetic neuropathy is a noteworthy reason for neuropathy worldwide and may prompt removal and inadequacy. It is evaluated that 371 million individuals matured from 20 to 79 years, worldwide have diabetes mellitus and at any rate half of them are informed. It is a heterogeneous arrangement of clinical or subclinical sign influencing the peripheral nervous system as an enlargement of diabetes mellitus. Among diabetic neuropathy patients, roughly 20% have neuropathic torment, inferring critical abatement in quality of life.[2] Patients with

type 2 diabetes mellitus may give distal polyneuropathy after just a couple of long periods of known poor glycemic control, some of the time these patients as of now have neuropathy at the time of diagnosis.[3] Distal symmetrical polyneuropathy presents sensory and autonomic symptoms with predominant involvement of small fibers, evolving with the involvement of sensory large fibers and finally motor fibers in its more severe stages.[2] The positive symptoms of diabetic neuropathy may be hypersensitivity to touch, electric shock like feeling of burning, pricking, pain, tingling and negative sensory symptoms are feeling of numbness and painless injury due to loss of sensation.[1] Diabetic neuropathy is noteworthy hazard factor for ulcers, deformities and removal and for the advancement of other micro vascular complexities.[2]

Peripheral nerve involvement is highly frequent in diabetes mellitus and it has been documented that 1/3 of diabetic patients have peripheral neuropathy. Incidence of tibial and sural nerve is more common i.e.86% and 82% respectively.[3] A sound nerve conducts signals quicker with more noteworthy speed and quality than the affected nerve. The speed of nerve conduction is impacted by the myelin sheath that gives protective covering, which encompasses the nerve. Most neuropathies are caused by harm to the nerve axons neither than harm to the myelin sheath enclosing the nerve.[4] Tibial nerve is the most widely recognized of all limb mono neuropathies. Association of the motor fibers in the regular peroneal nerve results in shortcoming of the dorsiflexors and "foot drop", yet loss of the motor supply to the tibialis anterior muscle additionally prompts shortcoming in eversion. This is went with by a sensory deficit.

Tibial nerve is the largest branch of sciatic nerve. It originates from ventral branch of 4^{th} and 5^{th} lumbar region and 1^{st} and 3^{rd} sacral region. It drives along the posterior aspect of the thigh and the popliteal fossa to the distal margin of the popliteal muscle. The tibial nerve can be subjected to extend amid the leg movements or various leg positions specially, ankle joint dorsiflexion and inversion of the foot. Therefore the nerve needs to adjust to such changes through its mechanical properties.[5] The large fiber compose symmetric polyneuropathies, loss of lower leg reflexes, diminished position and vibratory senses and sensory ataxia are present. Large fiber neuropathies may include tactile or motor nerves. These have a tendency to be the neuropathies of signs as opposed to side effects since large filaments subserve motor work, vibration discernment, position sense and cool thermal recognition. Dissimilar to the small filaments, these are the myelinated, fast leading fibers that start in the toes and have their first neural connection in the medulla. They have a tendency to be influenced first because of their length and the propensity in diabetes for nerves to "die back" (Vinik and Mehrabyan). Though sensory disturbances influences prevail in diabetic polyneuropathy, muscle weakness in distal part in the lower limbs might be available, more often in advanced cases, and is accepted to be identified with the neurogenic atrophy caused by motor axon degeneration.[6] Hyperglycemia prompts osmotic swelling of the nerves with damage to the axons and myelin sheath, which triggers the beginning of neuropathy. Patients ordinarily present with complaints of shivering, numbness, or prickling sensations influencing the feet. The symptoms are frequently observed in both limbs what's more, in an unsymmetrical distribution. The most regular sign is the absence of lower leg reflexes. Sensory disturbance is likewise normally observed, and the most widely recognized is the loss of vibration sense at the toes, took after by pinprick, temperature, and light touch sensations. Cross Sectional Area of the tibial nerve was at its most extreme in the diabetic patients with diabetic neuropathy, followed by diabetic patients without neuropathy and the non-diabetic healthy

volunteers. Subsequently, CSA of the tibial nerve might be utilized as a marker for identifying DN and furthermore in the evaluation of its seriousness. Also, there is maximum thickness of nerve fascicles of tibial nerve in patients with diabetic peripheral neuropathy than other patients with diabetes.[7] The traditional intervention for diabetic neuropathy consist of pharmacology treatment which includes the use of aldose reductase inhibitors and vasodilators have been shown to improve nerve regeneration.[8] The physiotherapy intervention involves application of TENS and sensory re-education to the lower limbs.

A nerve conduction study is a test, which is utilized to assess the functional capacity of electrical conduction of the motor and sensory nerve of the human body. [2] Nerve conduction velocity (NCV) empower the clinician to recognize signs that can't be affirmed by neurological examination alone and can manage diagnosis and treatment. [9] This process is known as electro diagnostic testing. NCV are utilized to screen nerve function after sometime to decide progression of disease, to survey complexities of treatment and in addition distinguishing the disease course. [10] Nerve conduction studies is thought to be the most sensitive, dependable, non-obtrusive and objective method for examination of diabetic polyneuropathy. [11] Exact separation and latency estimations are expected to guarantee precise nerve conduction values. This study aims to investigate the effect of tibial nerve mobilization on improving the nerve conduction velocity in diabetic neuropathy patients.

Neuro dynamic mobilization technique was first described in 1985 by Maitland, then in 1986 by Elvey and Butler then refined it in 1991 as an aide to assessment and treatment of neural pain syndromes. Michael Shacklock in 1995 depicted that neuro dynamic assembly adds to reestablishing the capacity of the sensory tissue itself to stress and pressure, and stimulates the recreation of ordinary physiological capacity of nerve cells alongside pain relief and functional enhancement.[12] The effects of Neuro dynamic mobilization were studied in many conditions such as carpal tunnel syndrome, cubital tunnel syndrome, radial tunnel syndrome, lateral epicondylitis, thoracic outlet syndrome, cervical cord compression, cervical radiculopathy, cervicobrachial pain syndrome, non-radicular low back pain, lumbar nerve root irritation, lower extremity symptoms and lumbar spine.[13] Neuro dynamic is an intervention for re-establishing the homeostasis in and around the nervous system by preparation of nervous system itself or the structures that encompass the nervous system. Neural activation could be accomplished through dynamic activities or uninvolved procedure. [14] Power and stretch can endanger the blood supply to the nerve, prompting ischemia that can influence the nerve work. [5] Nerve mobilization is a technique to reduce injuries or to assist in upgrading performance in activities included in the management. It helps in improving the strength. Nerve and muscle creates electrical signs that convey message to and from the brain. Injury and illness that influences nerves and muscles can back off or stop the development of this electrical signs. [15] The capacity of peripheral nerves to stretch and slide is believed to be significant to keep up perfect neural capacity. [16] This is known as nerve mobilization.

Purpose of the study

Distal symmetrical polyneuropathy is the commonest type in diabetic neuropathy. In this the tibial nerve is affected more in diabetic neuropathy patients. Nerve mobilization can be used to reduce the pain and improve the sensation in that region of the nerve where it supplies. Though there are nerve mobilization results proved over radial, medial and ulnar nerve in neurological conditions like Saturday night palsy, Carpal tunnel syndrome, Tardy ulnar nerve palsy etc. but a very few done on

tibial nerve mobilization in diabetic neuropathy patients.

Aim

To find out the effect of tibial nerve mobilization on improving the nerve conduction velocity in diabetic neuropathy patients.

Objective

To determine the improvement of nerve conduction velocity through nerve conduction study by mobilizing the tibial nerve in diabetic neuropathy patients over the period of three weeks.

METHODOLOGY

Study Design and Data collection

An experimental pre-post study design was performed in which the participants underwent the assessment protocol before and after the intervention was completed. The primary data was collected by the principle investigator. The study was conducted in Neuro physiotherapy department. The data was collected from the Department of Medicine, Pravara Institute of Medical Sciences, Loni and Department of Neuro physiotherapy, Dr. A.P.J. Abdul Kalam College of Physiotherapy. The sampling method was convenient sampling. The study received ethical approval from the Institutional Ethical Committee.

Participants

20 participants were selected as per the inclusion criteria. The duration of study was 5 months. The participants were selected according to inclusion and exclusion criteria. Patients diagnosed with diabetic neuropathy with bilateral pinprick sensation over the sole of foot, including both male and female participants within the age group of 50-60 years were included. These participants should have the ability to understand and co-operate for instructions of the test.

Patients with diabetic ulcer and comorbid disorders were excluded.

Equipment's and Outcome measures

NCV test was used as a diagnostic tool. Consent form and neurological assessment kit were the materials used. Sensory nerve conduction velocity (SNCV) was used as an outcome measure.

Intervention

The intervention protocol was built in order to determine the improvement of nerve conduction velocity in diabetic neuropathy patients when tibial nerve mobilization was given. All the participants were screened as per the inclusion and exclusion criteria. The informed consent was obtained from the participants regarding the procedure prior to the study. Pre-intervention NCV test of dominant extremity was assessed to determine the nerve conduction velocity of the patient. The sensory nerve conduction for sural nerve was done by placing the surface electrode (G1 G2) between lateral malleolus and tendoachilles tendon, the stimulating electrode placed at the postero-lateral calf, the stimulating electrode placed at 12cm from the surface electrode (black one) and the ground electrode was placed between the stimulating and recording electrode.

Tibial nerve mobilization: -Patient was positioned in supine lying. Therapist stood at the side which is to be mobilized, of the patient. The mobilization technique was given to both the lower limbs by the principle investigator. Patient's limb was kept in 90-90 position initially and the leg was then extended like in hamstring stretch with the foot kept in eversion. It was performed for 3 times with 1 minute interval in between for each session. Five sessions/week for 3 weeks were given. Then again NCV test was performed post-intervention after three weeks on the dominant extremity in order to check for the improvement on the conduction velocity of the sural nerve.

DATA ANALYSIS AND RESULTS

The objective of this study was to find out the improvement in nerve conduction velocity by mobilizing the tibial

nerve in diabetic neuropathy patients which was analysed on the basis of the results obtained on the conduction velocity from NCV test.

Statistical analysis was done using the Microsoft Excel and using GraphPad Instat version 3.06. Various statistical measures such as mean, standard deviation [S.D.] and test of significance such as student's paired 't' test were utilized to analyze the data. The results were concluded as statistically significant with $p<0.05$ and highly significant with $p<0.001$. Paired 't' test was used to compare the difference in scores between the pre-intervention and post-intervention values within a single group.

Demographics: - A total of fifty participants were screened for the study according to the inclusion and exclusion criteria. Out of which thirty participants were selected, of which ten participants refused to participate and so twenty is the sample size. The study consists of only one group. The mean age of the male participants is 46.33±4.79 years and the mean age of female participants is 50.36±7.24years. The gender ratio of male: female is 9:11.

Table 1: Showing demographic data in tabular form

Group item	Male	Female
Age	46.33 ±4.79 years	50.36 ±7.24 years
Gender	9	11

NCV test as an assessment tool

The improvement in the conduction velocity was measured by NCV test.

The pre intervention SNCV mean average score and standard deviation for NCV assessment in the participants was 21.42±3.08. After three weeks of intervention period the mean average score and standard deviation for NCV assessment in the participants was 25.37±4.90. The mean average difference in pre and post intervention score of the sensory nerve conduction velocity and standard deviation for NCV assessment was 3.95±1.82. There was statistically significant difference in the mean average scores of NCV assessment in participants treated with the mobilization technique ('t'=2.22, df=20, 'p'=<0.05).

Table 2: PRE and POST mean values of the sensory nerve conduction velocity in NCV test

Outcome measures	Pre intervention SNCV	Post intervention SNCV	'P' value[b]	't' value	Result
NCV machine	21.42(3.08)[a]	25.37(4.90)[a]	<0.05	2.22	Considered significant

Where,
Values expressed as mean (SD).
Analyzed by students unpaired't' test.

DISCUSSION

The present result of the study recommends that by performing the tibial nerve mobilization technique on patients helps to improve the conduction velocity of the nerve and thus reducing any neuropathic symptoms. Three weeks of tibial nerve mobilization technique on the patients resulted in significant improvement in nerve conduction velocity of the patients without causing any discomfort or aggravating any symptoms.

The physiological mechanism underlying the reduction in the nerve conduction velocity in the diabetic neuropathic patients is that hyperglycemia prompts osmotic swelling of the nerves with damage to the axons and myelin sheath, which triggers the beginning of neuropathy. Tissue mobility, blood circulation and axonal transport, which are essential for the useful and mechanical integrity of a neuron, will be expanded after the neural mobilization. Tibial nerve activation was adequate to scatter the edema, in this manner easing the hypoxia and diminishing the related indications and increment the nerve conduction speed.

On comparing the nerve conduction velocity of the pre to post intervention it was observed that the result was considered significant ($p<0.001$). The uncontrolled high

blood sugar damages nerves and interferes with their ability to send signals, leading to diabetic neuropathy. High blood sugar also weakens the walls of the small blood vessels that supply the nerves with oxygen and nutrients. The peripheral nerve trunks and their connective tissue sheaths have viscoelastic mechanical properties and consequently they can get adjusted to change in their length by insignificant metabolic and circulatory adjustments. Thus performing nerve mobilization will enhance the nerve conduction velocity by normalizing the axoplasmatic flow.

Patients with diabetic neuropathy usually possess with pinprick sensation, numbness and loss of ankle reflex. Such abnormal sensory and motor sensations can be reduced by mobilization technique given to the tibial nerve as mobilization could certainly effect the peripheral nerve regeneration through the following mechanisms such as decreasing the edema; decline in irregular nerve mechano-sensitivity, with consequent reduction of hyperalgesia and neurogenic inflammation; advancement of appropriate nerve mobility; reducing exposure to trauma; augmented neuronal and glial activity (Schwann cells) through stimulation of movement dependent receptors in the cell membrane.

NCV test for assessing the conduction velocity-

In the NCV results there was significant difference in the nerve conduction velocity in the patients. This positive difference was because the tibial nerve mobilization technique was able to influence the sensory deficits. Three weeks protocol was sufficient for the symptoms to subside. The nerve conduction velocity improved by approximately 4.09 (SD).

Limitations of the study

Dominant and non-dominant differences were not found. There is a lack of long term follow-up. The study was time bound. Certain parameters like latency, amplitude, H reflex were not included. Did not include equal number of male and female. Intervention was limited to only lower extremities.

Recommendation for future study

Study can be expanded to large sample size and in multi centers with patients from various geographical locations. Can include a wide range of age of participants. Further studies with long term follow-up could be included. Self-mobilization technique can be taught to the patient.

CONCLUSION

The conclusions based on the results of difference in pre and post mean scores using the NCV machine as an assessment tool shows that there is considerably significant improvement in the conduction velocity of the sural nerve when tibial nerve mobilization was given along with conventional physiotherapy. Diabetic Neuropathy is curable, and thus if identified, the appropriate treatment can be instituted in early stages, which can give rise to good outcome. As the peripheral nerve has the ability to regenerate, line of treatment can be planned.

Hence the null hypothesis is rejected and the alternate hypothesis is accepted which states, “There will be significant effect of tibial nerve mobilization on improving the nerve conduction velocity in diabetic neuropathy patients within three weeks.”

Clinical implications

This tibial nerve mobilization therapy can be used to improve the nerve conduction velocity in diabetic neuropathy patients. The technique is cost effective and doesn’t require assistance of any trained professional and hence can be combined actively even at home once he/she has learnt the technique properly.

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How to cite this article: Doshi. M.K., Singarvelan. R.M. Effect of tibial nerve mobilization on nerve conduction velocity in diabetic neuropathy patient. Int J Health Sci Res. 2019; 9(5):218-224.

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