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Exploring the Effectiveness of Peroneal Nerve Flossing in Alleviating Diabetic Peripheral Neuropathy Symptoms

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Abstract

AIM: This study aims to determine whether the common peroneal nerve flossing approach improves common peroneal nerve function and physical wellbeing. NEED OF THE STUDY: Diabetic neuropathy refers to dysfunction of peripheral nerves experienced by individuals with diabetes mellitus. This condition primarily affects the nerves located in the legs and feet, leading to damage and dysfunction. Increased glucose levels will also cause nerve damage. The nerve flossing technique nerve mobilization technique is used to improve the neuro dynamics in conditions that involve irritation of the nerve. It gently mobilizes the compressed nerves through a set of simple exercises. It helps to reduce pain and to improve the ROM and reduce the damage to the nerve. Nerve mobilization is a technique with static and dynamic stretching that moves the involved nerve through full ROM. Mostly used to treat nerve-related pain and entrapment syndromes. Thus, the study focuses on the effects of nerve mobilization and nerve flossing techniques in subjects with diabetic neuropathy. METHODOLOGY: This study involved recruiting 8 subjects aged between 40-60 years with diabetic neuropathy and an HbA1C level of 6.5% or higher. Both male and female participants with either type 1 or type 2 diabetes mellitus were included, and those with an abnormal score exceeding 2.5 on the MNSI, or the Michigan Neuropathy Screening Instrument were selected. Pre-test phase involved conducting nerve conduction studies (NCS), administering the QOL-DN questionnaire to assess quality of life, and then initiating the treatment protocol for a duration of 12 weeks, The treatment consisted of the nerve flossing technique performed twice for 5 repetitions, along with active mobilization performed five times with 10 repetitions and a 5-minute interval between sets. After completion of the treatment protocol, a post-test was administered, utilizing the same outcome measures. The collected data underwent statistical analysis for further evaluation. RESULT: The study results indicated that the nerve flossing technique effectively improved nerve function in individuals with diabetic neuropathy. The results emphasize the potential advantages of integrating nerve flossing techniques into the care and treatment of diabetic neuropathy.

Keywords: Diabetic neuropathy, QOL-DN, Nerve flossing technique, Nerve Conduction Study (NCS).

1. Introduction

Diabetes mellitus is a persistent metabolic disorder that negatively impacts the endothelial cells lining the blood vessels [1].It primarily affects people between the ages of 40 and 60 and is caused by the body's failure to produce or respond to insulin adequately, resulting in high blood sugar levels [2]. One frequent complication of diabetes is diabetic neuropathy, a condition characterized by nerve damage resulting from elevated blood glucose levels [3,4]. The nerves in the legs and feet are particularly susceptible to this condition. It is estimated that around 8% of newly diagnosed individuals and over 50% of long-term diabetes patients experience neuropathy. Symptoms of diabetic induced neuropathy encompass pain, burning sensations, tingling, numbness, and heightened

sensitivity to touch [5]. The manifestation of these symptoms can significantly affect an individual's mental well-being, sleep patterns, and overall quality of life. Timely detection of diabetes and effective management of blood sugar levels can aid in preventing the onset of diabetic neuropathy.

The progression of diabetic related neuropathy is gradual, typically commencing with nerve damage in the feet. Those with poor diabetes control, obesity, high blood pressure, and age over 40 are at higher risk [6]. Both type 1 and type 2 diabetics can experience diabetic neuropathy, which is a serious consequence of diabetes. With diabetes affecting 382 million people globally, it remains a leading cause of neuropathy [7]. Symptoms of diabetic neuropathy can vary in intensity, ranging from mild to severe, and can affect different bodily systems, including the digestive system, urinary tract, blood vessels, and heart [8]. Diabetic neuropathy significantly affects patients, intensifying the likelihood of falls, inducing discomfort, and diminishing their overall quality of life [9].

The occurrence of nerve damage caused by diabetes changes with the time span of diabetes in a person. Over a ten-year period, diabetic neuropathy incidence advances from 8% to 42% among people with type 2 diabetes [10]. People with non-insulin dependent diabetes have a larger chance of acquiring neuropathy than people with insulin dependent diabetes, and this risk increases with their age. The period of time that an individual has been living with diabetes and the levels of glycated hemoglobin (HbA1c) are predictive factors for diabetic neuropathy [11]. Obesity, smoking, alcohol misuse, and ageing are other contributing elements for developing this condition. Considering the high prevalence of neuropathy in diabetic individuals, efficient diagnostic and preventative care are necessary. [12].

Understanding absolute pathophysiology of diabetic neuropathy is essential in developing targeted treatments for this common and costly complication of diabetes. The pathophysiology of diabetic neuropathy involves damage to Schwann cells due to chronic hyperglycemia. This damage can lead to demyelination and various changes in axons. Schwann cells play a crucial role in maintaining axons and their proper functioning [13,14,15]. Inadequate support from Schwann cells, disrupted axon trafficking, and other factors contribute to axon degeneration [16]. Gene expression studies have revealed alterations in messenger-RNA and micro-RNA in sensory nerve cells are damages in prolonged diabetes [17]. Inflammation, bioenergetic changes, and lipid processing pathways are also implicated in diabetic neuropathy. [18]

Existence of symptoms and indications of peripheral nerve damage is necessary for a definitive diagnosis for diabetes linked neuropathy. Objective tests like nerve conduction studies can further confirm the diagnosis [9]. While it might not be able to reverse the condition, controlling glucose may assist to alleviate some symptoms and signs of diabetes-related neuropathy. [19,20].

In order to efficiently manage diabetic neuropathy, physiotherapy is extremely important as it minimizes the symptoms and improves patients' overall functional abilities. It encompasses various therapeutic interventions aimed at reducing pain, improving mobility, and enhancing the quality of life for individuals with this condition [21]. An valid and reliable instrument for evaluating quality of daily life in diabetic polyneuropathy is the Norfolk Quality of Life-Diabetic Neuropathy (QOL-DN) questionnaire[22]. Essential aspect of physiotherapy in managing diabetic neuropathy is exercise therapy. Exercise has been shown to improve peripheral nerve function, enhance blood circulation, and promote nerve regeneration [23]. Physiotherapists prescribe individualized exercise programs that include aerobic exercises, resistance training, and balance training in accordance with the distinctive demands and limitations of every individual [24]. Regular exercise can also assist in managing other risk factors associated with diabetic neuropathy, such as obesity and cardiovascular disease [25]. Additionally, manual treatment methods like soft-tissue massage and joint mobility, may assist to alleviate pain along with reducing muscle tension and restoring joint mobility [26].

One potential and emerging treatment approach for diabetic neuropathy is nerve flossing, also known as neural glide or nerve mobilization. This technique aims to improve neurodynamic , improve range of motion and quality of life. Therefore, this study focused to evaluate the impact of nerve flossing techniques on motor and sensory function in common peroneal nerve.

2. Methodology

This experimental study took place at the Physiotherapy OPD, ACS Medical College and Hospital. The institution's review board gave its approval for the study's ethical conduct. The research procedures adhered to the guidelines outlined in the updated Helsinki Declaration from 2008. Eight subjects were selected between 40-60 years, people who had diabetic neuropathy, both gender (male & female), people who had an HbA1C level of 6.5% or higher mean values were included, Patient with either type 1 or type 2 diabetes mellitus, subjects who had an abnormal score >2.5 on MNSI examination was included in the study. People with pathology related to cervical and lumbar spine, part or complete foot amputation, visual impairment and any systemic illness were eliminated from this study.

All the subjects received nerve flossing technique for about 2 sets 5times 5days a week, along with active mobilization for about 5times for 10 repetitions with an interval between 5 minutes for a period of 12 weeks. NCS-nerve conduction study and QOL-DN questionnaire were utilised during pre and post intervention period to asses the nerve function and quality of life respectively.

3. Intervention- *Nerve Flossing Technique*

Technique: 1 Common Peroneal (Lying)

The subject was positioned in supine lying the therapist pushes the affected leg of the patient towards his chest and then leg was gently extended by pointing the foot upwards until light stretches was felt, then therapist turns the foot inwards

Technique: 2 Common Peroneal (Sitting)

The subject was positioned in sitting at edge of the chair with foot supported. The subjects both hands were clasped behind his back in sloughed position by maintaining this position the therapist extends the affected leg of the patients and turns the foot inwards

Technique: 3 Double Knee To Chest Stretches

Participants are positioned on a treatment table in a supine position. They are then instructed to draw both knees toward their chest using their hands, aiming to bring them as close as possible. This procedure is repeated five times, with each repetition consisting of ten movements. There is a five-minute interval between each set of repetitions. The participants actively engage in performing this technique.

Technique: 4 Active Neural Mobilization

The subjects are positioned in a side-lying. Their trunk is partially flexed forward, and their hips and knees are flexed to around 80 degrees and 90 degrees, respectively.They are then instructed to actively extend their knee and return to the initial position. This sequence is repeated five times, with each repetition consisting of ten movements. A five-minute interval is observed between each set of repetitions.

Data Analysis

The gathered data were organized and analysed through descriptive and inferential statistics. All the parameters were assessed using the Statistical Package for the Social Sciences (SPSS) version 28. To determine the statistical differences within the groups, a Paired t-test was employed.

4. Results

Comparing the mean values of pre and post-tests for the right motor nerve conduction study revealed a significant increase in velocity from 37.61 to 42.19 ($P<0.001$), indicating an improvement in post-test values compared to the pre-test. As a result, the null hypothesis is rejected.

Similarly, the mean values for pre and post-tests of the left motor nerve conduction study showed a significant increase in velocity from 40.01 to 43.76 ($P<0.001$), suggesting an improvement in post-test values compared to the pre-test. Consequently, the null hypothesis is rejected.

Moreover, the comparison of mean values for pre and post-tests of the right sensory nerve conduction study demonstrated a significant increase in velocity from 35.04 to 41.23 (P<0.001), signifying an improvement in post-test values compared to the pre-test. Thus, the null hypothesis is rejected.

Likewise, the mean values for pre and post-tests of the left sensory nerve conduction study displayed a significant increase in velocity from 37.64 to 43.40 (P<0.001), indicating an improvement in post-test values compared to the pre-test. Consequently, the null hypothesis is rejected.

Furthermore, the mean value comparison for pre and post-tests of Quality of life indicated a significant decrease from 67.13 to 49.62 (P<0.001), demonstrating an improvement in post-test values compared to the pre-test. Hence, the null hypothesis is rejected.

TABLE-1 - Comparison of Motor Nerve Conction Velocity Right Peroneal Nerve between Pre-Test and Post-Test

MNCS	PRE TEST		POST TEST		t TEST	Df	Sign
	Mean	S.D	Mean	S.D			
NCV	37.61	.732	43.19	1.02	-32.14	7	.000

(*- P≤ 0.001)**

Table-2 - Comparison of Motor Nerve Conction Velocity Left Peroneal Nerve between Pre-Test And Post- Test

MNCS	PRE TEST		POST TEST		t TEST	Df	Sign
	Mean	S.D	Mean	S.D			
NCV	40.01	.732	43.76	.896	-22.91	7	.000

(*- P≤ 0.001)**

Table-3 - Comparison of Sensory Nerve Conction Velocity Right Superficial Peroneal Nerve between Pre-Test and Post- Test

SNCS	PRE TEST		POST TEST		t TEST	Df	Sign
	Mean	S.D	Mean	S.D			
NCV	35.04	2.15	41.23	2.21	-42.115	7	.000

(*- P≤ 0.001)**

Table-4 - Comparison of Sensory Nerve Conction Velocity Left Superficial Peroneal Nerve between Pre-Test and Post- Test

MNCS	PRE TEST		POST TEST		t TEST	Df	Sign
	Mean	S.D	Mean	S.D			
NCV	37.64	2.15	43.40	1.70	-21.51	7	.000

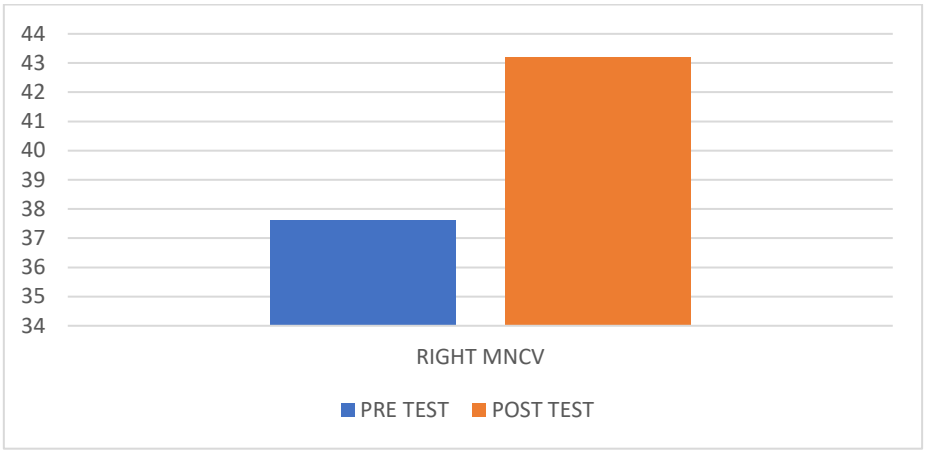
(*- P≤ 0.001)**

Table-5 - Comparison of Quality Of Life between Pre-Test and Post- Test

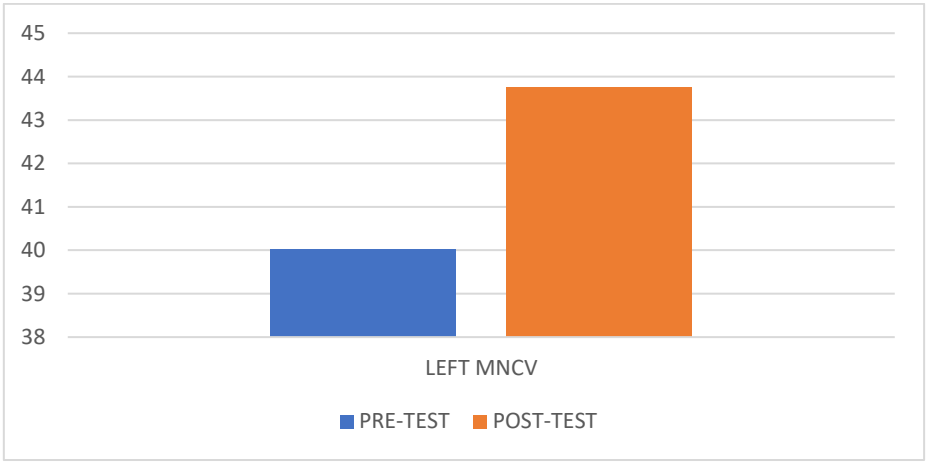
QOL	PRE TEST		POST TEST		t TEST	Df	Sign
	Mean	S.D	Mean	S.D			
QOL	67.13	2.75	49.63	5.32	8.75	7	.000

(*- P≤ 0.001)**

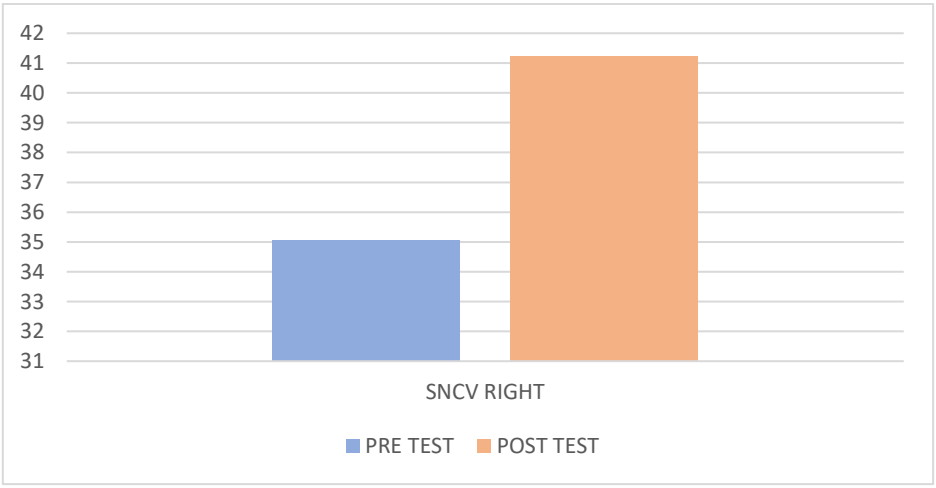
The mean, standard deviation (S.D.), t-value, and p-value between the pre- and post-tests for each group are shown in the above tables.Between the pre-test and post-test values within the group, there is a statistically significant difference (***- P 0.001).



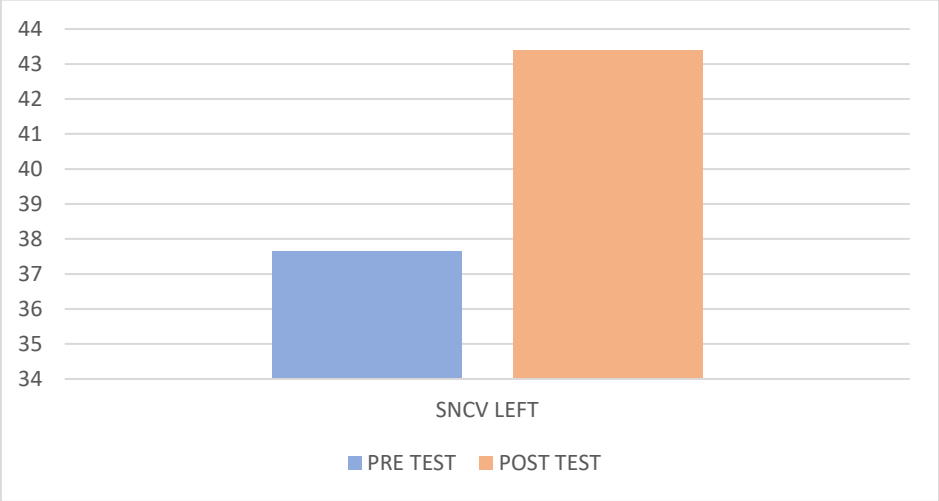
Graph-1 - Comparison Of Motor Nerve Conction Velocity Right Peroneal Nerve Between Pre-Test And Post-Test



Graph-2 - Comparison of Motor Nerve Conction Velocity Left Peroneal Nerve between Pre-Test and Post- Test



Graph-3 - Comparison of Sensory Nerve Conction Velocity Right Superficial Peroneal Nerve between Pre-Test and Post- Test



Graph-4 - Comparison of Sensory Nerve Conction Velocity Left Superficial Peroneal Nerve between Pre-Test and Post- Test

5. Discussion

Diabetes neuropathy is a widespread condition that significantly affects patients by raising their chance of falling, leaving them uncomfortable, and reducing their overall quality of life (QOL) [9]. Numerous research have been conducted on conventional therapy for neuropathic pain, such as TENS, IFT, tibial nerve mobilization, and desensitization, but results have been mixed. Therefore, more accurate methods of neuropathic pain management are needed. Hence this study is intended to assess the efficacy of peroneal nerve flossing techniques and its impact on standard of life and functions of nerves in people with diabetic peripheral neuropathy.

In the present study 8 subjects diagnosed with diabetic peripheral neuropathy for more than 10 years were included in the study, out of which 5 were male and 3 were female. When comparing pre-test and post-test data, the study's findings demonstrated notable improvements in all the measures. A significant reduction in latency, a rise in amplitude, and an increase in velocity were observed in the right sensory and motor nerve conduction studies. Similar results were seen in the left sensory and motor nerve conduction investigation, which showed a significant reduction in latency as well as an increase in velocity and amplitude. These results show that peroneal nerve flossing procedures have enhanced nerve function in both sensory and motor nerve paths. However, compared to motor nerve conduction study, sensory nerve conduction study demonstrated a higher improvement in nerve conduction velocity.

In addition to the nerve conduction studies, the study also assessed the impact of peroneal nerve flossing techniques on the quality of life of people who have diabetic peripheral neuropathy. The results revealed significant improvements in various domains of quality of life, including physical function/large fiber, activities of daily living/small fiber, and symptoms/autonomic. The decrease in scores in these domains indicates an improvement in the participants' quality of life post-treatment. However, higher improvement was noted in Physical function.

The nerve flossing technique, also known as neural gliding or neural dynamic mobilization, is a relatively new therapy with limited research for managing neuropathic pain.[27]. Neural flossing aims to improve nerve excursion, reduce adhesions, and alleviate symptoms by facilitating the nerve to move across its whole range of motion[28].Impairments in the nervous system can result in impaired axonal transport, greater neuronal ischemia, increased mechanosensitivity, and decreased nerve movement. Neural dysfunction-induced intraneural edema can also cause nerve injury, contributing to pain and numbness. To address these issues, therapists employ a technique called neuro mobilization to restore nerve function. Restoring normal nerve mobility is believed to restore lost function and alleviate pain[29]. LIM YH et al.in their study has found that Nerve mobilization techniques are crucial in the treatment of nervous system disorders, as restrictions in nervous system motion can lead to nervous system dysfunction[30]. Intraneural oedema caused by neural dysfunction can also cause nerve injury. All these

variables contribute to pain and numbness. As a result, therapists utilize a method called neuro mobilization to help restore nerve function. Normal nerve mobility is thought to be able to restore lost function and alleviate pain [31].

Muscle strength may also be improved by enhancing the flexibility of shortened nerves and the structures close to the joints. In such circumstances, enhancing sciatic nerve flexibility primarily aims to increase nerve tissue compliance by lowering the nervous system's mechanosensitivity.[32]. This is achieved through static and dynamic stretching treatments that push the affected nerve through its full range of motion.

In a study, the improvement in both motor and sensory nerve function following neural mobilization exercises is attributed to the facilitation of tissue vascularity and dispersion of noxious fluids [33][34]. These effects contribute to the enhancement of compressed neural tissue's health and functioning, allowing it to meet the metabolic and functional demands required during walking activities. The theoretical purpose of the nerve mobilization technique is to restore the relative nerve movement against surrounding tissues, reduce intra-neural pressure, and improve neural tissue's physiologic function [35].

The nerve is moved through the tissues as far proximally and distally as possible using the nerve flossing technique, covering every joint and body component that the nerve crosses. This procedure is similar to stretching a cord from one end while keeping the other loose, then changing the direction. When the sciatic nerve becomes trapped, scar tissue builds up along the nerve fibre, causing it to rub on muscles and bones[36]. Neural mobilization exercises can be easily performed by patients at home, requiring no special equipment and taking little time to perform as a daily maintenance program [37].

After analyzing the statistical data, this study demonstrated that nerve flossing exercises are an effective treatment technique for diabetic peripheral neuropathy. These exercises not only improve the nerve conduction velocity of both motor and sensory functions but also contribute to an enhanced quality of life.

6. Conclusion

Overall, the findings of this study demonstrate that the application of peroneal nerve flossing techniques resulted in improved nerve function and quality of life in individuals with diabetic peripheral neuropathy. These results suggest the potential effectiveness of this intervention in managing the symptoms and functional limitations associated with diabetic neuropathy. However, further research with larger sample sizes and long-term follow-up is warranted to validate these findings and determine the long-term efficacy and sustainability of peroneal nerve flossing techniques as a therapeutic intervention for diabetic peripheral neuropathy.

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