Effect of Contrast Bath Therapy on Superficial Peroneal Nerve Function in Diabetic Neuropathy Patients-An Informal Experimental Study

Hosanna Pereira[1], DR. R. M. Singaravelan[2]

[1]BPT student. [2]Professor/HOD of Neuro-Physiotherapy,
Dr. A.P.J. Abdul Kalam College of Physiotherapy, PIMS (DU), Loni Bk, Ahmednagar, Maharashtra, India.

ABSTRACT

BACKGROUND: Diabetes mellitus is a metabolic disease that causes high blood sugar. There are two groups of diabetes, type I diabetes and type II diabetes. Individuals suffering from diabetes mellitus tend to show signs and symptoms of diabetic neuropathy. Diabetic neuropathy is a condition which damages the nerve as a result of micro-vascular injury involving small vessels supplying the nerves due to uncontrolled blood sugar. In diabetic neuropathy, sensory abnormality is predominant and it affects the distal portion of the longest nerves first.

MATERIALS AND METHOD: A convenient sampling of 28 diabetic neuropathy patients including 15 females and 13 males were taken from Pravara rural hospital. Out of the 30 participants, during the study duration, only 28 participants received the therapy. The participants were assessed for superficial peroneal nerve function using Sensory Nerve Conduction Velocity studies. Later they were given contrast bath therapy for 20 minutes 3 times/week for 4 weeks. After 4 weeks post assessment was done.

RESULT: Contrast bath therapy showed highly significant improvement in the nerve function in participants after giving the protocol for 4 weeks ('t'=13.03, p=0.001).

CONCLUSION: The conclusion based on the results of difference in pre-post mean values of latency in sensory nerve conduction studies shows that there is a significant improvement in the superficial peroneal nerve function in Diabetic Neuropathy patients.

KEYWORDS: Diabetic neuropathy, Contrast bath therapy, Nerve conduction studies, superficial peroneal nerve.

INTRODUCTION

Diabetes mellitus is a metabolic disease which is also known as diabetes. It causes high blood sugar. The hormone insulin transfers sugar from the blood into your cells to be stored or used for energy. With diabetes, your body either doesn't make enough insulin or can't efficaciously use the insulin it does make. There are two groups of diabetes, type I diabetes and type II diabetes.

Type I diabetes is an autoimmune disease and type II diabetes occurs when the body is resistant to insulin. It is commonly seen that individuals suffering from Diabetes Mellitus tend to show signs and symptoms of diabetic neuropathy in due course of time.

Diabetic neuropathy is a condition in which the nerves are damaged due to chronic uncontrolled blood sugar levels. The condition is thought to be as a result from a diabetic micro-vascular injury involving small blood vessels that supply nerves (vasa nervorum). Diabetic neuropathy affects all the peripheral nerves including sensory and motor nerves. Initially there is progressive loss of sensation as a result of axonopathy and demyelination of small and large fibre nerves. [i] As the condition progresses, there is some level of motor deficits seen in the patients.

Various epidemiological studies from India showed wide prevalence of Diabetic neuropathy varying 5 to 2400 per 10,000 population in different community studies. [8] According to Pradeep Battula et.al., the prevalence of sensory peripheral neuropathy is 60.4% and Incidence of sensory peripheral neuropathy is 8.76% amongst the diabetic individuals in India. [7]

In Diabetic neuropathy sensory abnormality is predominant. The sensory loss affects the distal portion of the longest nerves first. C – Fibers contribute to pain and temperature sensations while A-δ fibers carry information about vibration and joint position sensation. These sensations are affected first in diabetic neuropathy. [i] The Nerve conduction studies, Electromyography, Skin biopsies are used as diagnostic tests. Severity of sensory diabetic neuropathy is classified into 3 stages. They are:

Stage 0: no signs of symptoms.
Stage 1: asymptomatic neuropathy.
1a: no symptoms/signs but nerve conduction velocity abnormalities or autonomic test abnormalities.
1b: N1a criteria+ neurological examination abnormality; vibration detection threshold abnormality.
Stage 2: symptomatic neuropathy.
2a: symptoms, signs and test abnormality*
2b: N2a criteria + significant weakness of ankle dorsiflexion.
Stage 3: disabling polyneuropathy.

According to American diabetes Association, Diabetic neuropathy is treated with tricyclic drugs or anticonvulsant agents. [10] Tricyclic drugs such as amitriptyline and nortriptyline, have also shown promise in patients with Diabetic neuropathy and are

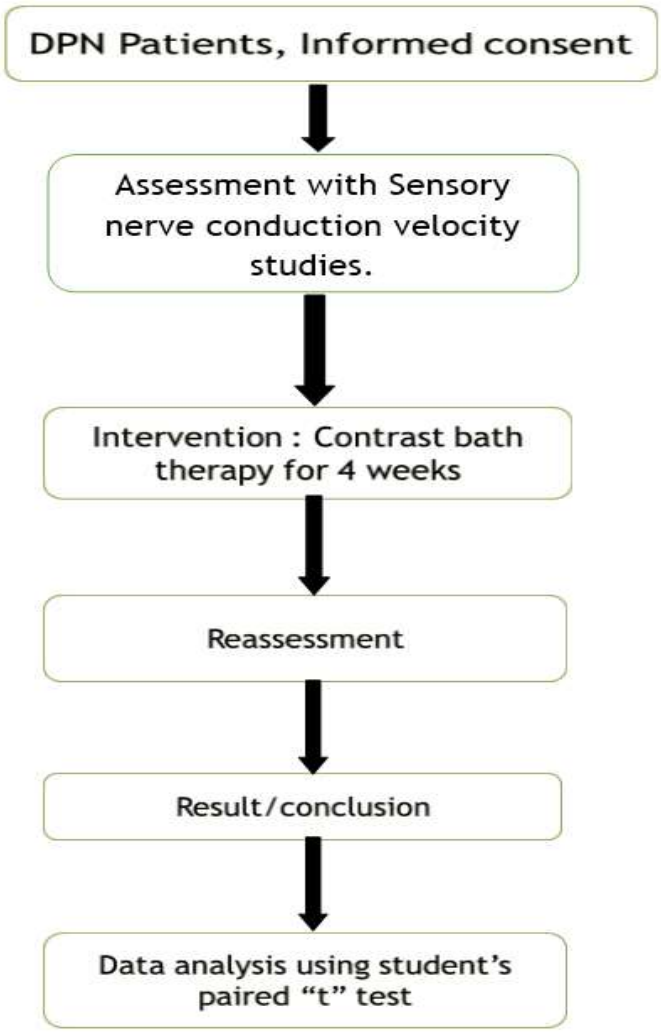
considered first-line treatment for Diabetic neuropathy at many centres. [11] Surgically, Diabetic neuropathy is treated by surgical release and decompression of the nerves. [12]
Contrast bath therapy involves alternate immersion in hot and cold water producing marked hyperaemia of the skin. Contrast baths are used because of the significant sensory stimulation they produce as the cutaneous hot and cold receptors are alternately activated. This stimulation is comparatively vigorous because each time neural accommodation starts to occur the temperature stimulation is reversed. [iv] Contrast bath therapy, due to alteration in activation of heat and cold receptors will improve the vascularity. This will improve the nutrition to the nerve thereby improving the nerve function.

Purpose of the study:
There are many therapies for improving the sensory impairments in Diabetic Neuropathy patients, but there are very less studies which have focused on the effectiveness of contrast bath therapy, which is universally used for pain relief, for improving the nerve function in Diabetic Neuropathy patients as it improves the vascularity of the nerve.

Aim: To assess the effect of contrast bath therapy over the period of 4 weeks on superficial peroneal nerve function in diabetic neuropathy patients.
Objectives of the study:
To assess the effect of contrast bath therapy given for 4 weeks on the superficial peroneal nerve function which was assessed by sensory nerve conduction velocity studies.

METHODOLOGY AND RESEARCH DESIGN
Ethical clearance was attained from the Institutional Ethical Committee. The study was an Informal Experimental Study which involved Convenient Sampling. The samples were the out-patients of Neuro-physiotherapy department of Dr. A. P. J. Abdul Kalam College of Physiotherapy, PIMS (DU), Loni Bk and the Department of Medicine, Pravara Rural Hospital, Loni Bk, Maharashtra. A sample size of 28 Diabetic neuropathy patients having sensory deficit stage 1a within the age group of 45 years to 65 years who were able co-operate were included. The intervention period was of 4 weeks and 3 sessions/week was given. Each session lasted for 20 minutes.
Outcome measures:
The participants were assessed superficial peroneal nerve function pre- and post-therapy. The tool used for assessing was Sensory Nerve Conduction Studies (SNCV).

Intervention:
The intervention protocol was built to improve superficial peroneal nerve function in Diabetic neuropathy patients. The protocol consists of Contrast bath therapy which is of 20 minutes. The patients were assessed for sensory nerve conduction velocity of superficial peroneal nerve. The Contrast bath therapy was given 3 times/week for 4 weeks. The therapy was given for 20 minutes per sessions. After 4 weeks, Post-test was done.



DATA ANALYSIS

The objective of the study was to find out the effect of contrast bath therapy in patients with Diabetic Neuropathy for improving superficial peroneal nerve function which was analyzed using sensory Nerve conduction velocity studies (NCS).

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

DEMOGRAPHICS

A total of 28 participants were screened and eligible for the study considering the inclusion and exclusion criteria. The participants who agreed to participate in the study were selected. There was no drop out of participants during the intervention. The sample size could not be completed.

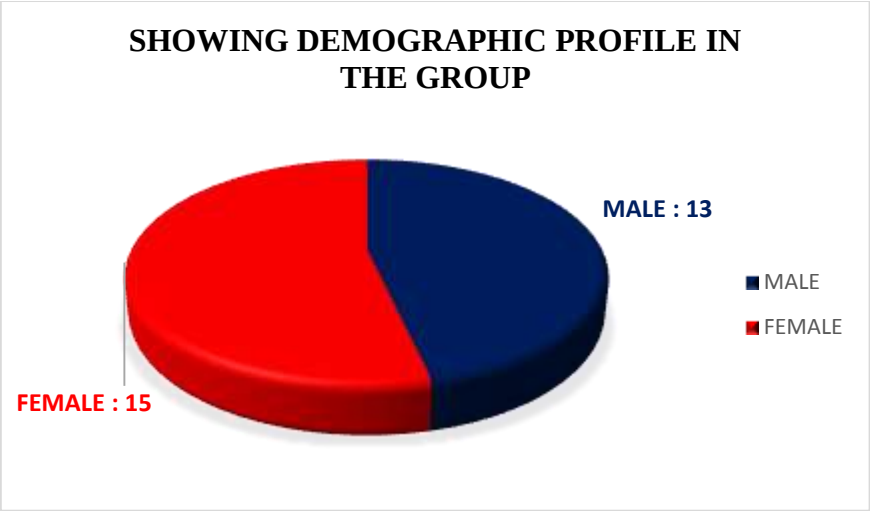
The mean age of the participants in group was 55.96±8.39 years.

The gender ratio in the Group was 13:15(13 men and 15 women).

The baseline demographic data was comparable.

Table 1: Showing demographic profile in the group.

Group item	Age(years)	Gender(M/F)
Participants	55.96±8.39	13(46.42%)/15(53.57%)



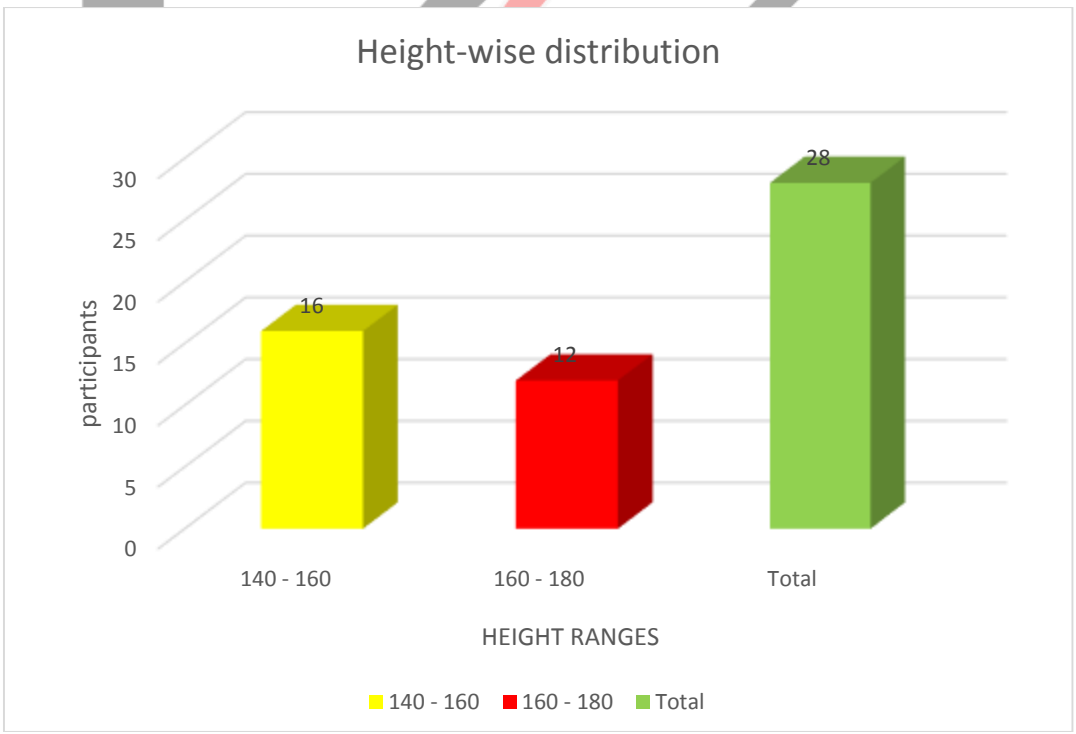
Graph 1 : **Showing demographic profile in the group.**

Height-weight wise distribution:

The study included 28 participants, out which 16 participants height was ranging under 140-160 cms and 12 participants height was ranging under 160-180 cms.

Table 2: showing height wise distribution in the group

Height (in cms)	Total
140 – 160	16
160 – 180	12
Total	28

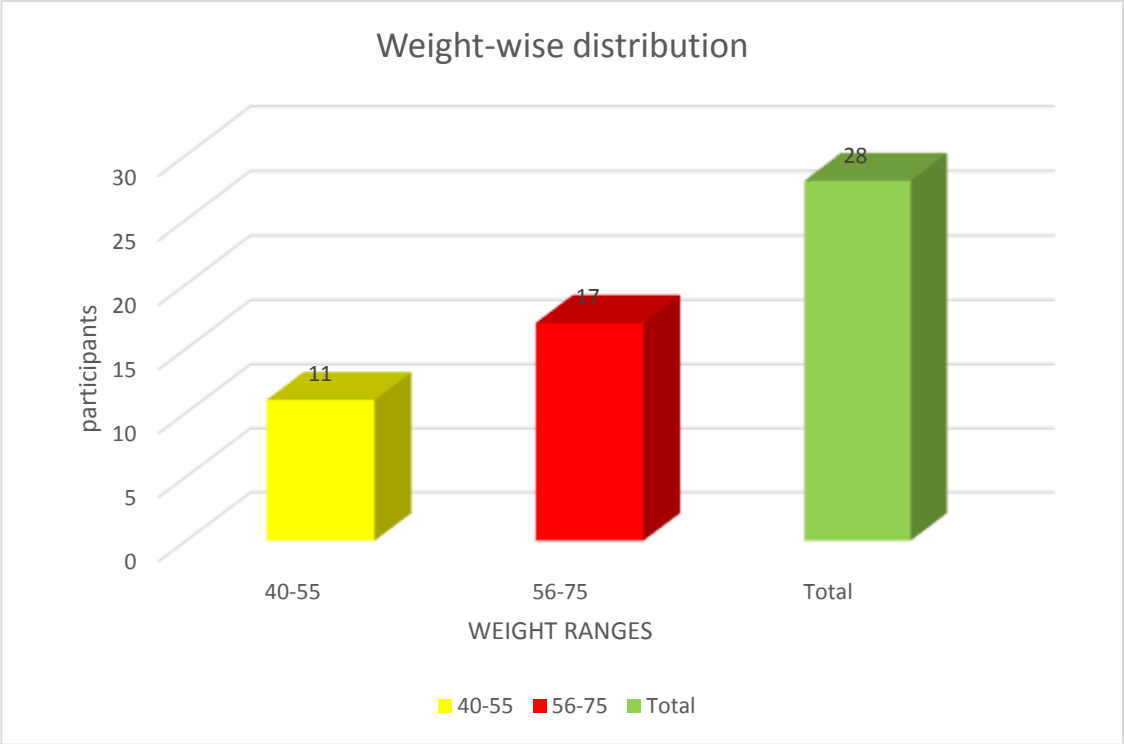


Graph 2: showing height wise distribution in the group

Out of 28 participants in the study, 11 participants weight was ranging between 40-55kgs and 17 participants weight was ranging from 56-75kgs.

Table 3: showing weight wise distribution in the group

Weight (in Kgs)	Total
40-55	11
56-75	17
Total	28



Graph 3: showing weight wise distribution in the group

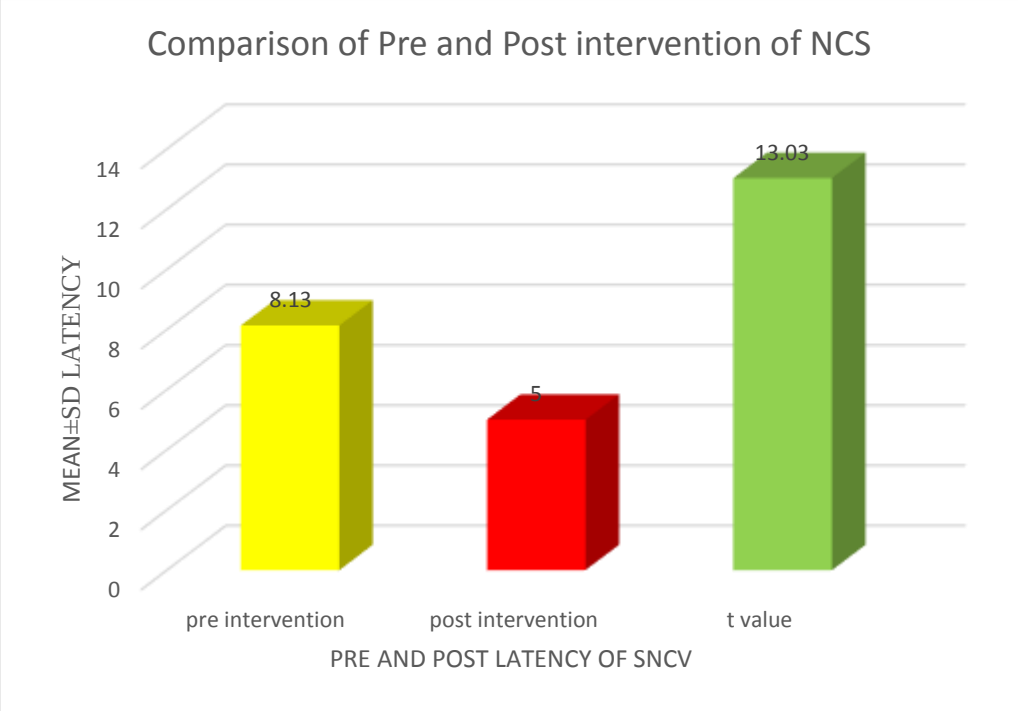
Sensory Nerve conduction studies pre-post intervention Mean ± SD:

The superficial peroneal nerve function in the participants was measured using Sensory nerve conduction studies (NCS). The pre-intervention mean average values and standard deviation of latency in SNCV of superficial peroneal nerve in the participants was 8.13±1.06 and post-intervention mean average values and standard deviation was 5.00±1.48.

There was statistically significant difference in the mean average values of the Pre and Post Intervention values of latency in SNCV of superficial peroneal nerve in the participants treated with intervention along with conventional physiotherapy (‘t’= 13.03, ‘p’=0.001).

Table 4: Pre and Post Mean values of latency in sensory Nerve conduction velocity studies.

SNCV	Pre-intervention (Mean±SD)	Post intervention (Mean±SD)	Students paired ‘t’ test	‘p’ value	Result
	8.13±1.06	5.00±1.48	13.03	p = 0.001	Highly significant



Graph 4: Pre and Post Mean values of latency in sensory Nerve conduction velocity studies.

DISCUSSION

Diabetic neuropathy is a condition in which the nerves are damaged due to chronic uncontrolled blood sugar levels. Patients with diabetes mellitus may have asymptomatic peripheral neuropathy and altered autonomic nerve function. Mechanisms of neuropathy in Diabetes Mellitus include increased endothelial vascular resistance and reduced nerve blood flow. The condition is believed to be as a consequence from a diabetic micro-vascular injury involving small blood vessels that supply nerves (vasa nervorum). Electrophysiological incidence of peripheral neuropathy has been about 30%. However, some studies have stated higher incidence going up to 82%. According to Pradeep Battula et.al., the prevalence of sensory peripheral neuropathy is 60.4% and Incidence of sensory peripheral neuropathy is 8.76% amongst the diabetic individuals in India. [7]

Diabetic neuropathy affects all the peripheral nerves including sensory and motor nerves. Initially there is progressive loss of sensation as a result of axonopathy and demyelination of small and large fiber nerves. [i] As the condition progresses, there is some level of motor deficits seen in the patients. De Souza et.al., reported decelerating of motor conduction velocity and decrease in amplitude of SNAP to be the earliest evidence of diabetic neuropathy in asymptomatic patients. This is trailed by prolongation of sensory latencies, reduction of sensory velocity, and far ahead by reduction in amplitudes of CMAP when patients are likely to manifest clinically. This describes the clinical and electrophysiological evolution of Diabetic neuropathy.

The present study was conducted to assess the effect of contrast bath therapy on improving the superficial peroneal nerve function which was assessed by nerve conduction velocity studies. Jerold Petrofsky et.al., (2007) conducted a study on Effects of contrast baths on skin blood flow on the dorsal and plantar foot in people with type – 2 DM and age – matched controls. The study concluded that in control subjects, there was also a greater plantar than dorsal blood flow. For subjects with diabetes, there was no statistical difference between the blood flow with contrast bath versus warm whirlpool; but in both cases blood flow was significantly less than that seen in control subjects under similar circumstances. The blood flow response to contrast temperatures may be a good diagnostic test for diabetic vascular impairment.[5] There are very less studies which have focused on the effectiveness of contrast bath therapy for improving the nerve function in Diabetic Neuropathy patients as it improves the vascularity of the nerve.

In the present study, a convenient sampling of 28 diabetic neuropathy patients including 15 females and 13 males were taken from Pravara rural hospital. The participants were assessed for superficial peroneal nerve function using nerve conduction studies by Sensory Nerve Conduction Studies. Later they were given contrast bath therapy for 20 minutes 3 times/week for 4 weeks. The therapy includes immersion of the limb in hot water having a temperature of 40^0C-45^0C for 3 minutes followed immersion in cold water having a temperature of 15^0C-20^0C for 1 minute. This cycle is repeated in 5 cycles. After 4 weeks, post-assessment was done.

The superficial peroneal nerve function was assessed using sensory Nerve Conduction Velocity studies. Table no.4 shows the pre-intervention mean average values and standard deviation of latency in Sensory Nerve Conduction Studies of superficial peroneal nerve in the participants which was 8.13±1.06. The post intervention mean average values and standard deviation for these participants was 5.00±1.48 (‘t’=13.03, p=0.001). The results were calculated using student’s Paired’t’ test, and it was highly significant. It was proposed that contrast therapy produces a series of local vasoconstriction and vasodilation resulting in a “pumping

effect". Fluctuations in arterial blood flow in response to contrast therapy have been measured by a number of researchers using a variety of techniques. Fiscus et.al., used strain gauge plethysmography to measure blood flow in the lower extremity. The study used four minutes to one-minute ratio of warm water immersion to cold water immersion, given for a period of 20 minutes, and produced a significant change in lower leg blood flow. There was diminution in blood flow during the alteration from warm to cold; increase in blood flow occurred during the change from cold to warm; this effect reduced during consecutive immersions. Hence due to changes in arterial blow flow, the blood flow to the nerves is improved, thereby improving the nerve function.

CONCLUSION

The conclusion based on the results of pre-post mean values of latency in Sensory Nerve conduction studies shows that there is a significant improvement in the superficial peroneal nerve function.

According to this study, Contrast bath therapy can be included in a treatment protocol clinically for improving the nerve function in Diabetic Neuropathy patients.

LIMITATIONS OF THIS STUDY

- The study included smaller sample study.
- The study was conducted on limited age group (45-65 years).
- The intervention was done only for 4 weeks.
- The study was limited to Pravara Rural Hospital.

RECOMMENDATIONS FOR FUTURE STUDY

- Study can be expanded to large sample size and in multi-centers with patients from various geographical locations.
- More research is needed to explore better results.

REFERENCES

A. BIBLIOGRAPHY: -

i. International Textbook of Diabetes Mellitus, Ralph A. Defronzo, Ele. Ferrannini, Paul Zimmet, K. George, M.M Alberti, The Diabetic foot, chapter 66, Page 964.
ii. Joslin's Diabetes Mellitus, 12th Edition, Alexandra Marble, Leo Krall, Robert B. radley, chapter 31, page 665.
iii. Contemporary issues in Endocrinology and Metabolism, volume 1, Jerrold. Olefsky, Robert Sherwin, Page 225.
iv. Electrotherapy Explained (Principles and Practice), Val Robertson, Alex Ward, John Low, Ann Reed, Chapter 11, page 348-349.
v. Textbook of INTERNAL MEDICINE, William N. Kelley, Chapter 428, page 2221-22.
vi. Physical Agents in Rehabilitation, 4th edition, Michelle H. Cameron, Part III, Chapter 8, page
vii. Handbook of Diabetes, 4th edition, Ruby Bilous & Richard d Donnelly, Chapter 17, page 129.

B. JOURNALS: -

1. Tavee J, Zhou L. Small fiber neuropathy: a burning problem. Cleve Clin J Med. 2009 May 1; 76(5):297-305.
2. Hovaguimian A, Gibbons CH. Diagnosis and treatment of pain in small-fiber neuropathy. Current pain and headache reports. 2011 Jun 1; 15(3):193-200.
3. Gilliatt RW, Willison RG. Peripheral nerve conduction in diabetic neuropathy. Journal of neurology, neurosurgery, and psychiatry. 1962 Feb; 25(1):11.
4. Kulkarni AP, Saroja AO, Naik KR, Ghatnatti V, Hesarur N. Nerve conduction abnormalities in patients with newly diagnosed diabetes mellitus. Journal of the Scientific Society. 2018 Jan 1; 45(1):30.
5. Petrofsky J, Lohman III E, Lee S, Cuesta ZD, Labial L, Iouciulescu R, Moseley B, Korson R, Malty AA. Effects of contrast baths on skin blood flow on the dorsal and plantar foot in people with type 2 diabetes and age-matched controls. Physiotherapy Theory and Practice. 2007 Jan 1; 23(4):189-97.
6. Battula P, Afreen S, Meena E, Reddy SSR, Sujatha G. prevalence of sensory peripheral neuropathy in diabetic patients at diabetes care center: a cross sectional study. Int J res Med Sci 2017; 5:4066-71.
7. Trivedi S, Pandit A, Ganguly G, Das SK. Epidemiology of peripheral neuropathy: an Indian perspective. Annals of Indian Academy of Neurology. 2017 Jul; 20(3):173.
8. NESTOR D, NELSON R. Performing motor and sensory neuronal conduction studies in adult humans.
9. Boulton AJ. Management of diabetic peripheral neuropathy. Clinical diabetes. 2005 Jan 1; 23(1):9-15.
10. Cohen K, Shinkazh N, Frank J, Israel I, Fellner C. Pharmacological treatment of diabetic peripheral neuropathy. Pharmacy and Therapeutics. 2015 Jun; 40(6):372.
11. Kumar SP, Adhikari P, Jeganathan PS, Misri ZK. Surgical management of painful diabetic peripheral neuropathy: A focused review. International Journal of Neurology and Neurosurgery. 2012; 4(1):21-5.
12. Farheen A, Malipatil BS, Arif G. Diabetic neuropathy, nerve conduction velocity, Glycosylated hemoglobin. (HbA1c). NERVE CONDUCTION IN TYPE 2 DIABETICS AND ITS CORRELATION WITH GLYCOSYLATED HAEMOGLOBIN. 2015 Jan 17(6568).
13. Behse F, Buchthal F, Carlsen F. Nerve biopsy and conduction studies in diabetic neuropathy. Journal of Neurology, Neurosurgery & Psychiatry. 1977 Nov 1; 40(11):1072-82.

14. Cotts BE, Knight KL, Myrer JW, Schulthies SS. Contrast-bath therapy and sensation over the anterior talofibular ligament. Journal of Sport Rehabilitation. 2004 May 1; 13(2):114-21.
15. Stanton DE, Lazaro R, MacDermid JC. A systematic review of the effectiveness of contrast baths. Journal of Hand Therapy. 2009 Jan 1; 22(1):57-70.
16. Vinik AI, Bril V, Litchy WJ, Price KL, Bastyr III EJ, MBBQ Study Group. Sural sensory action potential identifies diabetic peripheral neuropathy responders to therapy. Muscle & nerve. 2005 Nov; 32(5):619-25.
17. Dash S, Thakur AK. Perception of vibration threshold is a marker of diabetic neuropathy. Natl J Physiol Pharm Pharmacol 2017; 7(9):1003-1006.

How to Cite this Article?
Pereira.H, Singaravelan.R.M, Effect of contrast bath therapy on Superficial Peroneal Nerve Function in Diabetic Neuropathy Patients - An informal Experimental Study, International Journal of Science & Engineering Development Research (www.ijsdr.org), ISSN:2455-2631, Vol.5, Issue 2, page no.385 - 392, February-2020