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Original Article

Effect of Neural Mobilization on Grip Strength and Nerve Conduction in Leprosy

VH Shah[1], UL Yeole[2], SK Khairnar[3], PB Kamde[4]

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Leprosy is a chronic infective disease, which affects the peripheral nerves, reaching from the endings in the dermis to the nerve trunks, as a clinically mixed neuropathy. Neural mobilization (NM) is a set of tensioning and sliding techniques which aims to re-establish neurodynamic functions. Permission was taken from institutional ethical committee. An experimental study was conducted on 30 selected individuals based on inclusion and exclusion criteria. Randomized allocation of the participants was done into experimental (Conventional physical therapy with Median Nerve Mobilization) and control (Conventional physical therapy) groups. Participants were evaluated pre and post intervention for grip strength using Jamar hand dynamometer and nerve function using Nerve conduction studies. An eight-week intervention program was given to the patients for three times per week. Data was analyzed using Shapiro-wilk test, accordingly parametric or non-parametric test were performed. Between groups comparison showed significant ($p<0.05$) improvement in grip strength (6.52±0.67), nerve conduction velocity (4.11±2.11), latency (2.21±0.21) and amplitude (1.71±0.57) in experimental group as compared to grip strength (3.14±0.86), nerve conduction velocity (1.63±1.24), latency (1.03±0.22) and amplitude (0.44±0.45) in control group. Therefore, it can be concluded that leprosy patients undergoing the technique of neural mobilization had an improvement on grip strength and nerve functions.

Keywords : Leprosy, Neural mobilization (NM), Grip strength, Nerve conduction Study.

Introduction

Leprosy is also known as Hansen's disease, is a chronic infectious disease caused by *Mycobacterium leprae* (Swapna et al 2019). The disease mainly affects skin, peripheral nerve, mucosal surface of upper respiratory tract and the eyes (Veras et al 2012). The sequelae of untreated leprosy are irreversible and persistent disabilities which has physical and psychological impact on the quality of life. The global prevalence of leprosy at the end of 2016 was 171,948 cases with a registered prevalence rate of 0.23 per 10,000 population (Swapna et al 2019). Leprosy is almost eliminated from developed countries but in developing countries of Africa, Asia and Latin America it is still considered to be a

1 Dr VH Shah, MPT, Assistant Professor
2 Dr UL Yeole, MPT, Associate Professor
3 SK Khairnar, BPT, Intern
4 PB Kamde, BPT, Intern
Department of Physiotherapy, Tilak Maharashtra Vidyapeeth, Pune-411037, Maharashtra, India.
Correspondence : Dr VH Shah, **Email** : viralimagiyashah@gmail.com

public health problem (Agarwal et 2005).

Neural mobilization is one of treatment methods of tensioning and sliding techniques for peripheral neuropathy, which aims to re-establish neurodynamic functions through the application of mechanical loads, which are closely related to the morphology, biomechanics and physiology of the neural tissue (Santos et al 2016). It involves very specific movements to restore an adequate level of flexibility to the nervous system in the vertebra, upper extremities and lower extremities. The concept of nervous system mobility is that the nervous system should be adequately stretched and contracted to maintain normal muscular tension and ensure a proper range of mobility (Ha et al 2012).

In leprosy, *Mycobacterium leprae* hits the nerve and causes its degeneration. Compression and entrapment of the affected swollen nerve by neighbouring anatomic structures presents an inflammatory process that affects the surrounding tissues and results in characteristics of compression syndromes (impaired movement and mobility, loss of strength, paraesthesia, and pain), which causes peripheral nerve damage, especially for the neuritis of the leprosy reactions (Veras et al 2012). Neural mobilization technique has been used as a resource for the differential diagnosis and treatment of neurogenic disorders such as plantar fasciitis, carpal tunnel syndrome and other diseases (Alshami et al 2008, Coppieters and Butlin 2008). As a result, the neural mobilization technique is presented here as a non-pharmacological treatment option to see effect on grip strength and nerve function in people with leprosy.

Materials and Methods

Ethical clearance was taken from Institutional Ethical Committee. Different centers were approached, and permission was obtained prior to study. Participants who were willing to give consent and matched according to inclusion and exclusion criteria were selected for the study. Inclusion criteria were leprosy patients with lesion of median nerve, weakness in thenar muscle of hand, sensory impairments on lateral three and half fingers on anterior surface of hand and lateral aspect of palm, patient treated or in treatment with multi drug therapy, patient with grade I WHO disability grading of leprosy for hand and feet. Patient with implanted devices (such as cardiac pacemaker), disease like diabetes mellitus, alcoholic, or other cause of neuropathy, who underwent recent surgeries of upper limb were excluded from study. An experimental study was done on 30 patients taken from various hospitals and leprosy centers. Demographic details of the patients at the baseline are summarized in Table 1.

Participants were assessed using Jamar hand

Table 1 : Baseline Demographic Data

Demographic Data	Experimental Group Mean± SD	Control Group Mean± SD	P Value
Age (In years)	38.05±13.07	41.06±12.09	0.63
Gender: Male	9	11	0.39
Female	6	4	0.43

dynamometer and nerve conduction study test for hand grip strength and nerve function respectively before intervention. 30 leprosy patients were randomized into two groups: An Experimental group (EG) and Control group (CG) by random allocation using envelope method. Experimental group, the neural mobilization group, composed of 15 individuals undergoing conventional physical therapy with median nerve mobilization (MNM) and control group, composed of 15 individual who underwent conventional physical therapy. Both groups received treatment of 50 minutes with appropriate rest period as required. Number of treatment sessions was three times/week for eight weeks. In experimental group: each 50 minutes of session with appropriate rest period consist of flexibility exercise, strengthening with progressive resistance, electrotherapy, and median nerve mobilization.

Median nerve mobilization (MNM) technique includes: Participant were lay down in a supine position and kept the neck and the trunk in the neutral position as shown in Fig. 1.

The arm from shoulder to elbow was supported on the examiner's left thigh at 90 degrees of abduction, with the elbow joint at 90 degrees of flexion. The examiner depressed the participant's shoulder girdle with his or her left hand, extended the left wrist joint, and supinated the forearm with his or her right hand (Fig. 1). At the same time, external rotation was applied to the shoulder joint, and the elbow joint was slowly extended (Fig. 2). If the subject showed an adequate level of tension, lateral flexion was slowly performed for the neck in the opposite directions shown in Fig. 3, examining the subject's reaction so as not to cause excessive pain. Following which the hand was brought back into normal position as shown in Fig. 4. MNM has been performed with 3 set of 15 - 20 oscillation per

Fig. 1 : Examiner depressing the participant's shoulder girdle with her left hand, extending the left wrist joint, and supinating the forearm with her right hand

Fig. 2 : External rotation being applied to the shoulder joint, and the elbow joint slowly being extended

Fig. 3 : Examining the subject's reaction so as not to cause excessive pain

Fig. 4: Hand being brought back into normal position

minute, totaling 3 minutes. This maneuver is available to see on the video link. https://1drv.ms/v/s!At8jOelKoRx2g84Zt_4XAZUy96Rq4A

Control Group : Participants in the control group received flexibility exercise, strengthening with progressive resistance and electrotherapy in each 50 minutes of session with appropriate rest period as required. After eight weeks protocol hand grip strength and nerve function were reassessed by using Jamar hand dynamometer and nerve conduction study test, respectively. Pre and post test values were noted, and statistical analysis were done.

Statistical Analysis : Paired t-test was used for within group comparison between pre and post test analysis of all outcome measures. Unpaired t-test was used for comparison of pre-post test differences between experimental and control group. A p-value of 0.05 or less was considered statistically significant.

Results

It was observed that prior to intervention, EG and CG had no significant difference between them ($p>0.05$) in hand grip strength and nerve function. After the intervention, we observed the analysis of variations in the pre and post tests in each of the groups and pre-posttest difference between groups.

Table 2 presents the data of Jamar hand dynamometer in the experimental and control group. There was a significant increase in hand grip strength (p-value =0.0001) in EG as compared with the CG before and after testing. However, when the EG was compared with the CG for the pre-posttest difference, a significant difference was observed between the groups (p-value =0.0003).

Table 3 presents the data of nerve conduction study such as nerve conduction velocity, latency,

Table 2 : Comparison of Jamar hand dynamometer values within and between Experimental group and Control group

Outcome measure		Experimental Group Mean±SD	Control Group Mean±SD	P Value
Jamar Hand Dynamometer (Kg)	Pre	34.66±3.47	35.13±4.04	0.31
	Post	41.18±2.80	38.27± 3.18	
	P value	**0.0001**	**0.0001**	
	Pre and post difference	6.52±0.67	3.14±0.86	**0.0003**

Table 3 : Comparison of Nerve conduction study values within and between Experimental group and Control group

Outcome measure			Experimental Group Mean±SD	Control Group Mean±SD	P Value
NCS	Velocity (m/s) (Wrist to Elbow)	Pre	29.18±5.32	31.09±4.13	0.37
		Post	33.29±3.21	32.72±2.89	
		P value	**0.0001**	**0.0002**	
		Pre and post difference	4.11±2.11	1.63±1.24	**0.002**
	Latency (ms) (At Elbow)	Pre	10.27±0.57	9.75±0.79	0.29
		Post	8.06±0.78	8.72±0.57	
		P value	**0.0001**	**0.0001**	
		Pre and post difference	2.21±0.21	1.03±0.22	0.0001
	Amplitude (mV) (At Elbow)	Pre	3.04±1.02	2.78±0.75	0.34
		Post	4.75±1.59	3.22±1.20	
		P value	**0.0001**	**0.0001**	
		Pre and post difference	1.71±0.57	0.44±0.45	**0.0001**

and amplitude in the experimental and control group. When the nerve conduction velocity was analyzed, there was a significant increase (p-value=0.0001) in nerve conduction velocity compared with the EG in the pre and post tests. When the EG was compared with the CG in the pre-post test difference, there was also a significant difference between the groups (p=0.002). When comparisons were made on latency between the pre and post test and between the EG and CG for pre-post test difference, there is significantly decreased (p-value=0.0001) in latency. For amplitude by comparing the pre and post test and comparing the EG and CG pre-posttests difference, it was observed that there is significantly increased (p-value=0.0001) in amplitude.

Discussion

The aim of the research was to study the effect of median nerve mobilization technique on grip strength and nerve conduction study in leprosy patients. Leprosy is a chronic infectious disease caused by *Mycobacterium leprae*. The disease mainly affects skin, peripheral nerve, mucosal surface of upper respiratory tract and the eyes. Nerve lesions are the most important cause of disabilities and give rise to the strong disgrace associated with the disease (Swapna et al 2019). Neural mobilization (NM) is a set of tensioning and sliding techniques which aims to re-establish neurodynamic functions (Agarwal et al 2005).

The comparison of pre and post grip strength values within experimental and control group in our study shows there is more significant improvement in grip strength in experimental Group as compared to control group (Table 2). A similar study was carried out by Santos et al in 2016, to study on Electromyography activity and muscle strength after treatment with neural mobilization: a systematic review, the results indicate positive effects of neural mobilization techniques on electromyographic signal augmentation, muscle fibers recruitment, maintenance of peak strength of wrist and fingers flexor muscles (Santos et al 2016).

Grip strength depends on various factors including muscle strength and neuromuscular co-ordination. Normal extensibility and elasticity of nervous tissue is also an important component for grip strength. Nervous tissue mobilization helps to re-establish the dynamic equilibrium of neural tissue and normalize the physiological function. Vesicle clustering increases in responses to applied stretch. F-Actin polymerization is seen with stretch. One possible effect of stretch on axons is the enhanced ion flux through stretch sensitive ion channels. Ca^{2+} influx can trigger increased Actin polymerization, force generation, regulation and downstream signaling cascades, as well as mediate vesicle localization under the membrane from which they are released. So, mobilization of nervous tissue increases peripheral blood flow, implying a physiological shift toward parasympathetic dominance which improved neurological properties is indicative of improved grip strength (Dhabolkar et al 2015).

Table 3 show there is more significant improvement on nerve conduction velocity, latency and amplitude in individual who were under going conventional physical therapy with Median nerve mobilization as compare to conventional physical therapy alone. Another analogous study was performed by Veras et al (2012), to study electromyography function, disability degree and pain in leprosy patients undergoing neural mobilization treatment, concluded that leprosy patients who underwent a mobilization treatment had improvement in neural function and electromyography levels of muscular strength and reductions in the degree of disability and pain.

The possible explanation of result can be neurodynamic mobilization could positively influence the peripheral nerve regeneration through the mechanism of reduction of oedema, normalization of axoplasmic flow, decrease in abnormal nerve mechanosensitive, with consequent reduction of hyperalgesia and neurogenic inflammation, promotion of appropriate nerve mobility, reducing susceptibility to trauma, Increased neuronal and glial activity (Schwann cells) through stimulation of movement dependent receptors in the cell membrane. Therefore, neural mobilization is important in leprosy (Santana et al 2015).

Conclusions :

Based on observations of this study it is concluded that neural mobilization is effective in improving grip strength and nerve function in leprosy patients. These findings need to be validated in field conditions and logistics determined so as to make it available to leprosy afflicted persons who are the end users.

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Editor's Note : Leprosy is being integrated in all aspects. This manuscript points to a direction in which nerve mobilization methodology being used in other conditions has been tried in the leprosy with promising results. A large / multi-institutional study could establish its position in the leprosy field

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