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Effect of Nerve Flossing Technique on Tibial Nerve Conductivity and its Impact on Functionality in Tailors Using Mechanical Sewing Machine: A Randomized Controlled Trial

Dr. Darshita Satodiya[1], Dr. Mansi Sanghvi[2]

[1]Post Graduate Scholar at School of Physiotherapy, RK University
Email id: *dsatodiya098[at]rku.ac.in*

[2]Assistant Professor at School of Physiotherapy, RK University
Email id: *mansi.shah[at]rku.ac.in*

Abstract: ***Background: Nerves of lower limbs including tibial nerve, are exposed to strenuous and chronic vibration exerted by chronic paddling and vibration effect of the mechanical sewing machine. Due to the vibration effect, there are changes like neuropathic pain in the tibial nerve course distribution. The nerve flossing technique is a recent technique, and that is mainly used to treat the patient with neuropathic pain. Aim: To know the effect of the nerve flossing technique on tibial nerve conductivity and its impact on functionality in tailors using a mechanical sewing machine. Method: Total 26 subjects were included in the study according to selection criteria. They were divided into two groups by using the randomised sampling method.13 subjects in each group and nerve conduction velocity, lower extremity functional scale and numerical pain rating scale were taken before and after the intervention in both groups. Group A: Nerve flossing technique with conventional physiotherapy was given with 15 repetition, for 3 sets with an interval of 5 minutes between each set for 5 days/week, 3 weeks. Group B: only conventional physiotherapy was given for 5 days/week, 3 weeks. Result: The paired t - test and unpaired t - test were used to analyze data for the statistics. In the intragroup & intergroup analysis, there was significant improvement seen in NCV, LEFS, and NPRS in both group A and group B. Conclusion: Nerve flossing technique along with conventional treatment is effective in the improvement in conductivity and functional status of a patient suffering from neuropathic pain in tailors.***

Keywords: nerve conduction velocity, lower extremity functional scale, neuropathic pain, neurodynamics, tibial nerve slider, tibial nerve tensioner.

1. Introduction

Neuropathic pain is defined as "pain that can arise from disease or dysfunction of the nervous system" according to the international association for the study of pain - IASP. The peripheral neuropathic pain can be an increase from musculoskeletal causes due to entrapment syndromes and also from movement - induced mechanosensitivity. [1] Identification of musculoskeletal peripheral neuropathic pain is made based on the mechanical behavior of symptoms that alter with postures and movements. [2]

Symptoms arising from peripheral nerves are categorized into positive symptoms (dysesthetic pain such as hyperalgesia, allodynia, tingling, numbness, paresthesia, and shooting pain) and negative symptoms (with neurological deficits such as sensory loss, motor loss, and reflex loss). [2]

The application of mechanical sewing machines is still in existence on a large scale in most Asian countries. However, none of the epidemiological or related studies has been carried out to assess the prevalence of the use of mechanical sewing machines and their impact on the tibial nerve. People with lower socioeconomic status or low education levels commonly adopted this type of occupation. Thus, many skilled people adopted the tailoring occupation, and they are using a paddle - driven mechanical sewing machine. [3]

Nerves of lower limbs including tibial nerves are exposed to strenuous and chronic vibration exerted by chronic paddling and vibration effect of the Mechanical sewing machine. Some types of continuous and chronic stress may cause structural, functional, and pathological changes. [3]

The nerve flossing technique is a neurodynamic technique, which is given by Michael Shacklock, is an active procedure that is physiologically beneficial for a conservative treatment option. [5]

The nerve flossing technique is an alteration of combined movements of at least two joints in which one movement lengthens the nerve bed, thus increasing tension in the nerve while the other movement simultaneously decreases the length of the nerve bed while unloads the nerve. [6]

The tailors using mechanical sewing machines are exposed to chronic strenuous paddling and vibration effect of the mechanical sewing machine. Because of that, there can be the possibility of neuropathic pain in the tibial nerve. But very few studies available to see its effect on neuropathic pain.

Neuropathic pain can affect the functionality of tailors, and there can be the possibility of its effect on tibial nerve conductivity.

There are several studies done on conventional therapy like TENS, IFT, tibial nerve mobilization, and desensitization for the treatment of neuropathic pain but with a low level of improvement. So, there is a need to find out some more accurate techniques to reduce that neuropathic pain.

The nerve flossing technique is a new technique for the treatment of neuropathic pain, and there are very few studies available for this.

2. Methodology

The proposal was approved by Ethics Committee, School of Physiotherapy, RK University (ECR/259/Indt/GJ/2016), and CTRI (Clinical trial registry – India) CTRI//2020/12/029952. Total 26 subjects were taken from Rajkot and tramba with all covid 19 precautions. All the subjects were explained about the procedure before enrolment in study. Informed written consents were obtained from the subjects who fulfilled the inclusion and exclusion criteria and were willing to participate in the study.

Inclusion Criteria:

- Tailors with the age of (30 to 50 years).
- Male and Female (both) tailor included.
- Tailors with a minimum of 12 years of experience and daily working hours (8 - 10).
- Tailors with positive straight leg raised - 2.
- Subject with neuropathic pain in tibial nerve course distribution.

Exclusion Criteria:

- Any individual with neuromuscular transmission disorder, renal disorders & diabetes.
- Any individual suffering from a congenital deformity.
- Tailors who are using both legs for machine and as well as hand users.
- Tailors who have radiculopathy.
- Tailors who have cramp - like pain, coldness, and tropical changes in the lower extremity.

Materials and Apparatus:

- Pen
- Paper
- Consent form
- Assessment form
- Plinth
- Sanitizer
- Mask
- Measure tape
- Adhesive tape
- Lower extremity functional scale
- Nerve conduction velocity machine (JAVA RMS ALERON - 201)
- Electrodes (Button electrodes)
- Conductive gel (Electrode gel)

On the first visit, complete assessment was done and randomly divided into 2 groups by random sampling method with 13 subjects in each group.

GROUP A (n=13): - Nerve flossing technique with conventional physiotherapy (5 days/ week, 3 week)

1) Tibial nerve slider: - Tibial nerve slider was performed passively with the participant long sitting position on the plinth with the ankle in plantarflexion and inversion and the knee in extension, this position holding for 5 seconds. Then the therapist turns the ankle in dorsiflexion and eversion with the knee in flexion. The above procedure was repeated 15 times, 3 sets with an interval of 5 minutes between each set.
2) Tibial nerve tensioner: - Tibial nerve tensioner was performed passively with the participant supine position on plinth with hip and knee in 90◦ - 90◦. And the position of the ankle in plantarflexion and inversion. This position holding for 5 seconds. Then the therapist turns the ankle in dorsiflexion and eversion with the knee in extension as far as possible. This extended position was maintained for 5 seconds. The above procedure was repeated 15 times, 3 sets with an interval of 5 minutes between each set.
3) Conventional physiotherapy: - includes active movements of the knee, ankle, and foot (10 repetitions each). Passive stretching for plantar fascia, gastrosoleus, hamstring, and rectus femoris muscles (hold for 30 seconds, 3 repetitions) And tibial nerve massage (Transverse massage from proximal to distal) (Longitudinal massage from proximal to distal) for 5 minutes.

Group B (n=13): - only conventional physiotherapy (5 days/ week, 3 week)

It was done passively, as mentioned above.

Outcome measures used in this study were Nerve conduction velocity, Lower extremity functional scale, Numerical pain rating scale were taken on 1st day and after 3 weeks.

Nerve conduction velocity:
The patient's position was supine. Active electrode place over the medial foot, slightly anterior and inferior to the tubercle of the navicular bone at the most superior point of the arch formed by the junction of plantar skin and dorsal foot skin. Reference electrode Place slightly distal to the 1st metatarsophalangeal joint on the medial surface of the joint. And ground electrode Place on the dorsum of the foot.

Stimulation point (S1): The cathode was placed 8 cm proximal to the active electrode and slightly posterior to the medial malleolus. The anode was proximal.

Stimulation point (S2): The cathode was placed at the mid popliteal fossa or slightly medial or lateral to the midline. The anode was proximal.

In each subject, orthodromic motor parameters of the tibial nerve were measured. Supramaximal stimulation was given via a square wave current with a duration of 0.2 ms to stimulate the targeted nerve, and the action potential was taken by the recording electrode. Measure tape was used to measure the length of nerve.

Lower extremity functional scale:

LEFS has a 20 - item scale. Which include (Squatting, standing for 1 hour, hopping, running on uneven ground, etc. …). Each item has rated on a 5 - point scale. Total scores range from 0 to 80, with a higher score indicating better function. The LEFS had very high internal consistency (alpha coefficient ranged from 0.93 to 0.96) and good test - retest reliability (0.85 to 0.98), and good validity of LEFS. [27]

Numerical pain rating scale:
NPRS have an 11 - point scale, ranging from 0 (no pain) to 10 (worst pain). The average of the 3 ratings was used to represent the patient's level of pain.

3. Result

Statistical analysis was done by statistical package for the social science (SPSS) statistical software version 21.0. Graphs and tables were done by Microsoft excel.

The normality of data was checked by using the Shapiro - Wilk test, which showed that data is the parametric type for numerical pain rating scale, nerve conduction velocity, and lower extremity functional scale. The level of significance (p - value) was set at the 0.05 level.

The paired t - test for intragroup analysis and unpaired t - test for intergroup analysis was used.

The study involved 26 subjects with neuropathic pain in the tailors. The result is presented for 26 patients (13 patients in group A and 13 patients in group B)

Table 1: Age Distribution of Both Groups

Age (Year)	Mean	SD
Group A	43.69	5.31
Group B	43.77	4.71

Table 2: Group A Gender Distribution

Gender Group A	No. of Patients
Male	11
Female	3
Total	13

Table 3: Group B Gender Distribution

Gender Group B	No. of Patients
Male	8
Female	5
Total	13

The finding suggests that there was significant improvement seen in NCV, LEFS and NPRS in both group A and group B with P - value is lesser than 0.05 (table 4 - 5)

Table 4: Group A Intra Group Analysis

Outcome	Pre	Post	P Value
	Mean ± SD	Mean ± SD	
Ankle Latency (ms)	5.43 ± 0.30	4.28 ±0.48	0.000
Popliteal Latency (ms)	15.64 ±0.62	12.79 ±0.64	0.000
Ankle Amplitude (mV)	5.05 ±0.82	7.66 ±1.03	0.000
Popliteal Amplitude (mV)	2.51 ± 0.81	5.22 ± 0.64	0.000
NCV (m/s)	42.40 ± 2.09	50.89 ±2.18	0.000
LEFS	36.92 ± 2.56	48.15 ±1.34	0.000
NPRS	8.15 ± 0.89	3.69 ± 1.109	0.000

Table 5: Group B Intra Group Analysis

Outcome	Pre	Post	P Value
	Mean ± SD	Mean ± SD	
Ankle Latency (ms)	5.66 ± 0.34	5.26 ± 0.67	0.000
Popliteal Latency (ms)	16.03 ± 0.40	15.09 ± 0.52	0.000
Ankle Amplitude (mV)	3.59 ± 0.75	5.42 ± 0.84	0.000
Popliteal Amplitude (mV)	2.28 ± 0.54	3.60 ± 0.58	0.000
NCV (m/s)	41.24 ± 2.04	43.20 ± 1.58	0.000
LEFS	37.38 ± 2.43	41.92 ± 2.43	0.000
NPRS	8.15 ± 1.14	6.38 ± 1.12	0.000

There was statistically significant difference seen in NCV, LEFS and NPRS (p - value < 0.05) between group A and group B (table 6).

Table 6: Inter Group Analysis

Outcome	Group A	Group B	P Value
	Mean ± SD	Mean ± SD	
Ankle Latency (ms)	1.14 ± 0.49	0.49 ± 0.22	0.000
Popliteal Latency (ms)	2.85 ± 0.45	0.45 ± 0.30	0.000
Ankle Amplitude (mV)	2.61 ± 1, 82	1.82 ± 0.56	0.002
Popliteal Amplitude (mV)	2.72 ± 0.55	0.55 ± 0.58	0.000
NCV (m/s)	8.50 ± 2.07	2.07 ± 1.27	0.000
LEFS	11.23 ± 2.63	2.63 ± 1.20	0.000
NPRS	4.46 ± 0.73	0.73 ± 0.60	0.000

Finally, the finding of the study suggests that although the improvement was seen in both groups. A greater amount of improvement was seen in group A (Nerve flossing technique + conventional physiotherapy) than group B (only conventional physiotherapy) after 3 weeks of intervention.

So, based on the analysis of the result, the null hypothesis was rejected, and the experimental hypothesis was accepted, which suggests that there was a significant difference seen in the nerve flossing technique and conventional physiotherapy in tailors with neuropathic pain subjects.

4. Discussion

As our result shows a significant **reduction in latency and increase in conduction velocity** of the tibial nerve after the nerve flossing technique. It can be done by the concept of nerve sliding plays a major role in formulating a treatment plan for nerve mobilization. Tissue mobility, blood circulation, and axonal transport, which are required for the functional and structural integrity of a neuron, will be increased after neural mobilization.

Shacklock's principle of neurodynamics suggests the interconnection among nerve mechanics and physiology. Mechanical factors, including tension, compression, or traction of neural tissue, affect physiological responses in intraneural blood flow, axonal transport, mechanosensitivity, and sympathetic evaluation. In this study, an attempt was made to measure the effect of the nerve mechanics following a way theorized to affect the nerve physiology as measured by the latency and velocity of the tibial nerve. [8]

This comes in agreement with **Cleland et al.,** Who mentioned that When the nerve root was compressed, microcirculation was compromised, and the pressure received by the nerve will affect oedema and demyelination. Neural mobilization was sufficient to disperse oedema, thus

reduce the hypoxia and reducing the associated symptoms, and increases nerve conduction. [9]

The significant **decrease in pain intensity** may be due to the movement of the nerve that helps to control pain at the level of the central nervous system. This technique helps in the oxygenation of the nerve, thus decreasing the ischemic pain. In gate control theory, stimulation of mechanoreceptors inside the joint capsule and surrounding tissue prevents pain at the spinal cord level. [7]

Ibrahim Khalil et al. supported that the significant improvement in the numerical pain rating scale due to these therapeutic movements can have a positive impact on symptoms by improving intraneural circulation, axoplasmic flow, neural connective tissue viscoelasticity. [10]

In the nerve flossing technique, tension is placed upon the nerve system, which contracts the cross - sectional area of the nerve and closing the small blood vessels that cross the nerve epineurium, and thus increasing blood flow to the neuro fibres. In this process, the axonal transport system increases the flexibility of the contracted nerve and structures around the joints. So, this may be a better reason for **improvement were seen in lower extremity functions**. [11]

Hyun - Kyu Cha et al. presented that the nerve flossing technique increases the flexibility of the peripheral nerves and activates neurotransmission fibres related to motor function, thus improving the movement and motor ability of the lower extremity. [12]

However, subjects in the nerve flossing technique group showed more improvement than only the conventional physiotherapy group. May be nerve flossing technique shows the interconnection between nerve mechanics and physiology. It may reduce oedema, hypoxia and also reducing the other associated symptoms. In this way, it shows the improvement in nerve conduction velocity, numerical pain rating scale, and lower extremity functional scale. So, this may be a probable reason for the better improvement seen in the nerve flossing technique than conventional physiotherapy. Limitation of study are Small sample size, Long - term follow - up was not taken andonly tailors with neuropathic pain were included, Study can be done with other nerves like the sural, other types of neurological conditions, based on the dominant and non - dominant extremities and equal no. of gender distribution.

5. Conclusion

Based on the findings of statistical analysis and discussion, the present study concludes that the nerve flossing technique along with conventional treatment is effective in improvement in conductivity and functional status of patients suffering from neuropathic pain in tailors.

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