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An electrophysiological study on the immediate effects of nerve flossing technique on h-wave in patients with diabetic neuropathy

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Abstract
Introduction: Diabetic Neuropathy (DN) is one of the most complex and progressive disorders, characterized by symmetrical distal degeneration of peripheral nerves, resulting in features of pain and sensory loss. In DN, when persistent painful problems occur particularly in the lower limbs, produce diminished sensory thresholds, mobility, depression, and a lower quality of life, nerve flossing can play a key role in resolving the same. Studies have shown that alterations in the H-reflex provide an early indication of DN.
Methods: 20 participants of age 30 to 50 were selected on the basis of inclusion criteria. All subjects were assessed for diabetic neuropathy. Nerve flossing was given to all participants and H-reflex parameters were used for pre and post analysis.
Results: The results of the paired sample t-test demonstrate a clear and statistically significant difference between the values of pre and post data in H-reflex parameters of the posterior tibial nerve following the intervention.
Conclusion: The results of the present study suggest that the neural flossing techniques have significant effects in Diabetic neuropathy. Based on the findings it was concluded that H-reflex can show significant results in prognostic evaluation of the peripheral compressive neuritis of the nerve in diabetic neuropathy.

Keywords: Diabetic neuropathy, nerve flossing, sciatic nerve, h-wave

1. Introduction
Diabetic Neuropathy (DN) is one of the most complex and progressive disorders, characterized by symmetrical distal degeneration of peripheral nerves, resulting in features of pain and sensory loss [1]. It refers generally to peripheral neural dysfunction as a complication of Diabetes Mellitus (DM). The centres for disease control report that 29.1 million people or 9.3% of the population of the United States has been diagnosed with diabetes. Of this group, almost 95% are individuals with type 2 DM. Neuropathy is a common and costly complication of both type1 and type 2 diabetes and DN is estimated to occur in at least 20% of diagnosed patients [2]. Diabetic peripheral neuropathy (DPN) is a complication of diabetes experienced by more than 30% of all diabetes patients. It causes decreased sensation, proprioception, reflexes, and a strength in the lower extremities, leading to balance dysfunction [3]. Treatment options directed towards improvement of DPN are limited and have focused on pharmacological and dietary strategies linked to strict glycemic control. However, there is evidence of the benefits of exercise training-based interventions in treating and preventing the development or progression of DPN [4, 5]. These exercises helped in maintaining normal motor conduction velocity as well as other more direct effects on the neuromuscular system.
Nerve flossing aims to examine the neural tension in nerves and mobilize those with neural tension by passive or active movements by using tensioning, sliding and single joint movement techniques and focused on restoring the ability of the nervous system to tolerate the typical compressive, friction, and tensile forces associated with daily and sport activities. With this method, tension was gently applied to the involved nerve root that caused mild pulling but no pain and a low amplitude repetitive movement was introduced in the direction of the sensed neural tension [6].

In many cases, the diagnosis of diabetic neuropathy may also require electrophysiological testing [7]. One such test involves measurement of the Hoffmann reflex (H-reflex), which has been found to be more frequently altered in patients with recently diagnosed diabetes mellitus [8]. Studies have shown that alterations in the H-reflex provide an early indication of DN, since they are apparent before any changes in motor nerve conduction velocity (NCV) occur. These findings suggest that the H-reflex may be useful as a criterion for the diagnosis of DN [9, 8]. Standard nerve conduction studies for evaluation of the sciatic nerve includes testing the ipsilateral common peroneal and tibial motor nerve conduction and H-reflex [10].

The purpose of this study was to identify the immediate effects of neural flossing technique on the H-reflex parameters of posterior tibial nerve in patients with diabetic neuropathy.

2. Methodology

2.1 Sample

20 participants of age 30 to 50 were selected on the basis of inclusion criteria from Dr. APJ Abdul Kalam College of Physiotherapy. All subjects were assessed for diabetic neuropathy.

2.2 Inclusion Criteria

- Participants were required to have glycated haemoglobin (HbA1c) < 12% on their most recent test (within the past 3 months)
- Low back pain aggravated on sitting and standing
- Positive Lasegue sign
- Positive Bragard Test

2.3 Exclusion Criteria

- Recent history of back, hip and knee surgery
- Patients had any drug or alcohol dependency
- Diagnosed cases of PIVD
- Any trauma to the nerves of the lower extremity, open wounds or current pregnancy
- Spondylolisthesis
- Spinal TB, rheumatic disease
- Patients with cognitive deterioration preventing an accurate understanding of test procedures and patients with associated central nervous system abnormalities were also excluded

3. Procedure

Prior to testing, the procedure was explained and informed consent was obtained from all participants. Subjects from the institute with low back pain, tenderness at sciatic nerve and pain with prolonged sitting and standing were examined for positive Lasegue sign and positive Bragard test.

The H-reflex of the tibial posterior nerve was assessed using the RMS EMP EP Mark II. With the patient in the prone position and with a knee flexion of 120º, a stimulus was applied in the popliteal fossa. The cathode electrode was located proximal to the anode (for orthodromic stimulation) and stimulus intensity was in the range of 40-100V, with 1ms pulse duration. Recording electrodes were located as follows: the active electrode at the ventral side of the right pelvic twin muscle, and the reference electrode 4 cm away from the active one.

After that nerve flossing technique was actively performed with a subject sitting on a plinth, adopting the protocol of Pallipamula and singaravelan [11], the participants flexed the knee of the target lower extremity backwards beside the chair, as far back as possible and flexed the neck at same time, holding both the flexed knee and the neck in this position for 5 seconds. The participant in turn extended the neck and the knee of the target lower extremity, abducted and flexed the hip until pain was felt and did not push beyond that point. This extended position was equally maintained for 5 seconds. As the nerve became less sensitive, the participant increased the stretching effect by dorsiflexing the ankle and extending the toe of the foot upward toward the knee. This procedure was repeated for 15 times for 3 sets with an interval of 5 min between each set.

Followed by post intervention of H-reflex data evaluation through stimulating posterior tibial nerve.

4. Results

Patients from both genders were included in this study with 11 females and 9 males. The mean and standard deviation of their Age, height and weight are shown in Table 1.

Table 1: Physiological variable in study population

Physiological variables	N	Minimum	Maximum	Mean	Std. Deviation
Age (years)	20	31	49	40.06	5.19
Height (cm)	20	145	173	162.72	6.68
Weight (kg)	20	49	75	61.35	6.63

Table 2: Descriptive statistics for H-reflex study

Electrophysiological Parameters	PRE		POST		T-Value	P-Value
	Mean	SD	Mean	SD		
M-latency (ms)	30.52	1.2	28.9	1.1	-12.094	$p<0.001$
H-latency (ms)	31.79	1.15	30.16	1.18	-15.094	$p<0.001$
H-amplitude (mV)	2.78	0.49	3.58	0.52	12.697	$p<0.001$
H/M ratio	29.88	3.45	36.95	3.75	20.590	$p<0.001$

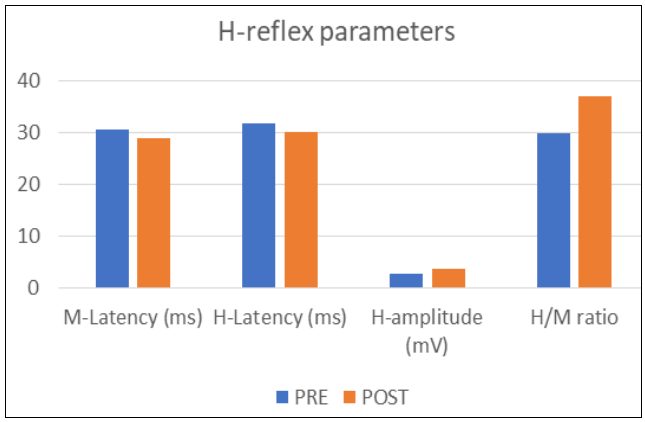

Fig 1: Bar chart representing pre and post intervention H-reflex parameters

The results of the paired sample t-test demonstrate a clear and statistically significant improvement in H-reflex parameters of the posterior tibial nerve following the intervention. The mean of M-latency and H-latency was decreased from 30.52±1.2 ms to 28.9±1.1 ms ($p<0.0001$) and 31.79±1.15 ms to 30.16±1.18 ms ($p<0.0001$) respectively, indicating faster conduction and improved neural responsiveness. Similarly, the mean amplitude increased from 2.78±0.49 mV to 3.58±0.52 mV ($p<0.0001$), reflecting enhanced excitability of the motor neurons. The H/M ratio, a sensitive marker of spinal motor neuron pool excitability, rose significantly from 29.88±3.45% to 36.95±3.75% ($p<0.0001$). Together, these changes suggest that the intervention effectively facilitated spinal cord

excitability and neuromuscular transmission, highlighting its potential clinical utility in improving reflex pathways and motor function.

5. Discussion

H-reflex studies have been established as a valuable tool in clinical neurophysiology [12]. In this study, attempt was made to measure the immediate effects on nerve mechanics following a technique theorized to affect the nerve physiology as measured by H-reflex parameters the latency and amplitude. The results showed that the latency of H-reflex were significant decreased while the amplitude of H-reflex were significantly increased when applying sciatic nerve flossing in diabetic neuropathy patients without causing any discomfort or aggravating any symptoms.

The present study showed considerable association between H-reflex abnormality and the presence of diabetic neuropathy and concluded that it could be used as an early diagnostic test for neuropathy in diabetic patients. This comes in agreement with the RO Millán-Guerrero *et al.* [13] and Trujillo-Hernández B *et al.* [9] study which demonstrated that asymptomatic diabetic patients showed a high incidence of subclinical neurophysiological abnormality. They reported H-reflex abnormality in 58% of the diabetic patient.

Benjamin S. Boyd *et al.* [14] found the three-dimensional motion of the tibial nerve during ankle dorsiflexion. The tibial nerve was observed to shift longitudinally toward the axis of movement, as well as superficially and medially at the knee. Additionally, this study demonstrated that the tibial nerve also moves superficially at the ankle during dorsiflexion. Collectively, these results indicate that the tibial nerve between the knee and ankle starts in a relatively slack position, and active dorsiflexion first removes this slack before applying tension along the nerve.

NFT which causes a dynamic variation in neural pressure (by stretching at one end and relaxing at the other end), hence leading to evacuation of intraneural oedema which might be present in acute sciatica [15, 16] and also the disability was reduced, thereby signifying an improvement in the condition of the patients. This result agrees with the findings of some previous studies where motor control plays a critical role in stabilizing the spinal system [17]. Findings of present study are matched with previous studies done either on slider technique and/or NFT. Shah Mohit B *et al.* [18] found that slider neurodynamic technique has an immediate effect in improving lower quadrant flexibility in patients with back pain and lumbosacral radiculopathy.

In the current study, H-reflex of posterior tibial nerve was obtained and minimum, maximum and mean latencies were evaluated. There was statistically significant difference in pre-test and post-test measures in posterior tibial H-reflex parameters; which coincides with study Paquet N *et al.* [19] who reported the effects of vestibular and neck receptors on tibial H-reflex amplitude generally indicate that static and dynamic head positions do exert an influence, depending on the direction of movement describing the role of neck mechanoreceptors in tonic reflexes [20, 21].

6. Conclusion

The results of the present study suggest that the neural flossing techniques have significant effects in Diabetic neuropathy. Based on the findings it was concluded that H-reflex can show significant results in prognostic evaluation of the peripheral compressive neuritis of the nerve in diabetic neuropathy.

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