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Effect of TENS versus high intensity LASER on sensory and motor nerves in diabetic polyneuropathy

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Approximately 20% of diabetic neuropathy patients have neuropathic pain, implying significant decrease in quality of life and functional capacity, TENS and High Intensity Laser are used to relieve pain in diabetic neuropathy patients for improving their quality of life. Objective: is to compare between the effect of TENS and High Intensity Laser on sensory and motor nerves conduction velocity in diabetic type 2 patients with polyneuropathy. Methods: forty diabetic patients men and women who have symptoms of neuropathy in lower limbs, all patients were randomly recruited, they are all type II-controlled diabetics, with reported abnormal nerve conduction findings and there was no significant difference between both groups in the mean age, weight, height and BMI, They were divided randomly into two main equal groups: group (I) formed of 20 patients and were assigned for TENS, group (II) formed of 20 patients and were assigned for HIL, Data obtained regarding sensory and motor nerve conduction studies and LEFS for both groups before and after treatment, Results: the obtained results showed that there was highly statistically significant increase in peroneal conduction velocity, amplitude and decrease in peroneal latency in group II compared with group I and there was highly statistically significant increase in sural amplitude and decrease in sural latency for group II compared with group I also, there was highly significant increase in LEFS in group II more than group I after 15 sessions of treatment.

Keywords: TENS - High Intensity Laser - Diabetic polyneuropathy - nerve conduction study.

INTRODUCTION

Diabetic peripheral neuropathy (DPN) is a manifestation of small fiber damage, characterized by burning pain and tingling with nocturnal exacerbation It has a significant impact on the patient's quality of life and can result in depression, anxiety and sleep disturbance (Dacosta et al., 2011).

Older age, longer duration of diabetes increases the risk for DPN (Jacovides A et al., 2014) and obesity, low physical activity, smoking, poor glycemic control, low high-density lipoprotein (HDL) cholesterol, and raised LDL cholesterol, triglycerides and creatinine are independent risk factors for DPN (Ziegler D et al., 2018).

In diabetic patients, chronic hyperglycemia can produce neuropathic changes that affect peripheral nerve function and produce extremity pain (Callaghan BC et al., 2012).

Among diabetic neuropathy patients,

approximately 20% have neuropathic pain, implying significant decrease in quality of life and functional capacity. In addition, A major problem with DN is that once it has developed and been complicated by, for example, ulcers and Charcot foot, it is difficult to reverse, and patients face an increased risk of amputations associated with increased mortality (Bowling FL et al., 2018). DPN is also a major contributor to falls and fractures (Morrison et al., 2012), through more advanced small- and large-fiber dysfunction, with loss of sensory, proprioception, temperature discrimination, and pain, all ultimately leading to unsteadiness, recurrent minor injuries, and an increased risk of falls (Brown SJ et al., 2015).

Transcutaneous electrical nerve stimulation (TENS) is an electrical current which stimulate peripheral nerves via skin surface electrodes, which are placed on the lower extremities according to the distribution of nerve fibers, at well tolerated intensities and are capable of being self-administered, TENS is thought to reduce neuropathic pain by stimulating endogenous opioid release and dilation of blood vessels (Chen CC et al., 2007).TENS helps to remove or diminish pain, decrease muscle atrophy, diminish pain, increase blood cycle, diminish edema and effusion, and diminish in muscle spasm (Servet et al., 2010)

High Intensity Laser (HIL) is a rehabilitation therapy successfully used, due to its fast efficacy, with rapid and permanent relief of pain and the resulting in reduction of the recovery time (Servet et al., 2010)

The most important physiological effects of HIL are increase in the activity of many intracellular enzymes, specifically in the Krebs cycle, increase of oxygen transportation and also, of glucose utilization, stimulation of DNA synthesis, activation of the Na/K membrane pumps, increase of fibroblast activity, increase of phagocytosis activation, activation of metabolic cellular processes, local changes in some important inflammation mediators (such as histamine and prostaglandins) and in endorphin levels. The most important clinical effects are: analgesia and bio stimulation (Santamato et al., 2009).

MATERIALS AND METHODS

The study was carried out on 40 diabetic type II patients' men and women (14 men and 26 women), their ages were ranged between 50 and 60 years with a mean of 57.65 ± 2.71 years, they were recruited from outpatient clinic from physical therapy center at port said and divided randomly into two main groups: 20 patients were assigned for TENS and 20 were assigned for HIL and they had symptoms of neuropathy in lower limbs (Numbness, tingling, Pain, burning, electric shocks, stabbing) and confirmed by abnormal conduction study.

Patients were excluded when they had causes that evoked symptoms of sensory polyneuropathy rather than diabetes: Systemic disease**,** Infectious, Inflammatory, Drugs**,** metal, Hereditary, contraindications of using HIL (irradiation of malignancies and potential precancerous growths, irradiation of patients with cochlear implants, irradiation of endocrine glands, patients with febrile conditions, epilepsy, pregnancy, irradiation of freckles or tattoos, photosensitive medication), Patients with contraindications of TENS (Patients with pacemaker, damaged skin, cancer (local site), epilepsy, hemorrhage and infection), Uncontrolled diabetic patients, Fractures or deformity of any bones of lower limb, Osteoporosis, Significant scar tissue or calluses on the feet, Patients with diabetic foot.

Before the initiation of treatment program, a consent form was obtained from each patient as an agreement to be included in the present study. Each patient received detailed explanation of procedures of the program of treatment and measurement devices and the purpose of the treatment was explained for each patient, sural and common peroneal nerves conduction studies and lower extremity functional scale (LEFS) were applied before and after treatment.

Instrumentations:

Assessment instrument:

Nerve conduction device: Neuropack S1 MEB-9004 NIHON KODEN, JAPAN nerve conduction velocity device for measuring the motor conduction velocity of the common peroneal nerve and sensory conduction study for sural nerve.

Functional lower extremity scale: is a questionnaire containing 20 questions about a person's ability to perform everyday tasks.

Treatment instruments:

Chattanooga INTELECT ADVANCED STIM for TENS application Which has more than 25 clinical waveforms, 2 independent Electrotherapy channels, documentation of treatment outcomes with Patient Data Cards, constant current/constant

voltage modes, on screen pad contact quality indicator.

BTL-6000 High Intensity Laser device which has a power up to 12 W in continuous mode, maximum therapeutic effect using 1064 nm wavelength, safety footswitch operation.

Procedures of the study:

All patients were referred after complete medical assessment and diagnosed as type II diabetes with peripheral neuropathy in both feet.

Physiotherapy assessment was done as follow:

General inspection of the feet:

Patient's both feet were examined and the condition of the skin was checked, Dermatological changes, such as dry or scaly skin, also abnormalities of sweating or circulatory instability in the feet, e.g. a hot or cold foot.

Musculoskeletal assessment:

Foot deformity, prominence of the metatarsal heads and other bony prominences that increase the risk of skin breakdown. Callus, claw toes, hammer toes, “Charcot foot” were examined.

Neurological and vascular assessment:

The classic pattern of sensory loss in a patient with symmetric distal polyneuropathy like light touch, pin prick and temperature. This is referred to as a “sock or stocking” distribution that may extend to the mid-calf, pain and light touch was assessed with the use of a sharp examination pin or sterile needle and a wisp of cotton wool. for Vascular assessment; The patient’s feet were palpated to determine the presence and character of the posterior tibial and dorsalis pedis pulses.

Nerve conduction velocity study:

This was done to measure amplitude, distal latency and conduction velocity of motor deep peroneal nerve and sensory sural nerve conduction latency and amplitude of both lower limbs. This was done before and after treatment program.

Lower Extremity Functional assessment:

Lower Extremity Functional Assessment was performed by Lower Extremity Functional Scale (LEFS) which is a questionnaire containing 20 questions about a person’s ability to perform everyday tasks. The LEFS can be used by clinicians as a measure of patients' initial function, ongoing progress and outcome, as well as to set functional goals, it can be used to monitor the patient over time and to evaluate the effectiveness of an intervention. The columns on the scale are summed to get a total score. The maximum score is 80. (Binkley JM et al., 1999)

Therapeutic procedure:

40 diabetic neuropathy patients were randomly divided into 2 groups;

Group I: Including 20 diabetic neuropathy patients were recommended for treatment with TENS for consecutive 15 sessions.

Group II: Including 20 diabetic neuropathy patients were recommended for treatment with HIL for consecutive 15 sessions.

TENS: for the TENS group one electrode was placed on the upper shin and one electrode was above the ankle for both feet treatment as a session once a day three times per week for 15 sessions.

Parameters:

Patient received (50 AMP, for 20 minutes) for every foot. The therapeutic intensity was most effective when related to what the patient felt during the stimulation, and this may vary from session to session and from one foot to the other for the same patient. As a general guide, it was based on participant’s subjective reaction regarding the felt sensation 2 to 3 times sensory threshold (DeSantana JM et al., 2008).

Precautions:

patient was positioned comfortably with the affected leg suitably supported (supine lying or long sitting position) without causing discomfort to the patient and the treated area cleansed with an alcohol swab to remove surface lipids, if intensity threshold was decreased during the treatment session, it had been raised to optimum intensity.

Nerve conduction velocity for motor Common peroneal and sensory sural nerve and lower extremity functional scale were applied before and after treatment.

High intensity laser:

For the HIL group a standard handpiece endowed with fixed spacer was used to provide the same distance to the skin and perpendicularly to the zone to be treated with a laser beam diameter of 30 mm for every foot treatment as a session once a day three times per week for 15 sessions.

parameters:

The wavelength was 1064 nm, with a power of 5.00 w and frequency used was 25 HZ in analgesic phase and continuous in biostimulation phase and size of spacer was 30mm. through two phases of treatment (Dundar et al., 2015).

Method of application:

Phase I (analgesic phase): the application was made by moving the applicator perpendicular to the foot in continuous circular movements in the whole planter surface of the foot and around tarsal tunnel from the center to outside with the most painful spots in the center started it about 5-7 cm from the most painful spot and created about 3-4 spirals and treatment time was 6 minutes for every foot.

Phase II (bio stimulation): the application was made at the pain inflicting region by using continuous linear movements these motions creates warmth so, patients asked about feeling of warm and prevent static application. Then, the area was warmed up and treatment time was 10 minutes for every foot.

Precautions:

Before laser application, the target areas were cleaned with alcohol (95%) to minimize any backscatter or reflection from oily skin, the patient and the therapist wearied protective eyewear and the therapy parameters had been adjusted according to the Fitzpatrick scale to avoid heating. no ointments, creams, lotions or heating lotion patches were used at or in close proximity of the treated area, no therapies that could change body temperature (ultrasound, thermal therapy and electrotherapy) were used prior to laser treatment (Ribeiro, B.G. et al., 2015).

These was applied on both feet of the patient with the same physiotherapist in all sessions and Nerve conduction velocity for motor Common peroneal and sensory sural nerve and lower extremity functional scale were applied before and after treatment.

DATA ANALYSIS

Descriptive and. t-test were conducted for comparison of subject characteristics between both groups. Chi- squared test was used for comparison of sex distribution between groups. Normal distribution of data was checked using the Shapiro-Wilk test for all variables. Levene's test for homogeneity of variances was conducted to test the homogeneity between groups. Mixed MANOVA was performed to compare within and between groups effects. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 22 for windows (IBM SPSS, Chicago, IL, USA)

RESULTS

Subject characteristics:

Table 1 showed the subject characteristics of both groups. There was no significant difference between both groups in the mean age, weight, height and BMI ($p > 0.05$). Also, there was no significant difference in sex distribution between groups (group=0.5)

Mean ±SD and p values of nerve conduction study pre treatment and post treatment test at both groups:

Mixed MANOVA revealed that there was a significant interaction of treatment and time. Table 2 showed descriptive statistics of measured variables as well as the significant level of comparison between groups and the significant level of comparison between pre and post treatment in each group. There was a significant increase in right and left nerve conduction findings and LEFS in the group I post treatment compared with that pretreatment ($p < 0.05$) (table 2) and There was a significant increase of right and left nerve conduction findings and LEFS in the group II post treatment compared with that pretreatment ($p < 0.001$)

Between groups comparison:

There was no significant difference in all parameters between both groups pretreatment ($p > 0.05$). post treatment there was a significant increase in right and left peroneal NCV, right and left peroneal amplitude, right and left sural amplitude and LEFS of the group II compared with that of group A ($p < 0.001$). Also, there was a significant decrease in right and left peroneal motor latency, right and left sural latency of group II compared with that of group I post treatment ($p < 0.001$). (table 2).

Table 1: Participant characteristics.

	Group I	Group II	t- value	p-value
	$\bar{x}$ ± SD	$\bar{x}$ ± SD		
Age (years)	57.65 ± 2.71	58.05 ± 2.16	-0.51	0.61
Weight (kg)	72.2 ± 5.51	73.3 ± 4.92	-0.66	0.51
Height (cm)	163.45 ± 3.97	162.95 ± 5.25	0.3	0.73
BMI (kg/m²)	27 ± 1.56	27.6 ± 1.32	-1.29	0.2
Males/females	***8/12***	***6/14***	(χ^2 = 0.***44***)	0.***5***

$\bar{x}$, Mean; SD, Standard deviation; χ^2, Chi squared value; p-value, Level of significance

Table 2: Mean ±SD and p values of nerve conduction study pre and post treatment at both groups:

	Pre treatment			Post -treatment			Repeated measures	
	Group I	Group II		Group I	Group II		Group I	Group II
	$\bar{x}$ ± SD	$\bar{x}$ ± SD	P value	$\bar{x}$ ± SD	$\bar{x}$ ± SD	P value	P value	P value
Right peroneal NCV (m/sec)	41.5 ± 2.92	42.23 ± 2.21	*0.**37***	42.26 ± 2.7	45.7 ± 3.57	*0.**001***	0.002	0.001
Left peroneal NCV (m/sec)	41.97 ± 1.57	41.85 ± 3.13	***0.88***	43.38 ± 1.66	45.51 ± 3.24	***0.001***	0.006	0.001
Right peroneal amplitude (mV)	1.94 ± 0.6	1.88 ± 0.58	***0.75***	2.12 ± 0.66	2.98 ± 0.68	***0.001***	0.0001	0.001
Left peroneal amplitude (mV)	2.05 ± 0.45	1.96 ± 0.54	***0.55***	2.3 ± 0.54	3.12 ± 0.8	***0.001***	0.0001	0.001
Right sural amplitude (mV)	2.0 ***8*** ± 0.6	2.12 ± 0.47	***0.8***	2.54 ± 0.84	6.34 ± 1.16	***0.001***	0.00***3***	0.001
Left sural amplitude(mV)	2.0 ***5*** ± 0.***57***	2.1 ***7*** ± 0.4***8***	*0.49*	2. ***72*** ± *0.**73***	6.41 ± 0.96	***0.001***	0.0001	0.001
Right peroneal motor latency (m/sec)	4.5 ± 0.67	4.54 ± 0.78	0.83	4.32 ± 0.6	4 ± 0.6	0.02	0.0001	0.001
Left peroneal motor latency (m/sec)	4. ***47*** ± 0.***53***	4.57 ± 0.66	0.59	4.11 ± 0.58	3.9 ***7*** ± 0.6***4***	0.01	0.001	0.001
Right sural latency (m/sec)	***4.88*** ± 0.***42***	4.72 ± 0.4	0.23	4.44 ± 0.7	3.82 ± 0.44	0.002	0.001	0.001
Left sural latency (m/sec)	***4.67*** ± 0.***45***	4.48 ± 0.46	0.2	4.21 ± 0.55	3.56 ± 0.68	0.002	0.0001	0.001
LEFS	36.55 ± 8.2	37.65 ± 5.41	0.61	46.2 ± 7.48	51.95 ± 5.87	0.01	0.0001	0.001

$\bar{x}$, Mean; SD, standard deviation; p-value, level of significance

Table 3: Comparison of nerve conduction parameters between right and left sides post treatment in group I and group II:

Group I	Right $\overline{X}$ ±SD	Left $\overline{X}$ ±SD	p-value	Group II	Right $\overline{X}$ ±SD	Left $\overline{X}$ ±SD	p-value
Peroneal NCV (m/sec)	42.26 ± 2.7	43.38 ± 1.66	0.08	**Peroneal NCV (m/sec)**	45.7 ± 3.57	45.51 ± 3.24	0.79
Peroneal amplitude(mV)	2.12 ± 0.66	2.3 ± 0.54	0.21	**Peroneal amplitude (mV)**	2.98 ± 0.68	3.12 ± 0.8	0.37
Sural amplitude (mV)	2.54 ± 0.84	2.72 ± 0.73	0.24	**Sural amplitude (mV)**	6.34 ± 1.16	6.41 ± 0.96	0.84
Peroneal motor latency (m/sec)	4.32 ± 0.6	4.11 ± 0.58	0.25	**Peroneal motor latency (m/sec)**	4.1 ± 0.72	3.97 ± 0.64	0.06
Sural latency (m/sec)	4.44 ± 0.7	4.21 ± 0.55	0.07	**Sural latency (m/sec)**	3.82 ± 0.44	3.56 ± 0.68	0.03

$\overline{x}$, Mean; SD, standard deviation; p-value, level of significance

Comparison of nerve conduction parameters between right and left sides post treatment at both groups:

In comparison of nerve conduction parameters between right and left sides there was no significant difference between right and left sides post treatment in group I and group II table (3).

DISCUSSION

Diabetic peripheral neuropathy (DPN) is a complex disorder with multiple etiologies that affects about 50% of those with diabetes, and about 30% have painful diabetic neuropathy (Pop-Busui et al., 2017). National data in Egypt confirms that more than 60% of Egyptian diabetic patients suffer from neuropathy (Amara et al., 2019).

Several studies have shown that TENS and HIL can successfully treat neuropathic pain. TENS therapy may be an effective and safe strategy in treatment of symptomatic DPN. Due to small sample and short-term treatment duration. Possible pain reducing effect of TENS may allow changes in function and self-efficacy which in turn may influence overall long-term perception of pain (Saragiotto BT et al., 2017).

High Intensity Laser therapy significantly reduced pain and improved the overall quality of life of adults with painful diabetic peripheral neuropathy, HIL is considered a safe, non-pharmacological management of pain in old adults with painful diabetic peripheral neuropathy (Prasun C et al., 2019).

NCSs are well-established neurophysiologic techniques used to assess the integrity of larger myelinated sensory and motor fibers. Thus, these studies are normal in pure small fiber neuropathies.

However, they can clarify if larger sensory and/or motor nerve fibers are concomitantly involved with a small fiber neuropathy (Hovaguimian A, 2011).

In the present study we compared between the results of two groups received the treatment for five consecutive weeks.

The first group (I) had been received TENS while group (II) received HILT.

Forty diabetic patients' men and women have symptoms of neuropathy in lower limbs (Numbness, tingling, Pain, burning, electric shocks, stabbing) selected randomly from outpatient clinic from physical therapy center at port said and divided randomly into two main groups: 20 patients were assigned for TENS and 20 were assigned for HIL with application of sensory and motor nerve conduction studies before and after treatment and LEFS before and after treatment, The study was conducted from April 2019 to January 2020. Their ages were ranged from 50 to 60 years old; they are all type II-controlled diabetics.

They suffered from peripheral neuropathy with symptoms of pain, glove stock hyposthesia, burning sensation and spasm of foot muscles , they had abnormal nerve conduction study and the general characteristics of the subjects of both groups revealed that there was no significant difference between both groups in the mean age, weight, height and BMI ($p > 0.05$).

Nerve conduction study was applied for measuring the motor conduction study of the common peroneal nerve pre and post treatment regarding peroneal nerve conduction velocity (NCV), amplitude and latency and sensory

conduction study of sural nerve amplitude and latency and Lower Extremity Functional Scale (LEFS) to evaluate the functional impairment of a patient with a disorder of both lower extremities pre and post treatment.

The results of this study found that, within groups, in group I, there was significant increase in right and left peroneal conduction velocity and amplitude and decreased latency pre and post treatment and there was significant increase in right and left sural nerve amplitude and decrease in latency pre and post treatment.

There was a significant increase in LEFS of the group I post treatment compared with that pre-treatment ($p = 0.0001$) and no significant difference between right and left peroneal conduction velocity and peroneal and sural amplitude and latency pre and post treatment.

In group II, there was significant difference between right and left peroneal conduction velocity, latency and amplitude of peroneal and sural nerves pre and post treatment ($P<0.01$), there was a highly significant increase in the right and left peroneal conduction velocity ,peroneal and sural amplitude and decrease in latency of the group II post treatment compared with that of pre-treatment ($P<0.01$) and there was a highly significant increase in the LEFS of the group II post treatment compared with that of pre-treatment ($p = 0.01$) with no significant difference between right and left peroneal and sural latency, amplitude and right and left peroneal conduction velocity.

But between groups the obtained results showed that there was highly statistically significant increase in right and left peroneal conduction velocity, amplitude and decrease in right and left peroneal latency in group II compared with group I and there was highly statistically significant increase in right and left sural amplitude and decrease in right and left sural latency for group II compared with group I also, there was highly significant increase in LEFS in group II more than group I after 15 sessions of treatment.

The results of this study are supported by Prasun C et al., (2019) who stated that Deep Tissue Laser was effective in managing pain in older adults with DPN and improved the overall quality of life of older adults with painful diabetic peripheral neuropathy, it leads to significant improvement in the Timed UP and Go score for both the reduction in pain and improvement in gait speed and physical performance also, times were significantly shorter and decreases pain at pain disability questionnaire, quadruple visual analogue, numeric pain scale So it approved that HIL leads to significant improvement in LEFS in our study.

Further explanation was presented by Rochkind et al. (2009) who studied influence of laser therapy on peripheral nerve injuries in rats, they reported that Laser promote proliferation of glial cells in both astrocytes and oligodenderocytes. This leads to higher neuron metabolism and better myelin production which in turn improves nerve conduction velocity.

The results also supported by Maher A et al. (2017) who stated that High intensity laser leads to improvements in ulnar nerve conduction velocity and pain relief in patients suffering from cubital tunnel which can be explained by anti-inflammatory and biostimulation properties of HILT as well as better penetration depth and absorption rate. So, it leads to significant improvement in nerve conduction studies for our study.

Also, the results agreed with Yamany AAM et al., (2016) who studied the Effect of Laser Therapy on Nerve Conduction and Foot Planter Pressures Distribution of Painful Diabetic Neuropathy, the study found that in the laser group, both peroneal and sural nerves conduction velocity and amplitude were significantly increased.

The study is supported by Kadria H.et al. (2011) who found that Laser and TENS have proven to be effective and non -invasive modalities to prevent complications of diabetic polyneuropathy especially that related to microcirculation; also, they have great effects on decreasing pain but LILT was more significant in decreasing pain intensity and increasing skin microcirculation than TENS.

The study is also supported by Joseph A.et al., (2007) who studied The Long-Term Management of Diabetic Neuropathy with High Power Laser Therapy (HPLT) who stated that High Power Laser Therapy has been demonstrated to accelerate nerve regeneration as well as vasodilation of blood vessels and neo-capillary formation. It is safe and virtually free of side effects, HPLT is much more than a deep heating modality.

Casale R et al., (2013) approved that High-intensity combined LASER wavelengths of 830 nm and 1064 nm, which produce a better transparency with less scattering and a high energy transfer, are better than TENS in improving both pain and paresthesia as well as

neurophysiological parameters in CTS and Visual analogue scale (VAS) for pain and paresthesia; median nerve distal motor latency and sensory nerve conduction velocity after fifteen sessions of treatment.

These results are supported by a study of Walsh et al., (2008), where researchers investigated the effect of four combinations of TENS parameters on nerve conduction velocity NCV parameters and negative peak latency NPL. Their findings revealed that the application of one combination of TENS parameter (100 Hz and 200 ms) directly over the course of the nerve produced a significant increase in NCV and a decrease in NPL so it leads to increase in sural nerve conduction study.

This study explained also by Servet Kavak et al., (2010) who stated that TENS therapy can improve the latency in the periods of after TENS and following term of TENS by decrease of membrane capacitance and membrane resistance, and regenerated demyelination of nerve's myelin layer when applied in ulnar and median nerves it demonstrates how it decreases latency of sural nerve and increases its amplitude.

These results are in contradiction with those of a study by Emmanuel A, et al., (2019) who stated that Transcutaneous electrical nerve stimulation and other forms of electrical stimulation reviewed in their study may be effective and safe non-pharmacological treatment modalities in relieving the symptoms associated with diabetic neuropathy. The effectiveness of LILT cannot be determined due to the different parameters used to evaluate patients' outcome and limited number of studies.

CONCLUSION

It can be concluded that the application of HIGH INTENSITY LASER of wavelength 1064 nm, power 5.00w with a dosage at analgesic phase of 10 J/cm2, treatment time 6 minutes and at biostimulation phase of 60 J/cm2 , treatment time 10 minutes for three times a week for fifteen sessions is better than TENS of 80 HZ, 50 AMP,0.2ms square pulses for 20 minutes for three times a week for fifteen sessions in common peroneal motor and sural sensory nerve conduction study and in LEFS..

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

SME, AAF, HEO, EMI and AMNE were responsible for the design, conduct the study and wrote the manuscript. SME conducted the participant selection, measurements and statistical analysis of data. AAF, HEO, EMI and AMNE reviewed the manuscript. All authors read and approved the final version.

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