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Low Level Laser Therapy in Diabetic Patients with Tarsal Tunnel Syndrome

Ahmed Essmat
Neurology Department, Al-Azhar University Faculty of Medicine, Al-Hussein University Hospital, Cairo, Egypt, ahmadesmat81@yahoo.com

Asmaa Swelim
Physical therapist, New Cairo Hospital, Cairo, Egypt, asmaaembaby7@gmail.com

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Low-Level Laser Therapy in Diabetic Patients with Tarsal Tunnel Syndrome (A Preliminary Report)

Asmaa S. Embaby[1] MB.Bch and Ahmed Essmat[2*] MD

[*]**Corresponding Author**
Ahmed Essmat
ahmadesmat81@yahoo.com

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[1]Physical Therapist, New Cairo Hospital, Cairo, Egypt.

[2]Department of Neurology, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

ABSTRACT

Background: Peripheral diabetic neuropathy (PDN) may be associated with nerve compression neuropathies including tarsal tunnel syndrome (TTS). Low levels of laser therapy (LLLT) is a suggested treatment. The present prospective study investigated the effect of LLLT on the clinical and neurophysiological parameters in diabetic patients with TTS.
Method and Materials: Thirty diabetic patients with TTS aged 40-60 years received LLLT. LLLT was achieved using a double diode laser device (LUMIX® 2 device, Fisioline, Italy) emitting at 904 nm. Patients received 3 sessions weekly for 12 weeks. Neurophysiological parameters and visual analog scale were measured before and after 12 weeks of LLLT.
Results: Comparison between pre and post-treatment outcome parameters revealed significant improvement of VAS (8.5 ± 1.2 versus 4.6 ± 1.7, $p<0.001$), motor distal latency (6.7 ± 0.9 versus 5.1 ± 0.9 ms, $p<0.001$), sensory peak distal latency (4.6 ± 0.5 versus 3.2 ± 0.3 ms, $p<0.001$), motor amplitude (2.6 ± 0.6 versus 4.1 ± 0.5 mV, $p<0.001$), medial planter amplitude (6.1 ± 3.2 versus 15.1 ± 3.5 mV, $p<0.001$) and medial planter amplitude (4.3 ± 2.0 versus 12.5 ± 1.6 mV, $p<0.001$).
Conclusion: LLLT has a positive impact on clinical and neurophysiological parameters in diabetic patients with TTS.

Keywords: Peripheral diabetic neuropathy; Low-Level Laser Therapy; Tarsal Tunnel syndrome.

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INTRODUCTION

Type II diabetes mellitus (DM) constitutes a global health burden. The condition is characterized by a wide range of associated morbidities and is related to a significant shortening of life expectancy[1,2]. Peripheral diabetic neuropathy (PDN) is a common complication of long-standing DM. Among many mechanisms provided to explain the pathogenesis of PDN, the vascular theory suggests that the primary event is vasa nervosum occlusion. This phenomenon is a typical example of diabetic affection of the peripheral microcirculation. However, others argue that diffuse and symmetrical distribution of PDN may be predominantly attributed to metabolic derangement which is related to increased sorbitol levels as a result of hyperglycemia[3]. In some instances, PDN can affect isolated set of peripheral nerves. This situation may be challenging as it's confusing to distinguish if symptoms are due to local pressure or systemic causes. The problem is particularly common in anatomic locations of nerve entrapment (compression neuropathy / nerve compression syndrome) [4,5].

Posterior tibial neuralgia or tarsal tunnel syndrome (TTS) is a common example of this condition. TTS describes a compression neuropathy of the posterior tibial nerve and its branches as it passes through an "entrapment location" which is the tarsal tunnel in

this case [6]. Clinically, patients present with a spectrum of symptoms including radiating diffuse pain and/or numbness or burning sensation [7]. Patients with recent affection usually report symptoms exacerbation concerning physical activity. However, as the pathology establishes, pain persists even during rest [8]. Diagnosis is usually based on clinical findings with Tinel's sign test considered as the most specific test for diagnosis of TTS [9]. However, imaging studies including MRI and ultrasound can help to discover the underlying etiology [10].

TSS can be managed conservatively or surgically depending on etiology and symptoms severity. Conservative treatment includes analgesics, neuropathic pain medications, and physical therapy. However, none of these options proved to be conveniently effective [11].

Low-Level Laser (LLL) uses low-power lasers (< 60 MW) to alter cellular function without generation of heat [12]. LLL therapy (LLLT) was suggested as a simple and non-invasive option in the treatment of TTS. Mechanisms implicated in its action include enhancement of the local microcirculation, improvement of axonal myelination, and augmented release of endorphins [13].

Therefore, this study proposed to evaluate the effect of LLLT on clinical symptoms and neurophysiological parameters in type II diabetic patients with TTS.

PATIENTS AND METHODS

The present prospective interventional study was conducted at New Cairo Hospital, New Cairo, Egypt. The study protocol was approved by the local ethical committee and all patients gave informed consent before participation. The study included thirty patients with type II diabetes for at least 5 years and TTS not responding to medical treatment (analgesics) and didn't receive any form of physical therapy. All patients were on oral hypoglycemics and under good diabetic control. Exclusion criteria were pregnancy, malignant tumors, unstable glycemic control, renal or hepatic disease, thyroid disease, epilepsy seizures, active hemorrhage, wound healing, limb ischemia, varicose veins local deformities and recent (within one month) use of medical therapy for TTS.

Included patients were subjected to careful history taking and thorough clinical examination. LLLT was achieved using a double diode laser device (LUMIX® 2 device, Fisioline, Italy) emitting at 904 nm. The laser probe was applied along the course of the tarsal tunnel from the proximal border of the flexor retinaculum in the midline for 3 points proximally, then passed distally for another 2 points across the retinaculum with a lateral division of the tibial nerve behind the medial malleolus. Each point received 120 seconds and the time of the complete session was 10 minutes. Patients received 3 sessions weekly for 12 weeks.

The outcome parameters were assessed before and after 12 weeks after intervention. Visual Analog Scale (VAS) was utilized for evaluation of pain using a 10-cm scale ranging from 0-10 with the minimum value referring to no pain and the maximum value referring to maximum possible pain [14]. Assessed neurophysiological parameters were sensory conduction velocity of the medial and lateral plantar nerves and motor conduction velocity at the abductor halluces brevis muscle [15-17]. All participants received treatment sessions under supervision.

Statistical Analysis

Results of the present study were expressed as number and percent or mean ± standard deviation. A paired t-test was used to compare pre and post-interventional variables. P-values of less than 0.05 were considered statistically significant. All statistical calculations were performed using SPSS version 25 (IBM, USA).

RESULTS

The present study included 30 patients. They comprised 17 males and 13 females with an age of 51.5 ± 6.63 years. Other basic criteria of the studied patients are shown in (Table1).

Male/Female number	17/13
Age (years) mean ± SD	51.5 ± 6.6
Weight (kg) mean ± SD	86.9 ± 13.1
Height (cm) mean ± SD	171.8 ± 5.7
BMI (kg/m²) mean ± SD	29.4 ± 3.8
Duration of diabetes (years) mean ± SD	17.9 ± 5.4

Table 1: Basic data of the studied group

Comparison between pre and post-treatment outcome parameters revealed significant improvement of all parameters including VAS (8.5 ± 1.2 versus 4.6 ± 1.7, p <0.001), motor distal latency (6.7 ± 0.9 versus 5.1 ± 0.9 ms, p <0.001), sensory peak distal latency (4.6 ± 0.5 versus 3.2 ± 0.3 ms, p <0.001), motor amplitude (2.6 ± 0.6 versus 4.1 ± 0.5 mV, p <0.001), medial planter amplitude (6.1 ± 3.2 versus 15.1 ± 3.5 mV, p <0.001) and medial planter amplitude (4.3 ± 2.0 versus 12.5 ± 1.6 mV, p <0.001) (Table 2).

	Pre treatment	Post treatment	% of change	P value
VAS	8.5 ± 1.2	4.6 ± 1.7	45.3	<0.001
Motor distal latency (msec)	6.7 ± 0.9	5.1 ± 0.9	23.4	<0.001
Sensory peak distal latency (msec)	4.6 ± 0.5	3.2 ± 0.3	29.7	<0.001
Motor amplitude (mV)	2.6 ± 0.6	4.1 ± 0.5	58.8	<0.001
Medial planter amplitude (mV)	6.1 ± 3.2	15.1 ± 3.5	150.1	<0.001
Medial planter amplitude (mV)	4.3 ± 2.0	12.5 ± 1.6	194.1	<0.001

Table 2: Comparison between the pre- and post-treatment outcome parameters in the studied groups

DISCUSSION

TTS is a painful compression neuropathy of the entrapped posterior tibial nerve and its branches[6]. Available treatment options include conservative medical and physical management and surgical release. However, the efficacy of these interventions remains controversial[11].

In the present study, LLLT proved to be effective in the management of TTS associated with PDN. Treatment resulted in a significant reduction of perceived pain and improvement of sensory and motor nerve functions. These findings are supported by other similar studies including the study of Cg, et al. [18] and Ali, et al. [19] who reported a significant reduction in pain severity after LLLT. Moreover, the study of Ali, et al. [19] noted significant improvement of sensory and motor nerve functions after LLLT. Similar conclusions were recognized by the study of Bakhtiary, et al. [20]. Also, the study of Yamany, et al. [21] appreciated the value of LLLT in the management of PDN including its positive impact on pain.

The healing and pain-relieving effects of LLLT are attributed to a combination of vascular, metabolic, and neurological actions. It enhances the local microcirculation and promotes the supply of nutrients to the affected tissues thus repairing the impaired metabolic processes[22].

The pain relief effect of LLLT is scientifically based on the stimulation of nerves and suppression of the generation of pain impulses. Also, LLLT increases the release of pain-antagonizing substances e.g. β-endorphins and catecholamines[23].

CONCLUSION

Conclusively, the present study showed that LLLT has a good effect on pain and neurophysiological parameters in diabetic patients with TTS.

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