

Laser Acupuncture as a Treatment Option for Carpal Tunnel Syndrome Management: a Case Series

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Carpal tunnel syndrome (CTS) is disease that gives burdens for many countries, with a few choices for the management such as drugs or surgery, each has side effects that decrease the quality of life. Acupuncture is proven to be an effective treatment for pain and can restore nerve functions, and laser acupuncture is one of the modalities. This study aims to assess the effectiveness of laser acupuncture with total sample of 3 patients (6 wrists) mostly with tingling sensations and the outcomes are Boston questionnaire (BCTQ), visual analogue scale (VAS), Tinel sign, Phalen sign, and parameters of nerve conduction study (NCS). Acupuncture points used here are PC6, PC7, EXUE9, and LI4. The results show a decrease in NCS grades for 3 wrists, all wrists have BCTQ score improvements, a decrease in VAS, but no significant improvement in Tinel and Phalen signs. It is concluded that laser acupuncture can be used as a treatment option for the management of carpal tunnel syndrome.

Keywords: Acupuncture, Carpal tunnel syndrome, Laser acupuncture, BCTQ, Nerve conduction study, Case series

INTRODUCTION

Carpal tunnel syndrome (CTS) is caused by median nerve entrapment in the wrist and is one of the most common nerve entrapment conditions [1]. The incidence of CTS is connected to occupational factors, particularly in those professions that require the use of vibrating tools or require repetitive wrist movement. Pregnant women and diabetic patients often suffer disproportionately from CTS, with an incidence of around 20% and 30%, respectively [2]. CTS is more common in women than men, and adversely affects quality of life. It is also one of the most reported reasons why people miss workdays in England, which is 27 days per year [2]. In the United States (US) one in every 20 people suffers from CTS, costing the economy around \$2 billion every year [2,3].

Median nerve injury in CTS is caused by nerve compression and traction, which can reduce intraneural microcirculation. This can lead to blood-nerve barrier disruption and the accumulation of proteins and inflammatory cells, leading to a compartment syndrome miniature, increased permeability, and edema. Edema can cause hypoxia and increased levels of both hypoxia-inducible factor 1 α (HIF-1 α) and vascular

endothelial growth factor (VEGF). Inflammation is caused by hypoxia and is influenced by inflammatory cytokines such as interleukin (IL)-1 β , IL-6, and tumor necrosis factor (TNF)- α [4,5].

The clinical symptoms of median nerve injury include a history of pain, tingling, hypesthesia, and muscle weakness in later stages. Physical examination findings include positive Tinel and Phalen tests, and thenar muscle atrophy.

Additional examinations such as ultrasonography and nerve conduction study (NCS) could assess the degree of nerve injury [6,7], while the Boston carpal tunnel questionnaire (BCTQ) is a commonly used tool that assesses clinical disabilities and improvements after treatment. It consists of the symptom severity scale (SSS) and the functional status scale (FSS) [8,9].

Laser acupuncture is a form of acupuncture therapy that has already been scientifically documented as being an effective treatment for neuropathic pain, particularly in China [10]. The National Institute of Health (NIH) in the US recommended acupuncture in the management of mild to moderate CTS [11]. This study aims to assess the effectiveness of laser acupuncture as a valid treatment option for CTS

management.

CASE PRESENTATION

Three patients (six wrists) who had received a clinical diagnosis of CTS volunteered to participate in the study and signed an informed consent form. They then underwent NCS examinations to determine the severity of their condition (Table 1). The patients were all women aged between 55 and 60 years, with no history of epilepsy, fever, or heart failure. None of them had used opioids seven days prior to the study and had not received TENS therapy, diathermy, sonotherapy, needle acupuncture, or laser acupuncture within two weeks of the study's commencement.

In this study, laser acupuncture was used to treat the patients using a near-infrared 785 nm continuous wave, 4 joules of energy per point, and 50 mW of power. The diameter of the aperture of the laser device was 2 mm, with 196.39 mW/cm² of power density and 15.71 J/cm² of energy density.

The acupuncture points used were PC6, PC7, EXUE9, and LI4 for each wrist, and treatment was spread across six

sessions, three times a week, for two weeks. The outcomes measured were the visual analog scale (VAS) for pain, the BCTQ, the Tinel test, the Phalen test, and NCS parameters such as distal motor latency and median sensory nerve latency (measured in ms).

Outcome assessments were conducted after the third and fifth therapy sessions, and two weeks after the end of the treatment for all outcomes, except for the NCS which was carried out two weeks after the end of the treatment. No side effects were reported by any of the patients. This study received approval from the Ethics Committee at the Faculty of Medicine Universitas Indonesia (ethical clearance no. KET-309/UN2.F1/ETIK/PPM.00.02/2020).

1. First patient

The first patient was a 56-year-old woman who presented with tingling sensations in both wrists. She first felt the tingling two years ago, which worsened with activity and was accompanied by pain during intense activity (Table 2). The complaints were more prominent in her left wrist. There was no hypesthesia or weakness in either wrist. NCS grading showed that the patient had grade III in both the right and left wrist. After the treatment session, the patient's right wrist NCS score decreased to grade II, but the left wrist remained at grade III.

2. Second patient

The second patient was a 58-year-old woman with tingling sensations in both wrists, which were first felt five years ago (Table 3). The tingling was worse when carrying out activities such as washing clothes at home. She only experienced pain during intense activity and there was no pain when resting. There was also no hypesthesia or weakness in either wrist. The patient's NCS scores were assessed as grade II for both the right and left wrist. After treatment, the NCS scores for both wrists decreased to grade I.

Table 1. The baseline demographics of the three patients

	First patient	Second patient	Third patient
Gender	Female	Female	Female
Age	56	58	57
Occupation	Nurse	Nurse	Cashier
Complaints			
Pain	Left	-	Right
Tingling	Bilateral	Bilateral	Bilateral
Hypesthesia	-	-	-
NCS grade	III right/III left	II right/II left	III right/I left
VAS	49 mm [‡]	0 mm [‡]	41 mm [‡]

[‡]mm = millimeter.

Table 2. The results of the first patient's right and left wrist

Wrist	Outcome	Baseline	At 3rd session	At 5th session	2 weeks after therapy	Difference (Δ)
Right (Wrist 1)	VAS (mm)	0	0	0	0	0
	Tinel test	-	-	-	-	
	Phalen test	-	-	-	-	
	SSS	1.36	1.36	1.36	1.09	-0.27
	FSS	2.37	2.12	2.12	2.12	-0.25
Left (Wrist 2)	VAS (mm)	49	43	39	36	-13
	Tinel test	+	+	+	+	
	Phalen test	+	+	+	+	
	SSS	1.72	1.63	1.63	1.63	-0.09
	FSS	2.37	2.12	2.12	2.12	-0.25

Table 3. The results of the second patient’s right and left wrist

Wrist	Outcome	Baseline	At 3rd session	At 5th session	2 weeks after therapy	Difference (Δ)
Right (Wrist 3)	VAS (mm)	0	0	0	0	0
	Tinel test	-	-	-	-	
	Phalen test	-	-	-	-	
	SSS	1.45	1.36	1.09	1.36	-0.09
	FSS	1.75	1.5	1.5	1.25	-0.5
Left (Wrist 4)	VAS (mm)	0	0	0	0	0
	Tinel test	-	-	-	-	
	Phalen test	-	-	-	-	
	SSS	1.45	1.36	1.27	1.18	-0.27
	FSS	1.5	1.37	1.25	1.25	-0.25

Table 4. The results of the third patient’s right and left wrist

Wrist	Outcome	Baseline	At 3rd session	At 5th session	2 weeks after therapy	Difference (Δ)
Right (Wrist 5)	VAS (mm)	41	41	34	21	-20
	Tinel test	+	+	+	+	
	Phalen test	+	+	+	+	
	SSS	2.00	1.81	1.54	1.63	-0.37
	FSS	1.87	1.87	1.5	1.62	-0.25
Left (Wrist 6)	VAS (mm)	29	23	21	17	-12
	Tinel test	+	-	-	-	
	Phalen test	+	-	-	-	
	SSS	1.72	1.54	1.27	1.09	-0.63
	FSS	1.5	1.5	1.37	1	-0.5

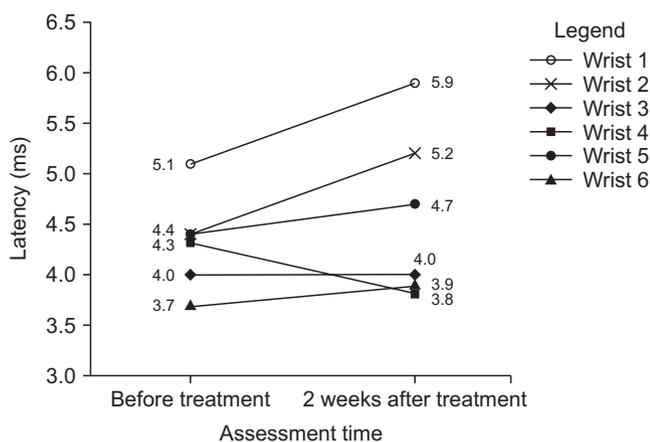


Fig. 1. Distal motor latency (millisecond) parameter on all wrists.

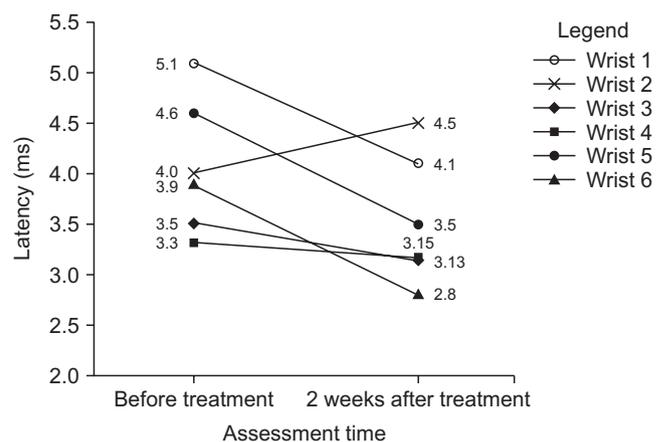


Fig. 2. Median sensory nerve latency (millisecond) parameter on all wrists.

3. Third patient

The third patient was a 57-year-old woman presenting with pain, tingling, and weakness that had been ongoing for one year (Table 4). Her symptoms worsened when working on her computer or when doing chores at home, and were more

severe in her right wrist. However, there was no evidence of hypesthesia. The patient’s NCS scores were assessed as grade III in the right wrist and grade I in the left wrist. After undergoing treatment, the patient’s NCS gradings did not change.

NCS parameters such as distal motor latency and median sensory nerve latency, as well as how they compare between the patients' six wrists are shown in Fig. 1 and Fig. 2.

DISCUSSION

In this study, a series of laser acupuncture treatments were carried out on three patients (six wrists) to determine its effectiveness in reducing the symptoms of CTS. The treatment sessions were conducted over six sessions, three times a week, for two weeks. Using continuous wave, 4-joule, 50 mW laser acupuncture at PC6, PC7, EXUE9, and LI4 acupuncture points for each wrist, we assessed several multiple outcomes such as VAS, the Tinel test, the Phalen test, BCTQ, and NCS parameters. The patients were all aged between 56 and 58 years old, with tingling the most commonly reported symptom.

The BCTQ scores decreased in most of the wrists, which reflected the clinical improvements in the patients, and there was a decrease in VAS in every patient who complained of pain. NCS grades were also reduced in three of the patients' wrists, but there were no changes in the other three wrists. Distal motor latency did not show any improvement, although improvements were seen in median sensory nerve latency.

Wolny et al. also obtained similar results in their RCT, which showed that sensory conduction velocity improved before there were any changes in motor conduction velocity [12]. A review by Naeser discussed several studies that used similar treatments to treat CTS and noted that two controlled studies that had a longer treatment period of five weeks showed a significantly higher incidence of return-to-work rates, greater improvements in grip and pinch strength, and significant improvements in nerve conduction for both sensory and motor latencies [13]. Based on this comparison, longer treatment periods are advisable.

The improvement in these parameters is caused by the anti-inflammation effects of laser acupuncture. Administering local opioids such as β -endorphins at the treatment sites can reduce mast cell degranulation and pro-inflammatory cytokines such as IL-1 β , IL-6, TNF- α , and prostaglandin [14,15]. Laser acupuncture also causes central opioids in the brain, which can help reduce neuropathic pain [14,15]. In addition to reducing inflammation, laser acupuncture can facilitate the healing of the median nerve through vasodilation and can increase ATP production via the photobiomodulation effect. By activating the mitochondria and facilitating ATP production, laser acupuncture produces calcitonin gene-related peptide (CGRP) and nitric oxide (NO), which have a vasodilatory effect [14,16]. This process improves the nutrition and oxygenation of the median nerve,

thus ameliorating nerve healing.

Laser acupuncture also contributes to the systemic immune regulation cholinergic anti-inflammatory pathway, where there is an increased expression of nicotinic acetylcholine receptors (α 7nAChR) on the surface of macrophages in body tissue [17]. Acetylcholine from the vagal pathway can bind to these macrophages thereby inhibiting pro-inflammatory cytokine synthesis [17]. Laser acupuncture can also increase BDNF's mRNA levels and BDNF expression itself, thereby increasing the survival, proliferation, and differentiation of these nerve stem cells [18,19].

Stimulating the acupuncture points in localized areas of the wrist can increase separation in the D2/D3 area of the S1 somatosensory cortex, thereby improving neuroplasticity via the GABA neurotransmitter [20,21]. It is possible that there is a form of central autonomic control of the arteriolar blood vessels that supply the nerve vasa of the median nerve so that vasodilation occurs as a result of parasympathetic impulses from the S1 cortex [20].

The Tinel test, the Phalen test, and the distal motor latency parameter in the NCS did not show improvements, which may be because of the limited therapy given and a premature follow-up time. Studies have suggested follow-ups after a minimum of one month, and up to 16 sessions of laser acupuncture [22,23]. The small number of total sessions and short follow-up times were the main limitations of this study.

CONCLUSIONS

Improvements were shown in BCTQ scores, VAS, NCS grade, and the median sensory nerve latency parameter after six sessions of laser acupuncture therapy. However, the Tinel test, the Phalen test, and the distal motor latency parameter in NCS showed no improvements. Based on these results, laser acupuncture can be suggested as a therapeutic option in the management of CTS.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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