

Effects of Acupuncture Therapy on Clinical and Electrophysiological Findings in Carpal Tunnel Syndrome

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Abstract

Investigating clinical and electrophysiological activity of manual body acupuncture therapy on patients with mild and moderate CTS diagnosis was aimed. In this study, patients diagnosed with mild-moderate level CTS by the clinic and Electromyography (EMG) in first 2 weeks, 3 sessions were performed followed by 2 sessions for 2 weeks and each session was for 30 minutes, a total of 10 sessions of acupuncture practice were performed. In acupuncture therapy, dry needling was practiced using PC-3, PC-6, and PC-7 points. Patients were evaluated by electrocardiographic parameters, paresthesia (numbness, tingling), Visual Analog Scale (VAS), Boston Scale (Symptom Severity and Functional Capacity), Tinnel and Phalen test before and at the first and third months of treatment. Out of 40 patients meeting the participation criteria, 37 were able to complete the study and were evaluated for the result. After the treatment, on the symptoms of numbness and tingling, statistically, significant improvements in Phalen test positivity were compared to pre-treatment ($p < 0.05$). Compared to pre-Acupuncture therapy, the VAS score and Boston Symptom Severity scale in the 1st and 3rd month after treatment showed significant improvements ($p < 0.01$). Among electrophysiological parameters, median nerve distal motor latency (mMDL) was significantly healed in 3rd month after the treatment in respect to before treatment ($p = 0.01$). As a result, the effect of acupuncture therapy practiced using PC-3, PC-6, PC-7 points in mild-moderate level CTS treatment on clinical findings was more apparent compared to electrophysiological findings. Acupuncture treatment in mild to moderate CTS may be a reliable symptomatic treatment option in patients with pain and paresthesia complaints.

Keywords: Carpal tunnel syndrome; Acupuncture; Paresthesia complaints; VAS; Boston scale; Electrophysiological parameters

Abbreviation

CTS: Carpal Tunnel Syndrome; DM: Diabetes Mellitus; CNS: Central Nervous System; VAS: Visual Analogue Scale; BMI: Body Mass Index; SPSS: Statistical Package for Social Sciences

Introduction

Most commonly seen entrapment neuropathy "Carpal Tunnel Syndrome (CTS)", occurs as a result of compression of the median nerve at the wrist within the carpal tunnel. As well as many illnesses being shown to cause CTS (rheumatoid arthritis, diabetes mellitus (DM), amyloidosis, acromegaly, myxedema, obesity, pregnancy etc.), in most of the cases occur as idiopathic [1-3]. Classic symptoms on patients with CTS are paresthesia (numbness, tingling) and pain on the median nerve distribution area at the hand (at the first three fingers radial half of the fourth finger), which occurs especially at night or with repetitive coercive hand movement and is relieved by shaking the hand or changing position. Weakness in thenar muscles and atrophy are late-period findings seen in long-term CTS symptoms [1-5]. Pains can spread to outer anatomic innervation area of the nerve and, proximal and shoulder [6].

CTS diagnosis in clinical application is usually made according to the existence of one or more symptoms and results of diagnostic proactive tests. Electrodiagnostic works are valuable in clinically

verifying CTS diagnosis and to determine the existence of other neuropathies [1,5]. Electrophysiological methods objectively lead to CTS diagnosis with accuracy at the rate of percentage 91-98 [7]. CTS is treated with conservative methods or surgically. Among conservative methods, there is splint usage, non-steroid anti-inflammatory medicine usage, corticosteroid injection in carpal tunnel and physiotherapy modalities [4]. Also, acupuncture and yoga are shown to reduce symptoms in CTS [8].

Acupuncture is an ancient Chinese treatment method done by pricking needles in specific points [9]. In acupuncture, the application is done to the skin and subcutaneous muscle tissue. About 70%-80% of the acupuncture points are similar with trigger points [10]. Receptors like nociceptor, Meissner's corpuscles, Krause bulbous, Golgi tendon organ are densely located in acupuncture points [11]. When the needle is applied in acupuncture points causes a zonal sensation of tension, pressure, warm-up, and pain called "De-Qi" in Chinese literature [12]. This may be a sign that proper points were chosen [13]. With pricking in acupuncture points, pain stimulus is transferred to the Central Nervous System (CNS) via nociceptors. Nociceptors are nude and free nerve endings in all skin and subcutaneous tissues sensitive to painful stimuli [14]. Acupuncture has various curative effects through different mechanisms, these are; the analgesic effect, homeostatic effect, immunity increasing effect, sedative effect, psychological effect, and motor curative effect. Two theories have been suggested regarding the application of this treatment in pain control. First is that acupuncture can stimulate broad sensory afferent fibers and suppress the sense of pain as understood in gate control theory. Secondly, its provision a pain control effect through inducing opiate-like endogenous substance

released by providing pain control effect through needle pricking effecting as a painful stimulus [15].

In CTS, the superiority of acupuncture therapy on placebo is proven by a large number of studies [16]. Along with this, no definitive proof exists regarding the effectiveness of acupuncture on CTS treatment at the present time. The aim of this article is to evaluate the efficacy of acupuncture therapy in patients with mild to moderate CTS.

Materials and Methods

The study was conducted with a total of 40 patients who met the inclusion and exclusion criteria sent to Neurology electrophysiology laboratory with the preliminary diagnosis of CTS. Ethics committee approval was obtained from our hospital.

Study inclusion criteria

Patients who had at least one of the symptoms of numbness, burning, tingling, pain in the region that matched the median nerve distribution, and who had mild and moderate carpal tunnel syndrome in the nerve conduction studies were included in the study. Volunteer patients were included in the study.

Exclusion criteria

Being surgically operated for CTS, having predisposed etiological factors for CTS like DM, gout, acute trauma, rheumatologic diseases, pregnancy, chronic kidney failure, thyroid diseases, cervical radiculopathy or polyneuropathy, those injected with steroids within last three months, having oral steroid treatment within last one month or participated in physical therapy program, those with thenar atrophy and heavy CTS cases were excluded.

Before being included in the study, all patients' detailed histories were taken, extensive physical examinations were made. All patients were made for pre-prandial blood glucose, HbA1C, biochemistry, complete blood count, erythrocyte sedimentation rate, rheumatoid factor, TSH, B12 vitamin measurements. In the first evaluation, patients' age, gender, occupation, dominant hand, and CTS developed hand were learned, body mass index (BMI) was calculated. Only the dominant hand values of patients with bilateral CTS were analyzed. The patient was treated with acupuncture. Visual Analogue Scale (VAS) was used to assess pain severity. The meanings of the numbers placed from 0 to 10 on a 10 cm line were told illness. It was revealed that there were 0 points at no pain at all, 5 points at medium pain, 10 points at the most severe pain felt in life. According to these explanations, the patient's pain was requested to be marked on a 10 cm line.

The Boston Carpal Tunnel Inquiry Questionnaire [17] was performed. The Boston scale is a valid, reliable, and sensitive test used to evaluate patient-induced symptom severity and functional capacity in patients with CTS [18]. This questionnaire is filled in by the patient himself. It consists of two parts; symptom severity scale and functional capacity scale. Tinel and Phalen tests were used as Provocation Tests. Patients were evaluated by electrophysiological parameters, paresthesia (numbness, tingling), VAS scores, Boston Scale (Symptom Severity and Functional Capacity), Tinel and Phalen Test, before treatment (BT), the first month after treatment (AT1) and third month after treatment (AT3).

All electrophysiological examinations were made by the same

researcher. Patients rested for 15 minutes pre-treatment in 22-24°C room temperatures in order to get their hands ready. In our study the key point, two-channel EMG device was used. In the electrodiagnostic study, motor and sensory nerve conduction studies were conventionally performed. Patients who are electrophysiological diagnosed CTS were grouped as mild, moderate and severe CTS according to their findings [19]. Patients detected with mild and moderate CTS were included in our study.

Application of acupuncture therapy

Acupuncture therapy was done as a total of 10 sessions, during 4 weeks, in the first two weeks as weekly 3, following 2 weeks as weekly 2 and each session as 30 minutes. Patients were moved to a room where they can get comfortable, were informed about acupuncture therapy and possible side effects and their consent was taken. Acupuncture points PC-7 (Daling), PC-6 (Neguan) and additionally PC-3 (Quze) on affected hand was used for each patient. During the treatment, sterile one-use steel (0.25-40 mm) needles were used. On each point, the skin was wiped with alcohol. Needles were manipulated to create a sense of De-Qi and left there for 30 minutes. These treatments were done by the same applicator and to reduce advocacy communication between acupuncture applicator and patient.

Statistical examinations

Data acquired from the study was transferred to the electronic environment and analyzed with SPSS (Statistical Package for Social Sciences) 22 statistic packaged software. Patients evaluation data were compared in acupuncture BT, AT1, and AT3. The presence of tingling, numbness symptoms, Phalen and Tinel test results at three different time points were evaluated with the Cochran Q test, and $p < 0.05$ was considered significant. In the significant groups, the intragroup paired comparison was made with Mc Nemar Test, $p < 0.05$ was accepted as statistically significant. On repetitive numeric measurements in comparisons, Anova Test was used and $p < 0.05$ was accepted as significant. In groups found significant, intragroup comparisons were made on subsidiary examples, $p < 0.05$ was accepted statistically significant. $P < 0.01$ was considered significant in all evaluations.

Findings

A total of 40 patients meeting inclusion and exclusion criteria were taken in the study, 37 of them were able to complete the study. Patients were evaluated in three different times as in BT, AT1, and AT3. All of the patients were female and 33 of them were housewives, 3 were cleaning staff and 1 was a nurse. The average age was 44.3. Average BMI level was 31 ± 5.5 . In 26 (70.3%) of the hands, CTS level was mild, in 11 (29.7%) was moderate. The dominant hand involvement rate was 13.5%, non-dominant hand involvement rate was 13.5%, and both hand involvement rate was 73%. All of our patients had numbness and 35 had pain and tingling.

Symptoms of numbness and tingling were compared in BT, AT1, and AT3. The symptom of numbness decreased in both AT1 and AT3 according to BT. This was statistically significant in AT1 ($p < 0.05$), while AT3 was highly significant ($p < 0.01$). The symptom of tingling was significantly decreased after acupuncture treatment compared to the first month and the third treatment ($p < 0.05$). Compared AT1 and AT3, there was a decrease in numbness and tingling symptoms, but this decrease was not statistically significant ($p > 0.05$) (Table 1).

	Numbness n (%)	Tingling n (%)	Phalen n (%)	Tinel n (%)
BT	37 (100)	35 (94.6)	26 (70.3)	12 (32.4)
AT1	31 (83.3)	27 (73)	20 (54.1)	11 (29.7)
AT3	29 (78.4)	27 (73)	21 (56.8)	10 (27)
p	0.003	0.01	0.012	0.717

BT: Before treatment, AT1: After treatment 1 month, AT3: After treatment 3 month.

Table 1: Comparison of numbness, tingling symptoms and phalene and tinel positivity change in acupuncture BT, AT1, and AT3.

Pain severity was assessed by VAS score in 35 patients with pain symptom. VAS scores were significantly lower at AT1 and AT3 than at BT ($p < 0.01$). AT3, the VAS score increased with respect to AT1; but this increase was not statistically significant ($p > 0.05$). Tinel test positive case number was reduced in comparison with pre-treatment but this decrease was not statistically significant ($p > 0.05$). Phalen test in BT, while it was positive in 26 cases, in AT1 20 cases, and in AT3 21 cases were detected positive. This change in the Phalen test positive case number was found statistically significant ($p < 0.05$). In comparison with BT both AT1 and AT3 had reduced the number of the positive case number, but only in AT1 decrease was statistically significant ($p < 0.05$) (Table 1).

In respect to BT, a decrease in the values of AT1 and AT3 Boston Functional Capacity and Symptom Severity Scale were detected to be statistically significant ($p < 0.05$). While the decrease in Symptom Severity Scale when BT was compared with AT1 and AT3, the difference was statistically significant, as well as a decrease in Boston symptom severity scale between AT1 and AT3 existed, this decrease was not statistically significant. Functional Capacity, in acupuncture AT1, was severely significantly lower compared with BT ($p < 0.01$). In AT3 this value as well as being lower compared to BT was not statistically significant ($p > 0.05$). When TS1 and TS3 were compared, an increase in Boston functional status scale was observed at 3rd month, but this increase was not statistically significant ($p > 0.05$) (Table 2).

	VAS Mean (\pm SD) n=35	Symptom Severity Mean (\pm SD) n=37	Functional Capacity Mean (\pm SD) n=37
BT	6.0 (\pm 2.8)	2.88 (\pm 0.80)	2.46 (\pm 0.70)
AT1	4.5 (\pm 2.5)	2.39 (\pm 0.79)	2.16 (\pm 0.68)
AT3	4.8 (\pm 2.6)	2.31 (\pm 0.84)	2.31 (\pm 0.82)
p	0.001	0.001	0.015

SD: Std. Deviation BT: Before treatment, AT1: After treatment 1 month, AT3: After treatment 3 month, VAS: Visual Analogue Scale

Table 2: Comparison of VAS score, symptom severity, and functional capacity in acupuncture BT, AT1, and AT3.

At acupuncture BT, AT1 and AT3, median nerve (2 fingers) motor amplitude and speeds, median nerve sensorial distal latency, amplitude and speed, median nerve (4 fingers) sensorial distal latency, amplitude and speed repetitive measurements were compared and no statistically significant difference between them was detected ($p > 0.05$). Patients median motor distal latency (mMDL) value was significantly reduced after treatment compared to before treatment ($p < 0.05$). This decrease

was only statistically significant at AT3 compared to BT ($p = 0.01$) (Table 3).

Median nerve motor distal latency (ms)	Mean (\pm SD)	p
BT	4,01 (\pm 1.68)	0.08
AT1	3.91 (\pm 0.83)	
BT	4,01 (\pm 1.68)	0.01
AT3	3.84 (\pm 0.74)	
AT1	3.91 (\pm 0.83)	0.12
AT3	3.84 (\pm 0.74)	

SD: Std. Deviation BT: Before treatment, AT1: After treatment 1 month, AT3: After treatment 3 month

Table 3: Median nerve motor distal latans, amplitude and speed comparison in acupuncture BT, AT1, and AT3.

Discussion

CTS prevalence increases with age and most commonly seen between ages 30-60 [1,20]. In our patient population average age was 44.3 ± 10.4 and compatible with the literature. CTS is seen 3 times more in women compared with men [18,21]. All of our CTS cases consisted of women and this situation was completely random. CTS is seen more in some occupational groups who use their hand in repetitive movements [1,22]. 33 of our cases were housewives, 3 of them were cleaning staff and one was a nurse. In CTS about 65% of the patients has bilateral hand affect [20,23]. In bilateral cases, the dominant hand is usually held earlier and more intensely, while the unilateral effect is often dominant [1,2,17]. For our patient's rate of bilateral hand, cricks were 73%. For hands cricked unilaterally (27%), in contrary to the literature dominant and non-dominant crick rate was equal with 13.5. About 70% of CTS patients are obese [21,24].

BMI average of our patients in the study was 31 ± 5.5 along with $BMI > 29$ and average of the patients was in the obese group. The rate of cases that are $BMI > 29$ were 56.8%, the rate of cases that are $BMI < 20$ were 2.7%. On CTS, earliest findings are sensory; patients come with paresthesia complaints that especially increase in nights like numbness, tingling in the beginning [1,25]. Of our patients, 70.3% were mild, 29.7% were moderate level CTS and all of 37 cases (100%) had complaints of numbness, 35 (94.6%) had tingling, 35 (94.6%) had pain complaints.

For CTS there are both conservative and surgical treatments are present. If conservational treatments, such as a splint, local steroid injection, ultrasonic and oral steroids fail, surgical treatment is recommended [26]. Acupuncture is widely used for symptomatic treatment of CTS. However, so far, numbers of researches that examine the efficiency of acupuncture in CTS treatment are a few [27]. In a randomized controlled assay made recently, acupuncture is shown to be as effective as oral prednisolone in mild and moderate level CTS [28]. In another study done in recent years, the effect of night splint and acupuncture for CTS were compared and electro-acupuncture was shown to be as effective as night splint in symptom management of mild-moderate level CTS [16].

In studies of Yang and friends in which they compared acupuncture therapy with oral steroid treatment, on symptoms of pain, numbness,

tingling both treatments were found similarly effective; save that patient who received acupuncture therapy when compared with steroid group shown a better improvement in waking up from sleep [25]. In our study too, all 37 cases at BT had numbness complaints, in AT1 this number decreased to 31, as for in AT3 to 29. This difference was significant in comparisons between BT and after treatment. Decrease in numbness symptom in the third month after treatment was not significant in respect to the first month. Of the other paresthesia complaints, on the tingling symptom, significant improvements were present after treatment in respect to pre-treatment. Acupuncture therapy was effective in eliminating numbness and tingling symptom and deceleration of improvement in complaints after the treatment has ended gave rise to the thought that 10 sessions treatment period may be extended with additional sessions.

Acupuncture is a practice that is preferred in our day by many of the pain clinics in pain treatment. In the United States of America, annually about one million patients with pain syndrome are applied acupuncture [29]. Kummerde and friends, on 61 mild and moderate CTS patients ranging between ages 27-67 applied 10 session electro-acupuncture twice a week and pre-prepared volar neutral night splint treatment at night for 5 weeks, pain severity was measured with VAS in the beginning and after the end of treatment protocol, as a result reached the conclusion that for CTS patients suffering hand pain acupuncture therapy might be a proper choice [16]. In the same study, with showing significant improvement on Boston Scale in the electro-acupuncture group, the conclusion of electro-acupuncture being as effective as night splints on the subject of general symptoms and functional progress was reached. In our study, VAS scores dropped significantly after acupuncture therapy (Table 2).

This situation shows that acupuncture therapy has a positive effect on pain severity in CTS. In our study, after acupuncture therapy evaluations, significant improvements were present on patients in Boston Symptom Severity and Functional Capacity in respect to pre-treatment in accordance with the literature. This showed that acupuncture therapy is effective in improving function in CTS. However, re-increase of VAS score in 3rd month after treatment and even though there was an improvement on Boston functional status scale in respect to pre-treatment, a decrease of this improvement in a 3rd month might give rise to the thought that the number of patients for acupuncture therapy sessions may require to be increased. The amount of this number may be a researching topic.

Tinel test is positive in 45% of cases with CTS and 80% in Phalen test [30]. In our study, the decay rate of the tests was similar of the hands with CTS, 12 (32.4%) of them were Tinel test positive and 26 (70.3%) were Phalen test positive. While Phalen test positive case number was significantly reduced in respect to pre-treatment, change in Tinel test positivity was not significant. Phalen test evaluation results were similar with improvements in other clinical parameters and reflected the efficiency of the treatment.

Electrophysiological examination in CTS is an important test that supports the diagnosis of clinical CTS and determines its degree. In our study, the only improvement in distal motor latency was significant in AT3 according to BT. This showed us on mild-moderate level CTS patients acupuncture therapy achieved better improvement on clinical findings in respect to electrophysiological parameters. While in CTS after treatment pain and paresthesia immediately get better, motor and neurological signs normalize in time and more slowly [31]. In the long

term observation (13 months) of the study done by Yang and friends and last randomized test work done, oral steroids against acupuncture were compared in CTS method and both groups have shown more than 50% improvement in Global Symptom Score in 7th and 13th month, furthermore on patients who received acupuncture therapy, when compared with steroid group, a better improvement significant in Global Symptom Score and distal motor latency and distal sensory latency were seen [32].

As for in a short-term study in 2009, in respect to steroid in acupuncture group significant improvement was seen in distal motor latency among electrophysiological parameters (in long-term study sensory distal latency was added to this improvement) and results of this study has shown more efficiency of acupuncture on nerve conduction, symptom evaluation and objective changes [28]. In our patient's mMDL value was significantly reduced after treatment compared to before treatment. This decrease was statistically significant at AT3 compared to BT ($p=0.01$) (Table 3). In our patients, the improvement in electrophysiological values was found later than in the clinical parameters. This shows that the values effectiveness of acupuncture treatment on electrophysiological parameters in CTS should be evaluated after 3 months or longer. Longest observation in our study included 3rd month after treatment.

In our study no side effects after treatment were seen on patients other than redness in needle locations. Acupuncture has no side effects and considered for patient satisfaction according to the results of our studies, CTS acupuncture therapy might be an additional treatment option for patients whose pain and paresthesia complaints are prominent. In our study 1 patient was diagnosed with simultaneous restless leg syndrome and after 5 sessions of acupuncture therapy, was notified sleeping more comfortably at nights and complaints in the legs was decreased. According to meta-analysis results, sufficient evidence regarding the efficiency of acupuncture in restless leg syndrome was not found [33]. This topic might be the subject of another research.

Sim and friends in the study data they made by collecting results of 6 randomize controlled studies in order to research the effect of acupuncture and acupuncture-like treatments on CTS treatment; stated that in five studies of acupuncture therapy PC-6, four studies of PC-7, three studies of PC-7 and PC-6 were used together and in addition to these, points like Li-11, TB-5, TB- 4, EX-UE-9, LI-4, PC-8, LU-10. SI-6, H-7, ear acupuncture points were used [34]. Again in the same study data, it can be seen that in a randomized controlled session, Chai and friends compared acupuncture with local steroid in a daily 30 minutes session for 10 days with a total of 4 sessions, Yang and friends a total of eight sessions practiced twice a week for 30 minutes each session, Hu and friends used acupuncture therapy in CTS in their studies for twenty days for once a day [34].

Along with acupuncture points used in CTS acupuncture therapy not being standard, in our study we used widely used PC-7 (Daling), PC-6 (Neiguan) points and in addition PC-3 (Quze) point in compliance with median nerve course. In our study acupuncture therapy was consisted of a total of ten sessions. However, in comparisons between AT-1 and AT-3, no improvement in any parameter was significant, by increasing the number of acupuncture sessions and extending the length of treatment period this deceleration of improvement might be prevented. In the light of studies that were and will be done, standardization of acupuncture points to be used in CTS treatment, treatment length and frequency of sessions thus increasing applicability and efficiency of the treatment is expected.

Conclusion and Recommendations

As a result; acupuncture treatment using PC-3, PC-6, PC-7 points in mild-moderate CTS; improvement in clinical findings was found to be more pronounced than electrophysiological findings. Acupuncture therapy in mild to moderate CTS may be a reliable symptomatic treatment option in patients with pain and paresthesia complaints. It may also be advisable to increase the number of acupuncture sessions for clinical healing at 3 weeks after treatment. It is hoped that this study will shed light on new work to be done on the application of acupuncture in the treatment of CTS.

Conflicts of Interest

We declare that there is no conflict of interest.

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