



## The Effects of Acupuncture on Clinical and Electrophysiologic Parameters in Carpal Tunnel Syndrome, in Addition to Overnight Splint Treatment and Tendon Sliding

Karpal Tünel Sendromunda Gece Atel Tedavisine ve Tendon Kaydırmaya Ek Olarak Akupunkturun Klinik ve Elektrofizyolojik Parametreler Üzerine Etkileri

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### ABSTRACT

**Aim:** To evaluate the effects of acupuncture on clinical and electrophysiologic parameters in Carpal Tunnel Syndrome, in addition to overnight splint treatment and tendon sliding exercises.

**Material and Method:** Mean age of the patients in group 1 is  $48.0 \pm 12.37$  and group 2 is  $51.3 \pm 14.82$  (26-83). 30 patients in group 1 received once a week for a total of 12 sessions in addition to night splint treatment and tendon sliding exercises. Meanwhile, patients in the second group received night splint treatment and tendon sliding exercises. All the patients in both groups used resting splint and received exercise for 12 weeks. 4 acupuncture points (PC-3, PC-6, PC-7, LU-9) are selected for treatment. 0.25x0.25 needle is placed for 20 minutes. Patients received for acupuncture treatment was applied once a week for a total of 12 sessions over 10 weeks. Patients are evaluated before and after treatment by using electroneurophysiologic parameters and Boston Scale which include Symptom Severity Scale and Functional Capacity Scale.

**Results:** When outcomes were compared between both groups, the Acu group showed more Symptom Severity Scale (SSS) and electroneurophysiological parameters DSL (distal sensory latency) reduction than the splint and exercise group ( $p=0.001$ ), ( $p=0.025$ ). The other parameters were not statistically significant for both groups.

**Conclusions:** We observed an improvement in patients who received acupuncture in addition to resting splint and exercise, Symptom Severity Scale, Functional Capacity Scale and median nerve distal sensory latency.

**Keywords:** Carpal tunnel syndrome, acupuncture, overnight splint, exercises.

### ÖZ

**Amaç:** Karpal Tünel Sendromunda gece atel tedavisi ve tendon kaydırma egzersizlerine ek olarak akupunkturun klinik ve elektrofizyolojik parametreler üzerindeki etkilerini değerlendirmek.

**Gereç ve Yöntem:** Grup 1'deki hastaların yaş ortalaması  $48,0 \pm 12,37$ , grup 2'de ise  $51,3 \pm 14,82$  (26-

83)'dir. Grup 1'deki 30 hastaya gece atel tedavisi ve tendon kaydırma egzersizlerine ek olarak haftada 1 seans olmak üzere 3 ay boyunca 12 seans akupunktur uygulandı. Bu arada ikinci gruptaki hastalara gece ateli tedavisi ve tendon kaydırma egzersizleri yapıldı. Her iki gruptaki tüm hastalar istirahat ateli kullandı ve 12 hafta boyunca egzersiz yaptı. Tedavi için 4 akupunktur noktası (PC-3, PC-6, PC-7, LU9) seçildi ve 0.25x0.25 iğne 20 dakika yerleştirildi. Hastalar 12 hafta boyunca 12 seans akupunktur aldı. Hastalar tedavi öncesi ve sonrası elektronörofizyolojik parametreler ve Boston Skalası kullanılarak değerlendirildi.

**Bulgular:** Her iki grup karşılaştırıldığında, akupunktur grubu, splint ve egzersiz grubuna göre daha fazla semptom şiddet ölççeği ve elektronörofizyolojik parametrelerde distal duyu gecikmesi azalma gösterdi ( $p$  sırasıyla= 0,001, 0,025). Diğer parametreler her iki grup için istatistiksel olarak anlamlı değildi.

**Sonuç:** Boston Skalası, fonksiyonel kapasite skalası ve median sinir distal duyu latansına göre istirahat ateli ve egzersize ek olarak akupunktur uygulanan hastalarda iyileşme gözlemledik.

**Anahtar Kelimeler:** Karpal tünel sendromu, akupunktur, gece ateli, egzersizler.

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## INTRODUCTION

Carpal tunnel syndrome is one of the most common peripheral neuropathies. It affects mainly middle-aged women. In the majority of patients, the exact cause and pathogenesis of CTS are unclear (1). The classic symptoms of CTS include nocturnal pain associated with tingling and numbness in the distribution of the median nerve in the hand. CTS diagnosis is often based on clinical symptoms, physical signs, electrophysiological measurements, or image study (2). The patient with mild symptoms of CTS can be managed with conservative treatment, particularly local injection of steroids. However, in moderate to severe cases, surgery is the only treatment that provides a cure (1). Most studies in the literature focus on surgical treatments of CTS. Recently, the application of non-surgical treatments that combine acupuncture has become one of the popular complementary alternative treatments in clinical rehabilitation to facilitate nerve function recovery (3). Before surgical approaches for severe CTS, conservative therapies are commonly recommended and acupuncture has been proposed as a viable option (4,5). CTS is a kind of median nerve damage due to inappropriate posture or mechanical overuse, resulting in a decrease in blood supply of the median nerve; hence, acupuncture is believed to be complementary method to treat CTS.

Acupuncture has healing effects through different mechanisms, these are; analgesic effect, homeostatic effect, immune-enhancing effect, sedative effect, psychological effect and enzyme healing effect. Two theories have been proposed for its use in pain control. First, acupuncture can stimulate large sensory afferent fibers and can be used in gate control theory.

It suppresses the perception of pain as it is understood. A painful needle prick pain by inducing the release of opiate-like endogenous substances by acting as a stimulus control effect (6). To endogenous opioids with the application of acupuncture. In addition, an increase in serotonin level was observed in the CNS (7).

The improvement in these parameters is caused by the anti-inflammation effects of acupuncture. Reducing inflammation, acupuncture can facilitate the healing of the median nerve through vasodilation and can increase ATP production via the photo-biomodulation effect. By activating the mitochondria and facilitating ATP production, acupuncture produces nitric oxide, which have a vasodilatory effect and calcitonin gene-related peptide (8). This process improves the nutrition and oxygenation of the median nerve, thus ameliorating nerve healing. 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 (9,10). 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 (9). The reason we chose these points in our study was to benefit from this effect of acupuncture. In addition, this point was chosen as the far point due to the effect of these points close the nerve.

Acupuncture is an alternative medicine technique used for the treatment of different types of painful disorders. The Acupuncture and carpal tunnel syndrome efficacy of acupuncture in management of mild to moderate CTS has been investigated in limited studies (11,12). Yang et al. showed that short-term acupuncture treatment is as effective as oral prednisolone in mild to moderate CTS (5). A recent randomized controlled trial study compared the efficacy of acupuncture with night splinting for CTS and found that electro-acupuncture was as effective as night splinting in management of symptoms in mild to moderate CTS (13). Hand splinting is frequently prescribed in mild-to-moderate cases of CTS because its safety and efficacy have been demonstrated and generally accepted (15,16).

It is recommended to use Boston Scale for evaluation of CTS treatment since it is functional and useful (12). Thus, we used Boston Symptom and Severity Scale to evaluate the effect of acupuncture in CTS. In a study where they showed the effect of acupuncture and night splint on CTS, they showed a significant improvement on Boston Scale for the electro-acupuncture group. They observed a better efficiency with acupuncture compared to night splint for pain reduction and similar efficiency for general symptoms and functional progression (13).

The aim of this study was to evaluate the effectiveness of acupuncture in addition to night splinting and exercise program in mild-moderate CTS.

## METHODS

### Patients

60 patients who applied to Beyhekim training and research hospital between 2021-2022 were included in the study and informed consent forms were obtained from the participants.

60 patients participating in the study were divided into two groups by simple random methods according to the closed-envelope method. All patients completed the study. Diagnosis of patients was made based on at least one of the following clinical criteria which were confirmed by Tinel's and Phalen's tests: Numbness and tingling in the thumb, index finger, middle finger, and ring finger (the region innervated by median nerve). Provocation of symptoms by repetitive actions of the hand or wrist. Nocturnal symptoms, mitigation of symptoms by changing hand posture or shaking the wrist, definitive diagnosis was made with emg.



### Study appraisal

In addition to night splinting and tendon sliding exercises, 12 sessions of acupuncture treatment were applied to 60 extremities of 30 patients in the first group for 3 months. In the second group, 30 patients were given night splint and tendon sliding exercises. All patients used wrist rest splint at night for 12 weeks (keeping the wrist at 0-5 degrees extension) and a tendon sliding exercise program was given.

Acupuncture was applied to all patients by the same experienced physician. 4 acupuncture points PC3 (Quze), PC-6 (Neiugan), PC-7 (Dailing), LU-9 (Taiyuan) were selected for treatment. A 0.25x0.25 mm needle was placed vertically and held at these points for 20 minutes. Acupuncture treatment was applied once a week for a total of 12 sessions for 12 weeks.

Patients were evaluated with electroneurophysiological parameters and Boston Scale (symptom severity and functional capacity) before and after treatment.

### Inclusion criteria

Inclusion criteria in the study; (1) It was determined as being diagnosed with carpal tunnel, continuing pain in the wrist for three months. (2) Patients who can adapt to treatment practices.

### Exclusion criteria

Patients were not admitted to the present study if any of the following criteria were present: (1) Pregnancy.(2) Severe degree CTS. (3) Thenar muscle atrophy. (4) History of carpal tunnel surgery. (5) Tendinitis or arthralgia in wrist or hand. (6) Obvious space-occupying lesion at the wrist. (7) Peripheral neuropathy. (8) History of local steroid injection. (9) Inability to discontinue analgesics. (10) Unwillingness to participate in the present study.

### Electrodiagnostic Studies

The diagnosis of all patients with clinically diagnosed CTS was confirmed by the presence of 1 or more of the following standard electrophysiological criteria (16). 1) Prolonged distal motor latency (DML  $\geq$  4.2ms). 2) Prolonged antidromic distal sensory latency (DSL) to the second digit ( $\geq$  3.6 ms). 3) Reduced wrist-palm sensory nerve conduction velocity (W-P SNCV  $<$  40 ms).

Electrophysiological parameters were assessed as the secondary outcome at baseline and four weeks after the intervention. These parameters included DML (distal motor latency), sensory NCV (nerve conduction velocity) and DSL (distal sensory latency). All tests were done using an Advantage EMG machine (Medelec synergy, UK). Nerve conduction studies were performed by an experienced electro-myographer who was blinded to random assignment. Surface stimulation in sensory and motor nerve conduction studies was done using standard methodology (17).

### The Boston Carpal Tunnel Questionnaire

Hand symptoms were assessed at baseline and immediately at the end of treatments using the Boston Carpal Tunnel Outcome Scales (BCTS). This self-administrated instrument was developed specifically to measure clinical changes in CTS (18).

CTS evaluation and diagnosis BCTS is a quantitative instrument that consists of two parts. The Functional capacity (FSS) and the Symptom Severity Scale (SSS), which needs considerable time to fulfill all the questions. 2.7.Ethics approval

The study was approved by Karatay University Clinical Research Ethics Committee on 11.03.2021 with the decision number 2021/047. Each patient gave written informed consent before entering the treatment and understood that they were free to withdraw from the treatment at any time. Our work was carried out in accordance with the principles of the Helsinki Declaration.

### Statistical analysis

IBM SPSS 22 statistics program was used for Windows. Kolmogorov-Smirnov normality test was used to evaluate whether continuous variables were normally distributed. Normally distributed student t-test was used for paired comparisons and paired t-test was used for pre-treatment evaluation. If at least one of the groups did not distribute normally, the nonparametric Mann Whitney U test was used in paired comparisons and the Wilcoxon Signed Ranks test was used to compare each group before and after treatment. A value of  $p \leq 0.05$  was considered significant.

## RESULTS

The mean age of patients in the acupuncture group was  $48.0 \pm 12.37$  years with a range of 24 to 77 years, of whom 24 patients were female. The control group consisted of 23 females. The mean age of these patients was  $51.30 \pm 14.82$  years with a range of 26 to 83 years. There was no statistically significant difference in demographic data between the two groups at the start of the trial ( $p > 0.05$ ). The results are presented in **Table 1**.

**Table 1. Age and gender of all participants**

	Acupuncture group (n=30)	Control Grup (n=30)	P
Age	$48.0 \pm 12.37$ (24-77)	$51.3 \pm 14.82$ (26-83)	0.348
Gender (Female/Male)	24\6	23\7	0.055

We observed in acu group improvement in sss and electrophysiological parameter dsl ( $p:0.001, 0.025$ ). There was no significant difference between the groups in other parameters. Results are also demonstrated in **Table 2**. No serious complication occurred in the present study.

**Table 2: Comparison between acupuncture and control groups**

	Acupuncture group(n=30)			Control group(n=30)		
	Pre-tx	Post-tx	P	Pre-tx	Post-tx	P
	Mean±SD (Min-Max)	Mean±SD (Min-Max)		Mean±SD (Min-Max)	Mean±SD (Min-Max)	
EMG L LATEN	4.19±1.46 (2.7-8.7)	4.033± 1.16 (2-6.6)	0.866	4.08±0.63 (3.4-5.3)	4.14±0.67 (3.3-5.4)	0.328
EMG R LATEN	4.37±1.63 (3-8.8)	4.22± 1.52 (2-9)	0.141	4.49±0.494 (3.6-6.3)	4.53±0.74 (3.3-7.4)	0.951
EMG L AMP	11.23±4.96 (1.4-23)	12.82± 4.15 (2.6-19)	0.098	12.59± 4.02 (4.7-18.0)	11.89±2.38 (7.8-15.8)	0.089
EMG R AMP	10.82±4.71 (2-19)	12.11±5.28 (1.2-22)	0.308	10.30±3.68 (5.1-18.0)	10.83±3.29 (2.6-16.7)	0.135
Sensorial L LATEN	2.98±0.61 (2-4)	3.06±1.05 (1-7.1)	0.807	3.35±0.46 (2.4-3.9)	3.43±0.58 (2.7-4.3)	0.082
Sensorial R LATEN	3.14±0.782 (2-4.30)	3.15±0.84 (2-5.7)	0.939	3.88±0.66 (2.6-5.0)	3.89±2.71 (2.7-17.9)	0.089
Sensorial L AM	11.81± 5.77 (3.30-27.6)	9.14± 5.57 (1.9-26)	0.025	10.12±5.68 (2.4-21.4)	13.72±8.12 (6.7-31.0)	0.015
Sensorial R AM	12.91±4.32 (4-25)	9.47± 6.12 (1.5-30)	0.006	8.24±4.79 (0.7-17.3)	10.83±7.64 (3.8-27.7)	0.105
Symptom severity scale (1-5 points)	3.278±0.738 (2.1-4.63)	1.32± 0.414 (0.81-2.09)	0.001	3.16±0.62 (1.6-4.0)	2.87±0.67 (1.3-4.0)	0.179
Functional status scale (1-5 points)	2.67±0.544 (1-3.1)	1.35±0.472 (1-2)	0.001	2.63±0.49 (2.0-3.0)	2.43±0.50 (2.0-3.0)	0.014

## DISCUSSION

In this study, we aim to investigate the efficiency of acupuncture in addition to night splint and exercise. We observed an improvement in SSS and electrophysiologic parameters when acupuncture is applied with night splint and exercise compared to the group that didn't receive acupuncture.

There is limited evidence of conservative treatment of CTS providing long-term relief from symptoms, and therefore no adequate data to allow accurate quantification of relapse rates (19,20). Because the standard treatments for CTS are not fully satisfactory, other conservative methods, including those from complementary and alternative medicine (CAM), need to be further evaluated (21).

When compared night splint with acupuncture for CTS, it has been shown that electro-acupuncture is as equally effective as night splint (13). In another study, where they compare acupuncture with night splint on CTS, they showed a significant improvement in Boston Scale. Whereas in night splint group, they observed significant improvement only in severity of the symptom. In the mid-level CTS, they showed acupuncture was able to reduce the pain better than night splint and acupuncture showed similar efficiency compared to night splint for general symptoms and functional progression (22).

Weinstein et al. evaluated the effect of manual acupuncture in comparison with sham acupuncture and found no statistical difference between the real and sham groups (23).

A Cochrane meta-analysis reviewed twenty one trials of different conservative managements of CTS including one laser acupuncture trial study, concluded that acupuncture

does not produce significant benefit (24). Another randomized controlled trial study found no significant differences between laser acupuncture and placebo on night pain at 3 weeks of follow-up (25).

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 (26). Iwan et al. evaluated a case series showed 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 (27). In summary, patients who received acupuncture showed better improvement in functional capacities. In addition, they also showed significant improvement in clinical symptoms. Acupuncture is a good treatment for patients with CTS who don't want surgery or other treatments.

### Limitations

Having a small sample size and a short follow-up period in both groups are limitation in this study. In addition, patients were not grouped based on CTS severity. In order to group them based on CTS severity, bigger sample size is required.

## CONCLUSION

Acupuncture treatment has more significant efficiency on clinical findings when compared to electrophysiological findings. Findings in this study indicate that acupuncture treatment is alternative for patients who have intolerance or contraindication to medication or who don't prefer surgery.



## ETHICAL DECLARATIONS

**Ethics Committee Approval:** The study was approved by Karatay University Clinical Research Ethics Committee on 11.03.2021 with the decision number 2021/047.

**Informed Consent:** All patients signed the free and informed consent form.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

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