

Original Article

The Assessment of Acupuncture and Exercise Therapy in Patients with Carpal Tunnel Syndrome: Randomized Clinical Trial

Shahin Salehi¹, Omid Hesami², Amir Rashed^{1*}, Mohammad Hassabi¹, Mehrshad Poursaeidesfahani¹, Amir Hosein Abedi Yakta¹, Hamid Mahdavi Mohtasham¹, Shahrzad Khosravi¹, Shahram Mohaghegh¹, Mohammad Reza Sohrabi³

¹ Department of Sports Medicine, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

² Department of Neurology, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

³ Department of Community Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Received: 28 April 2019; Accepted: 21 September 2019

Abstract

Background: The efficacy of acupuncture and exercise therapy in the treatment of carpal tunnel syndrome (CTS) has been investigated in limited studies with controversial results. The purpose of this study was to compare the short-term efficacy of acupuncture and exercise therapy in patients with mild to moderate CTS.

Materials and Methods: This study was a randomized controlled clinical trial study conducted on 60 patients (55 women) with mild to moderate CTS referring to Imam Hossein Hospital in Tehran in 2017. The patients were randomly divided in to 3 equal groups; group1: only night splint was used for 6 weeks (control), group2: splint with tendon and nerve gliding exercises (2 times a day for 6 weeks) were applied, group3: splint and electroacupuncture was performed for 12 sessions (2 sessions/week). The score on the Boston Carpal Tunnel Questionnaire (BCTQ) for Functional Status and Symptom Severity (BCTQ FUNCT and SYMPT) and visual analog scale (VAS) score were evaluated at baseline and after the treatment.

Results: At the final follow up, significant improvements in all parameters of quality of life and VAS were found in third groups ($p < 0.05$). Acupuncture affected the score on the BCTQ FUNCT and SYMPT, the VAS score more than exercise therapy. In addition, the efficacy of splint alone was less than intervention groups in all parameters.

Conclusion: Acupuncture with splint has a high effect on reducing pain and improving the quality of life in patients with mild to moderate CTS and could be adopted in the management of these patients.

Keywords: Carpal tunnel syndrome, Splint, Exercise, Acupuncture, Quality of life

*Corresponding Author: Amir Rashed, MD; Resident, Department of Sports Medicine, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran; Tel: (+98) 9379313372. Email: a.rashed1353@gmail.com

Please cite this article as: Salehi Sh, Hessami O, Rashed A, Hassabi M, PourSaeid Esfehiani M, Abedi Yakta, A et al. The Assessment of Acupuncture and Exercise Therapy in Patients with Carpal Tunnel Syndrome: Randomized Clinical Trial. *Novel Biomed.* 2019;7(4):201-9.

Introduction

Carpal tunnel syndrome (CTS) is the most common form of nerve trapping syndrome in the organs, which is due to compression of the median nerve in the wrist and involve millions around the world.

Annual prevalence percentage is estimated to be 3.8% in the general population and it can occur in all ages¹. However, now 40 to 60 years old is the most common age of this disease. It is estimated that 9% of female and 6% of male affected by this syndrome in their life². CTS is bilateral in 59% of patients³.

The main symptoms of this syndrome include pain, numbness, and irritation in the median nerve distribution pathway. In advanced stages this syndrome results in weakness and atrophy of the thenar muscle, decreased muscle strength, decreased sensation, and positivity of the irritation tests which leads to hand dysfunction and disability to be active^{3,4}.

CTS risk factors are as follow: occupational conditions, such as repetitive and repeated movements of hands when using computer, health conditions including obesity, non-inflammatory synovial fibrosis, metabolic syndrome, diabetes, pregnancy, OCP, menopause, increased age, using tobacco, caffeine, alcohol and inflammatory arthritis, hypothyroidism and renal dialysis⁵.

Without timely treatment, CTS sometimes causes permanent damage to the median nerve (some or all nerve fibers are destroyed) and results in transient or permanent sensory or motor disorder for the patient⁶. So, choosing proper treatment for CTS is important for improving life quality and decreasing medical costs.

So far, several methods have been proposed to treat this syndrome. Generally, treatment for carpal tunnel syndrome is done in both surgical and non-surgical procedures. Non-surgical procedures are as follow: avoid activities which cause disease, using brace, ultrasound, and night splint for limiting wrist movements, using anti-inflammatory drugs, both in form of steroidal and non-steroidal and regional injection. If these treatments are not effective, the patient will undergo surgery (open surgery or endoscopic procedure⁷).

Although recent studies have been observed that using splints and steroids is useful as primary treatments to improve the symptoms of patients, the effects of these methods are usually temporary and transient⁸. In addition, each of these methods also has its own side effects, for example gastrointestinal, renal and hepatic complications in using oral steroidal and non-steroidal anti-inflammatory drugs and tendon rupture and increased the probability of nerve injury following localized corticosteroid injection^{9,10}.

In some of the studies, the effects of acupuncture and massage therapy as well as stretching exercise were

studied on patients which have different results on improving symptoms and function^{1,11,12}. Today, among multiple interventions for pain management, special attention has been paid to acupuncture. The acupuncture is the most well-known complementary and alternative treatment, however, limited studies have been conducted on the efficacy of acupuncture in the treatment of mild to moderate CTS^{13, 14}. Although National Institutes of Health (NIH) has approved acupuncture for the treatment of mild and moderate CTS, still there is disagreement about its effectiveness¹⁵. Moreover, according to many guidelines wrist splinting is recommended as the primary treatment option for CTS patients despite no promise in its effectiveness¹⁶⁻¹⁸. Using acupuncture and exercise therapy is increasing for CTS treatment, but there is no specific recommendation about using them¹⁹⁻²¹. Also, there is limited evidence in regard to acupuncture and exercise therapy effectiveness and the previous studies of CTS have not dealt with Comparison of acupuncture and exercise therapy effectiveness on ones²²⁻²⁶. The specific controversy which drives the research in which to compare and determine the effectiveness of between the conservative treatments, acupuncture and exercise therapy.

We have limited studies on the effectiveness of acupuncture and therapeutic exercise in treatment of CTS, so the present study is performed to determine the effectiveness of two methods of acupuncture and exercise therapy in reducing pain and improving the quality of life of CTS patients.

Methods

Study Design: The present study is a randomized, controlled clinical trial which is performed on 60 CTS patients referring to the Sports Medicine Clinic of Imam Hossein Hospital in Tehran in 2017 (Figure 1). The neurologist based on the history and physical examination and using EMG/NCV explained in following at the Patient evaluation subsection made the definitive diagnosis of patients and disease severity. Patients enrolled in the study after receiving explanations by researchers regarding the purpose of the study and by obtaining informed consent.

Participants: The inclusion criteria for the study were mild and moderate CTS, the lack of limitation in upper

extremities that inhibit the desired exercise from the patient (such as wrist fracture, severe scarring, burn, presence of cyst or tumors in the area of wrists, and history of wrist surgery), no symptoms of atrophy or muscle weakness, absence of autoimmune or inflammatory diseases, no previous taking steroidal drugs, using splint and any treatment regarding CTS. Also, exclusion criteria were as follows: severe stage of the illness during the study, non-performing of the exercises requested, no referring at the requested time for acupuncture, using acetaminophen for more than 7 days because of severe pain, pregnancy, diabetes mellitus, any contraindication for needling such as bleeding tendency, local infection, or a history of needling shock.

Data Collection: At first, all patients were under full clinical examination. The demographic and history profiles were also completed for all patients. This form includes demographic characteristics (age, gender, place of living, marriage status), medical history and clinical information including smoking and alcohol consumption, underlying diseases, weight, height, drugs used and characteristics of CTS including pain severity, affected hand, and duration of CTS.

Intervention: Block randomization which used by Random Allocation Software random was applied to allocate patients to groups after eligibility confirmation^{27, 28}. Patients were randomly divided into three equal groups (20 patients in each group) with an adjusted age of 10 years. In the first group, the patients received only night splint with neutral positioning for a period of 6 weeks (control). In the second group, the splint and exercise therapy were used. Exercise therapy included tendon gliding and median nerve gliding, two times a day for 6 weeks (Figure 2). In the third group, splint and 12 sessions of 40 minutes electroacupuncture was performed (2 times a week) in two points of PC-7 (Daling) and PC-6 (Neiguan) using the thin sterile needle (0.25×25mm size gauge) with the frequency of 60-100 Hz up to pain threshold (Figure 3). The needles were inserted vertically into specific points in the depth of 2-5 mm. Acetaminophen was used in all three groups if needed.

To find acupoints the examiner asks patients to press the thumb and little finger together for the better

presentation of the tendon of the flexor carpi radialis and tendon of the palmaris longus. After appearing of the tendons, the needle located at between the tendons on the flexor aspect of the forearm, which are between the two tendons. The distance between PC-7 and PC-6 is two thumbs wide. PC-6 (Neiguan) is located at 2 cun above the transverse crease of the wrist PC-7, between palmaris longus and flexor carpi radialis tendons, on the line connecting PC-3 and PC-7. PC-7 (Daling) is located in the middle of the transverse crease of the wrist between palmaris longus and flexor carpi radialis tendons (Figure 3)²⁹. These acupoints chose because of their efficiency which is reported in previous studies³⁰.

Patients Evaluation: To evaluate the response to treatment, quality of life (symptoms and functional status) and pain intensity of patients were evaluated at baseline and after treatment. The parameters were compared in three groups before and after treatment.

The Boston carpal tunnel questionnaire (BCTQ) was used to assess the severity of symptoms and patients' performance. The questionnaire included 11 questions about the severity of the symptoms (BCTQ SYMPT) and 8 questions about functional status (BCTQ FUNCT). The items of each scale were scored from 1 (mildest) to 5 (most severe). The BCTQ SYMPT and scores were calculated as the mean±standard deviation for each item. In the present study, the Persian version of BCTQ was used which its reliability and sensitivity were confirmed in previous studies³¹.

Patients' pain intensity was assessed based on a visual analogue scale (VAS). The patient evaluated their pain intensity from zero (complete analgesia) to 10 (the most experienced patient's pain).

Entrance and evaluation of information after the end of treatment carried out by a researcher who did not know about grouping the patients. In other words, neither the patient nor the therapist and study investigator was aware of which groups is treatments or a control (triple-blind, randomized clinical trial). However, the sports medicine specialist and student were aware of the procedure and groups in order to prevent the inadvertent intra and post-intervention events.

Statistical Analysis: Version 22 of SPSS software was used to statistical analysis. Normality for variables was assessed using the Kolmogorov-Smirnov test.

Obtained data were analyzed by descriptive statistics including frequency, mean, standard deviation, frequency percentage and inferential statistics including paired sample t-test, Chi-square, and analysis of variance (ANOVA). A p-value < 0.05 was considered statistically significant.

Ethical approval of this study was obtained from Shahid Beheshti University of Medical Sciences, Tehran, Iran with ethic code: IR.SBMU.MSP.REC.1395.152. In addition, with RCT code IRCT20180212038693N1.

Results

In the present study, 55 women and 5 men with a mean age of 49.23 ± 8.96 (29-70 years) participated (Table 1). In this study, there was no statistically significant difference between age, gender, height, weight, job, presence of systemic disease, affected hand, and illness severity in three groups ($P > 0.05$).

In this study, the results of pain severity assessment and Boston questionnaire in CTS patients was shown that at the end of the sixth week, symptom severity was decreased and capacity of patients' performance was increased in all three groups ($P < 0.05$). However, the improvement rate was higher in the acupuncture group (Table 2).

The results of ANOVA showed that there was no statistical difference in pain ($P = 0.302$), symptoms

($P = 0.524$), performance ($P = 0.336$) and quality of life ($P = 0.281$) in three groups, before treatment.

Discussion

The aim of the current study was to determine the effectiveness of two methods of acupuncture and exercise therapy in reducing pain and improving the quality of life of CTS patients.

Regarding CTS treatment, limited studies have been conducted using exercise and acupuncture, and on the other hand, there is no controlled study to compare the effectiveness of these two therapies. Therefore, the present study is performed to compare the short-term effects of 6 weeks acupuncture and nerve and tendon gliding exercise on reducing pain and improvement of symptoms and patient performance in patients with mild to moderate CTS.

In the present study, there was no significant statistical difference between age, gender, height, weight, and job, presence of systemic disease, affected hand, and illness severity in three groups, which show that these factors do not affect our study results. There was no statistical difference in pain, symptoms and functional status and the quality of life in three groups, before treatment. These results indicated the complete randomization of samples and the absence of bias in sample selection.

In this study, the results of pain severity and Boston

Table 1: Participant characteristics at baseline*.

Variable	Brace+ acupuncture (n=20)	Brace+ Exercise therapy (n=20)	Control (n=20)	P-value**
Age (year)	50.75±9.59	49.55±8.41	47.4±8.96	0.495
Gender	Female: 18 (90) Male: 2 (10)	Female: 19 (95) Male: 1 (5)	Female: 19 (95) Male: 1 (5)	0.804
Weight (kg)	77.5±12.85	78.78±10.8	77.9±9.4	0.933
Height (cm)	159.35±5.3	160.2±5.8	163.5±7.8	0.098
Job	Employed: 18 (90) Housewife: 2 (10)	Employed: 15 (75) Housewife: 5 (25)	Employed: 12 (60) Housewife: 8 (40)	0.077
systemic disease (yes)	9 (11)	5 (25)	6 (30)	0.377
Affected hand	Right: 9 (45) Left: 11 (52)	Right: 8 (40) Left: 12 (60)	Right: 12 (60) Left: 8 (40)	0.420
Disease severity	Mild: 13 (65) Moderate: 7 (35)	Mild: 12 (60) Moderate: 8 (40)	Mild: 13 (65) Moderate: 7 (35)	0.931

*Data are presented as mean±SD or frequency (%)

**Significance at $p \leq 0.05$.

Table 2: Mean scores of pain severity, symptoms, performance and quality of life in CTS patients according to BCTQ questionnaire.

Variable	Group	Baseline (mean±SD)	After treatment (mean±SD)	difference	P-value**
VAS	Control	5.9 ± 0.97	4.8 ± 1.06	1.1 ± 0.85	<0.001
	Brace+ Exercise therapy	6.5 ± 1.39	4.35 ± 1.9	2.15 ± 1.56	<0.001
	Brace+ acupuncture	6.5 ± 1.73	2.85 ± 2	3.65 ± 1.84	<0.001
Functional Status	Control	24.7 ± 3.28	20.45 ± 3.25	4.25 ± 2.36	<0.001
	Brace+ Exercise therapy	24.6 ± 7.03	15.6 ± 7.42	9 ± 8.78	<0.001
	Brace+ acupuncture	23.8 ± 5.34	8.55 ± 4.99	15.25 ± 7.1	<0.001
Symptoms	Control	18.75 ± 3.06	16.1 ± 3.81	2.65 ± 2.78	0.002
	Brace+ Exercise therapy	19.85 ± 8.36	16.35 ± 9.48	3.5 ± 4.3	<0.001
	Brace+ acupuncture	21.65 ± 4.07	13.85 ± 3.5	7.8 ± 4.9	<0.001
quality of life	Control	43.45 ± 6.02	36.55 ± 6.58	6.9 ± 4.44	<0.001
	Brace+ Exercise therapy	44.45 ± 11.63	31.95 ± 14.63	12.5 ± 11.71	<0.001
	Brace+ acupuncture	45.45 ± 8.07	22.4 ± 7.83	23.05 ± 10.86	<0.001

VAS = visual analog scale; BCTQ = Boston Carpal Tunnel Questionnaire; SD = standard deviation.

**Significance at $p \leq 0.05$.

questionnaire in evaluating CTS patients was shown that at the end of the sixth week, symptom severity was decreased and patients' performance was increased in all three groups. In addition, the severity of pain was decreased in all three groups. However, the improvement of symptoms and performance and the rate of decreasing pain was higher in the acupuncture treatment group. The least improvement rate was seen in the splint group.

Highly effectiveness of acupuncture in improving symptoms and performance of CTS patients is reported in different studies. For example, Khosrawi et al, (2012) have shown better effectiveness of acupuncture + night splint compared to splint alone on improving clinical symptoms of CTS patients¹. Ho *et al.* also have shown that acupuncture results in improvement of clinical symptoms in patients with CTS³⁰. These findings are consistent with the findings of this study. As a result, treatment with an acupuncture + night splint in comparison with splint alone has a better effect on the improvement of subjective symptoms.

The results of Chung *et al.* (2016) study have shown that splinting only is not sufficient to improve symptoms and performance of CTS patients; but when acupuncture and night splint are used simultaneously for treatment of mild to moderate CTS, result in significant improvement in symptoms severity and patient's performance and decreasing pain²⁰. These findings are consistent with the findings of this study. Although in this study splint

alone was, also effective in improving symptoms and performance of patients, this effect was less than the splint + electroacupuncture.

In another study, Imami Razavi and colleagues (2010) showed that at the end of treatment with splint + acupuncture, clinical signs and electrodiagnostic findings were improved²¹. Zavela et al, (2010) also reported the effectiveness of acupuncture in decreasing pain and symptoms in CTS patients³². Furthermore, Rezvain (2008) found that the application of acupuncture with splinting is more effective in the treatment of CTS compared to splint alone (regarding symptoms and performance improvement)³³. These findings are consistent with the findings of this study. At the other hand, some evidence also did not show any improvement in CTS symptoms when intervening with acupuncture compared to control or placebo. For example, Yao et al, (2012) compared acupuncture with placebo (without treatment) in the treatment of CTS patients. Comparison of symptom scores and patient performance (CTSAQ) before and after treatment showed that the rate of symptom improvement and patient performance was significant in both groups, but there was no significant statistical difference between two groups³⁴. Another randomized control study also showed no significant difference between laser acupuncture and placebo (in 3 weeks follow up) regarding night pain³⁵. In another randomized control study comparing acupuncture (10 sessions) effectiveness with night splint (for 5 weeks), the result showed that electroacupuncture is as effective as night

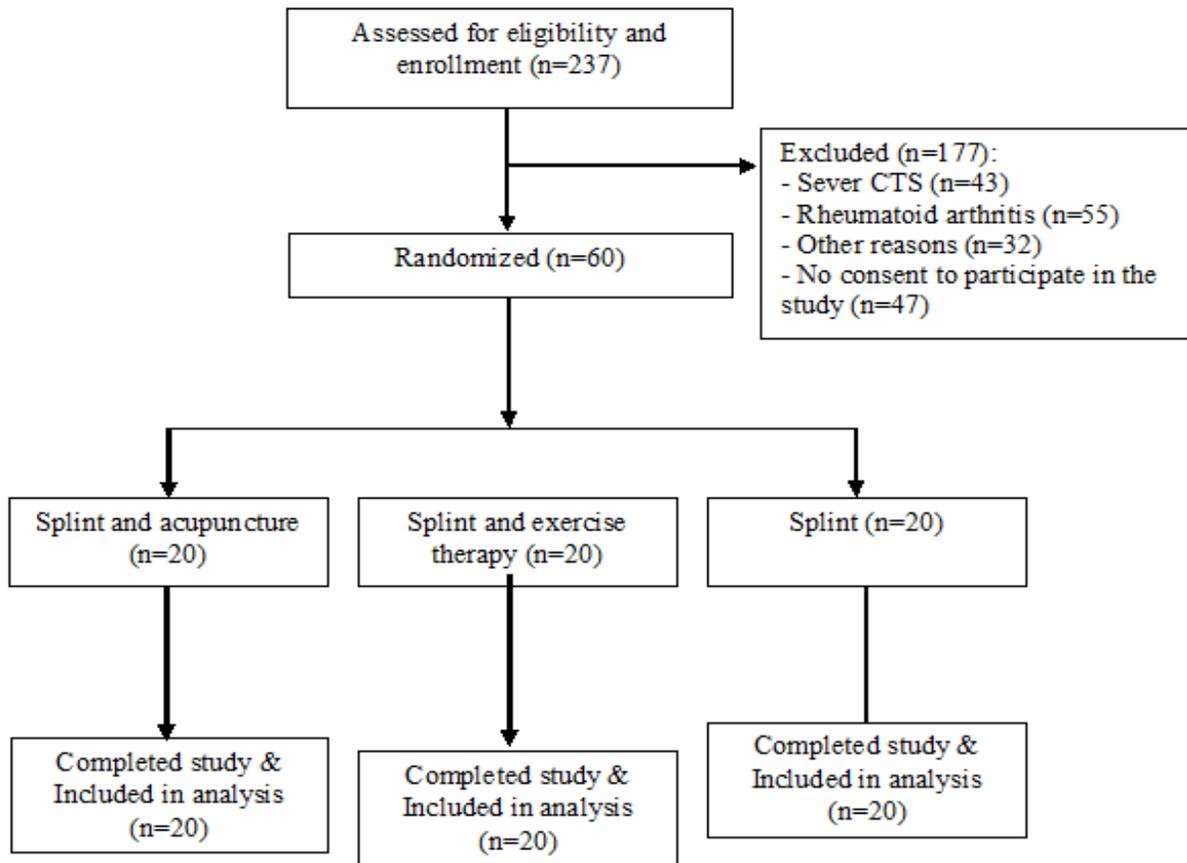


Figure 1. The study flowchart.

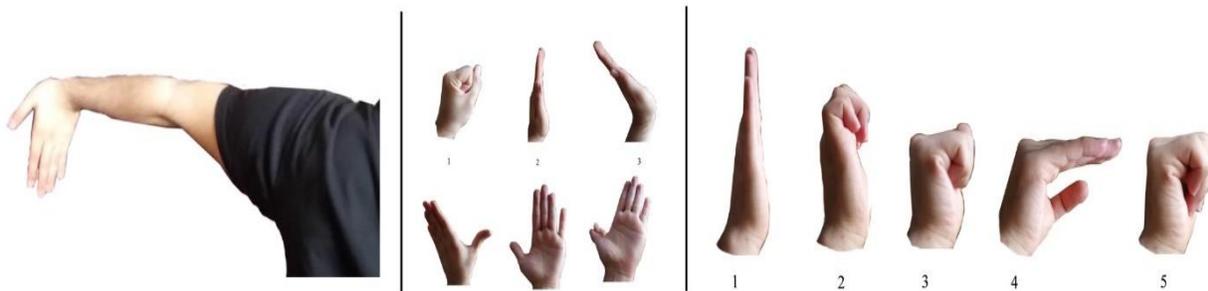


Figure 2. Tendon gliding (Right) and median nerve gliding exercise (middle and left). The patients were asked to do each position for 5 seconds, and repeat each position 10 times for at least two times a day.



Figure 3. Acupuncture points.

patients with mild to moderate CTS. But acupuncture is more effective than splint in decreasing pain (VAS)³⁶. The reason for the difference in the results is related to the individual characteristics of the patients, the difference in sample size and the population studied the difference in the criteria for evaluating the results as well as the difference in the number of sessions and method of the acupuncture and the

duration of the treatment.

On the other hand, the effectiveness of exercises therapy in reducing pain and improving symptoms and performance of CTS patients is reported in different studies. For example, Madenci et al, (2012) showed in a study that tendon and nerve gliding exercises along with night splinting for treating CTS result in a significant decrease of pain in CTS patients³⁷. The results of a study by Peñas *et al* (2017) in Spain also showed that exercises therapy is effective to improve the severity of symptoms and performance of CTS patients³⁸. In a study by Akalin *et al.*, patients with CTS were evaluated in two treatment groups of splint alone and splint along with tendon and nerve gliding exercises and significant improvement in all parameters (the score of severity of symptoms and function and neurophysiologic findings) were observed in both groups. In this study, though, the results in the exercise group were better than splint, but the difference between the two groups was not significant³⁹. These results are to somewhat consistent with the results of this study. However, further controlled studies are needed in relation to the application of mobilization techniques in the treatment of CTS.

Moghaddasi *et al.* (2014) showed that performing stretching exercises and mobilization in 8 weeks have a significant effect on decreasing pain in CTS patients⁹. The results of a study by Tal Akabi (2000) also showed that mobilization exercises of the wrist for 3 weeks results in significant improvement in CTS symptoms, decreasing pain and improvement of wrist range of motion⁴⁰.

In a systematic review by Kim et al, (2015) effectiveness of tendon and nerve gliding exercises in the treatment of CTS patient were evaluated and they found that these exercises result in significant improvement of symptoms severity and patient performance. However, the effectiveness of tendon and nerve gliding exercises alone was not determined, because in the above clinical studies were used a combination of sports exercises and standard conservative treatments including a splint, paraffin therapy, and other exercises. So more randomized controlled clinical studies are needed to assess the impact of these exercises in the management of CTS patients¹⁹.

Finally, it should be noted that the present study is for the first time comparing the effectiveness of two methods of therapeutic exercises and acupuncture in the treatment of mild to moderate CTS and this study gained valuable information, but there were also some limitations. The relatively small sample size and the lack of mid-term and long term monitoring of patients are major limitations of our study. The limited number of therapeutic sessions in the acupuncture group was another limitation. If treatment sessions are added, better treatment outcomes may be achieved. Since there has not been a study comparing the effectiveness of acupuncture with exercises in the treatment of CTS, it is not possible to compare the findings of this study with the results of other studies. Therefore, our results need to be confirmed in future studies with a larger sample and long-term monitoring.

Conclusion

The results of this study showed that all three treatments can improve the subjective symptoms of patients with carpal tunnel syndrome, but the effectiveness of both methods of acupuncture and exercise therapy was greater than the control group. When exercises or acupuncture with night splinting was used, the rate of improvement in the quality of life and the reduction of pain in the patient was more than the splint was used alone. In addition, the effectiveness of acupuncture was greater than exercise therapy. Therefore, acupuncture with night splint is an effective, inexpensive and safe treatment option available and can be applied to the treatment of mild to moderate CTS patients.

Acknowledgment

The present study is a part of the thesis written by Dr. Amir Rashed, with the registration number of 121 in Faculty of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

References

1. Khosrawi S, Moghtaderi A, Haghghat S. Acupuncture in treatment of carpal tunnel syndrome: A randomized controlled trial study. *Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences*. 2012;17(1):1.
2. Spaans F. Carpal tunnel syndrome: diagnosis, treatment,

- prevention and its relevance to dentistry. *Nederlands tijdschrift voor tandheelkunde*. 2009;116(2):97-101.
3. Jafari D, Mazhar FN, Shariatzadeh H, Shahverdi S, Moghimi Z, Mokhtari T. Inflammation and fibrosis of transverse carpal ligament and flexor tenosynovium in severe idiopathic carpal tunnel syndrome. *Shafa Orthopedic Journal*. 2014;1(3).
 4. Rayegani SM, Rad MM, Bahrami M, Eliaspour D. Frequency of carpal tunnel syndrome and its related risk factors in patients upper extremity pain. *Pajoohandeh Journal*. 2009;14(4):219-23.
 5. Ibrahim I, Khan W, Goddard N, Smitham P. Suppl 1: carpal tunnel syndrome: a review of the recent literature. *The open orthopaedics journal*. 2012;6:69.
 6. Aroori S, RA. S. Carpal tunnel syndrome. *Ulster Medical* 2008;77(1):6-17.
 7. Majd SA, Poorfarzam S, Barzi DM, Moghadamnia M. Comparison of Surgical Treatment with Splinting in Treating Carpal Tunnel Syndrome.
 8. Ono S, Clapham PJ, Chung KC. Optimal management of carpal tunnel syndrome. *International journal of general medicine*. 2010;3:255.
 9. Moghaddasi A, Abbasi Dareh Bidi M, S. R. The Effect of 8-Week Rehabilitation Program on Pain Reduction with Carpal Tunnel Syndrome. *MEJDS*. 2013;3(2):43-53.
 10. Pomerance J, Zurakowski D, Fine I. The cost-effectiveness of nonsurgical versus surgical treatment for carpal tunnel syndrome. *The Journal of hand surgery*. 2009;34(7):1193-200.
 11. Salehi S, Bohlouli M, Shahpar FM, Esfahani MP, Lahiji FA, Aslani H. P-50 The impact of stretching and massage therapy on pain and function of females suffering carpal tunnel syndrome. *BMJ Publishing Group Ltd and British Association of Sport and Exercise Medicine*; 2016.
 12. Tsao JC. Effectiveness of massage therapy for chronic, non-malignant pain: a review. *Evidence-based complementary and alternative medicine*. 2007;4(2):165-79.
 13. Freedman J. Acupuncture for carpal tunnel syndrome. *Acupuncture in medicine*. 2002;20(1):39-40.
 14. Schulman RA, Liem B, Moroz A. Treatment of carpal tunnel syndrome with medical acupuncture. *Medical Acupuncture*. 2008;20(3):163-7.
 15. Ernst E. Acupuncture: what does the most reliable evidence tell us? *Journal of pain and symptom management*. 2009;37(4):709-14.
 16. Lee S, Glass M, Harris JS, Bernard R, Blais M, Genovese E. Occupational medicine practice guidelines: evaluation and management of common health problems and functional recovery in workers: American College of Occupational and Environmental Medicine; 2008.
 17. Excellence NifHaC. Carpal tunnel syndrome. London (UK)2012.
 18. Surgeons AAoO. Management of carpal tunnel syndrome: evidence-based clinical practice guidelines. 2016. 2016.
 19. Kim S-D. Efficacy of tendon and nerve gliding exercises for carpal tunnel syndrome: a systematic review of randomized controlled trials. *Journal of physical therapy science*. 2015;27(8):2645-8.
 20. Chung VC, Ho RS, Liu S, Chong MK, Leung AW, Yip BH, et al. Electroacupuncture and splinting versus splinting alone to treat carpal tunnel syndrome: a randomized controlled trial. *Canadian Medical Association Journal*. 2016;cmaj. 151003.
 21. Razavi SZE, Azadvari M, Kargozar E, Kazemi S. Treatment of Carpal Tunnel Syndrome by Acupuncture. *Case Reports in Clinical Practice*. 2017;1(3):74-7.
 22. Carlson H, Colbert A, Frydl J, Arnall E, Elliot M, Carlson N. Current options for nonsurgical management of carpal tunnel syndrome. *International journal of clinical rheumatology*. 2010;5(1):129.
 23. Sim H, Shin B-C, Lee MS, Jung A, Lee H, Ernst E. Acupuncture for carpal tunnel syndrome: a systematic review of randomized controlled trials. *The Journal of Pain*. 2011;12(3):307-14.
 24. Cox J, Varatharajan S, Côté P, Collaboration O. Effectiveness of acupuncture therapies to manage musculoskeletal disorders of the extremities: a systematic review. *Journal of orthopaedic & sports physical therapy*. 2016;46(6):409-29.
 25. Ren Y-M, Wang X-S, Wei Z-J, Fan B-Y, Lin W, Zhou X-H, et al. Efficacy, safety, and cost of surgical versus nonsurgical treatment for carpal tunnel syndrome: a systematic review and meta-analysis. *Medicine*. 2016;95(40).
 26. Shi Q, Bobos P, Lalone EA, Warren L, MacDermid JC. Comparison of the short-term and long-term effects of surgery and nonsurgical intervention in treating carpal tunnel syndrome: A systematic review and meta-analysis. *Hand*. 2018;1558944718787892.
 27. Saghaei M. Random allocation software for parallel group randomized trials. *BMC medical research methodology*. 2004;4(1):26.
 28. Efirid J. Blocked randomization with randomly selected block sizes. *International journal of environmental research and public health*. 2010;8(1):15-20.
 29. Deadman P, Baker K, Al-Khafaji M. *A Manual of Acupuncture: Journal of Chinese Medicine Publications*. Ann Arbor, MI: Cushing Mallory. 2001:376-80.
 30. Ho C-Y, Lin H-C, Lee Y-C, Chou L-W, Kuo T-W, Chang H-W, et al. Clinical effectiveness of acupuncture for carpal tunnel syndrome. *The American journal of Chinese medicine*. 2014;42(02):303-14.
 31. Rezazadeh A, Bakhtiary AH, Samaei A, Moghimi J. Validity and reliability of the Persian Boston questionnaire in Iranian patients with carpal tunnel syndrome. *Koomesh*. 2014;15(2):138-45.
 32. Zavela NG. Acupuncture treatment for carpal tunnel syndrome. *Medical Acupuncture*. 2010;22(4):273-6.
 33. A. R. Evaluation of the effectiveness of acupuncture with wrist splint and application of splint in treatment of patients with mild to moderate carpal tunnel syndrome.: *Shahid Beheshti University of Medical Sciences*; 2007.
 34. Yao E, Gerritz PK, Henricson E, Abresch T, Kim J, Han J, et al. Randomized controlled trial comparing acupuncture with placebo acupuncture for the treatment of carpal tunnel syndrome. *PM&R*. 2012;4(5):367-73.
 35. Aigner N, Zöch G. Results of laser-acupuncture in carpal tunnel syndrome—a prospective; randomised and blinded study. *Focus on Alternative and Complementary Therapies*. 1998;3(4):180-.
 36. Kummerdee W, Kaewtong A. Efficacy of acupuncture versus night splinting for carpal tunnel syndrome: a randomized clinical trial. *Medical journal of the Medical Association of Thailand*. 2010;93(12):1463.

37. Madenci E, Altindag O, Koca I, Yilmaz M, Gur A. Reliability and efficacy of the new massage technique on the treatment in the patients with carpal tunnel syndrome. *Rheumatology international*. 2012;32(10):3171-9.

38. Fernandez-De-Las-Penas C, Cleland J, Palacios-Ceña M, Fuensalida-Novo S, Pareja JA, Alonso-Blanco C. The effectiveness of manual therapy versus surgery on self-reported function, cervical range of motion, and pinch grip force in carpal tunnel syndrome: a randomized clinical trial. *journal of orthopaedic & sports physical*

therapy. 2017;47(3):151-61.

39. Akalin E, El Ö, Peker Ö, Senocak Ö, Tamci S, Gülbahar S, et al. Treatment of carpal tunnel syndrome with nerve and tendon gliding exercises. *American journal of physical medicine & rehabilitation*. 2002;81(2):108-13.

40. Tal-Akabi A, Rushton A. An investigation to compare the effectiveness of carpal bone mobilisation and neurodynamic mobilisation as methods of treatment for carpal tunnel syndrome. *Manual Therapy*. 2000;5(4):214-22.